OPERATING AND SERVICE MANUAL

11666A REFLECTOMETER BRIDGE

01-AB-11666A-LE-M/C

HEWLETT hp PACKARD

SAFETY

This instrument has been designed and tested according to IEC Publication 348, "Safety Requirements for Electronic Measuring apparatus," and has been supplied in safe condition. This is a Safety Class I instrument. To ensure safe operation and to keep the instrument safe, the information, cautions, and warnings in this manual must be heeded. Refer to Section I for general safety considerations applicable to this instrument.

CERTIFICATION

Hewlett-Packard Company certifies that this instrument met its published specifications at the time of shipment from the factory. Hewlett-Packard Company further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship for a period of one year from the date of shipment, except that in the case of certain components, if any, listed in Section I of this operating manual, the warranty shall be for the specified period. Hewlett-Packard will, at its option, repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard, and provided the proper preventive maintenance procedures as listed in this manual are followed. Repairs necessitated by misuse of the product are not covered by this warranty. NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. HEWLETT-PACKARD IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

If this product is sold as a part of a Hewlett-Packard integrated instrument system, the above warranty shall not be applicable, and this product shall be covered only by the system warranty.

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

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

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OPERATING AND SERVICE MANUAL

11666A REFLECTOMETER BRIDGE

SERIAL NUMBERS

This manual applies directly to HP Model 11666A with serial prefix numbers 1531A and 1535A.

For additional information about serial numbers, see INSTRUMENTS COVERED BY MANUAL in Section I.

 HEWLETT-PACKARD COMPANY 1975
1400 FOUNTAIN GROVE PARKWAY, SANTA ROSA, CALIFORNIA, 95404, U.S.A.

MANUAL PART NO. 11666-90002
Microfiche Part No. 11666-90003

Printed: OCTOBER 1975

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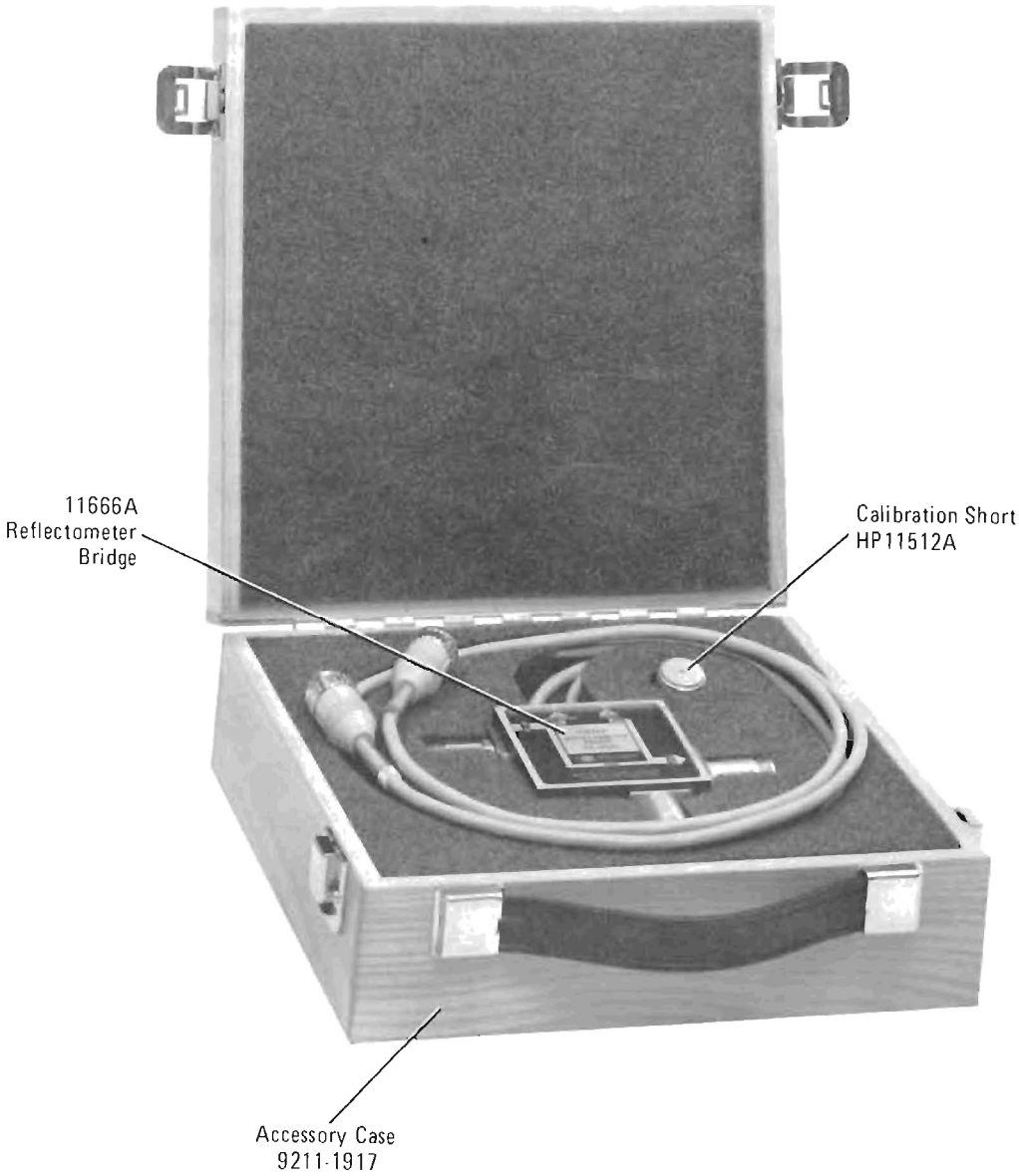


Figure 1-1. Model 11666A Reflectometer Bridge with Accessories Supplied

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This manual contains operating and service information for the Hewlett-Packard Model 11666A Reflectometer Bridge. The instrument is shown in Figure 1-1.

1-3. On the first page of this manual, below the manual part number, is a "Microfiche" part number. This number may be used to order 4x6-inch microfilm transparencies of the manual. Each microfiche contains up to 60 photo-duplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement as well as all pertinent Service Notes.

1-4. Instrument specifications are listed in Table 1-1. These specifications are performanance standards or limits against which the instrument may be tested. Table 1-2 lists supplemental chracteristics. Supplemental characteristics are not specifications but are typical characteristics included as additional information for the user.

1-5. INSTRUMENTS COVERED BY MANUAL

1-6. This instrument has a two-part serial number. The first four digits and the letter comprise the serial number prefix. The last five digits form the sequential suffix that is unique to each instrument. The contents of this manual apply directly to instruments having the same serial number prefix(es) as listed under SERIAL NUMBERS on the title page.

1-7. An instrument manufactured after the printing of this manual may have a serial prefix that is not listed on the title page. This unlisted serial prefix indicates that the instrument is different from those documented in this manual. The manual for this instrument is supplied with a yellow Manual Changes supplement that contains "change information" that documents the differences.

1-8. In addition to change information, the supplement contains 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 keyed to this manual's print date and part number, both of which appear on the title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-9. For information concerning a serial number listed in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-10. DESCRIPTION

1-11. The Model 11666A Reflectometer Bridge is used with the HP Model 8755A Swept Amplitude Analyzer for reflection and transmission measurements over the 40 MHz to 18 GHz frequency range. Effective external leveling is accomplished by measuring the ratio of Reflected and Test port signals to the RF input signal.

1-12. OPTIONS

1-13. The following connectors are available for the 11666A:

Option 001: RF IN, Type N Female; TEST, Type N Male
Option 002: RF IN, Type N Female TEST, APC-7
Option 003: RF IN, APC-7; TEST, APC-7

1-14. EQUIPMENT SUPPLIED

1-15. The equipment supplied is shown in Figure 1-1. A set of color-coded snap-on clips is also provided to identify the ends of the Incident and Reflected cables.

NOTE

All operation and maintenance procedures in this manual utilize the 11665B Modulator. The 11665B may be eliminated if the RF plug-in used is 8755A compatible. With the 11665B eliminated the 8755A MODULATOR DRIVE is connected to the 8620A EXT AM rear panel connector.

Table 1-1. Specifications

SPECIFICATIONS

Frequency Range: 40 MHz to 18 GHz

Maximum Input Power: +15 dBm (31.6 mW)

Frequency Range	Equivalent Directivity	Equivalent Output SWR
40 to 100 MHz	⩾ 30 dB	⩽ 1.25
0.1 to 1 GHz	⩾ 38 dB	⩽ 1.25
1 to 2 GHz	⩾ 36 dB	⩽ 1.25
2 to 4 GHz	⩾ 33 dB	⩽ 1.25
4 to 8 GHz	⩾ 29 dB	⩽ 1.25
8 to 12 GHz	⩾ 27 dB	⩽ 1.27
12 to 18 GHz	⩾ 26 dB	⩽ 1.52

Input SWR: ⩽ 1.92

Frequency Tracking:
Between Incident and Reflected ports: ⩽ 3.2 dB
Between Incident and Test ports: ⩽ 4.2 dB
(Includes 11664A Detector)

Connectors:
Standard: Type N-Female (Input and Output)
Option 001: Input Type N-Female, Output Type N-Male
Option 002: Input Type N-Female, Output APC-7
Option 003: APC-7 (Input and Output)

Dimensions:
69.9 mm wide X 69.9 mm high X 46.6 mm deep
(2.75 inches X 2.75 inches X 1.83 inches)
Cable Length: 1219 mm (48 inches)

Weight: Net, 0.7 kg (1.5 lb.)
Shipping, 2.26 kg (5.13 lb.)

Table 1-2. Supplemental Characteristics

SUPPLEMENTAL CHARACTERISTICS

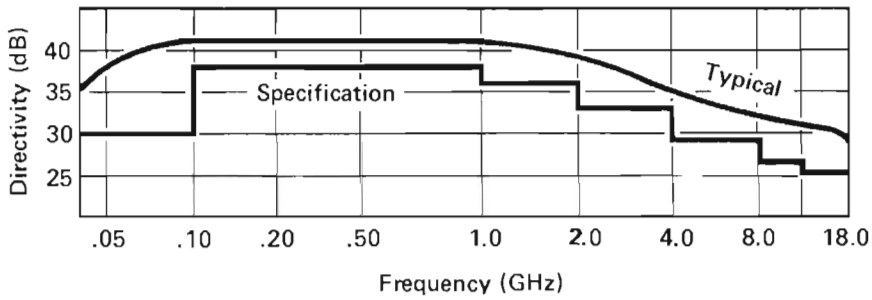
Nominal Coupling:

Incident Arm: 6 dB

Reflected Arm: 9 dB

Transmission Loss: 9 dB

Typical Directivity:



1-16. EQUIPMENT REQUIRED BUT NOT SUPPLIED

1-17. The following equipment is required to operate the 11666A with an HP 8755A:

1. HP Model 8755A Swept Amplitude Analyzer.

2. HP Model 180T-series Oscilloscope mainframe.

3. HP Model 11665B Modulator.

4. HP Model 11664A Detector (Transmission measurements only).

5. Sweep Oscillator, such as HP Model 8620-series.

1-18. Swept Amplitude Analyzer

1-19. The Model 8755A Swept Amplitude Analyzer with the 11666A Reflectometer Bridge, Model 11665B Modulator, and Model 11664A Detector measures amplitude levels of −50 to +10 dBm and amplitude ratios of 60 dB over a frequency range of 40 MHz to 18 GHz. The Model 8755A plugs into the Model 180-series oscilloscopes.

1-20. Oscilloscope

1-21. The Model 8755A Swept Amplitude Analyzer must be plugged into a Model 180T-series Oscilloscope to be useful. The Model 180 acts as a display indicator and power supply for the Model 8755A.

1-22. Modulator

1-23. The Model 11665B Modulator is designed to be used with the Model 8755A Swept Amplitude Analyzer. The Model 8755A supplies a 27.8 kHz modulating signal to the Model 11665B which then squarewave modulates the RF signal.

1-24. Detector

1-25. A Model 11664A Detector is required for transmission measurements with the 11666A. The detector is used to demodulate the 27.8 kHz modulation signal from the RF signal at the output of the device under test.

1-26. Sweep Oscillator

1-27. Sweep Oscillators are needed to furnish the RF input signal. Either the HP Model 8620-series or Model 8690-series Sweep Oscillators may be used.

1-28. EQUIPMENT AVAILABLE

1-29. The following accessories are available:

Model 11679A: 25-foot Extension Cable

Model 11679B: 200-foot Extension Cable

1-30. WARRANTY

1-31. Any attempt to disassemble or repair the Directional Bridge (A1), Reference Termination (AT1), or TEST port (A1J3) will automatically void the warranty. See Paragraph 8-9 in the Service section for the recommended repair procedures.

1-32. Subjection of the instrument to excessive RF INPUT power (>+15 dBm or 31.6 mw) will automatically void the warranty.

1-33. RECOMMENDED TEST EQUIPMENT

1-34. Table 1-3 lists recommended test equipment. This equipment is used in performance testing or troubleshooting the Model 11666A. Other equipment may be substituted, provided its specifications equal or exceed the specifications given under Critical Specifications.

Table 1-3. Recommended Test Equipment

Instrument Type	Critical Specifications	Recommended Model	Use*
Sweep Oscillator	Frequency, 40 MHz to 18 GHz	HP Model 8620A mainframe with: HP Model 86222 A (40 MHz to 2 GHz) HP Model 86290A (2 to 18 GHz)	P, T
Swept Amplitude Analyzer	Provides 27.8 kHz modulation signal Powers 11666A Reflectometer Bridge and 11664A Detector Processes and displays the detected signals.	HP 8755A/182T	P, T
Audio Oscillator	Frequency: 27.8 kHz Output: 10 mV adjustable	HP 200CD	T
Modulator	Frequency: 40 MHz to 18 GHz Modulation: 27.8 kHz	HP 11665B	P, T
Reflectometer Bridge		HP 11666A	P
Detector	Frequency: 40 MHz to 18 GHz	HP 11664A	P, T
20-cm Air Lines (2)	Frequency: 40 MHz to 18 GHz	HP 11567A	P
Sliding Load	Frequency: 2 GHz to 18 GHz Load SWR: ≤ 1.05	HP 905A	P
Coaxial Termination	Frequency: 40 MHz to 2 GHz Load SWR: ≤ 1.05 Connector: Type N Male	HP 909A Option 012	P
Coaxial Short	Fits 11666A TEST port connector	HP 11512A (Type N Male) HP 11511A (Type N Female) HP 11565A (APC-7)	P
Open-End Wrench	Thin 1/2 x 9/16-inch wrench	HP Part No. 8710-0877	P, T
Soldering Iron	Wattage: 37.5 watts Tip Temp: 750 to 800° F Tip Size: 1/8" OD	Ungar No. 776 Handle with Ungar No. 1237 Heating Unit	T
Soldering Tip	Shape: chisel Size: 1/8"	Ungar No. PL113	T
De-soldering Aid	Suction device to remove molten solder from connection	Soldavac by the Edsyn Company, Arleta, California	T
Protective Coating	Good electrical insulation, corrosion-prevention properties	Krylon No. 1302	T
Oscilloscope	Vert. Bandwidth: ≥250 kHz Vert. Sensitivity: >1 mV/cm	HP 182A/1801A/1802C	T

*P = Performance Testing T = Troubleshooting

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section contains information concerning initial inspection, preparation for use, mating connectors, and storage and shipment.

2-3. INITIAL INSPECTION

2-4. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as shown in Figure 1-1. Procedures for checking electrical performance are given in Section IV. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection. The HP office will arrange for repair or replacement without waiting for claim settlement.

2-5. PREPARATION FOR USE

2-6. Power Requirements

2-7. Power for the Model 11666A Reflectometer Bridge is obtained from the Model 8755A Swept Amplitude Analyzer.

2-8. Selecting RF Input Connector

2-9. The RF Input Connector outer shell and inner conductor assembly may be replaced, thereby changing the type of RF Input connector. This can be done by the operator using a thin open-end wrench. Refer to the Service section of this manual, Paragraph 8-14 for details.

2-10. Incident and Reflected Lead Identification

2-11. Colored clip-on clips are furnished for lead identification. Place matching clips on both ends of each cable.

2-12. Connecting the 11666A Reflectometer Bridge

2-13. To connect the 11666A to the 8755A, proceed as follows:

a. Insert the 11666A dc connectors into the corresponding 8755A mating connectors INDICENT to Channel R and REFL to Channel A. The connectors are keyed and the plug should be inserted with the key facing downwards.

b. Secure the dc connector in the 8755A turning the outer shell clockwise. This tightens the connector.

c. To connect the RF Input

1. Read CAUTION in paragraph 3-8.

2. If either connector is an APC-7, refer to Figure 2-1 for instructions.

2-14. Using APC-7 RF Connectors

2-15. Figure 2-1 shows the use of APC-7 connectors. Read the instructions on this figure before attempting to use APC-7 connectors.

2-16. Mating Connectors

2-17. Mating connectors for Type N connectors are the corresponding Type N connectors whose dimensions conform to US specification MIL-C-39012. Mating connectors for the APC-7 connectors are other APC-7 connectors. Mating connectors for other connector types are the corresponding connector of the same series.

2-18. Operating Environment

2-19. Temperature. The instrument may be operated in temperatures from −25°C to 55°C.

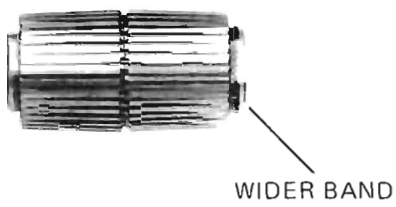
2-20. Humidity. The instrument may be operated in environments with humidity up to 95%. However, the instruments should also be protected from temperature extremes which cause condensation within the 11666A.

To Connect:

1. On one connector, retract the coupling sleeve by turning the coupling nut counterclockwise until the sleeve and nut disengage.
2. On the other connector, fully extend the coupling sleeve by turning the coupling nut clockwise. To engage coupling sleeve and coupling nut when the sleeve is fully retracted, press back lightly on the nut while turning it clockwise.
3. Push the connectors firmly together, and thread the coupling nut of the connector with retracted sleeve over the extended sleeve.
4. Do NOT tighten the other coupling nut since this will tend to loosen the electrical connection.

To Disconnect:

1. Loosen the coupling nut of the connector showing the wider gold band.



2. IMPORTANT: Part the connectors carefully to prevent striking the inner conductor contact.

Figure 2-1. Use of APC-7 Connectors

2-21. Altitude. The instrument may be operated at altitudes up to 25,000 feet.

2-22. STORAGE AND SHIPMENT

2-23. Environment

2-24. The instrument may be stored or shipped in environments within the following limits:

Temperature: 0°C to +75°C
Humidity: Up to 95%
Altitude: Up to 25,000 feet

The instrument should also be protected from temperature extremes which cause condensation within the instrument.

2-25. Packaging

2-26. 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, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

2-27. Other Packaging. The following general instructions should be used for re-packaging with commercially available materials:

a. Wrap the instrument in heavy paper or plastic. If shipping to a Hewlett-Packard office or service center. attach a tag indicating the type of service required, return address, model number, and full serial number.

b. Use a strong shipping container. A double-wall carton made of 350-pound test material is adequate.

c. Use enough shock-abosrbing material (3 to 4-inch layer) around all sides of the instrument to provide firm cushion and prevent movement inside the container.

d. Seal the shipping container securely.

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section contains instructions concerning operation of the Model 11666A Reflectometer Bridge.

3-3. FEATURES

3-4. Features of the Model 11666A are shown in Figure 3-1.

3-5. OPERATOR'S CHECK

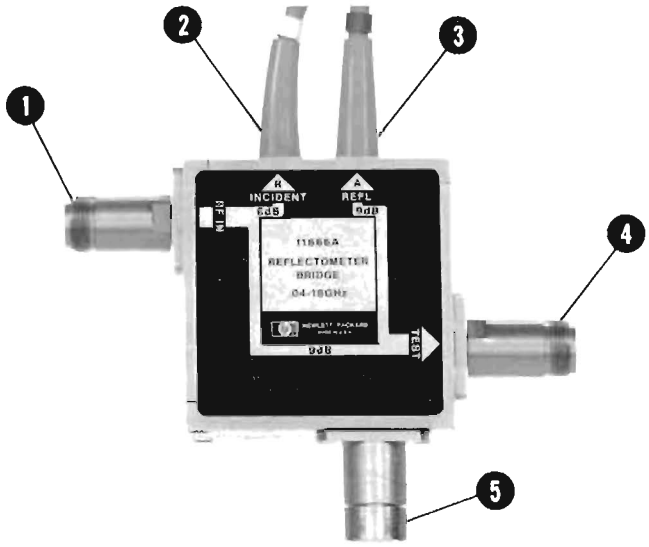
3-6. Figure 3-2 is an operator's check procedure, allowing the operator to make a quick check of the main system functions prior to use. The test covers the entire measurement system and incorrect indications may be caused by any portion of the system. If the Reflectometer Bridge is suspected, use the performance tests in Section IV to determine if the Reflectometer Bridge is working correctly. Otherwise, follow the troubleshooting tree in Section VIII to isolate the problem.

3-7. OPERATING INSTRUCTIONS

3-8. Figure 3-3 provides instructions for making reflection and transmission measurements. The test setup in Figure 3-3 shows a typical reflectometer test setup for simultaneously measuring reflection and transmission characteristics of a device under test.

CAUTION

Do NOT apply more than +15 dBm RF Power or more than ±10 volts dc into the 11666A. If more than this power or voltage is applied, the 11666A will be damaged.



1 RF IN port J1. The RF input signal is applied to this connector.

CAUTION

Do NOT apply more than +15 dBm RF CW power or ±10 Vdc into the 11666A. If more than this power or voltage is applied, the 11666A will be damaged.

2 INCIDENT port (R). Supplies the necessary dc voltage for operation of the Model 11666A A3 Preamplifier and feeds a voltage proportional to the signal input voltage to the Model 8755A Channel R input.

3 REFLECTED port (A). Supplies the necessary dc voltage for operation of the Model 11666A A2 Preamplifier and feeds a voltage proportional to the signal reflected from the device under test to the Model 8755A Channel A input.

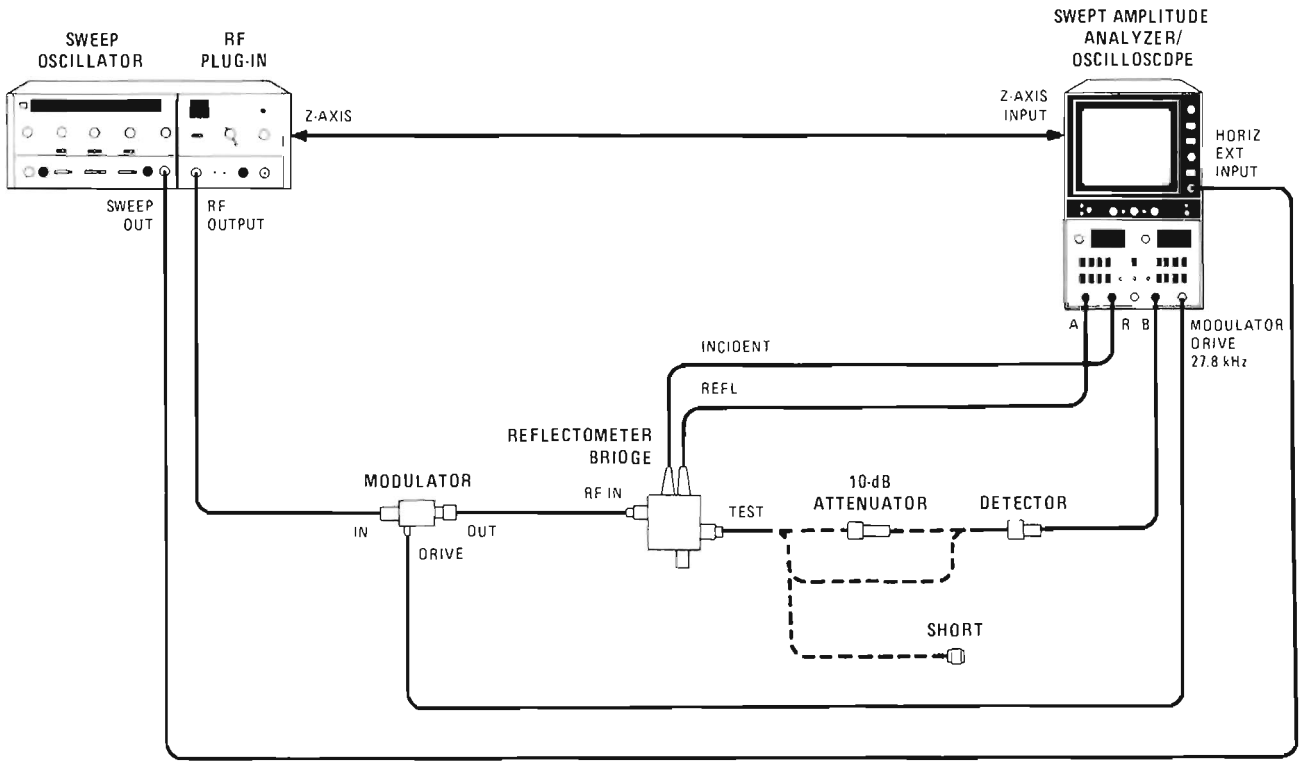
4 TEST port A1J3. The device under test and calibration short are connected to this port.

5 Reference Termination AT1. Provides a standard 50-ohm impedance to which the device under test is compared.

CAUTION

Do NOT loosen, remove or disassemble the Reference Termination as performance will be degraded.

Figure 3-1. Model 11666A Features



EQUIPMENT:

Sweep Oscillator	HP 8620A
RF Plug-in	HP 86290A
Swept Amplitude Analyzer/Oscilloscope	HP 8755A/182T
Reflectometer Bridge	HP 11666A
Modulator	HP 11665B
Detector	HP 11664A
10-dB Attenuator	HP 8491B Option 010
Short	HP 11512A

PROCEDURE:

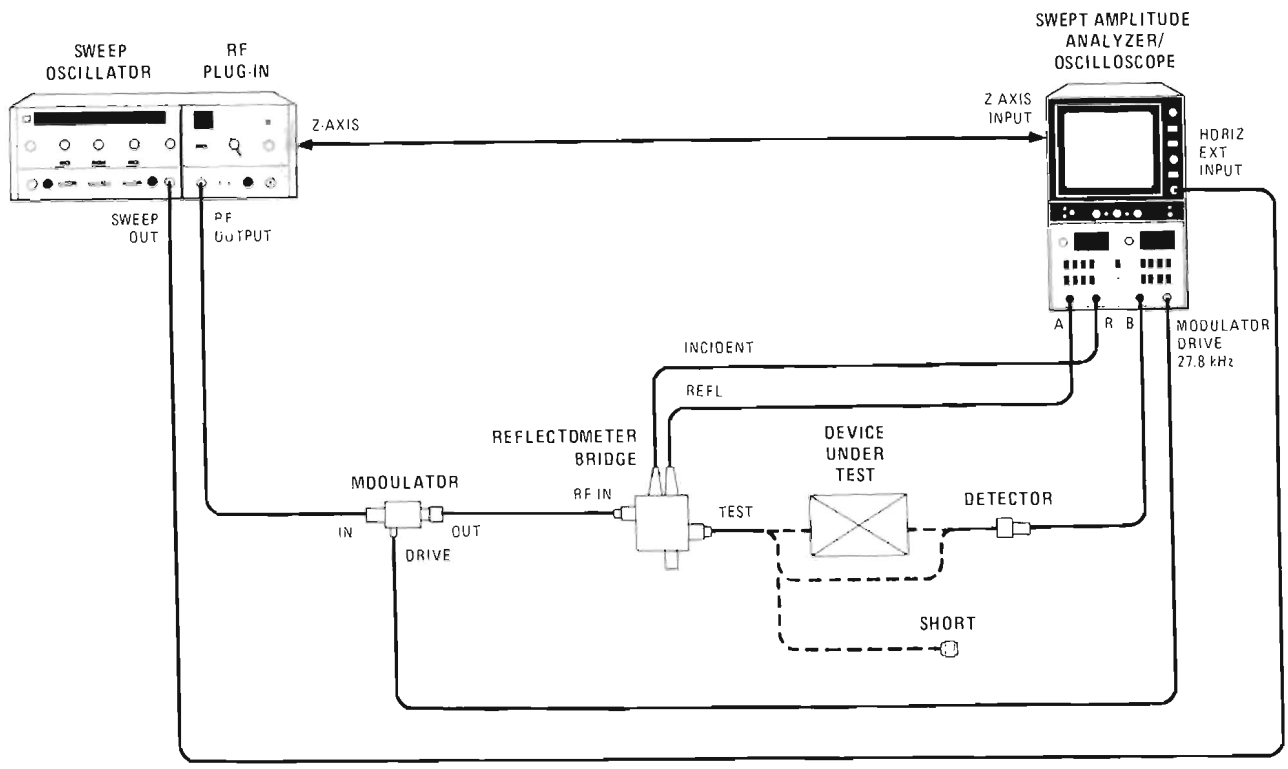
a. Connect equipment as shown in test setup and calibrate the system for a typical combination reflection and transmission measurement (Figure 3-3).

b. Connect 10-dB Attenuator to the 11666A TEST port as the device under test.

c. Check 11666A reflection measurement by ensuring the CHANNEL A trace is ≥14 dB below the reference.

d. Check 11666A transmission measurement by ensuring CHANNEL B trace is 10 dB ±1 dB below the reference.

Figure 3-2. Operator's Check



REFLECTION MEASUREMENT

To make a reflection measurement:

a. Connect equipment as shown in the test setup with no device under test connected and a type N short connected to the bridge TEST port.

b. Press one of the CHANNEL B DISPLAY pushbuttons part way in to "pop" all of the CHANNEL B DISPLAY pushbuttons out to turn off the CHANNEL B display.

c. On CHANNEL A panel, set OFFSET CAL to OFF, OFFSET dB to −00, and press 10 dB/DIV switch. Press DISPLAY POSITION switch and adjust POSITION screwdriver adjustment to place the CRT trace on "reference" graticule line near the top of the CRT.

d. Press CHANNEL A DISPLAY A pushbutton and adjust sweep oscillator POWER LEVEL to place the CRT trace near the "reference" graticule line. If sweep oscillator does not have sufficient power to obtain this level, set POWER LEVEL to maximum. (The trace should be one dB above the "reference" graticule line for + 10 dBm output from the sweep oscillator.)

e. Press CHANNEL A DISPLAY A/R pushbutton. Set OFFSET CAL ON/OFF switch to ON. Adjust OFFSET CAL control to place the CRT trace on the "reference" graticule line. Select 0.25 dB/DIV to make fine adjustment. The instrument is now ready to make a reflection measurement.

Figure 3-3. Model 11666A Typical Measurement Setup (1 of 3)

REFLECTION AND TRANSMISSION MEASUREMENT (Cont'd)

f. Select 10 dB/DIV resolution. Remove short from Bridge TEST port and connect device under test to the bridge. Adjust CHANNEL A OFFSET dB switches to place the CRT trace as close to the "reference" graticule line as possible. The return loss may be read directly by adding the setting of the CHANNEL A OFFSET dB switches to the trace position below the "reference" graticule line. If the trace is above the "reference" line, subtract that amount from the OFFSET dB switch setting.

TRANSMISSION MEASUREMENT

To make a transmission measurement:

a. Connect equipment as shown in the test setup with no device under test and the B detector connected directly to the TEST port of the Reflectometer Bridge.

b. Press one of the CHANNEL A DISPLAY pushbuttons part way in to "pop" all the CHANNEL A DISPLAY pushbuttons out to turn off the CHANNEL A display.

c. On CHANNEL B panel, set OFFSET CAL to OFF, OFFSET dB to —00, and press 10 dB/DIV. Press DISPLAY POSITION SWITCH and adjust POSITION screwdriver adjustment to place the CRT trace on any convenient graticule line for a "reference." (If the device under test has attenuation or loss, place the reference line near the top of the CRT. If the device under test has gain, place the reference near the bottom of the CRT.)

CAUTION

The following equipment setup assumes that the device under test has less than 10 dB of gain. If no, the sweep oscillator power level must be reduced to prevent $> \pm 15$ dBm signal at channel B 11664A detectors or damage may result.

d. Press CHANNEL B DISPLAY B pushbutton. Increase sweep oscillator POWER LEVEL to place the CRT trace to the line one division above the reference graticule line. (This is approximately +10 dBm from the sweep oscillator.) If the sweep oscillator does not have sufficient power to obtain this level, set POWER LEVEL to maximum.

e. Press CHANNEL B DISPLAY B/R pushbutton. Set the OFFSET CAL ON/OFF switch to ON and adjust OFFSET CAL control to place one end of the CRT trace on the "reference" graticule line established in step c. To make fine adjustment, increase resolution by depressing 0.25 dB/DIV switch. The instrument is now ready to make a transmission measurement. Do not move the OFFSET CAL control or calibration will be destroyed.

Figure 3-3. Model 11666A Typical Measurement Setup (2 of 3)

REFLECTION AND TRANSMISSION MEASUREMENT (Cont'd)

f. Select 10 dB/DIV resolution. Connect a device under test between the output of the bridge (TEST port) and the channel B 11664A detector.

g. Adjust CHANNEL B OFFSET dB switches to bring the trace back to near the "reference" graticule line. If the device under test has attenuation, the OFFSET dB switch setting will have a negative sign. Gain is indicated if the switch sign is positive. When measuring attenuation, the total attenuation of the device under test is obtained by adding the OFFSET dB setting to the attenuation indication of the CRT trace below the "reference" graticule line. (If the trace is above the "reference" line, subtract this amount from the OFFSET dB setting to obtain the net attenuation.) When calculating gain, add the OFFSET dB switch setting to the CRT display above the "reference" graticule line.

COMBINATION REFLECTION AND TRANSMISSION MEASUREMENT

The test setup shown allows simultaneous reflection and transmission measurements. The reflection measurement is performed on the CHANNEL A side of the front panel and transmission measurement on CHANNEL B side. Make the calibration and adjustments described in steps a through e of the REFLECTION MEASUREMENT procedure. Do not change the sweep oscillator power setting after this step, but make all of the adjustments described in steps a through e of the TRANSMISSION MEASUREMENT procedure. Insert the device under test in the test setup. Reflection is displayed by CHANNEL A CRT trace and transmission is displayed by CHANNEL B trace.

Figure 3-3. Model 11666A Typical Measurement Setup (3 of 3)

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. The procedures in this section test the instrument's electrical performance using the specifications of Table 1-1 as the performance standards. All tests can be performed without access to the interior of the instrument.

4-3. EQUIPMENT REQUIRED

4-4. Equipment required for the performance tests is listed in the Recommended Test Equipment table in Section I. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model.

4-5. TEST RECORD

4-6. Results of the performance tests may be tabulated on the Test Record at the end of the procedures. The Test Record lists all of the tested specifications and their acceptable limits. Test results recorded at incoming inspection can be used for comparison in periodic maintenance and troubleshooting and after repairs or adjustments.

PERFORMANCE TESTS

4-7. EQUIVALENT DIRECTIVITY AND OUTPUT SWR TEST

SPECIFICATION:

Frequency Range	Equivalent Directivity	Equivalent Output SWR
40 to 100 MHz	≥ 30 dB	≤ 1.25
0.1 to 1 GHz	≥ 38 dB	≤ 1.25
1 to 2 GHz	≥ 36 dB	≤ 1.25
2 to 4 GHz	≥ 33 dB	≤ 1.25
4 to 8 GHz	≥ 29 dB	≤ 1.25
8 to 12 GHz	≥ 27 dB	≤ 1.27
12 to 18 GHz	≥ 26 dB	≤ 1.52

DESCRIPTION:

NOTE

Figure 4-2 gives only an approximation of Equivalent Output SWR. Therefore, the criteria for determining that Equivalent Output SWR meets specifications is that both the Open-Short Ratio and Equivalent Directivity meet the requirements in this test.

PERFORMANCE TESTS

4-7. EQUIVALENT DIRECTIVITY AND OUTPUT SWR TEST (Cont'd)

Special test equipment (6:1 Mismatch Pad) is required for direct measurement of Output SWR,but the approximate value of Output SWR can be determined from the Open-Short Ratio and Directivity measurements as shown in Figure 4-2. The 11666A is connected in a typical reflectometer test setup and the TEST port is terminated through two 20-cm Air Lines with a short. The peak-to-peak signal displayed is the Open-Short Ratio. A line is drawn through the average of the Open-Short Ratio display for use as a reference in the Directivity measurement. The TEST port is then terminated with a precision 50-ohm load and the difference between the display and the reference (average of the Open-Short Ratio) is the Equivalent Directivity.

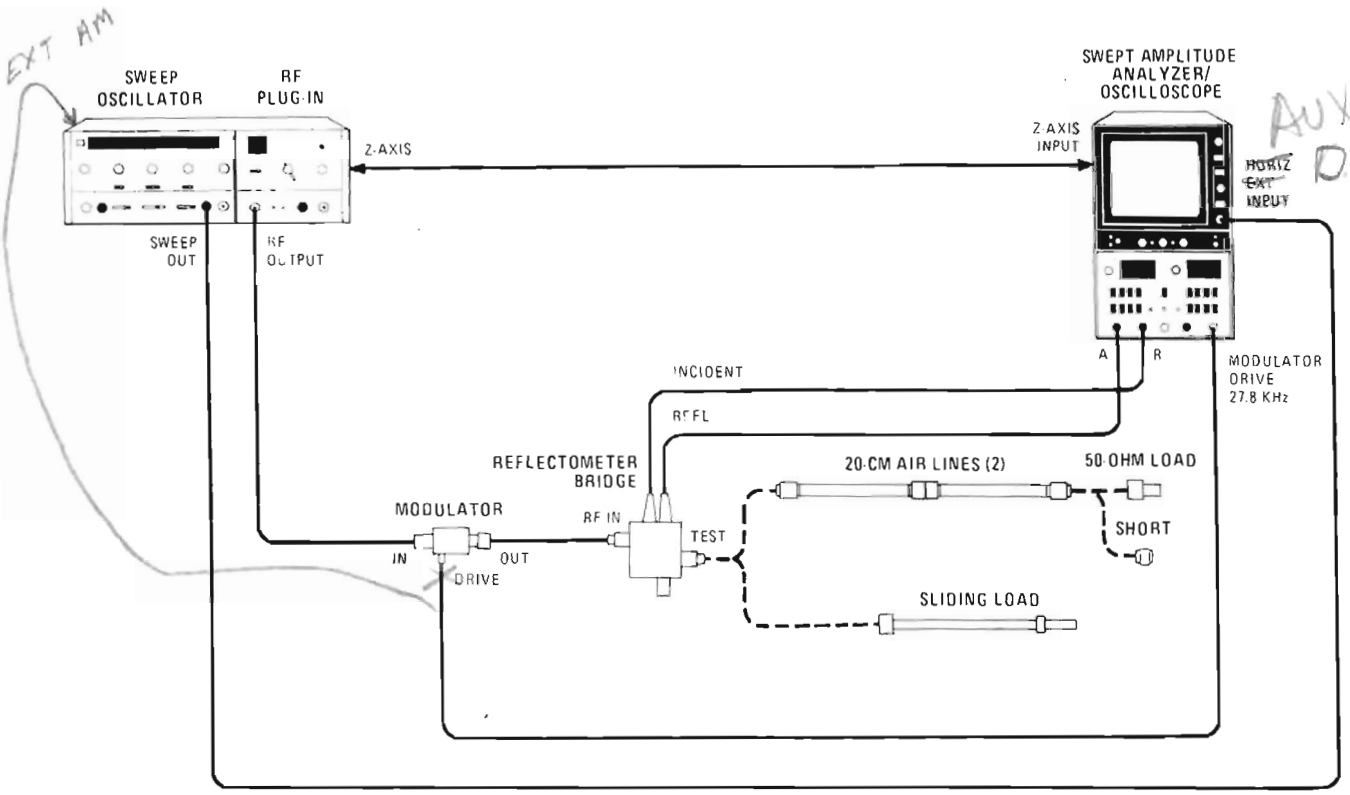


Figure 4-1. Equivalent Directivity and Output SWR Test Setup

EQUIPMENT:

Sweep Oscillator	HP 8620A
RF Plug-in	HP 86222A
RF Plug-in	HP 86290A
Swept Amplitude Analyzer/Oscilloscope	HP 8755A/182T
Reflectometer Bridge	HP 11666A
Modulator	HP 11665B
20 cm Air Line (2)	HP 11567A
Short	HP 11512A
50-ohm Load	HP 909A Option 012
Sliding Load	HP 905A

PERFORMANCE TESTS

4-7. EQUIVALENT DIRECTIVITY AND OUTPUT SWR TEST (Cont'd)

PROCEDURE:

a. Connect equipment as shown in Figure 4-1 using the 86222A RF Plug-in.

b. Connect Short to the 11666A TEST port through two 20 cm air lines.

c. Set controls as follows:

8620A:
START pointer ..... 40 MHz
STOP pointer ..... 100 MHz

86222A:
POWER LEVEL ..... +10 dBm

8755A (Channel A):
OFFSET CAL ..... OFF
dB/DIV 1
DISPLAY ..... A/R
SMOOTHING ..... OFF

d. Adjust 8755A OFFSET dB control to position display in center of the CRT.

e. Check that signal is less than 2.1 dB peak-to-peak (Open-Short Ratio for 40 to 100 MHz range).

f. Press 8755A Channel A 10 dB/DIV switch and adjust OFFSET dB control to position display one division above the center graticule line.

g. Trace the average of the reference display on the CRT face with a grease pencil.

h. Disconnect Short and connect precision 50-ohm load to the TEST port through two 20 cm air lines.

i. Ensure the minimum difference between the average of the display and the reference (grease pencil line) is greater than 30 dB (Directivity for 40 to 100 MHz range).

j. Replace 50-ohm load with the Short and press 8755A Channel A 1 dB/DIV switch.

k. Repeat steps d through j for the following frequencies.

NOTE

Output SWR specifications are verified for the frequency range selected, provided both Open-Short Ratio and Directivity tests, steps p and u, meet requirements.

Start Pointer	Stop Pointer	Directivity (Step i)	Open-Short Ratio (Step e)	Output SWR
100 MHz	1 GHz	≥ 38 dB	≤ 0.9 dB	≤ 1.25
1 GHz	2 GHz	≥ 36 dB	≤ 0.9 dB	≤ 1.25

PERFORMANCE TESTS

4-7. EQUIVALENT DIRECTIVITY AND OUTPUT SWR TEST (Cont'd)

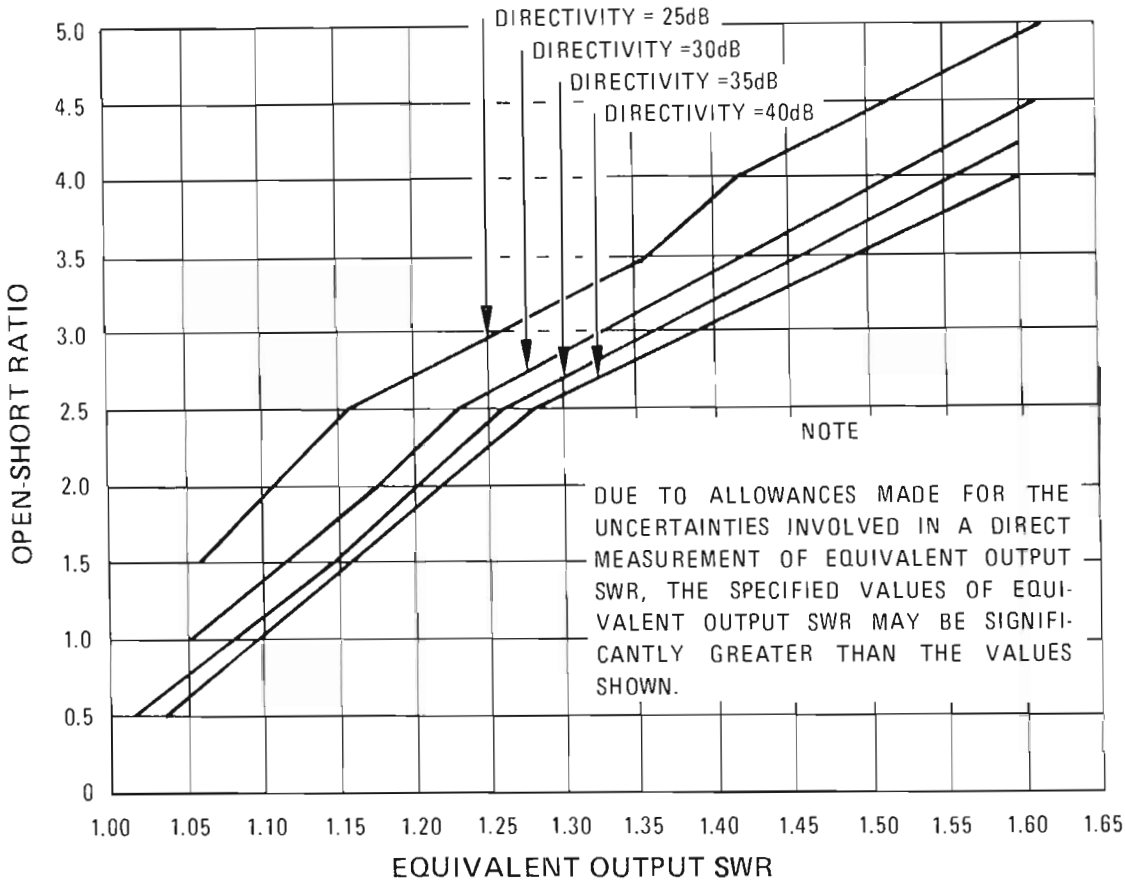


Figure 4-2. Graph for Approximating Equivalent Output SWR

l. Substitute the 86290A for the RF Plug-in and set POWER LEVEL fully clockwise.

m. Select 8620A BAND 4 (2 to 18 GHz) and set START/STOP pointers to cover 2 to 4 GHz.

n. Connect Short to 11666A TEST port through two 20-cm air lines.

o. Press 8755A Channel A 1 dB/DIV switch and center display on the CRT with the OFFSET dB control.

p. Check that signal is less than 1.5 dB peak-to-peak (Open-Short Ratio for 2 to 4 GHz range).

q. Press 8755A Channel A 10 dB/DIV switch and adjust OFFSET dB control to position display one division above center graticule line.

PERFORMANCE TESTS

4-7. EQUIVALENT DIRECTIVITY AND OUTPUT SWR TEST (Cont'd)

r. Trace the average of the reference display on the CRT face with a grease pencil.

s. Disconnect Short and connect sliding load.

t. Varying the sliding load will raise or lower the signal displayed. Position the sliding load for an average of the two extremes.

u. Ensure the minimum difference between the average of the envelope displayed and the reference (grease pencil line) is greater than 33 dB (Directivity for 2 to 4 GHz range).

v. Replace sliding load with the Short and press 8755A Channel A 1 dB/DIV switch.

w. Repeat steps m through v for the following frequencies.

NOTE

Output SWR specifications are verified for the frequency range selected, provided both Open-Short Ratio and Directivity tests, steps p and u, meet requirements.

Start Pointer	Stop Pointer	Directivity (Step u)	Open-Short Ratio (Step p)	Output SWR
4 GHz	8 GHz	≥ 29 dB	≤ 1.6 dB	≤ 1.25
8 GHz	12 GHz	≥ 27 dB	≤ 2.4 dB	≤ 1.27
12 GHz	18 GHz	≥ 26 dB	≤ 4.6 dB	≤ 1.52

4-8. INPUT SWR TEST

SPECIFICATION:

Input SWR: ≤ 1.92

DESCRIPTION:

The 11666A is connected as the device under test in a typical reflectometer test setup and return loss is measured.

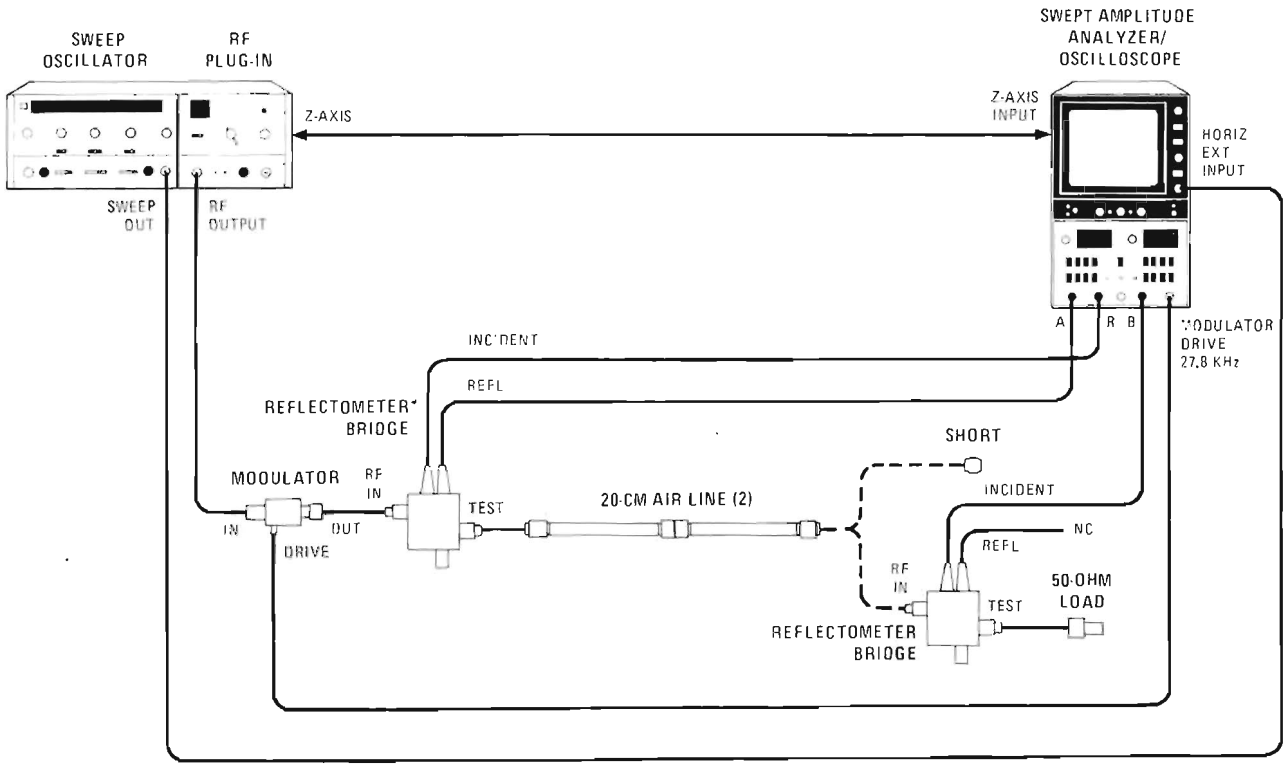


Figure 4-3. Input SWR Test Setup

EQUIPMENT:

Sweep Oscillator	HP 8620A
RF Plug-in	HP 86222A
RF Plug-in	HP 86290A
Swept Amplitude Analyzer/Oscilloscope	HP 8755A/182T
Reflectometer Bridge (2)	HP 11666A
20-cm Air Line (2)	HP 11567A
50-ohm Load	HP 909A Option 012
Short	HP 11512A

*A Dual Directional Coupler with two 11664A Detectors may be substituted.

4-8. INPUT SWR TEST (Cont'd)

PROCEDURE:

a. Connect equipment as shown in Figure 4-3 using RF Plug-in to cover band of interest.

b. Connect Short to 20-cm air line.

c. Set controls as follows:

8620A:
- START pointer ..... Left-hand end frequency selected
- STOP pointer ..... Right-hand end frequency selected
- TIME-SECONDS switch ..... .1 to .01
- TIME-SECONDS vernier ..... Fully clockwise

RF Plug-in:

POWER LEVEL
- 86222A ..... +10 dBm
- 86290A ..... Fully Clockwise

8755A (Channel A):
- OFFSET CAL ..... OFF
- dB/DIV 10
- DISPLAY ..... A/R
- SMOOTHING ..... OFF

d. Adjust 8755A OFFSET CAL to position reference display one division above center graticule line.

e. Trace the average of the reference display with a grease pencil.

f. Disconnect Short and connect 11666A RF IN port to the 20-cm air line.

g. Use grease pencil to trace a line through the average of the signal displayed or 6 dB down from the top of the peaks if the signal is greater than 12 dB peak-to-peak.

h. The minimum difference between the two grease pencil lines should be greater than 10 dB (SWR $\leq$ 1.92).

4-9. FREQUENCY TRACKING TEST

SPECIFICATION:

Frequency Tracking:
- Between Incident and Reflected Ports: $\leq$ 3.2 dB
- Between Incident and Test Ports: $\leq$ 4.2 dB
- (Includes 11664A Detector)

DESCRIPTION:

The 11666A TEST port is terminated with a short and an A/R measurement is taken. The flatness of the display is the frequency tracking between the Incident and Reflected ports. The 8755A Channel B is then connected to the Test port and a B/R measurement is taken. The flatness of the display is the frequency tracking between the Incident and Test ports (11664A Detector included).

4-9. FREQUENCY TRACKING TEST (Cont'd)

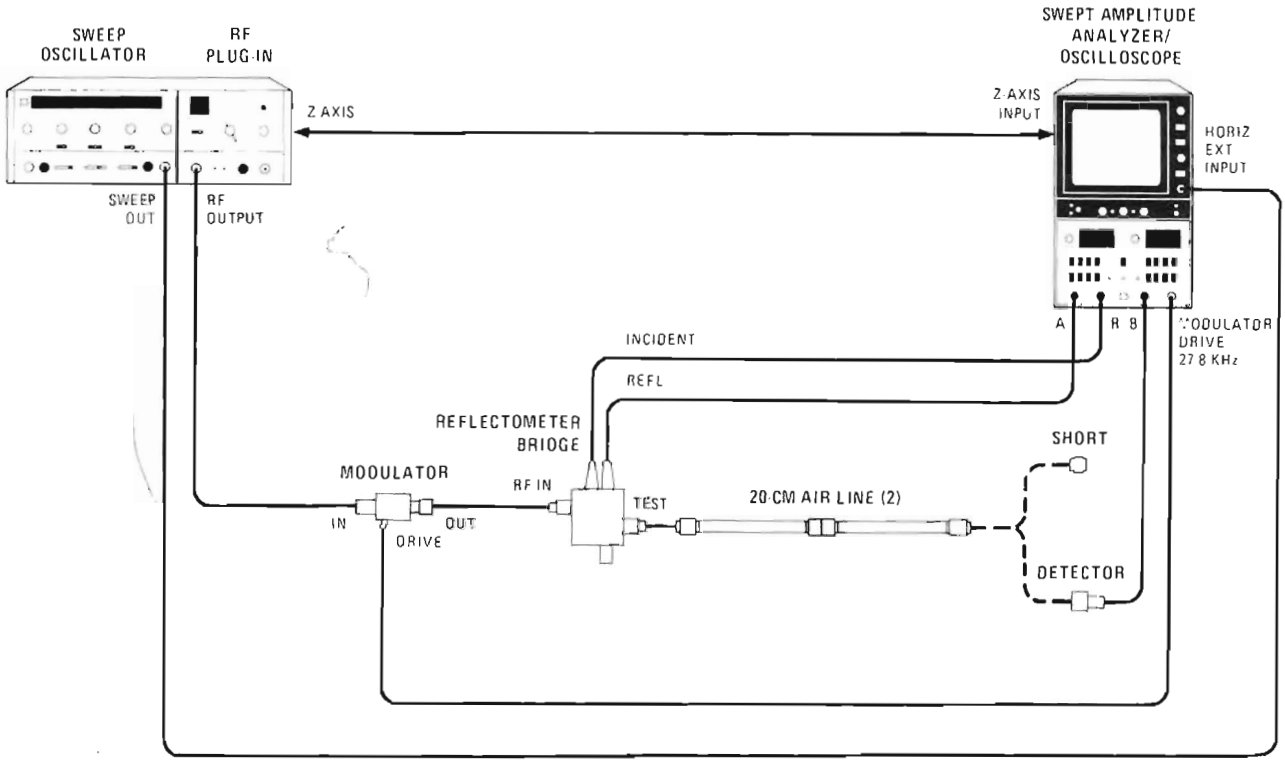


Figure 4-4. Frequency Tracking Test Setup

EQUIPMENT:

Sweep Oscillator	HP 8620A
RF Plug-in	HP 86222A
RF Plug-in	HP 86290
Swept Amplitude Analyzer/Oscilloscope	HP 8755A/182T
Reflectometer Bridge	HP 11666A
Detector	HP 11664A
Modulator	HP11665B
20-cm Air Line (2)	HP 11567A
Short	HP 11512A

PROCEDURE:

a. Connect equipment as shown in Figure 4-4 using RF plug-in to cover the band of interest.

b. Set controls as follows:

8620A:

START pointer	Left-hand end frequency selected
STOP pointer	Right-hand end frequency selected

4-9. FREQUENCY TRACKING TEST (Cont'd)

RF Plug-in:

86222A ..... +10 dBm
86290A ..... Fully Clockwise

8755A (Channels A and B):
OFFSET CAL ..... OFF
dB/DIV 1
DISPLAY ..... A/R
SMOOTHING ..... OFF

c. Connect Short to the 11666A TEST port through two 20-cm air lines.

d. Adjust 8755A OFFSET dB control to center display on CRT.

e. Trace a grease pencil line on the face of the CRT representing the average of the signal displayed.

f. Ensure the difference between the maximum and minimum levels of the grease pencil line is less than 3.2 dB. This is the flatness between INCIDENT and REFL ports.

g. Disconnect Short and connect the Detector to the 11666A TEST port through two 20-cm air lines.

h. Press 8755A B/R DISPLAY switch.

i. Adjust 8755A OFFSET dB control to center display on CRT.

j. Trace a grease pencil line on the face of the CRT representing the average of the signal displayed.

k. Ensure the difference between the maximum and minimum levels of the grease pencil line is less than 4.2 dB. This is the flatness between INCIDENT and TEST ports.

Table 4-1. Model 11666A Performance Test Record

Hewlett - Packard Model 11666A
Reflectometer Bridge

Test Performed By: _____

Serial Number: _____

Date: _____

Para	Description	Lower Limit	Measured Value	Upper Limit
4-7	**EQUIVALENT DIRECTIVITY AND OUTPUT SWR TEST**			
	e. and p. Open-Short Ratio			
	40 to 100 MHz		_____	2.1 dB
	0.1 to 1 GHz		_____	0.9 dB
	1 to 2 GHz		_____	0.9 dB
	2 to 4 GHz		_____	1.5 dB
	4 to 8 GHz		_____	1.6 dB
	8 to 12 GHz		_____	2.4 dB
	12 to 18 GHz		_____	4.6 dB
	i. and u. Equivalent Directivity			
	40 to 100 MHz	30 dB	_____	
	0.1 to 1 GHz	38 dB	_____	
	1 to 2 GHz	36 dB	_____	
	2 to 4 GHz	33 dB	_____	
	4 to 8 GHz	29 dB	_____	
	8 to 12 GHz	27 dB	_____	
	12 to 18 GHz	26 dB	_____	
4-8	**INPUT SWR TEST**			
	h. Return Loss	10.0 dB	_____	
4-9	**FREQUENCY TRACKING TEST**			
	f. Between Incident and Reflected ports		_____	3.2 dB
	k. Between Incident and Test ports		_____	4.2 dB

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section provides the adjustment procedure for the Model 11666A Reflectometer Bridge. This procedure should not be performed as a routine maintenance procedure but should be used (1) after replacement of a part or component, (2) when performance tests show that the specifications of Table 1-1 cannot be met, or (3) when instructed to do so in the troubleshooting chart in Section VIII. Before attempting the adjustment, allow 30 minutes warm-up time for the instrument.

5-3. EQUIPMENT REQUIRED

5-4. Table 1-3 lists the equipment required for the adjustment procedure. If the test equipment recommended is not available, other equipment may be used if its performance meets the "Critical Specifications" listed in the table. The test setup used for the adjustment procedure is referenced in the procedure.

5-5. LOCATION OF ADJUSTMENT

5-6. A4R1 is the only adjustable component in the 11666A and it is mounted on the Master Board. Access to this adjustment is gained by removing the bottom cover.

5-7. DIRECTIONAL BRIDGE BIAS ADJUSTMENT

REFERENCE:

Service Sheet 1 A4 Master Board Assembly

DESCRIPTION:

The bias voltage from the Master Board is adjusted to balance the Directional Bridge microcircuit to give best directivity.

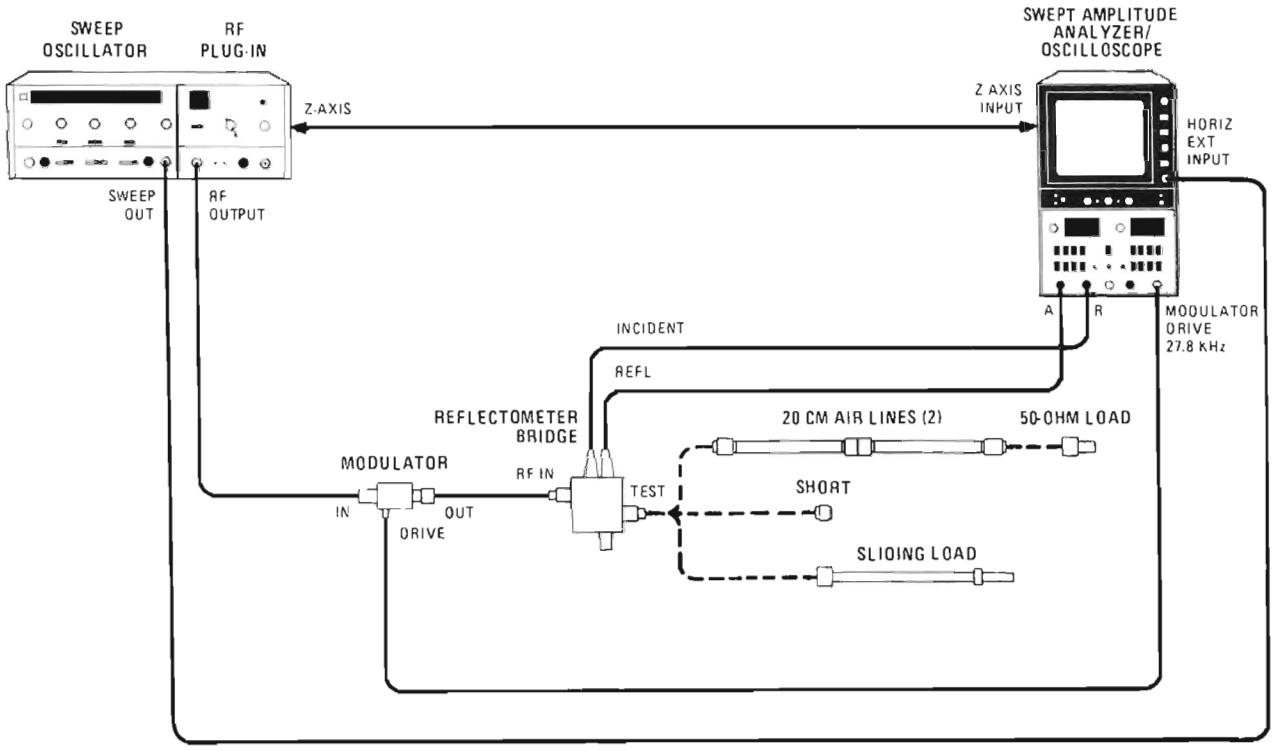


Figure 5-1. Directional Bridge Bias Adjustment Test Setup

ADJUSTMENTS

EQUIPMENT:

Sweep Oscillator	HP 8620A
RF Plug-in	HP 86290A
RF Plug-in	HP 86222A
Swept Amplitude Analyzer/Oscilloscope	HP 8755A/182T
Reflectometer Bridge	HP 11666A
Modulator	HP 11665B
20 cm Air Line (2)	HP 11567A
Short	HP 11512A
Sliding Load	HP 905A

PROCEDURE:

a. Connect equipment as shown in Figure 5-1 with the Short connected to the 11666A TEST port.

b. Set controls as follows:

8620A:

START pointer	2 GHz
STOP pointer	18 GHz

86290A:

POWER LEVEL	Fully Clockwise

8755A (Channel A):

OFFSET CAL	OFF
dB/DIV	10
DISPLAY	A/R
SMOOTHING	OFF

c. Adjust 8755A OFFSET dB and OFFSET CAL controls to position the reference display in the upper half of the CRT.

d. Disconnect the Short and connect the sliding load through two 20-cm air lines to the 11666A TEST port.

e. Varying the sliding load will raise or lower the signal displayed. Position the sliding load for an average of the two extremes.

f. Adjust A4R1 for the maximum difference between the average of the envelope displayed and the reference set in step c.

g. Substitute the 86222A for the RF Plug-in and set POWER LEVEL to +10 dBm.

h. Set the 8620A START/STOP pointers to cover 40 MHz to 2 GHz.

i. Connect Short to 11666A TEST port and adjust 8755A OFFSET dB and OFFSET CAL controls to position the reference display in the upper half of the CRT.

j. Disconnect Short and connect precision 50-ohm load through two 20-cm air lines to the 11666A TEST port.

NOTE

If step k is not satisfactory, compromise the A4R1 adjustment until the Directivity specifications are met over the entire 40 MHz to 18 GHz frequency range.

k. Ensure the minimum difference between the average of the display and the reference set in step i meets the Directivity requirements in the table below.

Frequency Range	Directivity
40 to 100 MHz	30 dB
0.1 to 1 GHz	38 dB
1 to 2 GHz	36 dB

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering parts. Table 6-1 lists abbreviations used in the parts list and throughout the manual. Table 6-2 lists all replaceable parts in reference designator order.

6-3. ABBREVIATIONS

6-4. Table 6-1 gives a list of abbreviations used in the parts list, schematics, and throughout the manual. In some cases, two forms of the abbreviation are given, one all capital letters, and one partial or no capitals. This occurs because the abbreviations in the parts list are always all capitals, since the computer readout does not print lower case letters. However, in the schematics and other parts of the manual, other abbreviation forms are used with both lower case and upper case letters.

6-5. REPLACEABLE PARTS LIST

6-6. Table 6-2 is the list of replaceable parts and is organized as follows:

a. Electrical assemblies and their components in alpha-numerical order by reference designation.

b. Chassis-mounted parts in alpha-numeric order by reference designation.

c. Miscellaneous parts.

d. Illustrated parts breakdown, if appropriate.

The information given for each part consists of the following:

a. The Hewlett-Packard part number.

b. The total quantity (Qty) in the instrument.

c. The description of the part.

d. The typical manufacturer of the part in a five-digit code.

e. Manufacturer code number for the part.

The total quantity for each part is given only once – at the first appearance of the part number in the list.

6-7. ORDERING INSTRUCTIONS

6-8. To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number, indicate quantity required, and address the order to the nearest Hewlett-Packard office.

6-9. 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.

Table 6-1. Reference Designators and Abbreviations Used in Manual

REFERENCE DESIGNATORS

A	assembly	CR	diode	L	inductor	R	resistor
BT	battery	F	fuse	P	plug	S	switch
C	capacitor	J	jack	Q	transistor	U	integrated circuit
						W	cable

ABBREVIATIONS

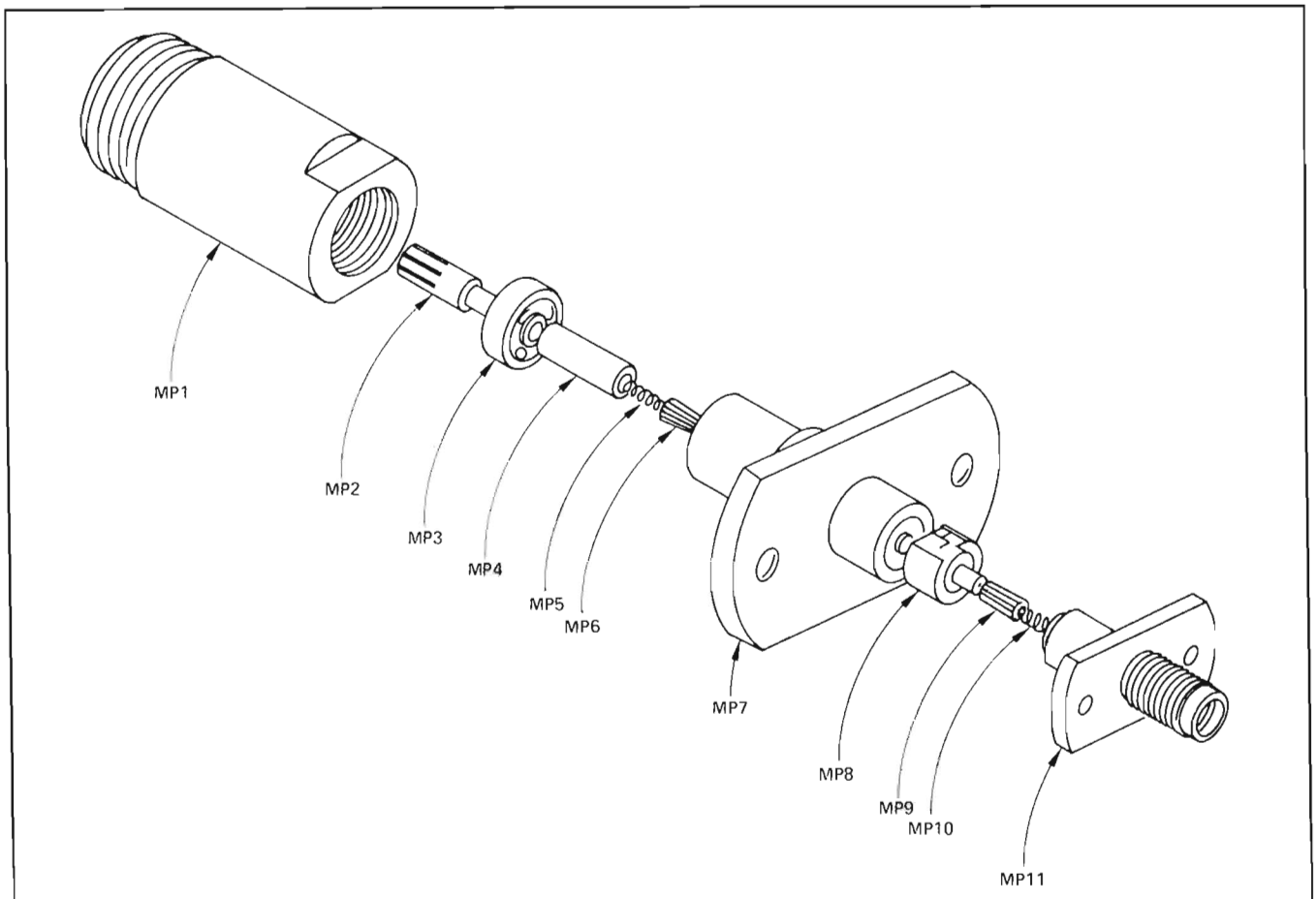
AMPL	amplifier	G	giga (10^9)	MHz	mega Hertz	RMS	root-mean-square
CCW	counterclockwise	H	henries	NPN	negative-positive-negative	S-B	slow-blow
COMP	composition	K	kilo = 1000			SI	silicon
CONN	connector	M	milli = 10^{-3}	P	peak	VAR	variable
CW	clockwise	MEG	meg = 10^6	PIV	peak inverse voltage	VDCW	dc working volts
DEPC	deposited carbon	MET FLM	metal film	PNP	positive-negative-positive	W	watts
ELECT	electrolytic	MET OX	metallic oxide			WIV	working inverse voltage
F	farads	MFR	manufacturer	PP	peak-to-peak		

Table 6-2. Replaceable Parts (1 of 2)

Reference Designation	HP Part Number	Qty	Description
A1		1	DIRECTIONAL BRIDGE ASSEMBLY (NOT FIELD SERVICE REPLACEABLE)
A1J3	1250-0914	2	RF CONN: BODY
	1250-0915	2	RF CONN: CONTACT
A2	11666-60019	2	BOARD ASSY: PRE AMP
A2C1	0160-3878	2	C: FXD 1000 PF
A2C2	0180-2492	4	C: FXD 2.7 UF
A2C3	0180-2492		C: FXD 2.7 UF
A2CR1	1901-0025	4	DIODE SIL
A2CR2	1901-0025		DIODE SIL
A2Q1	1854-0023	2	TRANSISTOR: NPN
A2Q2	1853-0007	4	TRANSISTOR: PNP
A2Q3	1854-0071	2	TRANSISTOR: NPN
A2Q4	1853-0007		TRANSISTOR: PNP
A2R1	0698-7249	2	R-F 3.48K 2%
A2R2	0698-7279	2	R-F 61.9K 2%
A2R3	0698-8273	2	R-F 133 OHM
A2R4	0698-7236	2	R-F 1K 2%
A2R5	0698-7238	2	R-F 1.21K 2%
A2R6	0698-8274	2	R-F 348 OHM
A2R7	0698-7205	4	R-F 51.1 OHM
A2R8	0698-7205		R-F 51.1 OHM
A3			SAME AS A2, USE A3 PREFIX
A4	11666-60001	1	BOARD ASSY: MASTER
A4C1	0160-3877	1	C: FXD 100 PF
A4C2	0160-3879	1	C: FXD .01 UF
A4L1	9140-0144	1	INDUCTOR: 4.7 UH
A4R1	2100-3094	1	R: VAR 100K
A4R2	0698-7249	1	R-F 3.48K 2%
A4R3	0698-7273	1	R-F 34.8K 2%
AT1		1	REFERENCE TERMINATION (NOT FIELD SERVICE REPLACEABLE
J1	1250-0914		RF CONN: BODY
	1250-0915		RF CONN: CONTACT
W1	11666-20008	1	CABLE: RF IN
W2	11666-60002	1	CABLE ASSY: INCIDENT
W3	8720-1788	1	CABLE ASSY: REFLECTED

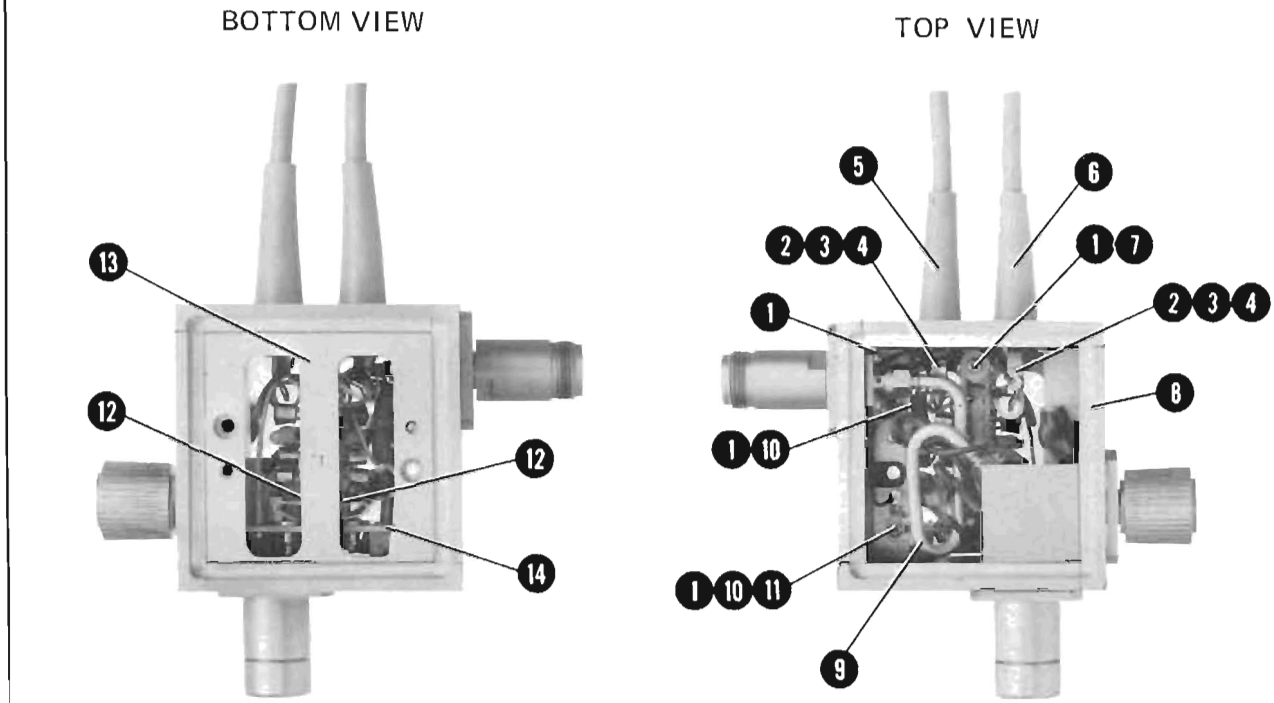
Table 6-2. Replaceable Parts (2 of 2)

Reference Designation	HP Part Number	Qty	Description
Z1	11666-60003	3	TOROIDAL INDUCTOR
Z2	11666-60003		TOROIDAL INDUCTOR
Z3	11666-60003		TOROIDAL INDUCTOR
		MISCELLANEOUS	
	11666-20007	2	COVER: TOP
	11666-20007		COVER: BOTTOM
	0380-0533	2	STANDOFF 1.000 LG
	7120-3773	1	LABEL: TOP COVER
	7120-1002	1	LABEL: SERIAL
	7120-4122	1	LABEL: ID
	7120-3103	2	MARKER CABLE: WHITE
	7120-3105	2	MARKER CABLE: BLUE
	2200-0104	2	SCREW: 4-40 X .25
	2200-0115	2	SCREW: 4-40 X .75
	2200-0166	6	SCREW: 4-40 X .312
	2200-0519	2	SCREW: 4-40 X .25
	3030-0414	8	SCREW: HEX 4-40 X .375



Reference Designation	HP Part Number	Qty	Description	Mfr. Code	Mfr. Part Number
J1MP1	1250-0914	2	Body: RF Connector	02660	131-150
J1MP2	1250-0915	2	Contact: RF Connector	02660	131-149
J1MP3	5040-0306	1	Insulator	28480	5040-0306
J1MP4	11666-20005	1	Conductor Inner	28480	11666-20005
J1MP5	1460-0526	2	Spring	28480	1460-0526
J1MP6	08491-200	2	Contact Sliding	28480	08491-2009
J1MP7	1250-0548	1	Connector Flange	28480	1250-0548
J1MP8	5086-3146	1	DC Return	28480	5086-3146
J1MP9	08491-2009	2	Contact Sliding	28480	08491-2009
J1MP10	1460-0526	2	Spring	28480	1460-0526
J1MP11	1250-1185	1	Connector Assembly	28480	1250-1185

Figure 6-1. RF IN Connector J1 Exploded View



Reference Designation	Quantity	Description	HP Part Number
1	4	Screw	0520-0128
2	2	Nut	2950-0001
3	2	Terminal Lug	0360-1190
4	2	Washer: Lock	2190-0016
5	1	Cable Assembly	11666-60002
6	1	Cable Assembly	8120-1788
7	1	Washer	2190-0319
8	1	Housing: Main	11666-20018
9	1	RF Cable: Semi-rigid	11666-20008
10	2	Terminal Lug	0360-0002
11	1	Washer: Lock	2190-0014
12	2	Board Assembly: Preamp	11666-60019
13	1	Housing: Printed Circuit	11666-20006
14	1	Board Assembly: Master	11666-60001

Figure 6-2. Model 11666A Illustrated Parts Breakdown

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section normally contains information for adapting this manual to instruments for which the content does not apply directly. Since this manual does apply directly to instruments having serial numbers listed on the title page, no change information is given here. Refer to INSTRUMENTS COVERED BY MANUAL in Section I for additional important information about serial number coverage.

SECTION VIII
SERVICE

8-1. INTRODUCTION

8-2. This section contains troubleshooting and repair information. The general organization of this section is:

(a) text covering repair procedures.

(b) a troubleshooting tree to find troubles.

(c) Service Sheets containing parts identification, principles of operation, and schematic diagrams.

8-3. PRINCIPLES OF OPERATION

8-4. A circuit description keyed to the schematic diagram is given opposite the schematic. This is helpful in understanding each major circuit function.

8-5 TROUBLESHOOTING

8-6. Troubleshooting is presented in easy to follow, block-style flowgraph diagrams. The first step in troubleshooting is to refer to TROUBLESHOOTING PROCEDURES, where a troubleshooting procedure is outlined to isolate the problem to an assembly or component level. If special repair procedures are needed for replacing the individual component, these will be found under REPAIR.

8-7. RECOMMENDED TEST EQUIPMENT

8-8. Equipment recommended to test and maintain the instrument is listed in Table 1-3. Special tools for servicing the instrument are also listed.

8-9. REPAIR

8-10. This section gives detailed step-by-step repair procedures for some individual components where special care is necessary.

CAUTION

Any attempt to REMOVE OR REPAIR the Directional Bridge (A1), TEST port (A1J3), or the Reference Termination (AT1) will automatically void the warranty (inside front cover).

8-11. Due to critical alignment, repair or replacement of the Directional Bridge (A1), TEST port (A1J3) or Reference Termination (AT1) requires the return of the 11666A Reflectometer Bridge to Hewlett-Packard.

8-12: Printed Circuit Board Removal and Installation

8-13. The procedure for removal and replacement of printed circuit boards is described in Figure 8-1.

8-14. Changing Type N Connectors

8-15. To replace the connector outer shell and inner conductor assembly, proceed as follows:

a. With a 7/16-inch open-end wrench, loosen the connector outer shell on the 11666A.

b. Carefully remove the outer shell and inner conductor assembly.

CAUTION

Do NOT disassemble the center conductor assembly. If the sliding contact is removed, reassembly is difficult.

c. Insert new center conductor assembly in the RF connector shell. Push down on the center conductor to seat the center conductor assembly.

d. Screw the outer shell assembly on the connector mounting.

e. Tighten outer shell assembly with a 7/16-inch open-end wrench.

8-16. APC-7 Connector Center Collet Replacement

8-17. Through wear or damage, the contact in the center conductor may need replacing. This contact is a small four-pronged collet which snaps into a recess in the center conductor. This contact is normally held in by the spring-action of the four prongs. With a magnifying glass examine this contact to determine if it

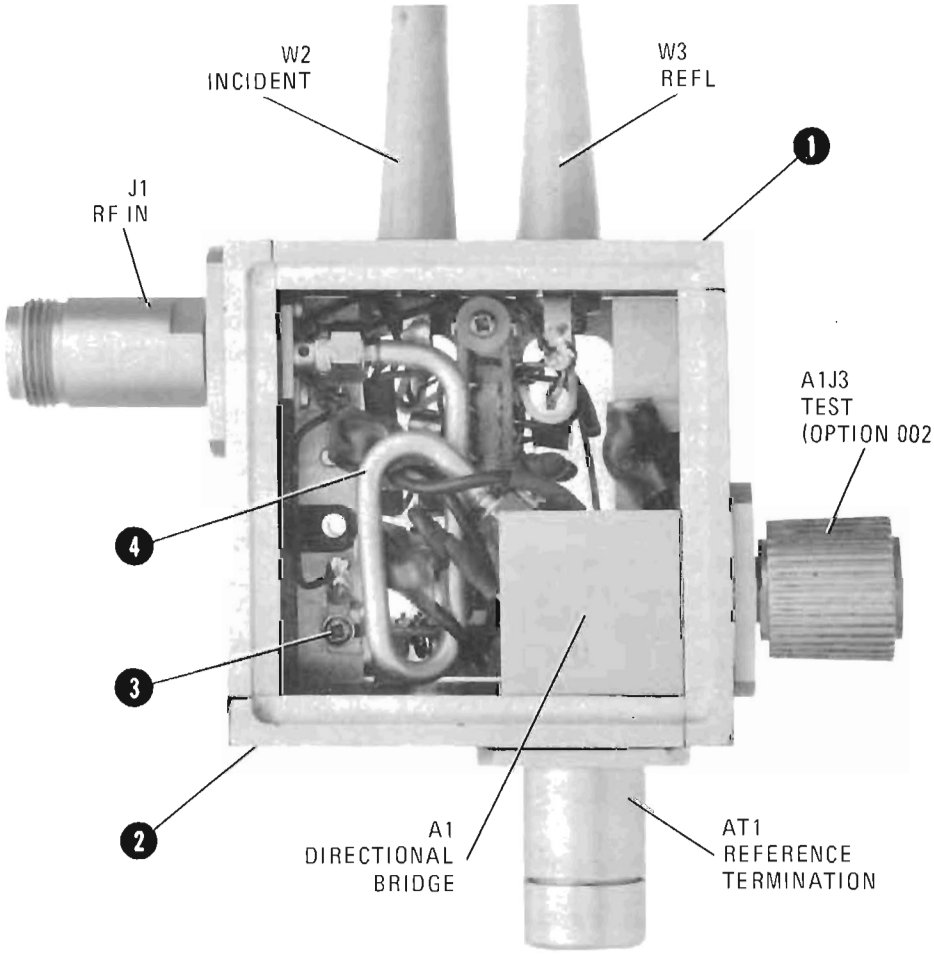


Figure 8-1. Printed Circuit Board Removal and Replacement (1 of 3)

PRINTED CIRCUIT BOARD REMOVAL

CAUTION

DO NOT REMOVE OR LOOSEN any screws which may change the physical alignment of the TEST port (A1J3) or Reference Terminaion (AT1) with the Directional Bridge (A1). This alignment is critical for proper operation and requires return of the 11666A to Hewlett-Packard for realignment.

a. Remove two flat-head, pozi-drive, screws securing the bottom cover and remove the bottom cover.

b. Remove two pozi-drive screws in bottom of board housing and remove the top cover.

c. With a 5/16-inch open-end wrench, disconnect and remove W1 semi-rigid cable ❹ between RF IN port (J1) and Directional Bridge Assembly (A1).

d. Remove pozi-drive screw securing terminal lug (black wire) ❸ to the top of the board housing.

e. Remove two allen screws ❷ securing the Reference Termination side plate to the RF IN side plate.

f. Remove two allen screws ❶ securing the REFL and INCIDENT port side plate to the TEST port side plate.

g. Disconnect the violet wire from the pin connection on the Master Board.

h. Insert a shim (1/4-inch wide X 3-inches long X0.020-inches thick) between the Master Board and spring contacts of each Amplifier Board Assembly (A2 and A3)

i. Carefully pull the Master Board out of the Board housing with a pair of long-nosed pliers.

j. Remove both Amplifier Board Assemblies from the Board housing.

Figure 8-1. Printed Circuit Board Removal and Replacement (2 of 3)

PRINTED CIRCUIT BOARD INSTALLATION

a. Insert both Amplifier Board Assemblies into board housing.

b. Compress spring contacts on amplifier boards with shims and carefully slide Master Board into board housing.

c. Connect the violet wire to the pin connection on the Master Board.

d. Align printed circuit board housing and Directional Bridge Assembly (A1) with side plates and slide them together.

e. Insert and tighten four allen screws ❶ ❷ into the side plates.

f. Secure terminal lug ❸ to the top of the board housing with pozi-drive screw.

g. Connect W1 semi-rigid cable ❹ between RF IN port (J1) and Directional Bridge Assembly (A1). Ensure both connections are tight.

h. Replace top cover with stand-offs and secure with two pozi-drive screws through bottom of the board housing.

i. Replace bottom cover and secure with two flat-head, pozi-drive, screws.

Figure 8-1. Printed Circuit Board Removal and Replacement (3 of 3)

needs replacement. DO NOT REMOVE THIS CONTACT FOR INSPECTION (it may be damaged by removing). The contact should be free of burrs or wear and the prongs should be equally spaced. If the contact is removed do NOT re-use it (it may be damaged by removal). This contact is Amphenal part number 131-129 and HP 1250-0907. If this contact needs replacement, proceed as follows:

a. Place the 11666A so the connector faces down.

b. Tap the connector lightly and the contact should now protrude slightly. Insert the centering pin of the HP contact extractor, part number 5060-0236, with the jaws open. If this tool is not available, an ordinary draftman's mechanical pencil may be used.

c. Allow the jaws on the tool used to close and pull straight away from the connector without twisting.

d. Snap in a new contact by pushing a new contact in place.

8-18. Soldering Cable Leads

8-19. When unsoldering or soldering cable leads on the amplifier printed circuit boards use extreme care so that plastic insulation on cable wires is not damaged. Always use a heat sink, such as a pair of long-nose pliers, between the insulation and connection. Always use the minimum amount of heat necessary to make the connection. The connections are:

a. Shield wire to Ground (near E2)

b. Violet wire to E4.

c. Red wire to E2.

d. White wire to E3.

8-20. Soldering to Etched Circuit Boards

8-21. The etched circuit boards in the Reflectometer Bridge are of the plated-through type consisting of metallic conductors bonded to both sides of the 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.

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

d. After soldering, remove excess flux from the soldered areas and apply a protective coating to prevent contamination and corrosion.

8-22. Component Replacement

To replace a defective component, proceed as follows:

a. Remove defective component from circuit board.

b. Remove solder from mounting holes 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 original was positioned. DO NOT FORCE LEADS OF REPLACEMENT COMPONENT INTO MOUNTING HOLES. Sharp lead ends may damage plated-through conductor.

8-23. Transistor Replacement

8-24. In addition to the above precautions, observe the following when replacing a transistor.

a. Do not apply excessive heat. See Table 1-3 for soldering tool specifications.

b. Use a heat sink, such as long-nosed pliers, between transistor body and hot soldering iron.

c. When installing a replacement transistor, ensure sufficient lead length to dissipate heat of soldering by maintaining about the same length of exposed lead as used for the original transistor.

8-25. TROUBLESHOOTING PROCEDURES

8-26. Troubleshooting the 11666A involves performing the Operator's Check and Performance Tests, then making the following checks:

CAUTION

An analog voltmeter is required for dc measurements on the Directional Bridge microcircuit. Using a digital voltmeter may cause damage to the microcircuit.

a. In cases where the instrument is not close to specifications, check the dc voltages at points (A) (B) and (C) to verify the Directional Bridge Assembly (A1) is working properly(Figure 8-7).

b. Perform the troubleshooting procedure in Figure 8-4 to determine if A2 and A3 Amplifier Assemblies are working properly.

c. Perform the troubleshooting procedure in Figure 8-5 to isolate the trouble on an amplifier assembly to a particular component.

8-27. TROUBLESHOOTING HINTS

8-28. To troubleshoot an Amplifier Board Assembly a Dummy Input Circuit (Figure 8-3) must be connected to the input of the amplifier. This must be done to place the proper bias on the input transistor. In normal operation the detector in the Directional Bridge microcircuit loads down the input circuit of the amplifier.

NOTE

When troubleshooting an amplifier assembly out of the Reflectometer Bridge, the Dummy Input Circuit must be used.

8-29. If the equipment used in Figure 8-3 is not available, dc measurements may be used. The same Dummy Input Circuit may be used to preserve the input bias. Any trouble will most likely shift the dc-coupled voltages far from their normal values. Start by measuring the input bias. If this voltage is 50% high or low, the voltages in the entire amplifier may be off. From this point on, standard transistor troubleshooting techniques may be used. For instance, measure the emitter-base voltage of Q1. Substitution of Q1 is an easy operation, as it has plug-in terminals.

SCHEMATIC DIAGRAM NOTES

For symbols not shown, refer to USA Standard Y32.2—1967 "Graphic Symbols for Electrical and Electronic Diagrams."

Logic Symbols used conform to MIL-STD-806B (Military Standard 806B) "Graphic Symbols for Logic Diagrams."

R, L, C — Resistance is in ohms, capacitance is in picofarads, and inductance is in microhenries unless otherwise noted.

P/O — P/O = part of.

* — * Asterisk denotes a factory-selected value. Value shown is typical. Capacitors may be omitted or resistors jumpered.

 — Screwdriver adjustment

 — Encloses top cover designations.

 — Circuit assembly borderline

 — Other assembly borderline

 — Heavy line with arrows indicates path and direction of main signal.

 — Heavy dashed line with arrows indicates path and direction of main feedback.

Wiper moves toward CW with clockwise rotation of control as viewed from shaft or knob.

Numbers in stars on circuit assemblies show locations of test points.

 — Encloses wire color code. Code used (MIL-STD-681) is the same as the resistor color code. First number identifies the base color, second number the wider stripe, and the third number identifies the narrower strip, e.g., (947) denotes white base, yellow wide stripe, violet narrow stripe.

Figure 8-2. Schematic Diagram Notes (1 of 2)

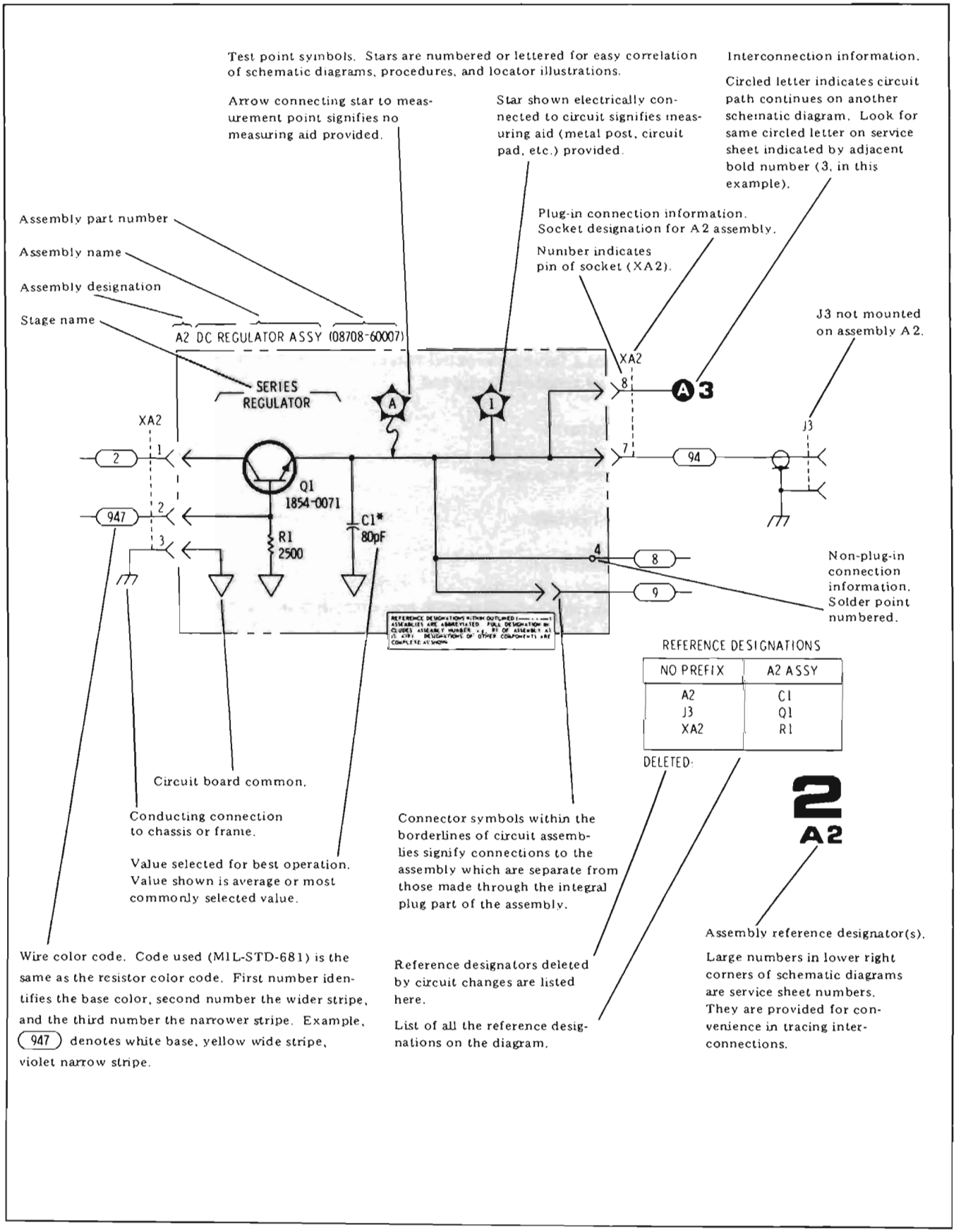
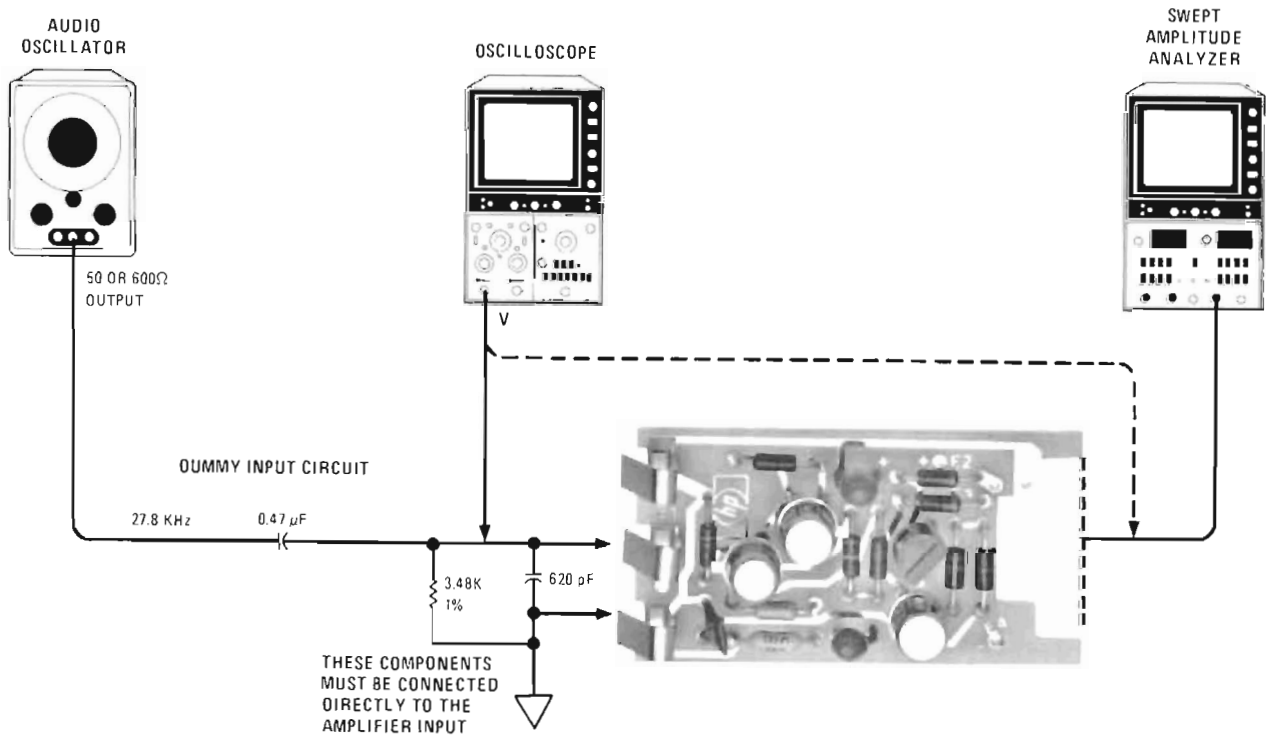


Figure 8-2. Schematic Diagram Notes (2 of 2)



DUMMY INPUT CIRCUIT COMPONENTS

Description	HP Part No.
0.47μF Capacitor	0160-3545
620pF Capacitor	0160-3536
3.48K Resistor	0698-5354

Figure 8-3. Test Setup for Measuring AC Gain

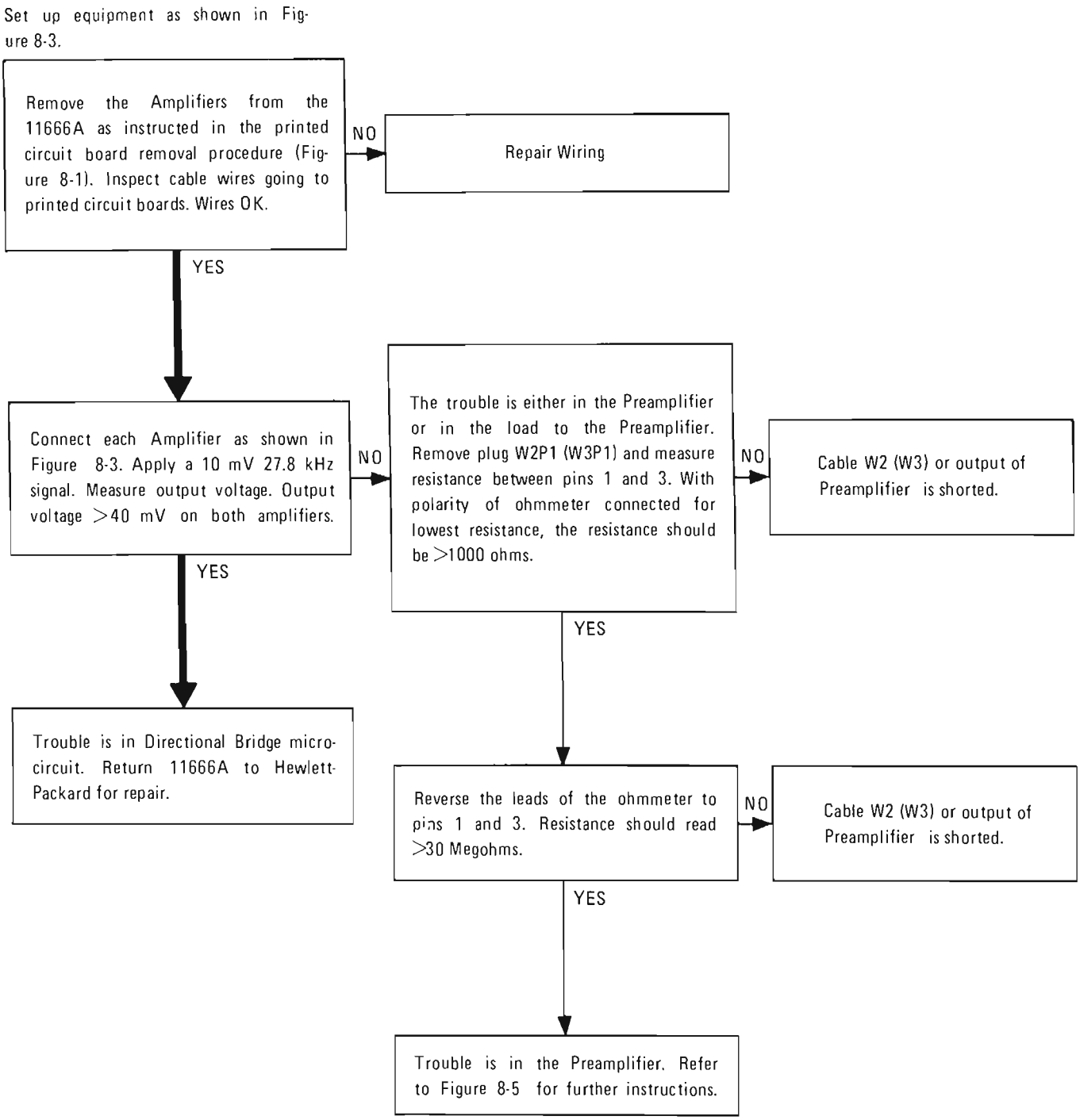


Figure 8-4. Model 11666A Troubleshooting Flow Diagram

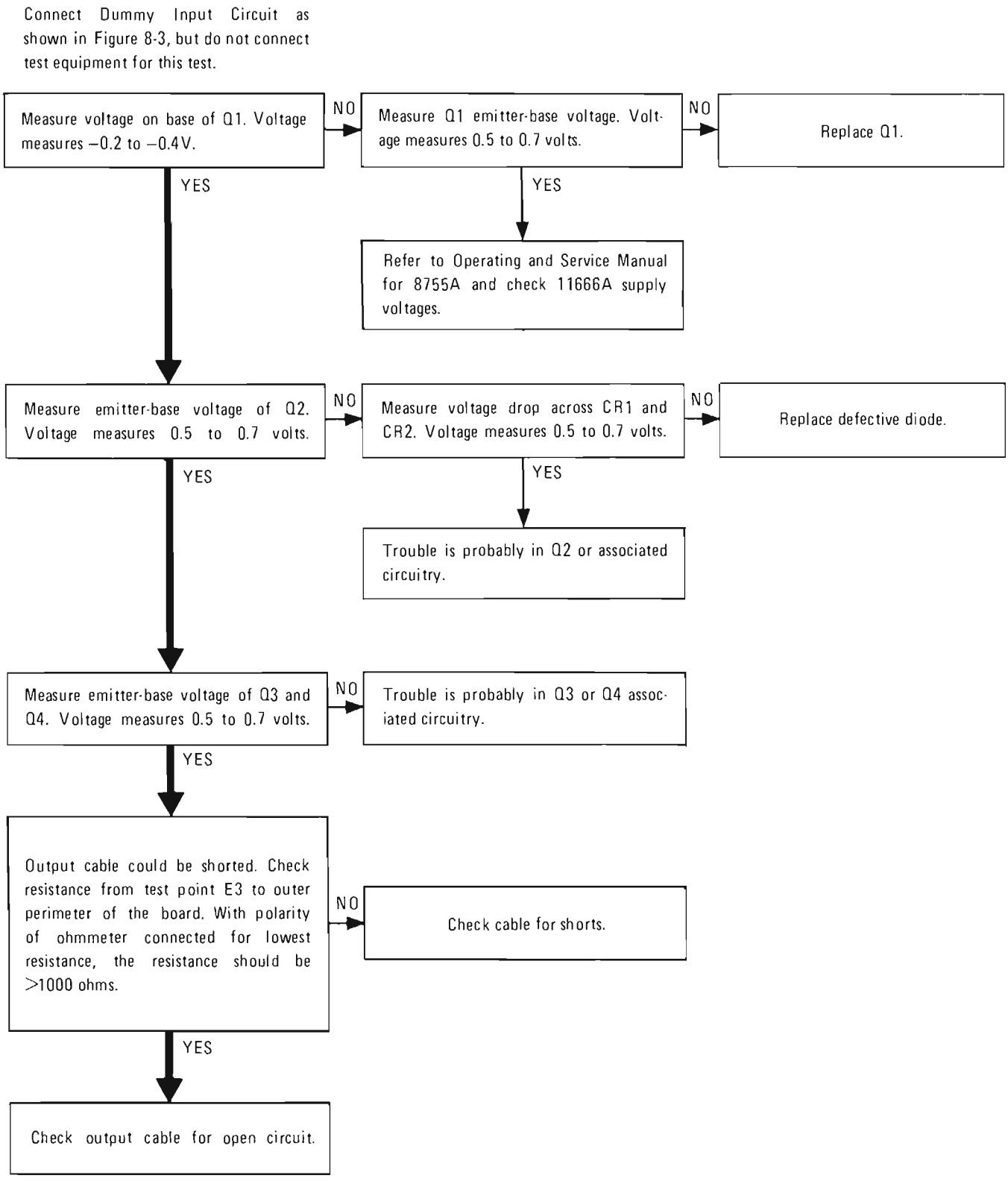


Figure 8-5. Isolating Trouble to an Individual Component in the Amplifier

PRINCIPLES OF OPERATION

11666A Reflectometer Bridge

Operation of the Reflectometer Bridge is based on the principles of the Wheatstone Bridge. The Directional Bridge consists of legs A, B, and C connected in a delta configuration with the precision 50-ohm load and TEST port completing the Wheatstone Bridge configuration. The B leg is biased by a voltage divider network on the Master Board for precision balancing of the bridge. The A leg detector couples a signal, which is directly proportional to the RF IN voltage, through the A3 Preamplifier to the HP 8755A reference channel. A voltage drop across the C leg occurs when the precision 50-ohm load and TEST port do not reflect equal impedances to the A and B legs respectively. This voltage is directly proportional to the reflection coefficient of the device under test on the TEST port. The voltage across the C leg is coupled off and fed through the A2 Preamplifier to the HP 8755A for display.

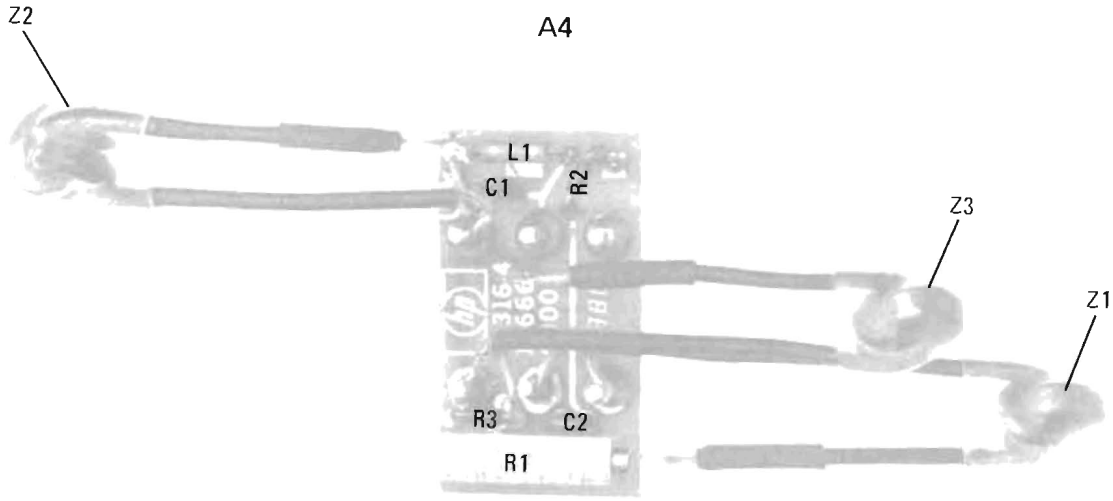


Figure 8-6. A4 Master Board, Component Location

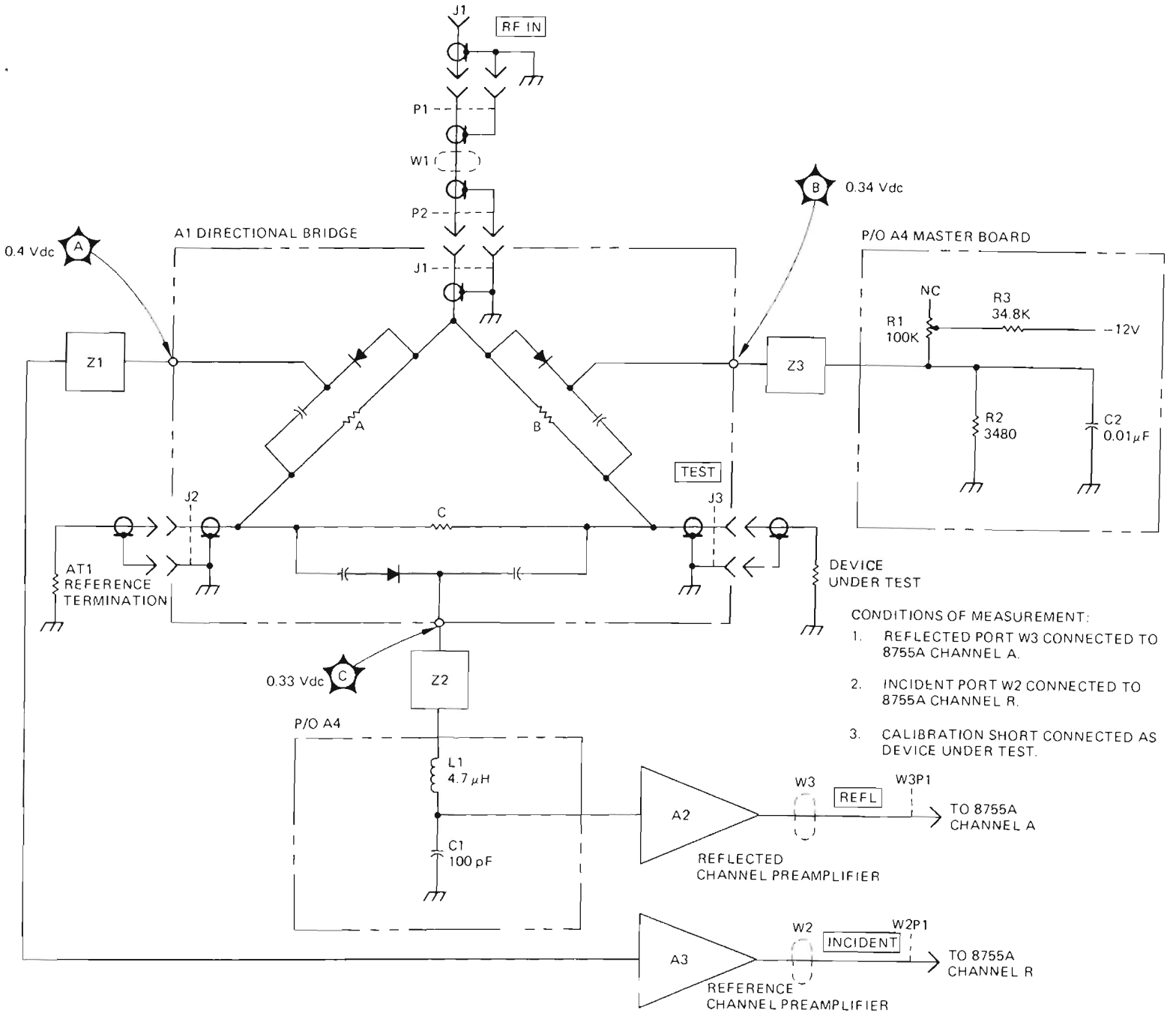


Figure 8-7. Model 11666A, Schematic Diagram

PRINCIPLES OF OPERATION

Amplifier

The 27.8 kHz squarewave signal from the Directional Bridge (A1) is fed into the base of A2Q1. Resistor A2R1 reduces the input RC time-constant to less than 2 microseconds so that the input to the Amplifier will follow the modulation envelope at power levels greater than ±5 dBm. A resistor, A2R2, adjusts the bias on the base of A2Q1 and across A2CR1.

Transistors A2Q1 and A2Q2 comprise a feedback pair. They are a high-gain direct-coupled amplifier stage composed of an NPN and a PNP transistor cascaded together. A positive-going pulse to the base of A2Q1 will increase the voltage through A2Q1, giving a negative going pulse to the base of A2Q2. This pulse will, by a similar action, give a positive-going pulse to the emitter of A2Q1. This positive-going pulse on the emitter of A2Q1 tends to limit the gain of the amplifier.

Transistors A2Q3 and A2Q4 are output emitter followers connected in parallel. They are complementary symmetry fed from the emitter and collector of A2Q1. The necessary difference in bias is furnished by diodes A2CR1 and A2CR2.

The principles of operation are the same for the A3 amplifier assembly, just substitute an A3 prefix for each component called out above.

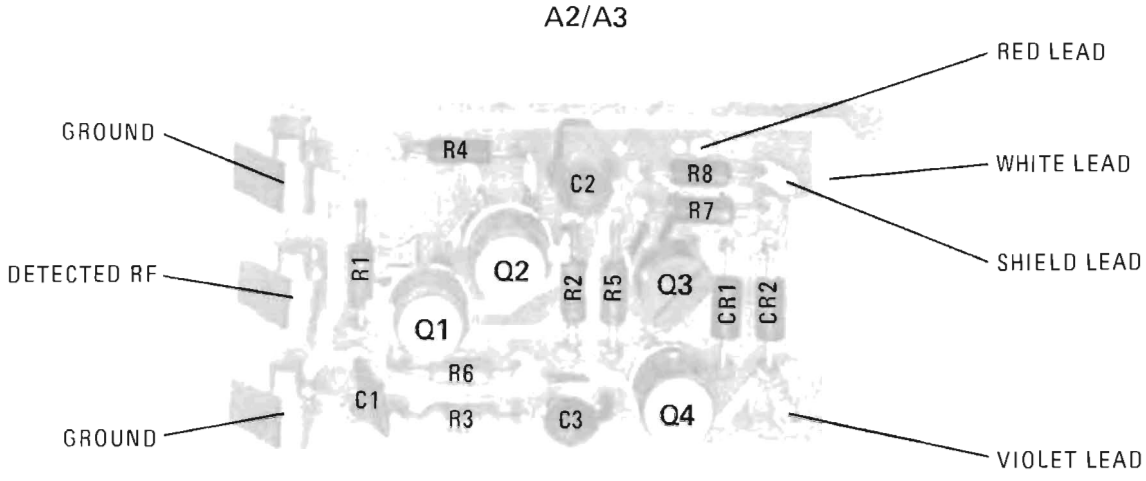


Figure 8-8. A2/A3 Preamplifier Component Identification Illustration

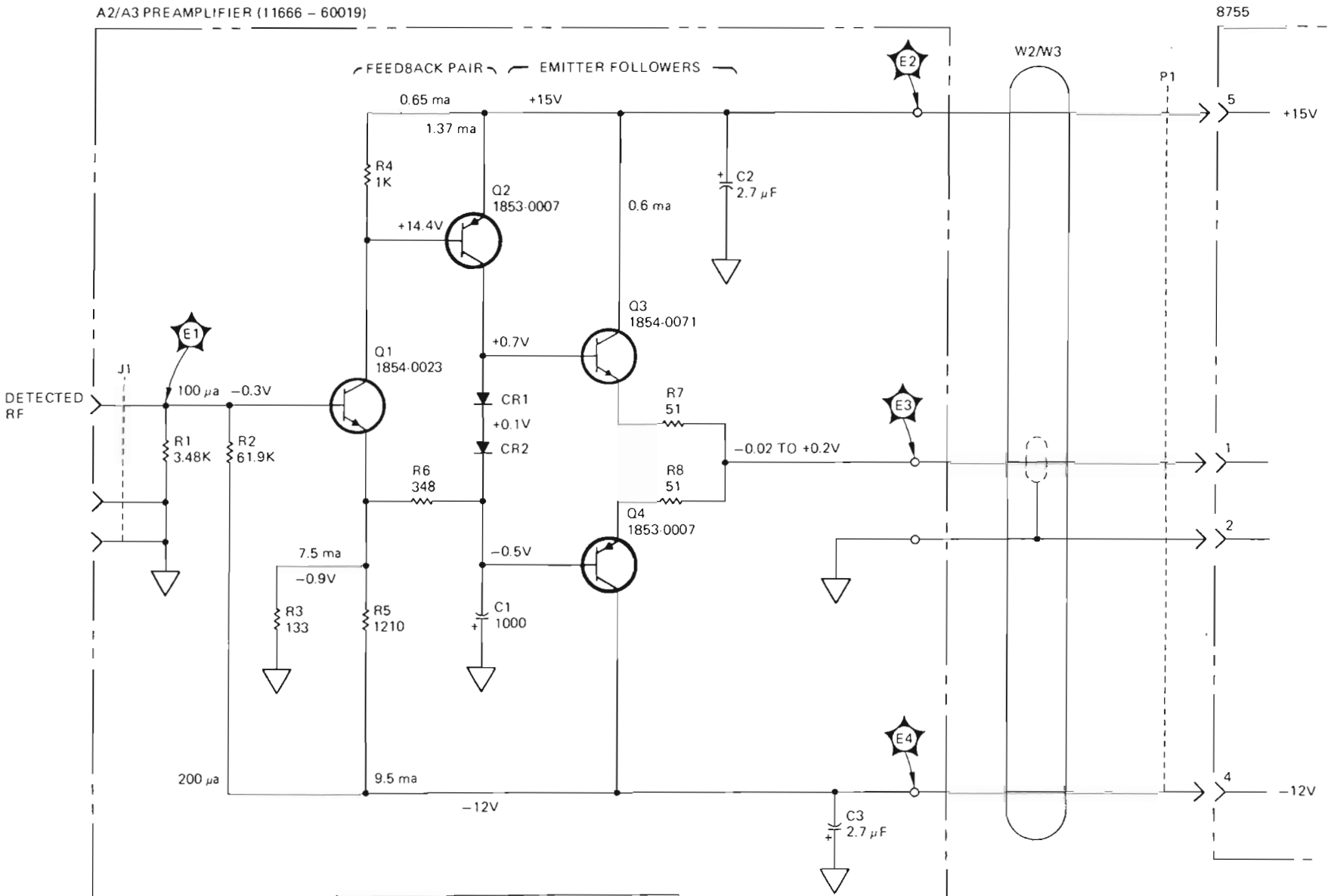


Figure 8-9. A2/A3 Preamplifier Assembly, Schematic Diagram

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