

11720A 2-18 GHz PULSE MODULATOR

SERIAL NUMBERS

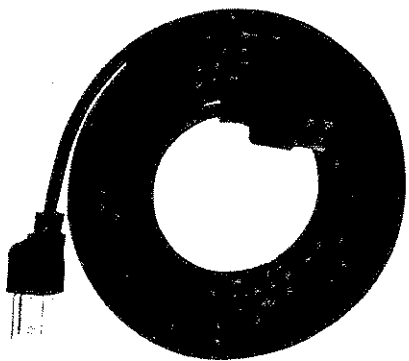
This manual applies directly to instruments with serial numbers prefixed 1714A.

For additional important information about serial numbers, see paragraph on INSTRUMENTS COVERED BY MANUAL.

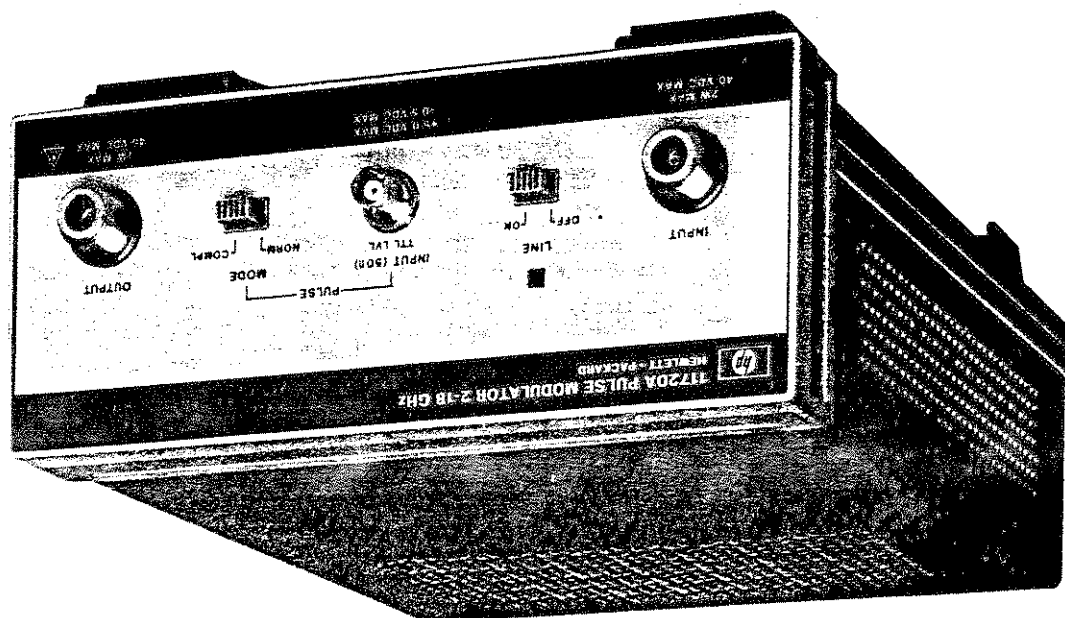


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1501 PAGE MILL ROAD, PALO ALTO, CALIFORNIA, U.S.A.

Figure 1. HP Model 11720A 2-18 GHz Pulse Modulator and Accessory Supplied



POWER CABLE
(For HP Part Number refer to Figure 3)



MODEL 11720A

1. GENERAL INFORMATION

2. This Operating and Service Manual contains information required to install, operate, test, adjust, and service the Hewlett-Packard 11720A 2-18 GHz Pulse Modulator. Figure 1 shows the 11720A and all supplied accessories.

3. Listed on the title page of this manual (below the manual part number) is a Microfiche part number. This number can be used to order 10 x 15 cm (4 x 6 inch) microfilm transparencies of the manual. Each microfiche contains up to 96 photoduplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement as well as pertinent Service Notes.

4. SPECIFICATIONS

5. Instrument specifications are listed in Table I. These specifications are the performance standards or limits against which the instrument is tested.

6. SAFETY CONSIDERATIONS

7. The 11720A is a Safety Class I instrument (provided with a protective earth terminal). This instrument and all related documentation must be reviewed for familiarization with safety markings and instructions before operation. Safety information pertinent to the task at hand (in-stallation, operation, performance testing, adjustments, or service) is found throughout this manual.

8. INSTRUMENTS COVERED BY MANUAL

9. Attached to the instrument is a serial number plate. The serial number is in the form: 0000A00000. It is in two parts; the first four digits and the letter are the serial prefix and the last five digits are the suffix. The prefix is the same for all identical instruments; it changes only when a change is made to the instrument. The suffix, however, is assigned sequentially and is different for each instrument. The contents of this manual apply to instruments with the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

10. An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number indicates the instrument is different from those described in this manual. The manual for this newer instrument is accompanied by a yellow Manual Changes supplement. This supplement contains "change information" that

explains how to adapt the manual to the newer instrument.

11. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is identified with the manual print date and part number, both of which appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

12. For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

13. DESCRIPTION

14. The Hewlett-Packard 11720A 2-18 GHz Pulse Modulator is a broadband, fully integrated, microwave PIN diode pulse modulator. Complete control of the PIN modulator is self-contained. This includes proper impedance matching as well as supplying the appropriate modulation wave shapes and bias levels for fast rise and fall times and the rated on/off ratio. The high level of performance is complemented by the ease with which an RF pulse generation system can be assembled. The 11720A requires a CW microwave signal source to furnish the RF input and a standard pulse generator to supply the video input (50Ω, TTL compatible). In addition, a NORM/COMPL function is provided to adapt the 11720A to positive true, or negative true logic video inputs.

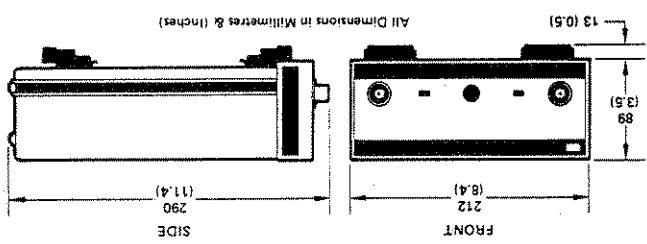
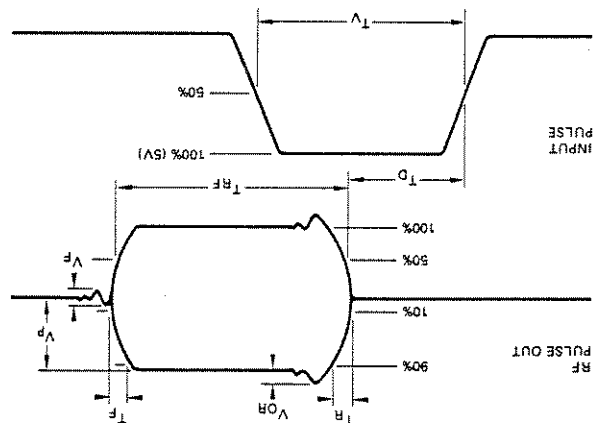
15. EQUIPMENT AVAILABLE

16. Accessories and equipment may be ordered or information about them may be obtained by contacting your nearest Hewlett-Packard office. Refer to the HP model number.

17. Microwave Signal Source, 2-18 GHz. The HP Model 8672A Synthesized Signal Generator is a highly stable, leveled RF source suitable for use with the Pulse Modulator. This synthesizer provides calibrated AM and FM.

18. Microwave Signal Source, 2-6.2 GHz. The HP Model 8671A Synthesizer is a highly stable, un-leveled RF source suitable for use with the Pulse Modulator. This synthesizer provides calibrated FM.

Table 1. Specifications

<p>Pulse Input Normal Mode: >3V (on), <0.5V (off). Complement Mode: <0.5V (on), >8V (off). Impedance: 50Ω nominal.</p> <p>Damage Levels RF Input: ac: 2 watts (+33 dBm). dc: 40 volts. Pulse Input: ±6V peak from ≥50Ω Source, +6V peak, -0.5V peak from <50Ω Source.</p> <p>Connectors RF (IN and OUT): Type N Female. Pulse Input: BNC Female.</p> <p>General Operating Temperature: 0°C to +55°C. RF Leakage³: Meets Radiated and Conducted Limits of MIL-I-6181D. Power: 100, 120, 220 and 240V, +5%, -10% 100 and 120 volts, 48 to 440 Hz. 220 and 240 volts, 48 to 66 Hz. 25 VA max.</p> <p>Weight: Net, 2.6 kg (5 lb, 12 oz); shipping, 3.6 kg (8 lb)</p> <p>Dimensions⁴:</p>  <p>FRONT: 212 (8.4) mm, 89 (3.5) mm, 13 (0.5) mm SIDE: 290 (11.4) mm</p> <p>All Dimensions in Millimeters & (Inches)</p>	<p>Frequency Range: 2 to 18 GHz</p> <p>On/Off Ratio: >80 dB.</p> <p>Insertion Loss: 2 to 12.4 GHz: <6 dB. 2 to 18 GHz: <10 dB.</p> <p>Rise (TR) and Fall (TF) Times: <10 ns.</p> <p>Maximum RF Input Power: +20 dBm.</p> <p>Minimum RF Pulse Width¹ (TRF): <50 ns.</p> <p>Pulse Width Compression (TV - TRF): <20 ns.</p> <p>Maximum Pulse Repetition Rate: >5 MHz.</p> <p>Maximum Delay Time (TD): <60 ns.</p> <p>Video Feedthrough (VF): <50 mV peak-to-peak.</p> <p>Overshoot, Ringing² (VOR/Vp): <0.2.</p> <p>Pulse Definitions:</p>  <p>RF PULSE OUT</p> <p>INPUT PULSE</p> <p>TR - Delay Time TRF - RF Pulse Rise Time TR - RF Pulse Fall Time TRF - RF Pulse Length TV - Input Pulse Length VF - Video Feedthrough VOR - Overshoot and Ringing Vp - RF Pulse Amplitude</p>
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20. RECOMMENDED TEST EQUIPMENT

21. Test equipment required to maintain the Model 11720A is listed in Table 2. Equipment other than the recommended models can be used provided the minimum specifications are satisfied.

19. Pulse Generator. The HP Model 8013B Pulse Generator is a 50 MHz pulse source that meets or exceeds all of the modulation input requirements of the Pulse Modulator. This generator is capable of operation in either the normal or complementary mode and may be triggered by a sine wave.

¹Off time must be ≥ 140 ns.
²Overshoot and ringing may be reduced by operating at <10 dBm RF input and >+15°C ambient temperature.
³For pulse repetition rates <1 MHz.
⁴Dimensions are for general use only. If dimensions are required for building special enclosures, contact your HP office.

Table 2. Recommended Test Equipment

Instrument Type	Critical Specifications	Suggested Model	Use*
Adapter, Tee	BNC Tee, Male to two Females	HP 1250-0781	P, A, T
Adapter, SMA (3 req.)	SMA Male to Type N Female	HP 1250-1562	P, A, T
Amplifier, 22 dB	Frequency Range: 100 kHz to 1300 MHz Gain (Mean): 22 dB \pm 1.5 dB	HP 8447E	P, A, T
Attenuator (2 req.)	6 dB; 2-18 GHz SWR: < 1.5	HP 8491B Option 006	P, A, T
Attenuator	10 dB; 2-18 GHz SWR: < 1.5	HP 8491B Option 010	P, A, T
Digital Multimeter	DC Volts Range: to 20V Current Range: \leq 100 mA	HP 3455A	A, T
Mixer, Double Balanced	Frequency Range: 2 to 18 GHz	RHG DM1-18	P, A, T
Power Meter and	Frequency Range: 2-18 GHz Input Level: +10 to -15 dBm Resolution: < 0.5 dB	HP 436A/8481A	P, T
Oscilloscope	Dual Channel, triggerable Bandwidth: \geq 200 MHz Risettime: < 1.75 ns	HP 1715A	P, A, T
Probe, divide by 10	Compatible with HP 1715A	HP 10018A	A, T
Pulse Generator	Variable Delay Pulse Width: < 50 ns to > 100 μ s Amplitude: 5V into 50 Ω Rise Time: < 5 ns	HP 8013B	P, A, T
Signal Generator (2 req.)	Frequency Range: 2-18 GHz Output Level: +3 dBm	HP 8672A	P, A, T
Spectrum Analyzer	Frequency Range: 2-18 GHz Input Sensitivity: better than -80 dBm Maximum Input: > +10 dBm Resolution Bandwidth: < 1 GHz	HP 141T/8552B/8555A	P, A, T
Type N to APC-7 [®] Adapter (2 req.)	Type N Female to APC-7	HP 11524A	P, T

* P = Performance, A = Adjustment, T = Troubleshooting

[®] A registered trademark of the Bunker Ramo Corp.

22. INSTALLATION

23. Initial Inspection

Inspect the shipping container for damage. If the shipping container or packaging material is damaged it should be kept until the contents of the shipment have been checked mechanically and electrically. If there is mechanical damage or if the instrument does not pass the performance tests, notify the nearest Hewlett-Packard office. Keep the damaged shipping materials (if any) for the carrier and a Hewlett-Packard representative to inspect. The HP office will arrange for repair or re-shipment at HP option without waiting for claim settlement.

24. Inspect the shipping container for damage. If the shipping container or packaging material is damaged it should be kept until the contents of the shipment have been checked mechanically and electrically.

25. Power Requirements
 26. The 11720A 2-18 GHz Pulse Modulator requires a power source with an output of 100, 120, 220, or 240V, +5, -10%, 48 to 440 Hz single phase. Power consumption is less than 25 VA.

27. Line Voltage Selection

28. Figure 2 provides instructions for line voltage and fuse selection.

CAUTION

Before the instrument is switched on, it must be set to the voltage of the power source, or damage to the instrument may result.

29. Power Cable

30. In accordance with international safety standards, this instrument is equipped with a three-wire power cable. When connected to an appropriate power receptacle, this cable grounds the instrument cabinet. The type of power cable plug shipped with each instrument depends on the country of destination. See Figure 3 for the part numbers of the power cable plugs available.

33. Operating Environment
 34. The operating environment should be within the following limits:

Temperature: 0 to 55°C
 Humidity: Up to 95% relative
 Altitude: Up to 4500 metres (15 000 ft)

35. Bench Operation

36. The 11720A cabinet is equipped with plastic feet and fold-away tilt stands for convenience in bench operation. (The plastic feet are shaped to en-

31. Mating Connectors
 32. Mating connectors used with the Model 11720A should be either 50 ohm type BNC male or type N male connectors that are compatible with US MIL-C-39012.

The protection provided by grounding the instrument cabinet may be lost if any power cable other than the three-pronged type supplied is used to couple the ac line voltage to the instrument.

WARNING

PC BOARD, HP 5020-8157

WARNING

To avoid the possibility of hazardous electrical shock, do not operate this instrument at line voltages greater than 126.5 Vac with line frequencies greater than 66 Hz (leakage currents at these line settings may exceed 3.5 mA).

1. Open cover door and rotate fuse-pull to left.
2. Select operating voltage by orienting PC board to position desired voltage on top-left side. Push board firmly into module slot.
3. Rotate fuse-pull back in holders, using caution to select correct fuse value.

SELECTION OF OPERATING VOLTAGE

Operating voltage is shown in module window.

VOLTAGE CHANGES ON BOTH SIDES OF PC BOARD

Figure 2. Line Voltage Selection

44. Other Packaging. The following general instructions should be used for repackaging with commercially available materials:

- a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard office or service center, fill out and attach one of the blue service tags located at the back of this manual.)

- b. Use a strong shipping container.

- c. Use a layer of shock-absorbing material 75 to 100 mm (3 to 4 in.) thick around all sides of the instrument to provide a firm cushion and prevent movement inside the container. Protect the control panel with cardboard.

- d. Seal the shipping container securely.

- e. Mark the shipping container FRAGILE to assure careful handling.

- f. In any correspondence, refer to instrument by model number and full serial number.

45. OPERATION

WARNINGS

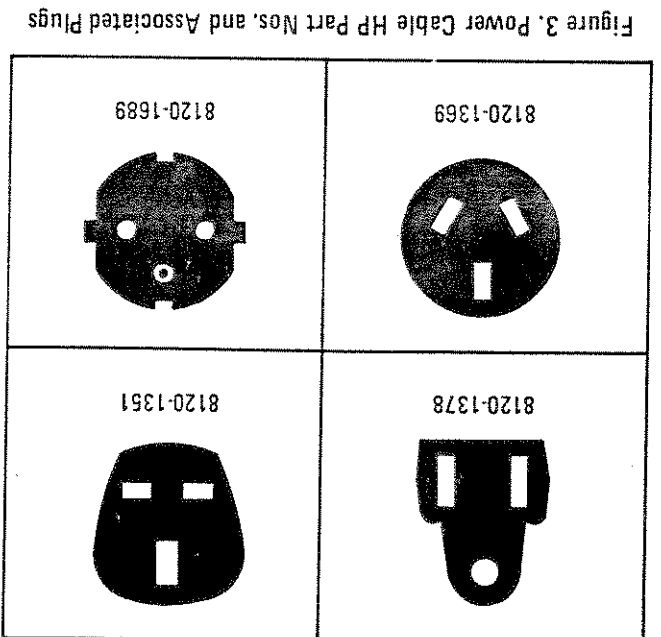
Before the instrument is switched on, all protective earth terminals, extension cords, auto-transformers, and devices connected to it should be connected to a protective earth grounded socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in personal injury.

Only fuses with the required rated current and specified type should be used. Do not use repaired fuses or short circuited fuseholders. To do so could cause a shock or fire hazard.

46. Panel Features

47. Controls, connectors, and indicators of the 11720A are explained in Figure 4. To operate the instrument, proceed as follows:

- a. Verify that the power transformer primary of the 11720A is matched to the line voltage by the Line Voltage Selection Card.



The tilt stands raise the front of the instrument for easier viewing of the control panel.

37. Rack Mounting

38. The instrument can be rack mounted by using an adapter frame. The adapter frame is a rack frame that accepts several combinations of sub-modular units. For additional information, address inquiries to your nearest Hewlett-Packard office.

39. STORAGE AND SHIPMENT

40. Environment

41. The instrument should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment:

Temperature: -40 to +75°C

Humidity: Up to 95% relative

Altitude: Up to 7630 metres (25 000 ft)

42. Packaging

43. Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, fill out and attach one of the blue service tags located at the back of this manual. Also, mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

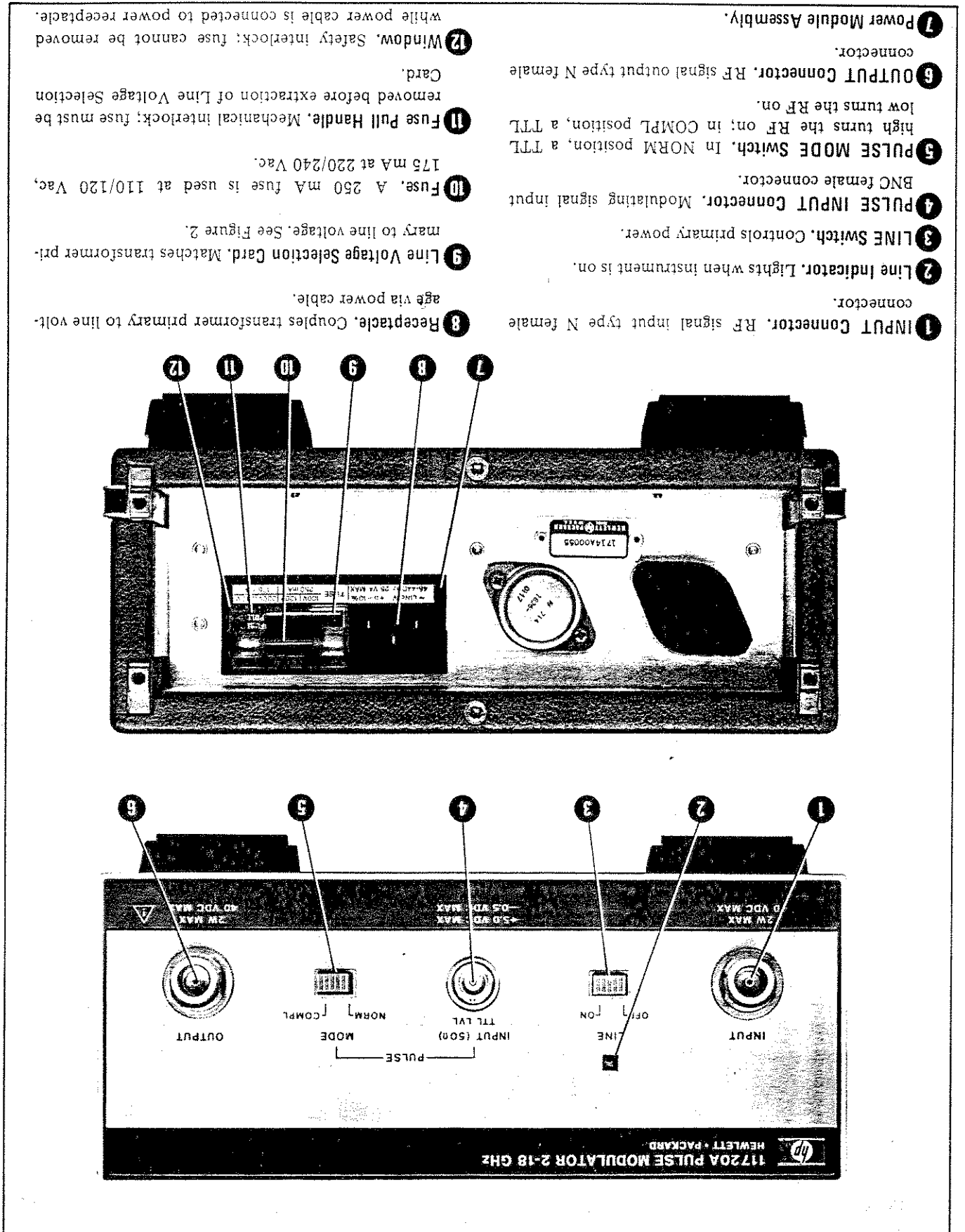


Figure 4. Front and Rear Panel Controls, Connectors, and Indicators

- b. Check the 11720A power fuse for correct rating. The correct fuse ratings for various line voltages are given on the Line Power Module on the rear panel.
- c. Connect the RF INPUT and RF OUTPUT cables.

CAUTION

Do not apply signal levels greater than 33 dBm (2W) or 40 Vdc to the RF INPUT or RF OUTPUT jacks.

- d. Connect the power cable to the power receptacle. Press the LINE switch and release. The switch should remain in, the lamp above the switch should be lighted, and the cursor on the switch should indicate ON.

51. PERFORMANCE TESTS AND ADJUSTMENTS

Be sure to select the correct fuse rating for the selected line voltage. Do not use repaired fuses or short circuited fuse holders. To do so could cause a shock or fire hazard. Fuse ratings are listed on the fuse compartment.

WARNING

- 50. Rear Panel Fuse Replacement. The main ac line fuse is located on the rear panel next to the power cable jack (see Figure 2). To remove the fuse, first remove the line power cable from its jack. Slide the fuse compartment cover to the left, then pull the handle marked FUSE PULL and remove the fuse.

- e. Connect the PULSE INPUT cable and set the PULSE MODE to be compatible with the pulse source by depressing or releasing the NORM/COMPL switch.

CAUTION

Do not apply voltages greater than ±6V peak from ≥50Ω source or +6V peak, -0.5V peak from <50Ω source to the PULSE INPUT jack.

- 48. Operator Maintenance
- 49. Operator maintenance is limited to replacement of the rear panel fuse.

- a. On/Off Ratio Test.
- b. Insertion Loss Test.
- c. Pulse Performance Test.
- d. Offset Adjustment.
- e. Rise and Fall Time Adjustment.

53. The tests and adjustments are presented in the following order:

PERFORMANCE TESTS

54. ON/OFF RATIO TEST

SPECIFICATION: On/Off Ratio: > 80 dB.

DESCRIPTION: A spectrum analyzer is used to measure the change in power output when the Pulse Modulator is switched from NORMAL mode to COMPLement mode.

PERFORMANCE TESTS

54. ON/OFF RATIO TEST (Cont'd)

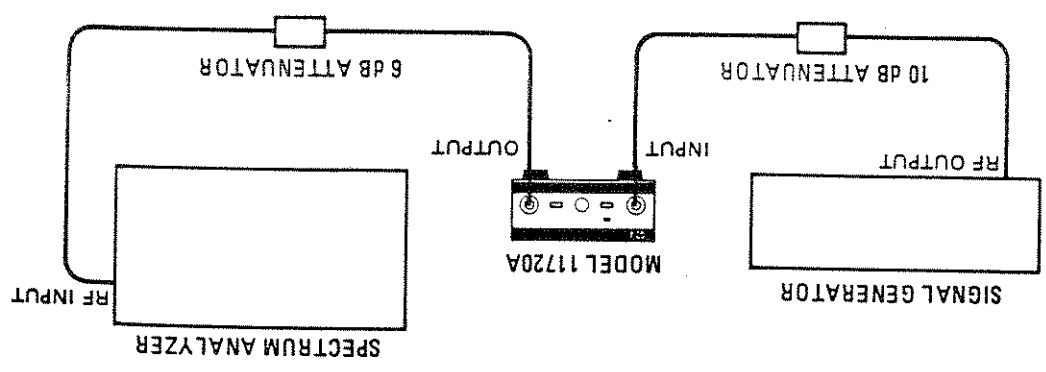


Figure 5. On/Off Ratio Test Setup

EQUIPMENT:

- 6 dB Attenuator HP 8491B Option 006
- 10 dB Attenuator HP 8491B Option 010
- Signal Generator HP 8672A
- Spectrum Analyzer HP 141T/8555A/8552B

PROCEDURE:

1. Set synthesizer to 14 GHz or any other frequency of interest. Set power output to about +3 dBm with modulation off.
2. Connect equipment as shown in Figure 5.
3. Set PULSE MODE switch on the Pulse Modulator to COMPL.
4. Adjust spectrum analyzer to establish a reference signal at the top graticule line. Use at least 40 dB of input attenuation and a bandwidth of 1 kHz or less.
5. Set PULSE MODE switch to NORM.
6. Reduce spectrum analyzer reference level as needed to observe the residual signal. It should be > 80 dB below the reference established in step 4.

55. INSERTION LOSS TEST

SPECIFICATION: Insertion Loss: 2 to 12.4 GHz < 6 dB.
 2 to 18 GHz < 10 dB.

DESCRIPTION:

A signal generator and power meter are connected through an adapter and reference power levels are measured. The Pulse Modulator is then inserted in place of the adapter and the insertion loss is determined.

PERFORMANCE TESTS

55. INSERTION LOSS TEST (Cont'd)

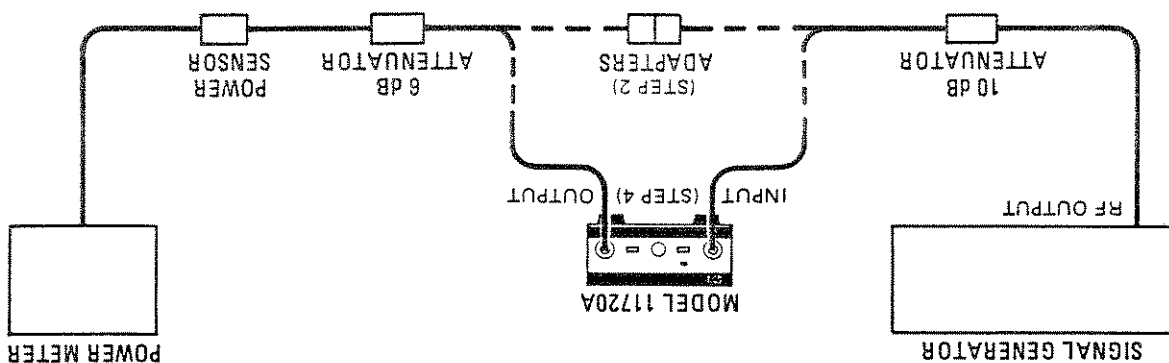


Figure 6. Insertion Loss Test Setup

- EQUIPMENT:
- 6 dB Attenuator HP 8491A Opt. 006
 - 10 dB Attenuator HP 8491A Opt. 010
 - Power Meter HP 436A
 - Power Sensor HP 8481A
 - Signal Generator HP 8672A
 - Type N Female to APC-7 Adapter (2 req'd) HP 11524A

PROCEDURE:

1. Set signal generator to 3 GHz at +3 dBm with modulation off.
2. Connect equipment as shown in Figure 6, using the two Type N to APC-7 adapters connected together.
3. Measure and record reference powers at the following frequencies:

3 GHz	P _{ref}	-13.59	-14.88	-15.55
6 GHz	P _{ref}	-14.19	-16.33	-16.99
9 GHz	P _{ref}	-14.10	-16.85	-17.24
12 GHz	P _{ref}	-14.07	-16.96	-17.21
15 GHz	P _{ref}	-14.47	-17.23	-17.51
18 GHz	P _{ref}	-14.52	-20.35	-18.33
4. Install the 11720A Pulse Modulator in the test setup in place of the adapters. Be careful not to disturb the power output controls of the signal generator.
5. Set the PULSE MODE control to COMPL.
6. Measure and record the output power from the Pulse Modulator at the following frequencies:

PERFORMANCE TESTS

55. INSERTION LOSS TEST (Cont'd)

3 GHz P_{out}	_____
6 GHz P_{out}	_____
9 GHz P_{out}	_____
12 GHz P_{out}	_____
15 GHz P_{out}	_____
18 GHz P_{out}	_____

$P_{ref} - P_{out}$ should be less than 6 dB for frequencies below 12.4 GHz and less than 10 dB for frequencies below 18 GHz.

56. PULSE PERFORMANCE TEST

SPECIFICATIONS:

- Rise and Fall Times: < 10 ns
- Minimum RF Pulse Width: < 50 ns (with off time > 140 ns)
- Pulse Width Compression: < 20 ns
- Maximum Delay Time: < 60 ns
- Overshoot, Ringing: < 0.2
- Video Feedthrough: < 50 mV peak-to-peak.

DESCRIPTION:

The RF output of a signal generator is modulated by the Pulse Modulator. The pulse modulated output of the Pulse Modulator is applied to the RF port of a double balanced mixer. The LO port of the mixer is fed an RF signal from another signal generator that is 20 MHz above or below the pulsed RF signal. The resulting 20 MHz IF signal is amplified and applied to a dual channel oscilloscope.

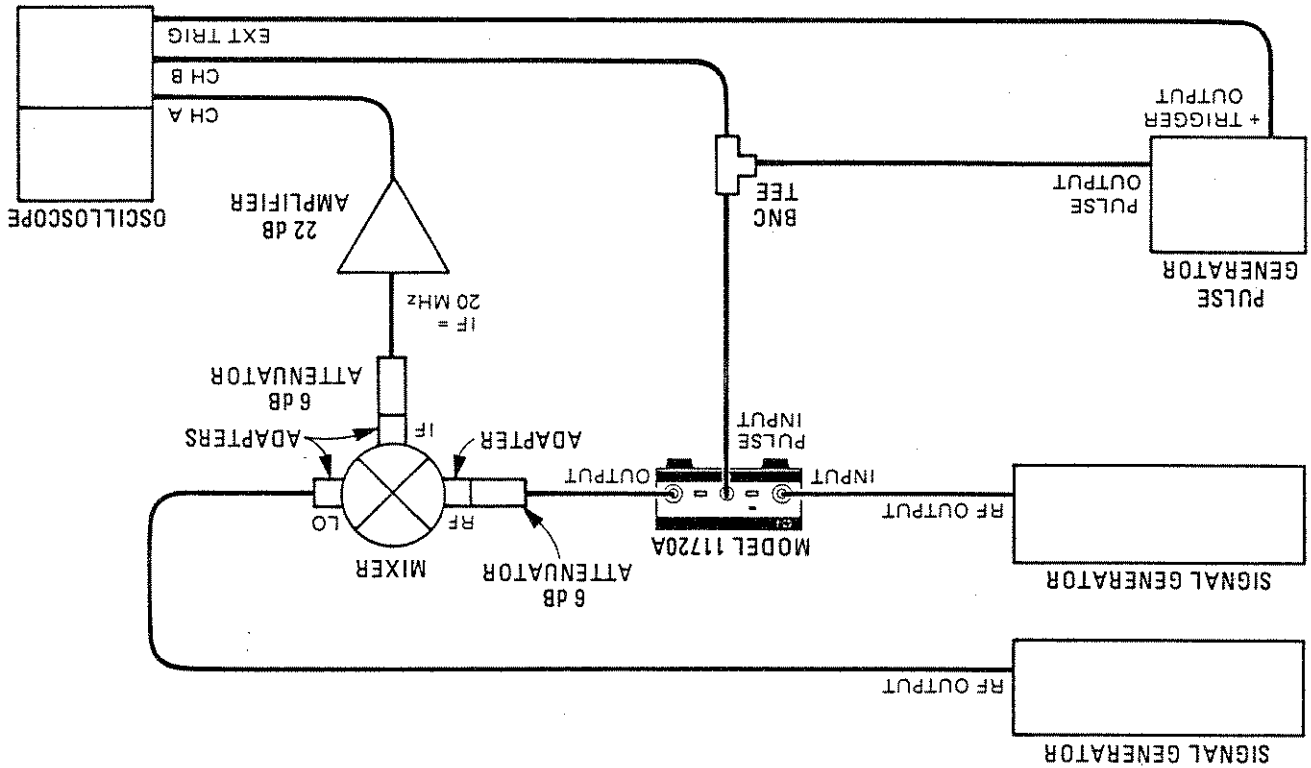


Figure 7. Pulse Performance Test Setup

PERFORMANCE TESTS

56. PULSE PERFORMANCE TEST (Cont'd)

EQUIPMENT:	Adapter, SMA (3 req'd)	SMA Male to Type N Female
	Adapter, BNC Tee	BNC Male to 2 BNC Females
	Amplifier, 22 dB	HP 8447E
	6 dB Attenuators (2 req'd)	HP 8491A Option 006
	Double Balanced Mixer	RHG DBM1-18
	Oscilloscope	HP 1715A
	Pulse Generator	HP 8013B
	Signal Generator (2 req'd)	HP 8672A

PROCEDURE:

1. Connect equipment as shown in Figure 7.
2. Set the two signal generators so their frequencies are approximately 20 MHz apart. The difference is not critical.
3. Set the output level of the signal generators to approximately 0 dBm.
4. Set both vertical channels on the oscilloscope to 50 ohms.
5. Set the Pulse Modulator to COMPL mode and disconnect the pulse input.
6. Adjust the oscilloscope to display about 4 divisions of vertical deflection of the IF signal. It is not necessary to obtain a stable display of the IF signal.
7. Reconnect the pulse input to the Pulse Modulator and set it to the NORM mode.
8. Set the pulse generator for 50 ns wide pulses at 4 to 5 volts amplitude and with a period of 100 μ s. Adjust the pulse delay to position the pulse at a convenient location on the oscilloscope display.
9. Set the oscilloscope to .05 μ s/division and the x 10 scale expansion to obtain 5 ns/division. Increase the gain of channel A to obtain full screen deflection of either the top or bottom half of the pulse envelope.
10. Measure the rise time, fall time, pulse delay, and pulse width compression as shown in Figure 8. Note that pulse width compression is the difference in width between the input pulse and the resulting RF pulse.
11. This test may be repeated at any frequency between 2 and 18 GHz.

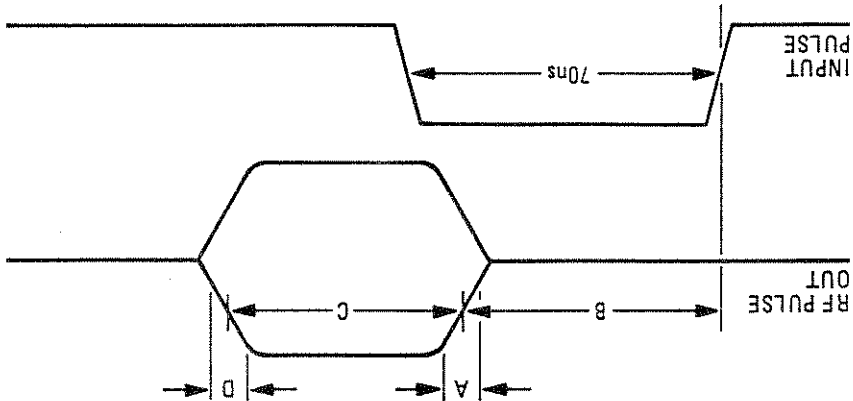


Figure 8. Pulse Performance Parameters

ADJUSTMENTS

57. OFFSET ADJUSTMENT

REFERENCE: Service Sheet 1.

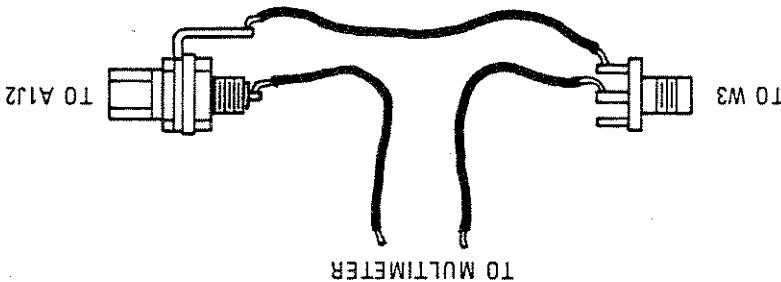
DESCRIPTION: Using an ammeter, the current through the modulator is adjusted while the modulator is in the RF on mode.

EQUIPMENT: Current Measuring Adapter See Figure 9
Digital Multimeter HP 3455A

PROCEDURE: 1. Remove top cover of Pulse Modulator.

Maintenance described herein is performed with power supplied to the instrument, and protective covers removed. Such maintenance should be performed only by service-trained personnel who are aware of the hazards involved. Where maintenance can be performed without power applied, the power should be removed.

- 2. Disconnect cable W3 at jack A1J2. (See Figure 22 for location of W3 and A1J2.) Insert a locally fabricated current measuring adapter (see Figure 9) between cable W3 and A1J2. Connect the digital multimeter to the center conductor leads of the adapter and set the multimeter to read current.



- SMC MALE P.C. CONNECTOR HP 1250-0835
- SMC FEMALE CONNECTOR HP 1250-0880
- SOLDER LUG, #10 HP 0360-0452

Figure 9. Current Measuring Adapter

- 3. Connect Pulse Modulator to mains. Set POWER switch ON and PULSE MODE switch to COMPL.
- 4. Adjust A1R30 "OS" to obtain a modulator current of 46 mA.

ADJUSTMENTS

57. OFFSET ADJUSTMENT (Cont'd)

5. Set PULSE MODE switch to NORM. The current should be between -75 and -95 mA. This is a check only, there is no adjustment.
6. Reconnect cable W3 to jack A1J2.

58. RISE AND FALL TIME ADJUSTMENT

REFERENCE: Service Sheet I.

DESCRIPTION: The timing of the Turn-On and Turn-Off Monostable Flip-Flops is adjusted while observing their outputs on an oscilloscope. The rise and fall time adjustments are then optimized while observing the RF output pulse on the oscilloscope using the same method as in the Pulse Performance Test, paragraph 56.

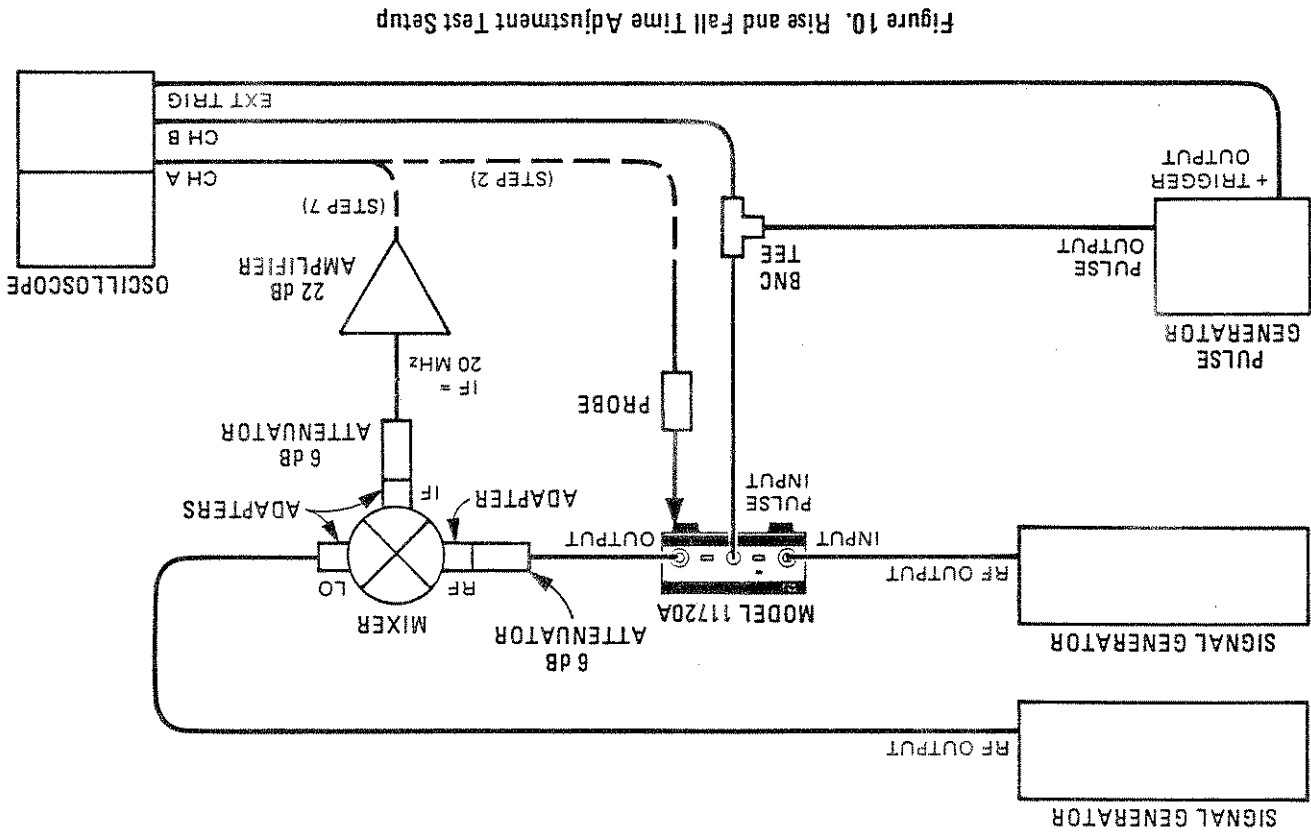


Figure 10. Rise and Fall Time Adjustment Test Setup

ADJUSTMENTS

58. RISE AND FALL TIME ADJUSTMENT (Cont'd)

<p>Adapter, SMA (3 req'd)</p> <p>Adapter, BNC Tee</p> <p>BNC Male to 2 Females</p> <p>HP 8447E</p> <p>HP 8491A Option 006</p> <p>RHG DBM1-18</p> <p>HP 1715A</p> <p>HP 10018A</p> <p>HP 8013B</p> <p>HP 8672A</p>	<p>Signal Generator (2 req'd)</p> <p>Pulse Generator</p> <p>Probe, divide by 10</p> <p>Oscilloscope</p> <p>Double Balanced Mixer</p> <p>6 dB Attenuators (2 req'd)</p> <p>Amplifier, 22 dB</p>	<p>EQUIPMENT:</p>
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PROCEDURE: 1. Remove top cover of Pulse Modulator.

WARNING

Maintenance described herein is performed with power supplied to the instrument, and protective covers removed. Such maintenance should be performed only by service-trained personnel who are aware of the hazards involved. Where maintenance can be performed without power applied, the power should be removed.

2. Connect equipment as shown in Figure 10 leaving the 22 dB amplifier's output disconnected and connecting the divide by 10 probe to the oscilloscope.
3. Set the pulse generator for a convenient pulse width of approximately 500 ns with a repetition rate of less than 2 MHz. The duty cycle should be less than 50% for this adjustment. The pulse amplitude should be between 4 and 5 volts.
4. Connect the probe to TP17 and set the oscilloscope to 2 volts/division and the proper sweep speed to display the waveforms.
5. Set potentiometer AIR14, "+PW", fully clockwise, then adjust counterclockwise until the trailing edge of the positive pulse just starts to dip negative.
6. Set potentiometers AIR7, "-P", and AIR12, "-PW", to the center of their ranges. Adjust AIR12, "-PW", for a pulse width of 7 ns on the negative pulse at TP17. Remove the probe from TP17 and the oscilloscope.
7. Connect the output of the 22 dB amplifier to the Channel A input of the oscilloscope.
8. Set the signal generators so their frequencies are approximately 20 MHz apart. The difference is not critical.
9. Set the output level of the signal generators to approximately 0 dbm.
10. Set both vertical channels on the oscilloscope to 50 ohms.

ADJUSTMENTS

58. RISE AND FALL TIME ADJUSTMENT (Cont'd)

11. Set the Pulse Modulator to the NORM mode.
12. Set the pulse generator for 50 ns wide pulses at 4 to 5 volts amplitude and with a period of 100 μ s. Adjust the pulse delay to position the pulse at a convenient location on the oscilloscope display.
13. Set the oscilloscope to .05 μ s/division and the x10 scale expansion to obtain 5 ns/division. Increase the gain of channel A to obtain full screen deflection of either the top or bottom half of the pulse envelope.
14. Adjust potentiometer A1R7, "P", for the shortest RF pulse fall time.
15. Set the signal generators to approximately 2000 MHz with a 20 MHz difference and verify that the rise time is greater than 10 ns but less than 11 ns as in paragraph 56, step 10. Set the signal generators to approximately 18 000 MHz with a 20 MHz difference and verify the rise time as before. If the rise time is between 10 and 11 ns, replace A1R18 with an 1800 ohm resistor (HP part number 0757-0424). When the new value resistor is in place, repeat the test. If the rise time is greater than 11 ns, proceed to the Service portion of this manual.

59. REPLACEABLE PARTS

60. Table 3 lists all replaceable parts in reference designator order. Table 4 contains the names and addresses that correspond to the manufacturer's code numbers.

61. ORDERING INFORMATION

62. To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number and check digit (CD), indicate the quantity required, and address the order to the nearest Hewlett-Packard office.

NOTE

63. To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

Within the USA, it is better to order directly from the HP Parts Center in Mt. View, California. Ask your nearest HP office for information and forms for the "Direct Mail Order System".

Table 3. Replaceable Parts

Reference Designation	HP Part Number	C	D	Qty	Description	Mfr Code	Mfr Part Number
A1	11720-60001	7	1	1	PULSE DRIVER BOARD ASSEMBLY	28480	11720-60001
A1C1	0160-3875	3	3	3	CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
A1C2	0160-3875	3	3	3	CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
A1C3	0160-2254	0	1	1	CAPACITOR-FXD 7.5PF +- .25PF 500VDC CER	28480	0160-2254
A1C4	0160-3879	7	21	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C5	0150-0059	8	1	1	CAPACITOR-FXD 3.3PF +- .25PF 500VDC CER	28480	0150-0059
A1C6	0160-3879	7	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C7	0160-3879	7	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C8	0160-3879	7	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C9	0160-3879	7	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C10	0160-3879	7	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C11	0160-3875	3	3	3	CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
A1C12	0160-0576	9	9	9	CAPACITOR-FXD 220PF +-20% 100VDC CER	28480	0160-0576
A1C13	0160-3879	7	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C14	0160-3879	7	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C15	0160-2220	0	1	1	CAPACITOR-FXD 1200PF +-5% 300VDC MICA	28480	0160-2220
A1C16	0160-3879	7	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C17	0160-3879	7	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C18	0160-3879	7	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C19	0160-3879	7	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C20	0160-3879	7	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C21	0160-0571	0	1	1	CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A1C22	0160-0174	9	9	9	CAPACITOR-FXD .47UF +-80-20% 25VDC CER	28480	0160-0174
A1C23	0160-0174	9	9	9	CAPACITOR-FXD .47UF +-80-20% 25VDC CER	28480	0160-0174
A1C24	0160-3879	7	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C25	0160-3879	7	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C26	0160-3879	7	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C27	0160-3879	7	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C28	0160-3879	7	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C29	0160-3879	7	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C30	0160-3879	7	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C31	0160-3879	7	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C32	0160-0291	3	3	3	CAPACITOR-FXD .01UF +-10% 35VDC TA	28480	0160-0291
A1C33	0160-0291	3	3	3	CAPACITOR-FXD .01UF +-10% 35VDC TA	28480	0160-0291
A1C34	0160-0374	3	3	3	CAPACITOR-FXD .01UF +-10% 20VDC TA	28480	0160-0374
A1C35	0160-0374	3	3	3	CAPACITOR-FXD .01UF +-10% 20VDC TA	28480	0160-0374
A1C36	0160-0127	2	2	2	CAPACITOR-FXD .1UF +-20% 25VDC CER	28480	0160-0127
A1C37	0160-3878	6	6	6	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A1C38	0160-0127	2	2	2	CAPACITOR-FXD .1UF +-20% 25VDC CER	28480	0160-0127
A1C39	0160-3879	7	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1C81	1901-0535	9	9	9	DIODE-SM SIC SCHOTTKY	28480	1901-0535
A1C82	1901-0535	9	9	9	DIODE-SM SIC SCHOTTKY	28480	1901-0535
A1C83	1901-0040	1	1	1	DIODE-SM SCHOTTKY	28480	1901-0040
A1C84	1901-0040	1	1	1	DIODE-SM SCHOTTKY	28480	1901-0040
A1C85	1901-0040	1	1	1	DIODE-SM SCHOTTKY	28480	1901-0040
A1C86	1901-0159	2	2	2	DIODE-FM BRDQ 200V 1A	28480	1901-0159
A1C87	1901-0159	2	2	2	DIODE-FM BRDQ 200V 1A	28480	1901-0159
A1D81	1990-0485	5	5	5	LED-VISIBLE LUM-INT=800UCD IF=30MA-MAX	28480	1990-0485
A1D82	1990-0485	5	5	5	LED-VISIBLE LUM-INT=800UCD IF=30MA-MAX	28480	1990-0485
A1E1	9170-0029	2	2	2	CORE-SHIELDING BEAD	28480	9170-0029
A1E2	9170-0029	2	2	2	CORE-SHIELDING BEAD	28480	9170-0029
A1E3	9170-0029	2	2	2	CORE-SHIELDING BEAD	28480	9170-0029
A1E4	9170-0029	2	2	2	CORE-SHIELDING BEAD	28480	9170-0029
A1E5	9170-0029	2	2	2	CORE-SHIELDING BEAD	28480	9170-0029
A1E6	9170-0029	2	2	2	CORE-SHIELDING BEAD	28480	9170-0029
A1E7	9170-0029	2	2	2	CORE-SHIELDING BEAD	28480	9170-0029
A1E8	9170-0029	2	2	2	CORE-SHIELDING BEAD	28480	9170-0029
A1I1	1250-0835	1	1	1	CONNECTOR-RF SMC M PC 50-OHM	28480	1250-0835
A1I2	1250-0835	1	1	1	CONNECTOR-RF SMC M PC 50-OHM	28480	1250-0835
A1I3	1250-0835	1	1	1	CONNECTOR-RF SMC M PC 50-OHM	28480	1250-0835
A1L1	9140-0210	1	1	1	INDUCTOR RF-CH-MLD 100UH 5% .16BDX.385LC	28480	9140-0210
A1L2	9140-0210	1	1	1	INDUCTOR RF-CH-MLD 100UH 5% .16BDX.385LC	28480	9140-0210
A1O1	1884-0012	9	9	9	THYRISTOR-SCR 2N3528 10-8 VRRM=200	0192B	2N3528
A1O2	1884-0012	9	9	9	THYRISTOR-SCR 2N3528 10-8 VRRM=200	0192B	2N3528
A1O3	1854-0401	7	7	7	TRANSISTOR NPN SI 10-72 PD=200MW	28480	1854-0401
A1O4	1854-0401	7	7	7	TRANSISTOR NPN SI 10-72 PD=200MW	28480	1854-0401
A1Q5	1853-0430	0	0	4	TRANSISTOR PNP 2N4959 SI 10-72 PD=200MW	04713	2N4959
	1205-0012	1	1	1	HEAT SINK 10-18-CS	28480	1205-0012
	11720-00008	8	8	8	CLIP	28480	11720-00008

See introduction to this section for ordering information
 *Indicates factory selected value

Table 3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1Q6	1853-0430	0	TRANSISTOR PNP 2N4959 SI 10-72 PD=200MW	04713	2N4959
A1Q7	1285-0012	1	HEAT SINK 10-18-CS	28480	1205-0012
A1Q7	1853-0438	0	TRANSISTOR PNP 2N4959 SI 10-72 PD=200MW	04713	2N4959
A1Q8	1285-0037	0	HEAT SINK 10-18-CS	28480	1205-0037
A1Q8	1853-0430	0	TRANSISTOR PNP 2N4959 SI 10-72 PD=200MW	04713	2N4959
A1Q9	1854-0401	7	TRANSISTOR NPN SI 10-72 PD=200MW	28480	1854-0401
A1Q9	1285-0037	0	HEAT SINK 10-18-CS	28480	1205-0037
A1R1	0698-3447	4	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-10-422R-F
A1R2	0698-3438	3	RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-10-147R-F
A1R3	0698-3438	3	RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-10-147R-F
A1R4	0698-3438	3	RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-10-147R-F
A1R5	0757-0405	4	RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-10-162R-F
A1R6	0698-3440	7	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-10-196R-F
A1R7	0757-0417	8	RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-10-562R-F
A1R7	0757-0417	8	RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-10-562R-F
A1R8	0698-3447	4	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-10-422R-F
A1R9	0698-3447	4	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-10-422R-F
A1R9	0698-3447	4	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-10-422R-F
A1R10	0698-3447	4	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-10-422R-F
A1R11	0698-3440	8	RESISTOR 511 1% .125W F TC=0+-100	24546	C3-1/8-10-511R-G
A1R12	2100-1288	9	RESISTOR 511 1% .125W F TC=0+-100	24546	C3-1/8-10-511R-G
A1R13	0698-3440	8	RESISTOR 511 1% .125W F TC=0+-100	24546	C3-1/8-10-511R-G
A1R14	2100-1788	9	RESISTOR 511 1% .125W F TC=0+-100	24546	C3-1/8-10-511R-G
A1R15	0698-3440	8	RESISTOR 511 1% .125W F TC=0+-100	24546	C3-1/8-10-511R-G
A1R16	0698-3440	8	RESISTOR 511 1% .125W F TC=0+-100	24546	C3-1/8-10-511R-G
A1R17	0698-3440	8	RESISTOR 511 1% .125W F TC=0+-100	24546	C3-1/8-10-511R-G
A1R18	0757-0417	8	RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-10-562R-F
A1R19	0698-3440	8	RESISTOR 511 1% .125W F TC=0+-100	24546	C3-1/8-10-511R-G
A1R20	0698-3440	9	RESISTOR 511 1% .125W F TC=0+-100	24546	C3-1/8-10-511R-G
A1R21	0757-0405	4	RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-10-162R-F
A1R22	0698-3442	9	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-10-237R-F
A1R23	0698-3442	9	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-10-237R-F
A1R24	0698-3440	7	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-10-196R-F
A1R25	0698-3445	1	RESISTOR 56.2 1% .05W F TC=0+-100	24546	C3-1/8-10-56.2R-G
A1R26	0698-3440	7	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-10-196R-F
A1R27	0698-3440	7	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-10-196R-F
A1R28	0698-3440	7	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-10-196R-F
A1R29	0698-3440	5	RESISTOR 100 5% 2W MO TC=0+-200	28480	C4-1/8-10-196R-F
A1R30	2100-1788	9	RESISTOR-TRMW 500 10% C 10P-ADJ 1-TRN	73138	82PR500
A1R31	0698-3451	7	RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-10-2871-F
A1R32	0698-3150	6	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-10-2371-F
A1R33	0698-0082	7	RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-10-464R-F
A1R34	0757-0280	3	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-10-1001-F
A1R35	0698-2212	9	RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-10-100R-G
A1R36	0698-3446	3	RESISTOR 21.5 1% .05W F TC=0+-100	24546	C3-1/8-10-21.5R-G
A1R37	0698-3446	3	RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-10-383R-F
A1R38	0698-3445	2	RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-10-348R-F
A1R39	0698-3445	2	RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-10-348R-F
A1R40	0698-8690	9	RESISTOR 4.75 1% .125W F TC=0+-100	28480	C3-1/8-10-4.75R-G
A1R41	0698-3447	4	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-10-422R-F
A1R42	0698-7188	8	RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-10-10R-G
A1R43	0757-0438	3	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-10-5111-F
A1R44	0757-0438	3	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-10-5111-F
A1R45	0757-0401	0	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-10-101-F
A1R46	0757-0401	0	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-10-101-F
A1R47	0757-0799	9	RESISTOR 121 1% .5W F TC=0+-100	28480	C4-1/8-10-121-F
A1R48	0698-3611	4	RESISTOR 27 5% 2W MO TC=0+-200	27167	FP2-2-100-27R0-J
A1R49	0698-3437	2	RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-10-133R-F
A1R50	0698-3437	2	RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-10-133R-F
A1S1	3101-0555	9	SWITCH-PB PDP1 ALTNG 4A 250VAC	28480	3101-0555
A1S2	3101-2031	0	SWITCH-PB PDP1 ALTNG 1A	28480	3101-2031
A1S2	0624-0227	7	SCREW-TFC 4-40 .25-IN-LG PAN-HD-POZI STL	00000	ORDER BY DESCRIPTION
A1S2	08655-00015	0	INSULATOR, SINGLE	28480	08655-00015
A1F1	1251-0600	0	CONNECTOR-SGL CONT PIN 1,14-MM-BSC-SZ SQ	28480	1251-0600
A1F1	1251-0600	0	CONNECTOR-SGL CONT PIN 1,14-MM-BSC-SZ SQ	28480	1251-0600
A1F2	1251-0600	0	CONNECTOR-SGL CONT PIN 1,14-MM-BSC-SZ SQ	28480	1251-0600
A1F3	1251-0600	0	CONNECTOR-SGL CONT PIN 1,14-MM-BSC-SZ SQ	28480	1251-0600
A1F4	1251-0600	0	CONNECTOR-SGL CONT PIN 1,14-MM-BSC-SZ SQ	28480	1251-0600
A1F5	1251-0600	0	CONNECTOR-SGL CONT PIN 1,14-MM-BSC-SZ SQ	28480	1251-0600
A1F6	1251-0600	0	CONNECTOR-SGL CONT PIN 1,14-MM-BSC-SZ SQ	28480	1251-0600
A1F7	1251-0600	0	CONNECTOR-SGL CONT PIN 1,14-MM-BSC-SZ SQ	28480	1251-0600
A1F8	1251-0600	0	CONNECTOR-SGL CONT PIN 1,14-MM-BSC-SZ SQ	28480	1251-0600
A1F9	1251-0600	0	CONNECTOR-SGL CONT PIN 1,14-MM-BSC-SZ SQ	28480	1251-0600
A1F10	1251-0600	0	CONNECTOR-SGL CONT PIN 1,14-MM-BSC-SZ SQ	28480	1251-0600

*Indicates factory selected value
See introduction to this section for ordering information

Table 3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1P11	1251-0600	0	CONNECTOR-SCL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1P12	1251-0600	0	CONNECTOR-SCL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1P13	1251-0600	0	CONNECTOR-SCL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1P14	1251-0600	0	CONNECTOR-SCL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1P15	1251-0600	0	CONNECTOR-SCL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1P16	1251-0600	0	CONNECTOR-SCL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1P17	1251-0600	0	CONNECTOR-SCL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1P18	1251-0600	0	CONNECTOR-SCL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1U1	1820-0917	5	IC DRV T1L 2-1NP	22014	DH0035C
A1U2	1820-0917	5	IC FF ECL D-M/S DUAL	04713	KC10131P
A1U3	1820-0917	5	IC INV T1L 5 HEX 1-1NP	01285	SN74504N
A1U4	1820-0794	0	IC FF ECL D-M/S	04713	KC1670L
A1U5	1826-0179	0	IC FF ECL D-M/S	04713	KC1670L
A1U6	1826-0179	7	IC V RGLTR 10-39	22014	LK320H-S-2
A1U7	1902-0533	1	HEAT SINK 10-5/10-39-CS	28480	1205-0073
A1U8	1902-0533	3	DIODE-ZNR 4.99V 2X DO-15 PD=1W TC=-.012X	28480	1902-0533
A1U9	1902-0533	1	DIODE-ZNR 7.5V 5X DO-15 PD=1W TC=+.05X	28480	1902-0799
A1UR3	1902-3193	3	DIODE-ZNR 13.3V 5X DO-35 PD=.4W	28480	1902-3193
A1UR4	1902-3193	3	DIODE-ZNR 13.3V 5X DO-35 PD=.4W	28480	1902-3193
A1UR5	1902-3193	3	DIODE-ZNR 13.3V 5X DO-35 PD=.4W	28480	1902-3193
A1UR6	1902-0533	9	DIODE-ZNR 4.99V 2X DO-15 PD=1W TC=-.012X	28480	1902-0533
A1UR7	1902-0048	1	DIODE-ZNR 6.81V 5X DO-35 PD=.4W	28480	1902-0048
A1UR8	1902-0048	1	DIODE-ZNR 6.81V 5X DO-35 PD=.4W	28480	1902-0048
A2	0960-0443	1	MODULE LINE FILTER	28480	0960-0443
A2B1	5020-8257	4	LINE VOLTAGE SELECTION BOARD	28480	5020-8257
A11	11720-60010	8	PIN DIODE MODULATOR	28480	11720-60010
C1	0180-2181	4	CAPACITOR-FXD 1300UF+75-10X 50VDC AL	00853	539-7471-02
C2	0180-2181	4	WASHER-LK INTL 1 NO. 10 .195-IN-ID	28480	2190-0011
C3	0180-2181	4	WASHER-LK INTL 1 NO. 10 .195-IN-ID	28480	2190-0011
DS1	2140-0300	3	LAMP-INCAND 7370 18VDC 40MA T-1-1/3/4-BULB	08806	7370
F1	2110-0004	1	FUSE .25A 250V MTD 1.25X.25 UL (FOR 100/120V OPERATION)	28480	2110-0004
F2	2110-0479	4	FUSE .175A 250V MTD 1.25X.25 UL (FOR 220/240V OPERATION)	71400	MDL-175/1000
FL1	11720-60003	9	HIGH PASS FILTER ASSEMBLY	28480	11720-60003
FL2	11720-60009	5	LOW PASS FILTER ASSEMBLY	28480	11720-60009
J1	NSR, P/O W4		NSR, P/O W4		
J2	NSR, P/O W5		NSR, P/O W5		
MP1	0370-2248	7	KNOB, PUSHBUTTON (ON-OFF)	28480	0370-2248
MP2	0370-0914	8	BEZEL-PB KNOB, 490LG, 330M, 165MI, JADE	28480	0370-0914
MP3	11720-20007	9	POWER SWITCH, PUSHROD (FOR S1)	28480	11720-20007
MP4	11720-20008	0	PULSE SWITCH, PUSHROD (FOR S2)	28480	11720-20008
MP5	11720-00004	4	SUPPORT, MOTHER BOARD	28480	11720-00004
MP6	11720-00005	5	SUPPORT, FRONT, MOTHER BOARD	28480	11720-00005
MP7	11720-00006	6	MODULATOR SUPPORT	28480	11720-00006
MP8	08731-210	2	NUT-LOCK	28480	08731-210
MP9	5040-0235	4	BASE/LAMPHOLDER	28480	5040-0235
MP10	5040-0311	7	LAMPHOLDER FOR DS1	28480	5040-0311
MP11	0340-0486	8	INSULATOR-COVER NYLON	28480	0340-0486
MP12	11720-00001	1	PANEL, FRONT	28480	11720-00001
MP13	11720-00002	2	SUB-PANEL, FRONT	28480	11720-00002
MP14	11720-00003	3	PANEL, REAR	28480	11720-00003
MP15	5020-8813	8	FRAME, FRONT	28480	5020-8813
MP16	5020-8814	9	FRAME, REAR	28480	5020-8814
MP17	5020-8829	6	SIDE STRUTS	28480	5020-8829

See introduction to this section for ordering information
 *Indicates factory selected value

Table 3. Replaceable Parts

Reference Designation	HP Part Number	D	C	Qty	Description	Mfr Code	Mfr Part Number
MP18	5061-0835	4	1	1	COVER-PERFORATED	28480	5061-0835
	0570-1171	2	2	2	SCREW-SPLC 6-32 .468-IN-LG UNCT 100	28480	0570-1171
	0570-1171	4	2	2	RETAINER-RING E-R EXT .141-IN-DIA STL	28480	0570-1171
MP19	5060-9971	5	1	1	COVER, PERFORATED, BOTTOM	28480	5060-9971
	0510-0043	3	1	1	RETAINER-RING E-R EXT .141-IN-DIA STL	28480	0510-0043
	0570-1171	4	2	2	SCREW-SPLC 6-32 .468-IN-LG UNCT 100	28480	0570-1171
	0510-0043	7	4	4	RETAINER-RING E-R EXT .141-IN-DIA STL	28480	0510-0043
MP20	5040-7201	8	2	2	FOOT (STANDARD) FRONT	28480	5040-7201
MP21	5040-7222	3	2	2	FOOT-REAR NO SKID	28480	5040-7222
MP22	5040-7222	7	3	3	TRIM, SIDE 3-1/2	28480	5040-7222
MP23	5001-0438	2	2	2	TRIM STRIP	28480	5001-0438
MP24	5040-7203	0	1	1	RETAINER-PUSH ON KB-T0-SHFT EXT	28480	5040-7203
MP25	0510-1148	2	2	2	(SECURES FRONT PANEL)	28480	0510-1148
MP26	7120-4163	7	2	2	LABEL, INFO .CAUTION	28480	7120-4163
MP27	7120-4627	6	1	1	LABEL-WARNING 6-IN-WD 1.8-IN-LG VINYL	28480	7120-3528
MP28	7120-3528	6	1	1	LABEL, INFO (FUSE RATINGS)	28480	7120-3528
MP29	7120-3984	9	1	1	CLAMP-CABLE .25-DIA .5-WD NYL	28480	7120-3984
MP30	3050-0066	8	2	2	WASHER-LK HLCL NO. 6 .147-IN-ID	28480	3050-0066
	2190-0018	5	2	2	WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
	2190-0003	1	1	1	SCREW-MACH 6-32 .5-IN-LG PAN-HD-PHL BRS	28480	2190-0003
MP31	11720-00007	7	1	1	AC LINE VOLTAGE SHIELD (S1)	28480	11720-00007
	2200-0143	0	0	0	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	2200-0143
	3050-0105	6	6	6	WASHER-LK HLCL NO. 4 .125-IN-ID	28480	3050-0105
	2190-0019	6	6	6	WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
MP32	2510-0192	6	8	8	(SIDE STRUTS TO FRAME)	28480	2510-0192
MP33	2460-0003	1	1	1	SCREW-MACH 6-32 .5-IN-LG PAN-HD-PHL BRS	00000	2460-0003
	2360-0121	2	2	2	(FRONT SUPPORT TO SIDE STRUT)	00000	2360-0121
MP34	2360-0121	2	2	2	SCREW-MACH 6-32 .5-IN-LG PAN-HD-POZI	00000	2360-0121
	2360-0113	2	2	2	(FRONT SUPPORT TO SIDE STRUT)	00000	2360-0113
MP35	2360-0113	2	2	2	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	2360-0113
MP36	2360-0113	2	2	2	(A1 TO FRONT SUPPORT)	00000	2360-0113
MP37	2200-0103	2	11	11	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	2200-0103
	2360-0113	2	2	2	(A1 TO SIDE/REAR SUPPORT)	00000	2360-0113
MP38	2360-0113	2	2	2	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	2360-0113
	0590-1011	6	1	1	(REAR PANEL TO FRAME)	28480	0590-1011
MP39	0590-1011	6	1	1	NUT-KNRLDR 15/32-32-THD .12-IN-THK (FOR J2)	28480	0590-1011
11	9100-3973	5	1	1	TRANSFORMER-POWER	28480	9100-3973
	2200-0127	6	2	2	SCREW-MACH 4-40 .468-IN-LG FIL-HD-SLT	00000	2200-0127
	3050-0105	6	6	6	WASHER-LK HLCL NO. 4 .125-IN-ID	28480	3050-0105
	2190-0019	6	6	6	WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
	2190-0004	6	2	2	WASHER-LK INTR T NO. 4 .115-IN-ID	28480	2190-0004
U1	1826-0123	1	1	1	IC 7912 V RGLTR 10-3	00000	1826-0123
	2200-0149	6	6	6	SCREW-MACH 4-40 .625-IN-LG PAN-HD-POZI	00000	2200-0149
	3050-0105	6	6	6	WASHER-LK HLCL NO. 4 .125-IN-ID	28480	3050-0105
	2190-0019	6	6	6	WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
	2260-0001	5	5	5	NUT-HEX-DBL-CHAM 4-40-THD .094-IN-THK	28480	2260-0001
	0360-0016	2	2	2	TERMINAL-SLDR LUG LK-MTG FOR-44-SCR	28480	0360-0016
U2	1826-0117	3	1	1	IC 7812 V RGLTR 10-3	00000	1826-0117
	2200-0149	6	6	6	SCREW-MACH 4-40 .625-IN-LG PAN-HD-POZI	00000	2200-0149
	3050-0105	6	6	6	WASHER-LK HLCL NO. 4 .125-IN-ID	28480	3050-0105
	2190-0019	6	6	6	WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
	2260-0001	5	5	5	NUT-HEX-DBL-CHAM 4-40-THD .094-IN-THK	28480	2260-0001
	0360-0016	2	2	2	TERMINAL-SLDR LUG LK-MTG FOR-44-SCR	28480	0360-0016
	1200-0043	8	1	1	INSULATOR-XSTR ALUMINUM	28480	1200-0043
	1200-0081	4	2	2	INSULATOR-FLG-BSHG NYLON	28480	1200-0081
W1	11720-60007	3	3	3	CABLE ASSEMBLY, PULSE INPUT	28480	11720-60007
	11720-60004	0	1	1	CABLE ASSEMBLY, BIAS TEE	28480	11720-60004
W2	11720-60005	1	1	1	CABLE ASSEMBLY, MODULATOR	28480	11720-60005
W3	8120-2499	9	1	1	CABLE ASSEMBLY-RF INPUT	28480	8120-2499
W4	8120-2499	1	1	1	CABLE ASSEMBLY-RF OUTPUT	28480	8120-2499
W5	8120-2500	3	1	1	CABLE ASSEMBLY-RF OUTPUT	28480	8120-2500
W6	8120-1378	1	1	1	CABLE ASSY 18AWG 3-CNDCT JGK-JKT	28480	8120-1378

See introduction to this section for ordering information
*Indicates factory selected value

Table 4. Code List of Manufacturers

Mfr Code	Manufacturer Name	Address	Zip Code
00000	ANY SATISFACTORY SUPPLIER		
00523	SARGAND ELEC CO S CAROLINA DIV	PICKENS SC	29671
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	SC	75222
01928	RCA CORP SOLID STATE DIV	DALLAS TX	08876
04713	MOTOROLA SEMICONDUCOR PRODUCTS	PHOENIX AZ	85062
07263	FAIRCHILD SEMICONDUCOR DIV	MOUNTAIN VIEW CA	94042
08806	GE CO MINIATURE LAMP PROD DEPT	CLEVELAND OH	44112
20532	EMCON DIV ITW	SAN DIEGO CA	92129
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD PA	16701
27014	NATIONAL SEMICONDUCOR CORP	SANTA CLARA CA	95051
27167	CORNING GLASS WORKS (WILMINGTON)	WILMINGTON NC	28401
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	01247
71400	BUSSMAN MFG DIV OF MCGRAW-EDISON CO	ST LOUIS MO	62107
72136	ELECTRO MOTIVE CORP SUB IEC	WILLIAMTIC CT	06226
73138	BECKMAN INSTRUMENTS INC HELIPOT DIV	FULLERTON CA	92634

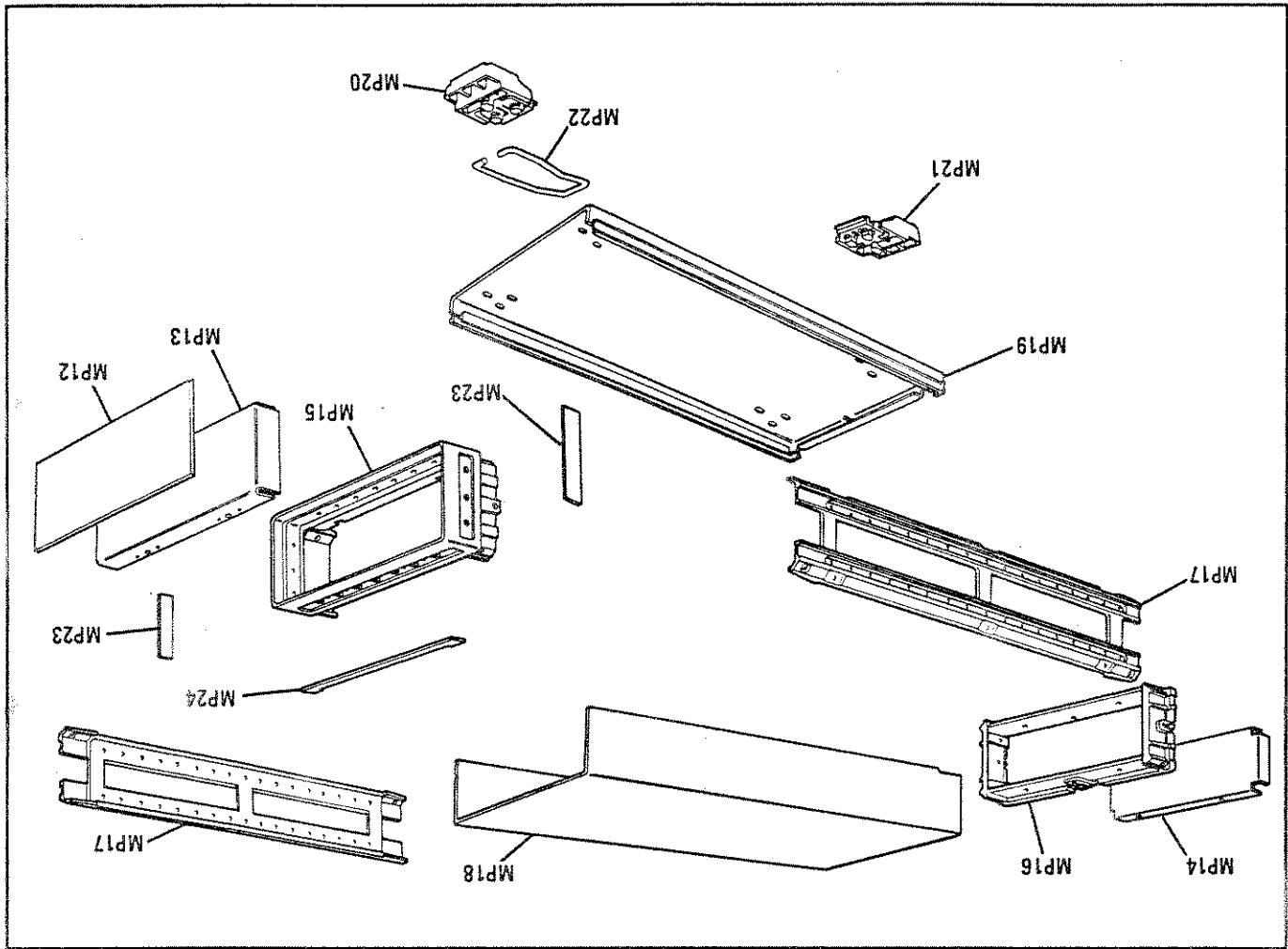


Figure 11. Cabinet Parts

64. SERVICE
65. Service instructions consist of principles of operation, troubleshooting, and repairs.

66. PRINCIPLES OF OPERATION

67. General. (See Service Sheet 1.) The modulator drive circuits provide the signal required to switch the modulator on and off in a manner which ensures short rise and fall times on the RF output pulses. The main modulator drive signal is introduced into the modulator at the node between the anodes of the shunt diodes and the cathode of the series diode. The series and shunt diodes are all switched by the main drive signal. However, to achieve short transition times, it is also necessary to pulse the series diode each time the modulator switches. Positive and negative pulses, produced by the turn-on and turn-off circuits, are introduced through the Bias Tee to the anode of the series diode. They provide a properly timed complement to the drive signal during pulse transition and ensure rapid series diode switching.

68. PIN Modulator Driver. The PIN Modulator Driver translates buffered TTL-level signals from the PULSE INPUT J1 into the voltages necessary to drive the PIN diodes in the modulator. Current from U1 turns the RF on by biasing the modulator shunt diodes off and the series diode off. When U1 changes state, it discharges either C15 or C21 producing short output spikes that quickly switch the shunt diodes in the modulator. Depending on the mode selected, the PULSE MODE switch, S2, receives the input signal directly from J1 or its complement from U3B pin 4, U3C, U3D, and U3E provided buffering and the complementary drive required by the PIN Modulator Driver, U1.

69. Turn-Off Switching. The turn-off circuits produce a short negative pulse that arrives at the anode of the modulator series diode just as the modulator is switching the RF off. The pulse ensures rapid diode turn-off. Pulses from U3D are differentiated by RC network C1, R1, and R2. The positive-going spike, corresponding to the input pulse trailing edge, triggers flip-flop U2. U2 is configured as a positive edge triggered one-shot multivibrator with its output pulse width determined by C3 and R7. This time constant determines the delay between the input pulse trailing edge and the initiation of the turn-off pulse. As U2 resets, U4 is clocked. U4 is also connected as a one-shot multivibrator with its output pulse width determined by C3 and R7. This time constant determines the delay between the input pulse trailing edge and the initiation of the turn-off pulse. As U2 resets, U4 is clocked. U4 is also connected as a one-shot multivibrator with its output pulse width determined by C5 and R12. This time constant sets the width of the turn-off pulse. The complementary outputs of U4 drive differential pair Q3 and Q4 and appear as a short negative-going pulse at the summing junction at the base of Q7. Amplified by the On/Off Pulse Driver circuit, this pulse complements the main drive signal from U1 and rapidly switches the modulator's series diode on.

70. Turn-On Switching. Similar to the diode turn-off circuits, the turn-on circuits produce a short positive pulse that arrives at the anode of the modulator series diode just as the modulator is switching the RF on. This pulse ensures rapid diode turn-on. Because of the inversion through U3F, the positive spike that clocks U5 coincides with the leading edge of the input pulse. U5 is configured as a positive edge triggered one-shot multivibrator with its output pulse width set by C7 and R14. The output pulse width of U5 determines the width of the turn-on pulse. The complementary outputs of U5 drive differential pair Q5 and Q6 and appear as a short positive-going pulse at the summing junction at the base of Q7. Amplified by the On/Off Pulse Driver circuit, this pulse complements the main drive signal from U1 and rapidly switches the modulator's series diode on.

71. On/Off Pulse Driver. The On/Off Pulse Driver sums the switching pulses from the Turn-On and Turn-Off Amplifiers with a dc offset voltage, and drives the anode of the modulator's series diode. Q7 through Q10 form a complementary emitter follower amplifier. Q7 sums the positive and negative pulses from the Turn-On and Turn-Off Amplifiers with the offset voltage set by R30. R30 is adjusted so that Q9 and Q10 drive enough current through the modulator's series diode to keep its insertion loss low when the RF is on. When the RF is off, Q8 draws a small bias current through the diode's parallel resistor to hold the diode off. Resistors R35 and R36 prevent output stage oscillation, and CR3 and CR4 assure proper bias of the complementary output transistors.

72. Bias Tee, Modulator, and Filters. RF enters the Bias Tee from J1 through W4. The Bias Tee provides both high pass filtering to block video feed-through and dc isolation of the modulator's series diode. In the NORM mode, PIN Modulator Driver A1U1 holds the modulator's shunt diodes on. The series diode is held off by the current from A1U1 to A1Q8. When a pulse enters PULSE INPUT, A1U1 turns the shunt diodes off. The series diode receives a positive pulse at its

modulator off. Set the Mode to COMPLEMENT; the voltage should go to -3.7 Vdc to turn the modulator on. (See Figure 12.)

b. Connect dc voltmeter to TP17. In NORM, this test point should measure about -0.2 Vdc, and in COMPL, it should be about -0.5 Vdc. If the voltages in steps 1 and 2 are correct, the circuit is basically OK although further tests are needed to check pulse performance. If the voltages are wrong, troubleshoot using the dc voltages noted on the schematics.

c. Connect equipment to observe RF pulses as in Figure 7 in the Pulse Performance Test. If the rise or fall time is too long, perform the adjustment procedure. The +PW adjustment affects rise time and the -P and -PW adjustments affect fall time. The OS (offset) adjustment affects insertion loss.

d. If the fall time cannot be adjusted to within specifications, use waveforms (Figures 13, 14, and 15) to troubleshoot U2, U4, Q3 and Q4.

e. If the rise time is out of specification, use waveforms (Figures 15 and 16) to troubleshoot U5, Q5, and Q6.

f. If both rise and fall time are out of specification, troubleshoot Q7, Q8, Q9 and Q10 using dc bias voltages, and the waveform of Figure 17.

g. If pulse performance is good, check on-off ratio using a spectrum analyzer as shown in the On/Off Ratio Test. If the on-off ratio is too low, check the microwave chain for loose connectors or cracks at connectors or in the silver paint. If the connections are all OK, troubleshoot U3, U1, and ATT.

76. Repair. In some instances, repair consists of merely making the required adjustments to bring the instrument up to specification levels. In other cases, repair requires the replacement of malfunctioning component with a known good component. Assembly and chassis component locations are shown in Figure 22. Parts locations for PC board A1 are shown in Figures 18 and 20. To gain access to the chassis-mounted components and the PC board remove the top (or bottom) cover by loosening the single screw at the rear of the cover.

CAUTION

To prevent damage to semi-rigid cables W4 and W5, remove entire microwave chain (including J1 and J3) before disassembly it for component replacement.

anode from the turn-on circuits and switches on. When the input pulse falls, modulator driver A1U1 turns the shunt diodes on. A negative pulse from the turn-off circuits switches the series element back off. The Low Pass Filter prevents RF from leaking into the bias and switching circuits. The High Pass Filter reduces video feedthrough and couples the RF to the output, J3.

73. Power Supply Regulators. (See Service Sheet 2.) The $\pm 12V$ regulators are integrated circuits which contain a reference, series pass transistor, and built-in over-current protection. CR6 and CR7 protect each supply against shorts to a supply of opposite polarity. Over voltage protection is provided by Q1 and Q2. A resistor (contained internally) between the gate and cathode of Q1 completes the bias path from R45 through VR4 to ground. If the output voltage is too high VR1 triggers Q1 and shuts down the supply. DS1 and DS2 indicate that the supplies are operating. The +5V power supply is derived from the +12V supply by use of a zener. The -5V supply is derived from the -12V supply by use of a regulator similar to that used in the $\pm 12V$ supplies.

74. TROUBLESHOOTING

75. The 11720A Pulse Modulator circuits are conventional and not complicated. Significant circuit stage functions and operation levels are identified on the schematic diagrams. Use the information on the schematics and the procedure below to isolate malfunction.

WARNINGS

Maintenance described herein is performed with power supplied to the instrument, and protective covers removed. Such maintenance should be performed only by service-trained personnel who are aware of the hazards involved. Where maintenance can be performed without power applied, the power should be removed.

Before any repair is completed, ensure that all safety features are intact and functioning and that all parts requiring protective grounding are so grounded.

a. Connect dc voltmeter to A1TP2. Set front panel MODE switch to NORMAL. The PIN modulator bias voltage should be +1.1 Vdc to turn the

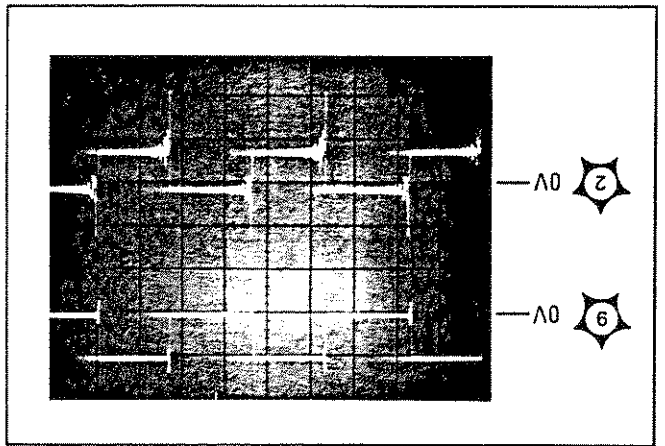


Figure 12. Pulse Input (A1TP9, 5V per division) vs. Waveform at A1TP2 (5V per division).
Horizontal scale: 1 μ s per division.

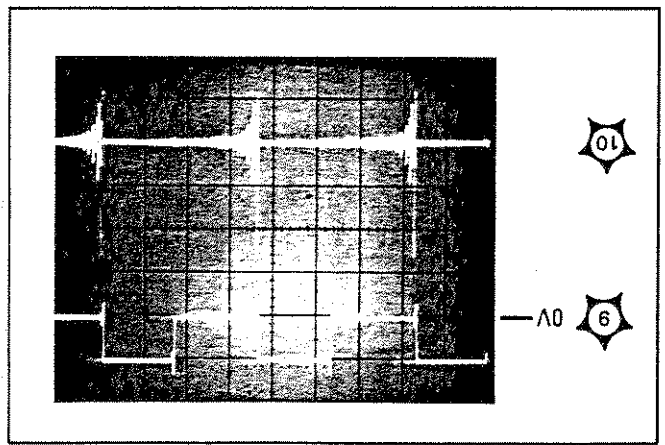


Figure 14. Pulse Input (A1TP9, 5V per division) vs. Waveform at A1TP10 (0.2V per division, ac coupled).
Horizontal scale: 1 μ s per division.

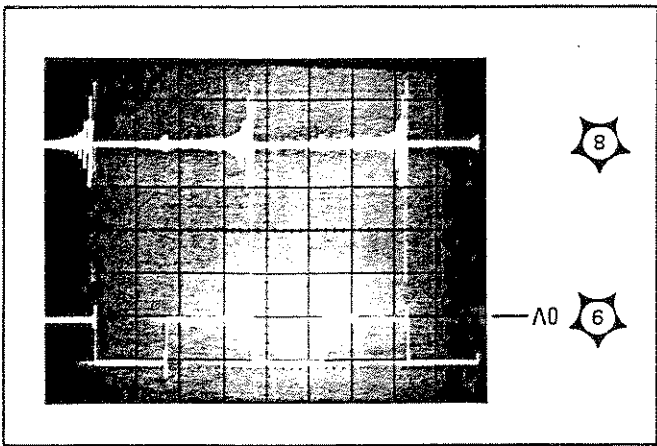


Figure 13. Pulse Input (A1TP9, 5V per division) vs. Waveform at A1TP8 (0.2V per division, ac coupled).
Horizontal scale: 1 μ s per division.

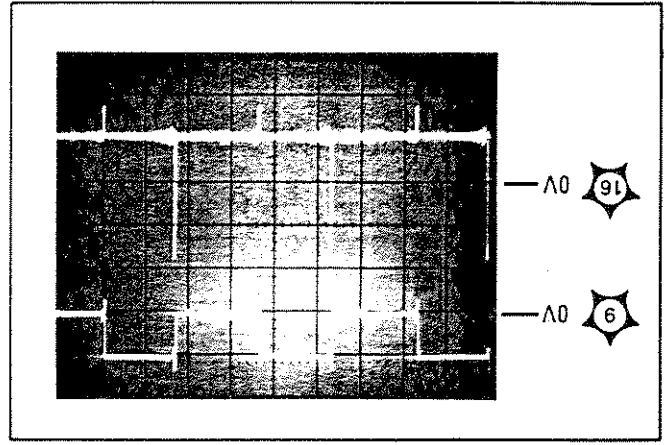


Figure 16. Pulse Input (A1TP9, 5V per division) vs. Waveform at A1TP16 (2V per division).
Horizontal scale: 1 μ s per division.

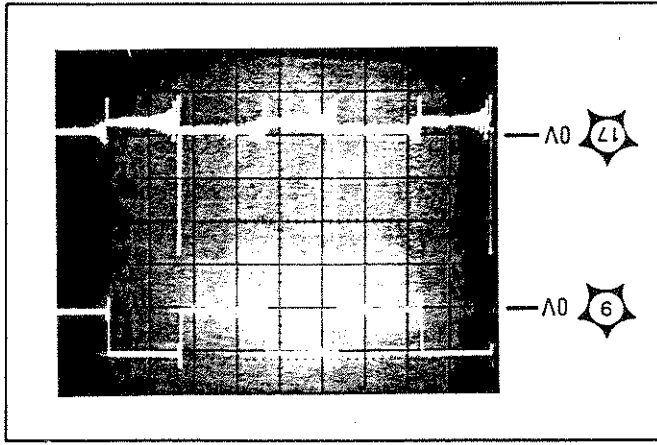


Figure 17. Pulse Input (A1TP9, 5V per division) vs. Waveform at A1TP17 (2V per division).
Horizontal scale: 1 μ s per division.

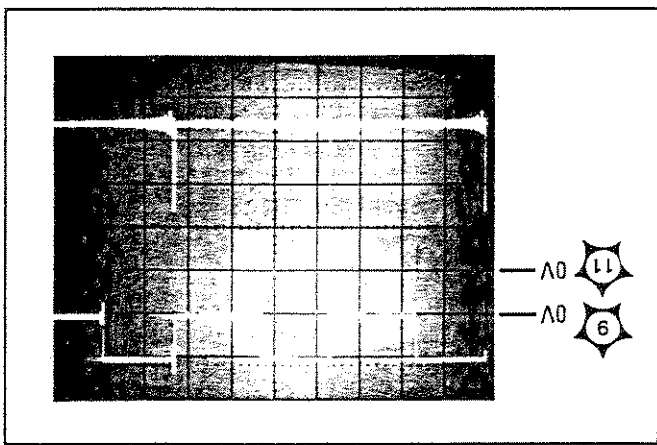


Figure 15. Pulse Input (A1TP9, 5V per division) vs. Waveform at A1TP11 (0.5V per division).
Horizontal scale: 1 μ s per division.

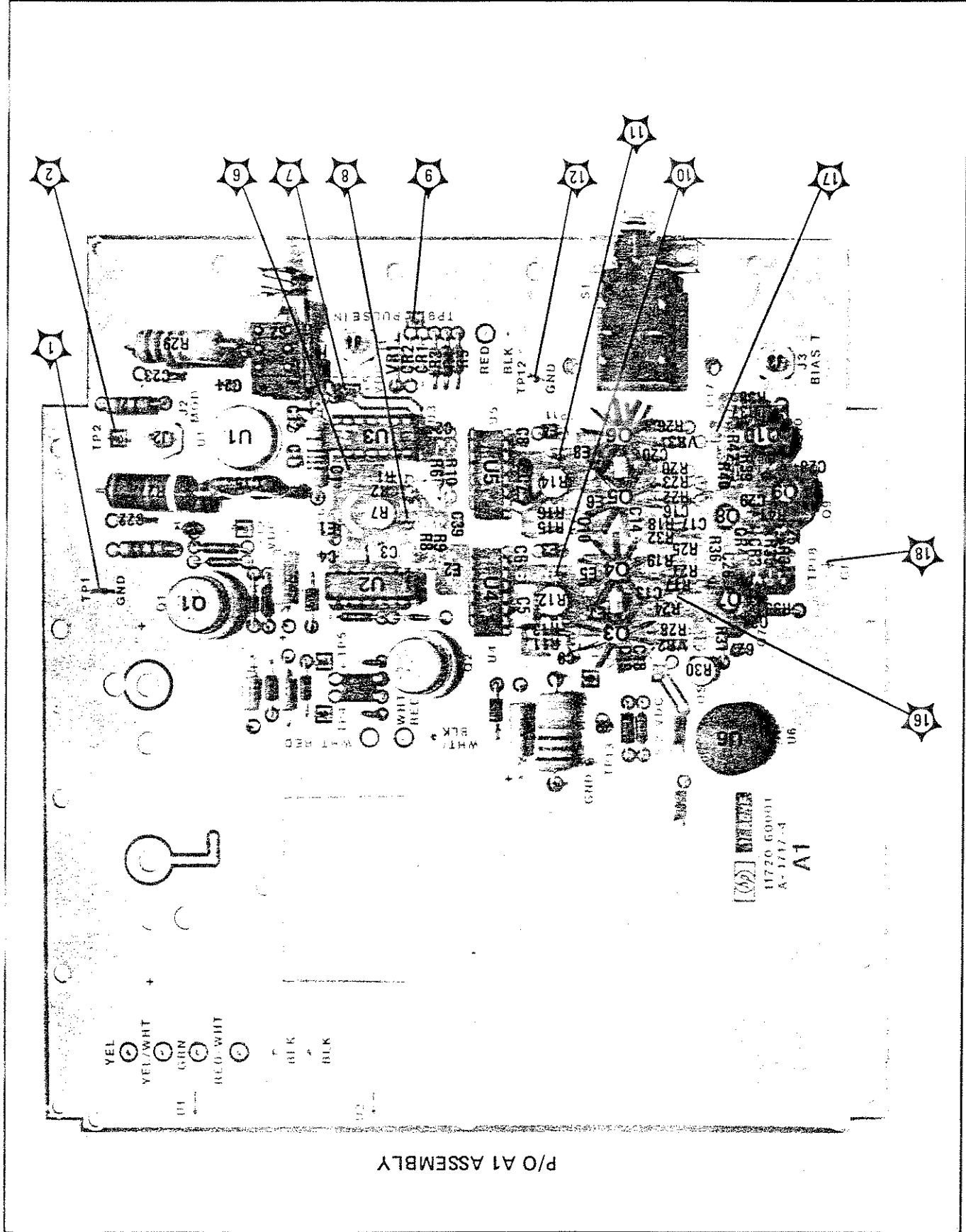
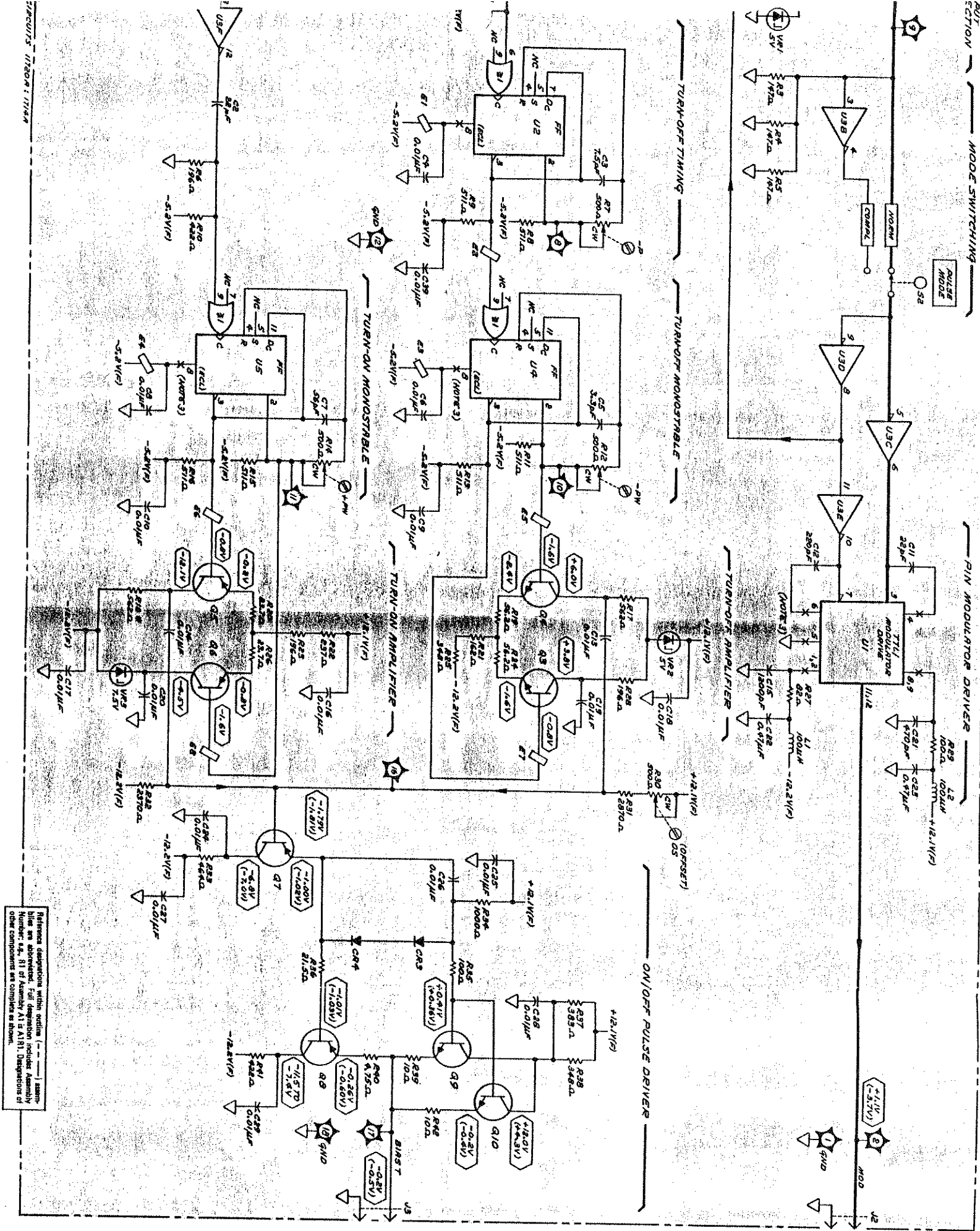
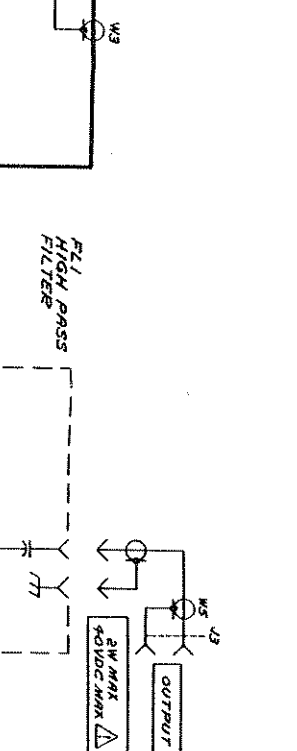


Figure 18. P/O A1 Pulse Driver Board Assembly Component Locations

E DRIVER BOARD ASSEMBLY (11780 - 60001)



Reference designations within outline (---) same as those on subassembly. Full designation includes Assembly Number; e.g. U1 of Assembly A1 is A1U1. Designations of items components are complete as shown.



- NOTES**
1. DC VOLTAGES ARE SHOWN WITH NO PULSE INPUT AND IN NORMAL MODE. VOLTAGES IN PARENTHESES ARE FOR COMPL MODE.
 2. VOLTAGE TOLERANCES ARE $\pm 10\%$. HIGHER RESOLUTION IS SHOWN AT SOME MODES TO INDICATE TYPICAL CHANGES BETWEEN NORM AND COMPL MODES.
 3. X DENOTES NOT-A-LOAD INPUT. * PARTS SHOULD BEET 80% AND FULL TIME PRODUCTION.

REFERENCE DESIGNATIONS

NO PREFIX	NO PREFIX
RTI	Q1 - Q2, Q9
CP1	Q3 - Q4
FL1,2	Q5 - Q8
U1 - 5	U1 - 5
W1 - 5	W1 - 5
	Q3 - Q4
	Q5 - Q8
	U1 - 5
	W1 - 5

LOGIC LEVELS

LOGIC	TTL	ECL	SEEL	CMOS
HIGH (1)	3.2V	3.0-3.5V	3.0-3.1V	3.0V
LOW (0)	0.0-0.8V	0.0-1.5V	0.0-0.6V	0.0-1.0V
* EQUAL TO OR MORE NEGATIVE THAN				
* EQUAL TO OR MORE POSITIVE THAN				
INPUT	TTL	ECL	SEEL	CMOS
GROUND	LOW (0)	HIGH (1)	LOW (0)	LOW (0)
OPEN	HIGH (1)	LOW (0)	LOW (0)	X
* GROUND - 0V; X = UNDESIGNED				

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATION	PART NUMBER
Q3, Q4, Q5, Q10	1828 - 0401
Q3 - 9	1828 - 0400
U1	1820 - 1797
U2	1820 - 0817
U4, 5	1820 - 0794

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATION	VIN NUMBER	VOUT NUMBER
U2, 5, 5	-5.2V(1) - 9	-1, 16
U3	+5.2V(1) - 14	- 7

Figure 19. Modulator and Drive Circuits Schematic Diagram





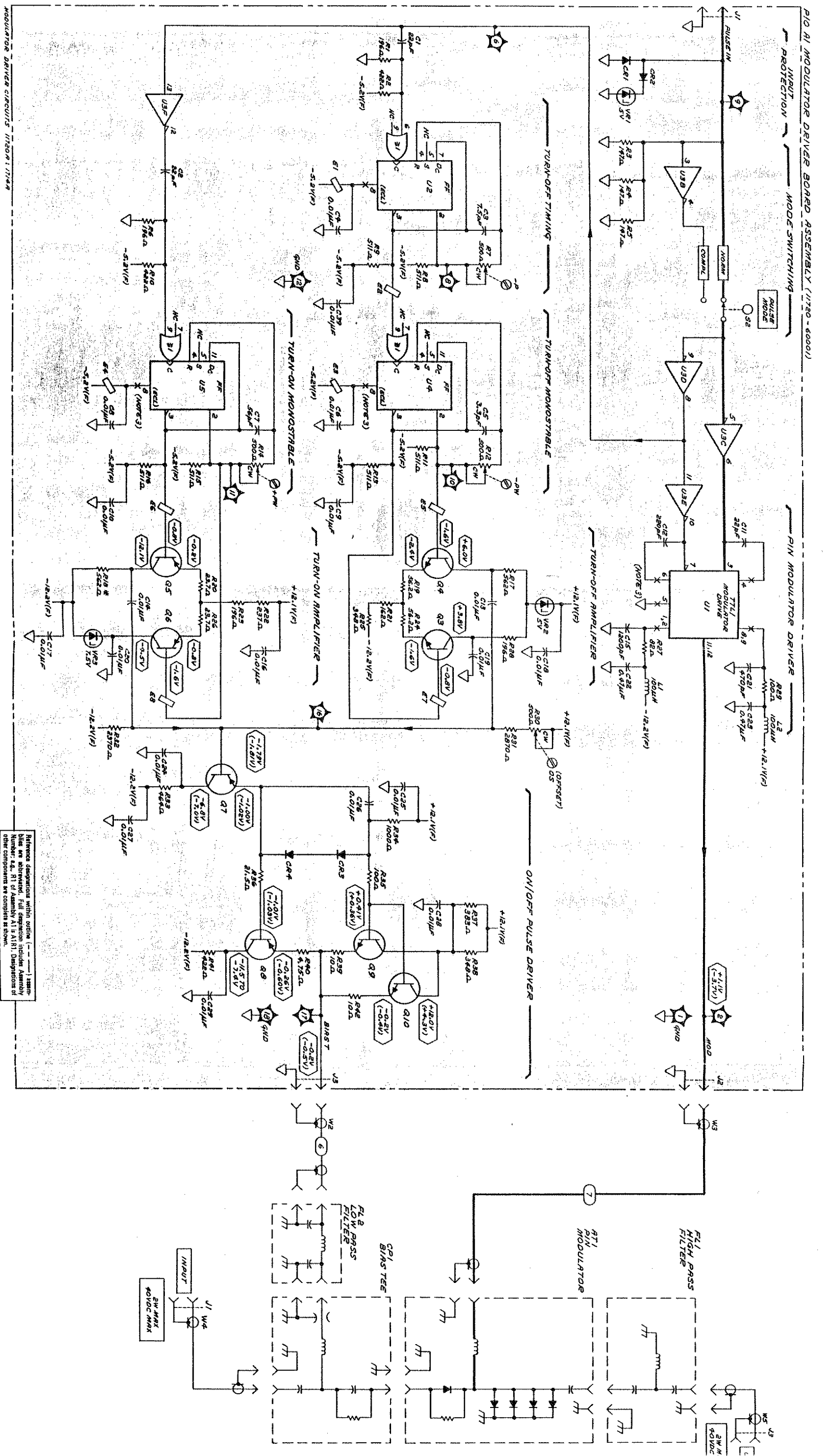


Figure 19. Mod

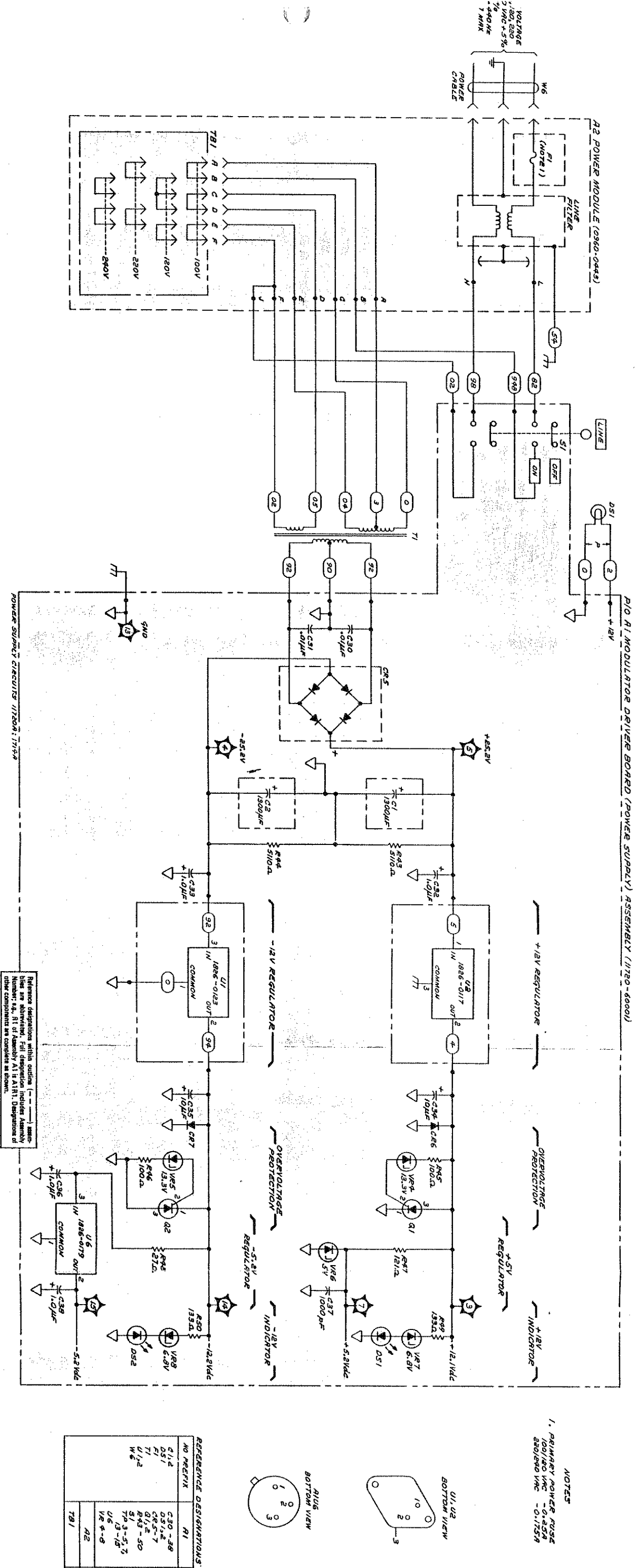


Figure 21. Power Supplies Schematic Diagram

P/OA1,A2



P/O A1 ASSEMBLY

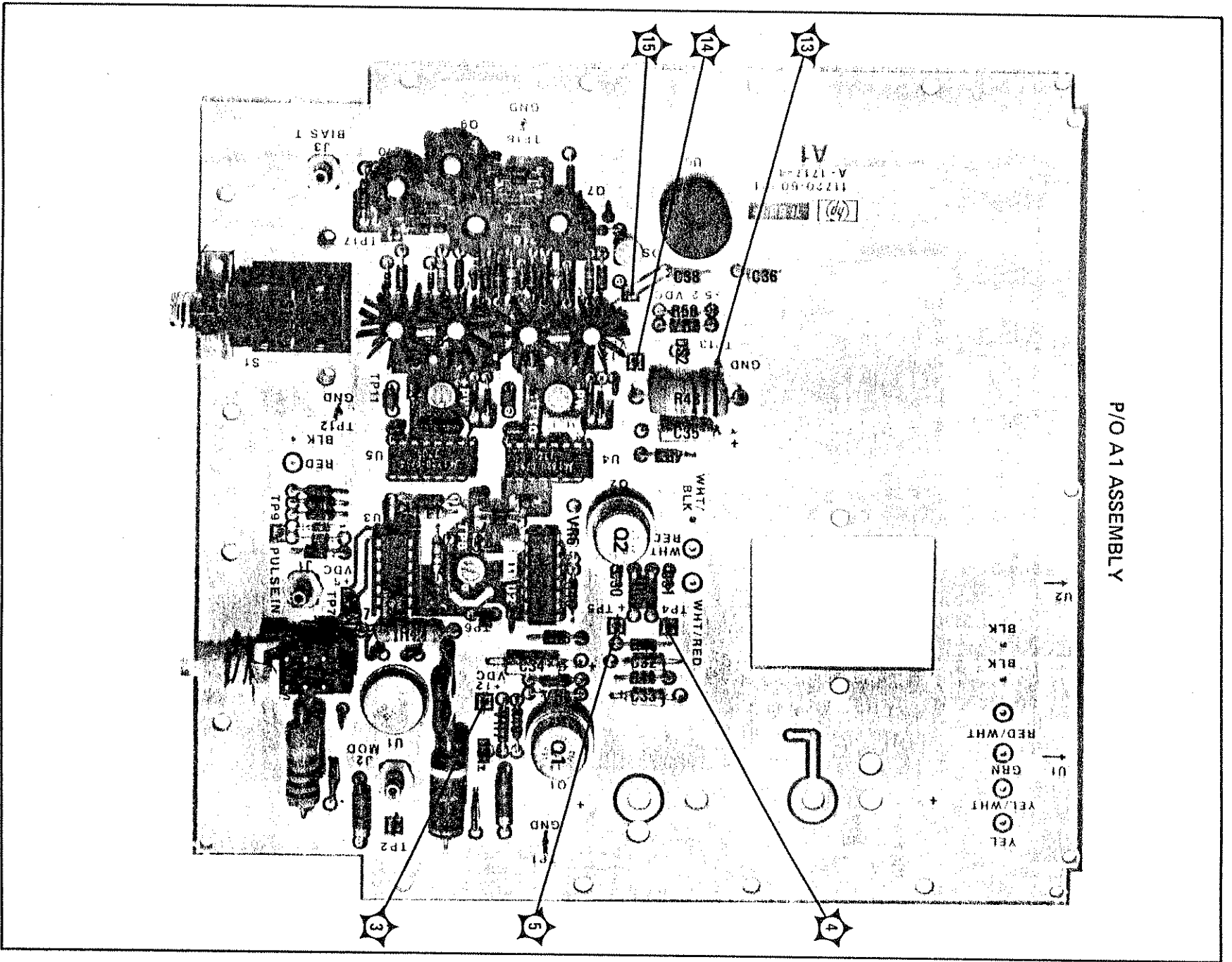
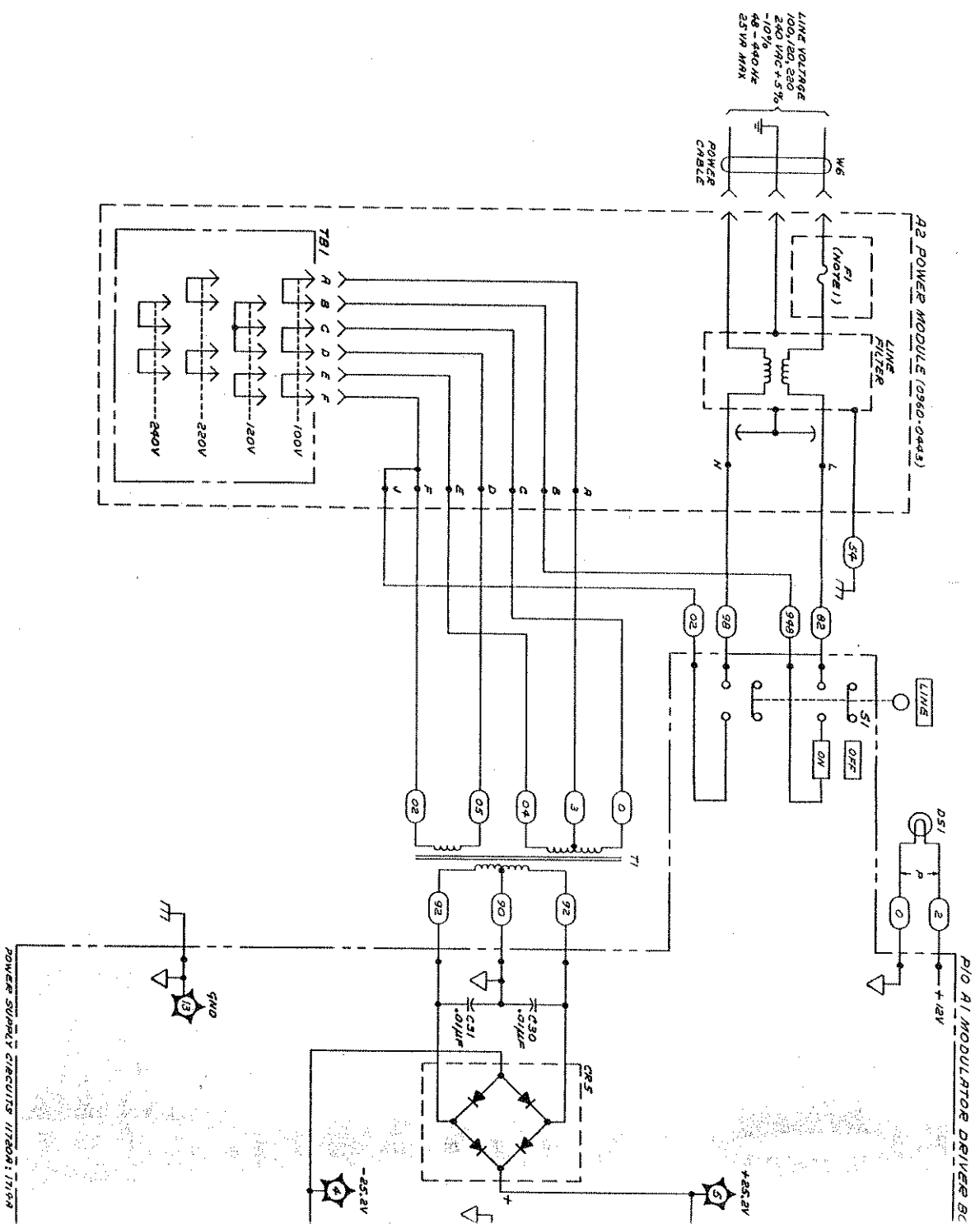


Figure 20. P/O A1 Pulse Driver Board Assembly Component Locations





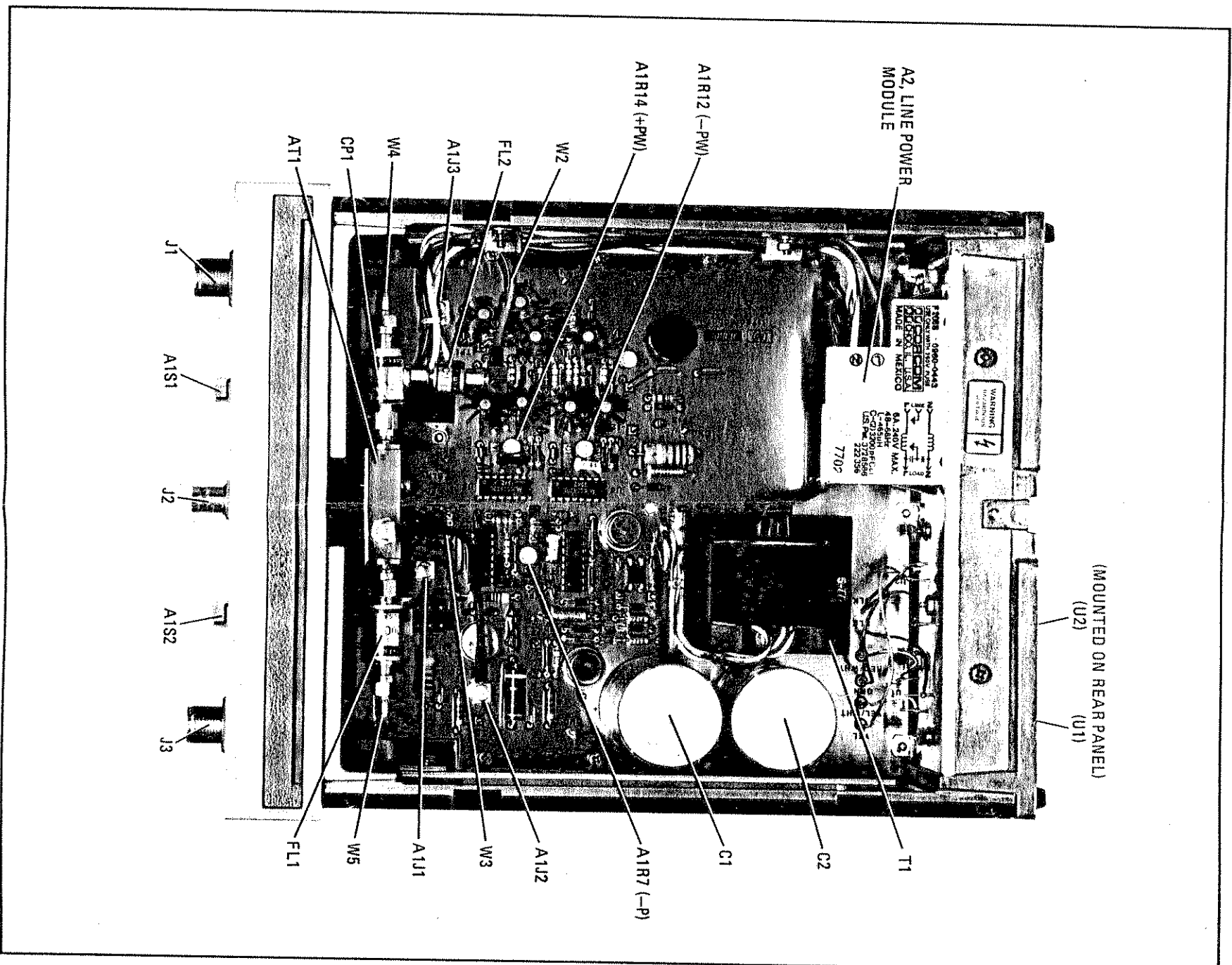


Figure 22. Top Internal View

Power Supplies
SERVICE SHEET 2

MANUAL CHANGES

MANUAL IDENTIFICATION
 Model Number: 11720A
 Date Printed: December 1980
 Part Number: 11720-90007

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 or Number	Make Manual Changes
1721A	1
1736A, 1828A	1, 2
1913A	1-3
1913A00453 through 1913A00460, 1934A	1-4
Serial Prefix or Number	Make Manual Changes
2021A	1-5

NEW ITEM

CHANGE 1

Page 18, Table 3:
 Change AIR36 to 0698-7205, RESISTOR 51.1Ω 2% .05W F TC=0±100.

Page 27, Figure 19 (Service Sheet 1):
 Change AIR36 to 51.1Ω.

CHANGE 2

Page 29, Figure 21 (Service Sheet 2):
 Change the wire colors indicated for the wiring between the A2 Power Module and the LINE switch A2S1 as follows:

CHANGE 3

Page 2, Table 1:
 Change the Video Feedthrough (V_F) specification from <50 mVp-p to <60 mVp-p.

Page 10, paragraph 56:
 Change the Video Feedthrough specification to <60 mVp-p.

NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.



CHANGE 4

Page 2, Table 1:

Change Dimensions side view to 302 (11.9).

Page 19, Table 3:

Change J1 and J3 Descriptions to Connector - RF APC-N FEM. J1 and J3 are made up of the parts listed in Table 1 and shown in Figure 1 of this supplement.

Delete MP8 08731-210.

Change MP12 to 11720-00013, same description.

Change MP13 to 11720-00014, same description.

Page 20, Table 3:

Change W4 to 11720-20016, same description.

Change W5 to 11720-20017, same description.

Table 1. Replaceable Parts (P/O Change 4)

Item Number	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	1250-0914	1	CONNECTOR-RF APC-N FEM UNMTD	9D949	131-150
2	1250-0915	1	CONTACT, RF CONNECTOR, FEMALE	71785	131-149
3	2190-0104	1	WASHER-LK INTL T NO.-7/16 .439-IN-ID CENTER	78189	1922-04
4	2950-0132	1	NUT-HEX DBL-CHM 7/16-28-THD	73734	7650NMP
5	5040-0306	1	INSULATOR	28480	5040-0306
6	08555-20093	1	CENTER CONDUCTOR	28480	08555-20093
7	08555-20094	1	BODY, BULKHEAD	28480	08555-20094
8	08761-2027	1	INSULATOR	28480	08761-2027

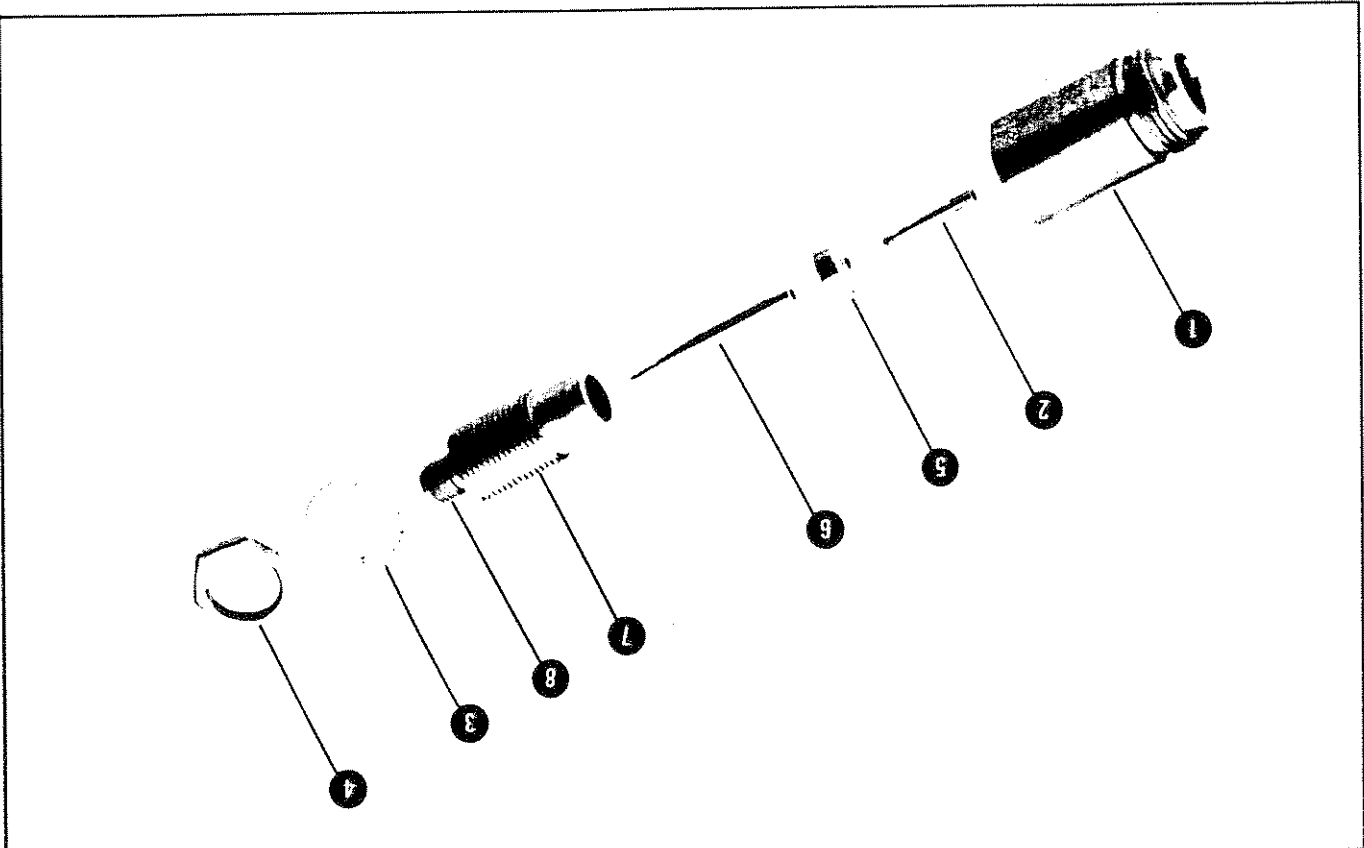


Figure 1. Type N Connector (P/O Change 4)

Under U2, delete 2200-0149 SCREW-MACH 4-40
Add 2200-0147 CD4 SCREW-MACH 4-40 .50-IN-LG PAN-HD-POZI 28480 2200-0147
Add 0340-0833 CD9 INSULATOR-XSTR NYLON BLACK 28480 0340-0833

Page 20, Table 3:

CHANGE 5

Model 11720A

11720-90007

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