Errata

Title & Document Type: **8502A Transmission / Reflection Test Set Operating and Service Manual**

Manual Part Number: **08502-90001**

Revision Date: **August 1977**

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HP References in this Manual

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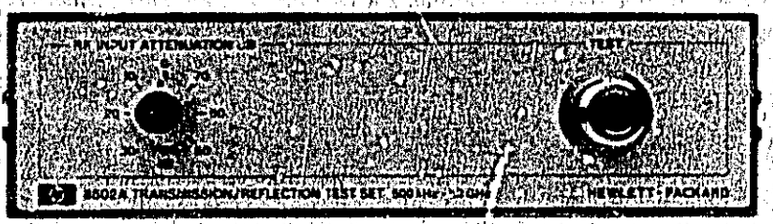
OPERATING AND SERVICE MANUAL

8502A TRANSMISSION/ REFLECTION TEST SET

500 kHz — 1.3 GHz



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SAFETY

This instrument has been designed and tested according to International Safety Requirements. 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. 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.

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OPERATING AND SERVICE MANUAL

8502A TRANSMISSION/REFLECTION TEST SET

500 kHz — 1.3 GHz

SERIAL NUMBERS

This manual applies directly to HP Model 8502A with serial prefix numbers 1603A and 1616A.

For additional information about serial numbers, see INSTRUMENTS COVERED BY MANUAL in Paragraph 7.

1400 FOUNTAIN GROVE PARKWAY, SANTA ROSA, CALIFORNIA, U.S.A.

MANUAL PART NO. 08502-90001
Microfiche Part No. 08502-90002

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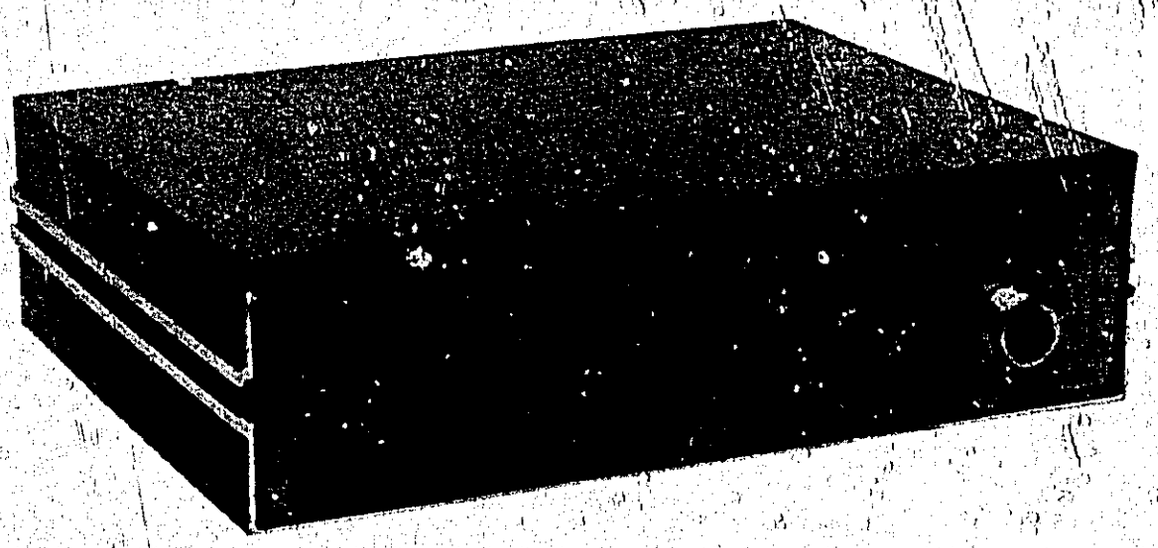


MODEL 8502A

Figure 1. Model 8502A Transmission/Reflection Test Set

1. GENERAL INFORMATION

2. Introduction

3. This Operating and Service manual applies to the Hewlett-Packard Model 8502A Transmission/Reflection Test Set (Figure 1). It contains information necessary to operate, test, and service the HP Model 8502A.

4. On the title page of this manual, below the manual part number, is a "Microfiche" part number. This number may be used to order a 4- x 6-inch microfilm transparency of this manual.

5. Description

6. The Hewlett-Packard Model 8502A Transmission/Reflection Test Set provides all of the RF hardware necessary to make simultaneous transmission and reflection measurements between 500 KHz and 1300 MHz. The test set consists of an RF power splitter to develop a reference or incident signal, a directional bridge to develop a reflected signal, and an attenuator to control the signal incident on the device under test.

7. Instruments Covered by Manual

8. Attached to the instrument is a serial number plate (Figure 2). The serial number is in two parts. The first four digits and the letter are the serial number prefix; 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. If your instrument does not have a serial number prefix that is listed on the title page, refer to the manual changes supplement, or contact your nearest HP office for change information.

9. Input Level Caution

CAUTION

Do not apply signals greater than listed below or damage to the test set circuits may result. TEST port limits are +26 dBm and 30 Vdc. RF INPUT port limits are +30 dBm (1.0 watt) and 7.0 Vdc. BIAS INPUT port limits are 500 mA and 30 Vdc.

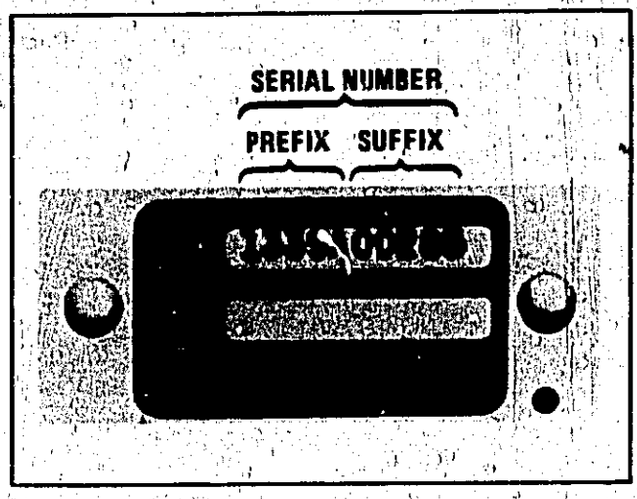


Figure 2. Serial Number Plate

10. Specifications

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

12. Equipment Available

13. Hewlett-Packard Cable Accessory Set 11851A, shown in Figure 3, contains four double-shielded and phase-matched cables for high accuracy measurements with the HP Model 8505A Network Analyzer and other instruments.

14. Recommended Test Equipment

15. Equipment required for performance testing and troubleshooting of the Hewlett-Packard Model 8502A Transmission/Reflection Test Set is listed in Table 3. Other equipment may be substituted if it meets or exceeds the critical specifications listed in the table.

Table 1. Model 8502A Specifications

SPECIFICATIONS
8502A TRANSMISSION/REFLECTION TEST SET

Frequency Range: 500 kHz to 1.3 GHz

Impedance: 50 ohms

Directivity: ≥40 dB

Frequency Response:

Transmission:

Magnitude: ≤±0.8 dB
** **Phase:** ≤±8°

Reflection:

Magnitude: ≤±1.5 dB from 0.5 to 1300 MHz
Phase: ≤±15° from 0.5 to 1300 MHz

** **Phase:** ≤±10° from 2 to 1300 MHz

Port Match:

Test Port Return Loss*:

≥26 dB (≤1.11 SWR) from 2 to 1300 MHz
≥20 dB (≤1.22 SWR) from 0.5 to 2 MHz

Test Port Open/Short Ratio:

Magnitude: ≤±0.75 dB from 2 to 1000 MHz
Phase: ≤±6° from 2 to 1000 MHz
Magnitude: ≤±0.9 dB from 1000 to 1300 MHz
Phase: ≤±7.5° from 1000 to 1300 MHz
Magnitude: ≤±1.25 dB from 0.5 to 2 MHz
Phase: ≤±10° from 0.5 to 2 MHz

Incident Port Return Loss*:

≥25 dB (≤1.12 SWR) from 2 to 1000 MHz
≥23 dB (≤1.15 SWR) from 0.5 to 1300 MHz

Reflection Port Return Loss*:

≥25 dB (≤1.12 SWR) from 2 to 1000 MHz
≥23 dB (≤1.15 SWR) from 0.5 to 1300 MHz

RF Input Port Return Loss*:

≥23 dB (≤1.15 SWR)

Maximum Operating Level: ≤+20 dBm
TEST port: +26 dBm 30 Vdc Max
RF INPUT port: +30 dBm (1W) 7 Vdc Max
Bias: 30 Vdc 500 mA Max

Damage Level: >1 watt (+30 dBm) CW

Dimensions: 101 mm wide, 61.5mm high, 204mm deep (7-1/2" x 2-7/16" x 8")

Weight:
Net: 1.7 kg (3-3/4 lb.)
Shipping: 3.1 kg (7 lb.)

*Other ports terminated in 50 ohms ±10% tolerance.

**± degrees, specified as deviation from linear phase.

Table 2. Model 8502A Supplemental Characteristics

Test Port Return Loss: Typically 30 dB from 2 to 1300 MHz

Insertion Loss with Attenuator Set to Zero:

Input to Test Port: 13 dB

Input to Incident Port: 19 dB

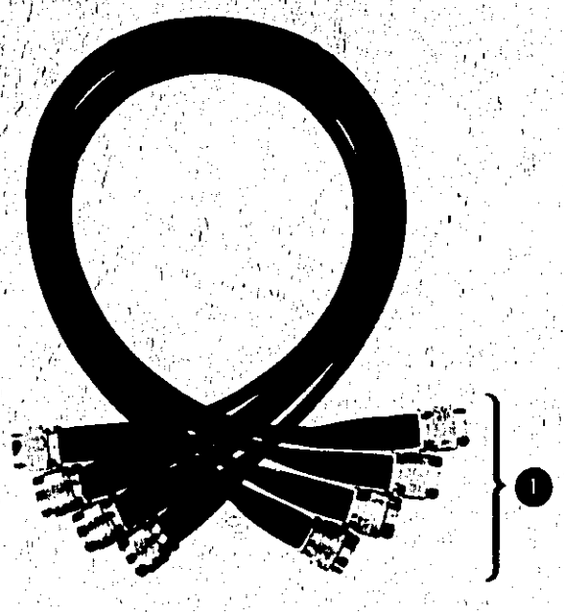
Input to Reflection Port with Short on Test Port: 19 dB

RF Attenuator Range: 0 to 70 dB in 10-dB steps

DC Bias Input Range: ±30 Vdc, ±200 mA; some degradation in RF specifications from 500 kHz to 100 MHz. 500 mA maximum.

RF Connectors: 50 ohm Type N Female

DC Bias Input Connector: Type BNC Female



Item	Name	Qty	HP Part No.	Description
1	Cable Assembly	4	8120-2292	61 cm (24 in.) 50-ohm cables, phase matched to a standard within ±2° at 1300 MHz, with 50 ohm Type N male connectors on each end.

Figure 3. HP Model 11851A Cable Accessory Set

16. INSTALLATION

17. Initial Inspection

18. Inspect the shipping container for damage. 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. Procedures for checking electrical performance are given in Paragraph 35. If the contents of the shipment are incomplete or if the equipment is mechanically damaged, or does not pass the electrical performance test, notify the nearest Hewlett-Packard office. If, in addition, the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection. At Hewlett-Packard's option, the HP office may arrange for repair or replacement without waiting for claim settlement.

19. Preparation for Use

20. Mating Connectors

21. The connectors that mate with the HP Model 8502A ports are shown in Table 4. This table identifies each connector and gives the HP Part Number and part numbers of alternative sources.

Table 3. Recommended Test Equipment

Instrument	Critical Specifications	Recommended Model	Use*
Network Analyzer	Frequency Range: 0.5 – 1300 MHz	HP 8505A	P, T
Dual Directional Coupler	Frequency Range: 100 – 1300 MHz Directivity: ≥ 36 dB, 0.1 – 1 GHz ≥32 dB, 1.0 – 1.3 GHz	HP 778D, Opt. 012	P
Directional Bridge[1]	Frequency Range: 0.5 – 100 MHz Directivity: ≥40 dB, 1 – 100 MHz ≥30 dB, .5 – 1 MHz	HP 8721A	P
3-Way Power Splitter	Tracking between any two ports: ≤ 0.1 dB Magnitude ≤ 1.5° Phase ≥ 32 dB Output Source Match	HP 11850A	P
Termination (4 required)	Impedance: 50Ω with Type N male connector	HP 909A, Opt. 012	P
Termination[2]	Impedance: 50Ω with Type N male SWR: <1.005	HP 909A, Opt. 012 and H69	P P
Short	Type N female Connector	HP 11511A	P
Short	Type N male Connector	HP 11512A	P, T
Adapter (2 required)	Type BNC male to N male	HP 1250-1473	P
Adapter	Type N female to SMA female	Cablewave Systems No. 721	T
Adapter[4] (2 required)	Type N female to SMA male	Cablewave Systems No. 718	T
Cable	6 ft. 50Ω coaxial cable, Type R6-214, with Type N male connectors on both ends	HP 11500A	P
Cable (2 required)	6 ft. 50Ω coaxial cable, Type RG-214, with Type N male connector on one end and Type N female connector on the other end	HP 11501A	P
Cable Set[3]	24 in. 50Ω coaxial cable phase matched matched to a standard within ±2° at 1300 MHz with Type N male connectors on both ends	HP 11851A	P

*P = Performance; T = Troubleshooting
[1] This part is included in HP 11652A Transmission/Reflection Kit.
[2] These parts are included in HP 85032A 50Ω Type N Calibration Kit.
[3] These parts are included in HP 11851A RF Cable Kit.
[4] Part of HP11854A 50Ω BNC Accessory Kit

Table 4. Connectors that Mate with 8502A Ports

Connector	Industry Identification	HP Part Number	Alternate Sources and Part Numbers
J1	Type N male, UG-216/U	1250-0882	Bendix, No. 30481-2 Specialty Connectors, No. 25P117-2
J2 Bias	Type BNC male, UG-88/U	1250-0256	Amphenol, No. 31-202-1021

22. Operating Environment

23. The operating environment should be within the following limits:

a. Temperature: 0° C (+32° F) to 55° C (+131°F)
b. Humidity: <95% relative
c. Altitude (Barometric): <15,000 feet (4,600 meters)

24. Storage and Shipment

25. Environment

26. The Model 8502A should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment:

a. Temperature: −40° C (−40° F) to +75° C (+167° F)
b. Humidity: <95% relative
c. Altitude (Barometric): <50,000 feet (15,300 meters)

27. Packaging for Shipment

28. Original Type Packaging. Containers and materials identical with those used in factory packing 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 the model number and full serial number.

29. 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 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-absorbing material (3 to 4-inch layer) around all sides of the instrument to provide firm cushion and prevent movement inside the container. Protect the front of the instrument with cardboard.

d. Seal the shipping container securely.

e. Mark shipping container FRAGILE to assure handling.

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

30. OPERATION

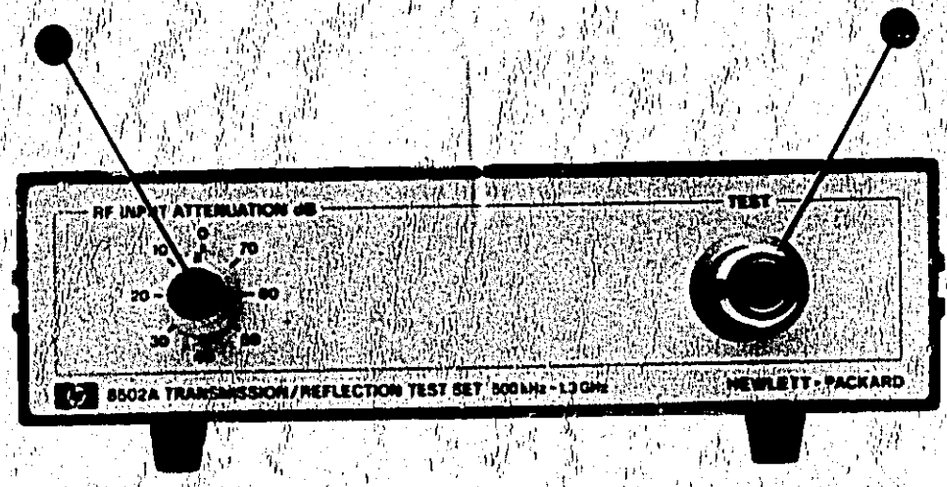
31. Panel Features

32. Front and rear panel controls and connectors are illustrated and functionally described in Figure 4.

33. Incoming Inspection

34. The test given in Figure 5 is primarily designed to meet the needs of incoming inspection. The test will prove that the HP Model 8502A Transmission/Reflection Test Set is functioning correctly, and tests that the most critical specification, directivity, is within the specification. If a test for each detailed specification is required, then go to the performance test section beginning with Paragraph 35 and run each test.

FRONT PANEL FEATURES



REAR PANEL FEATURES

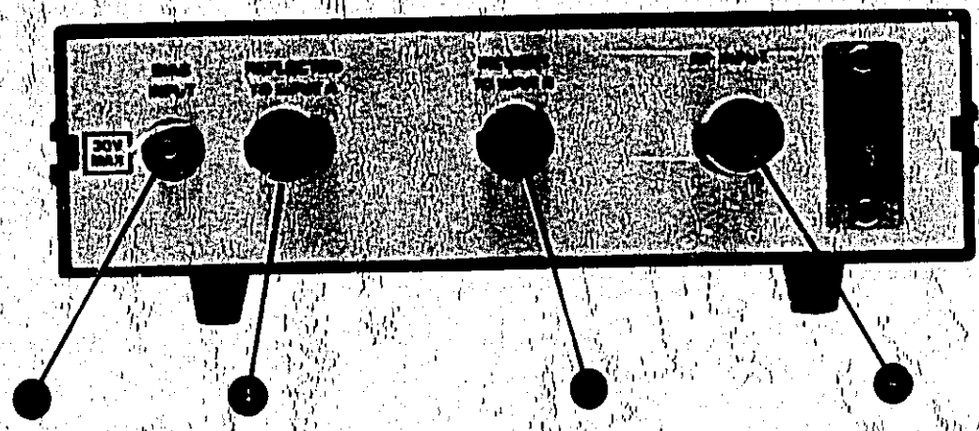
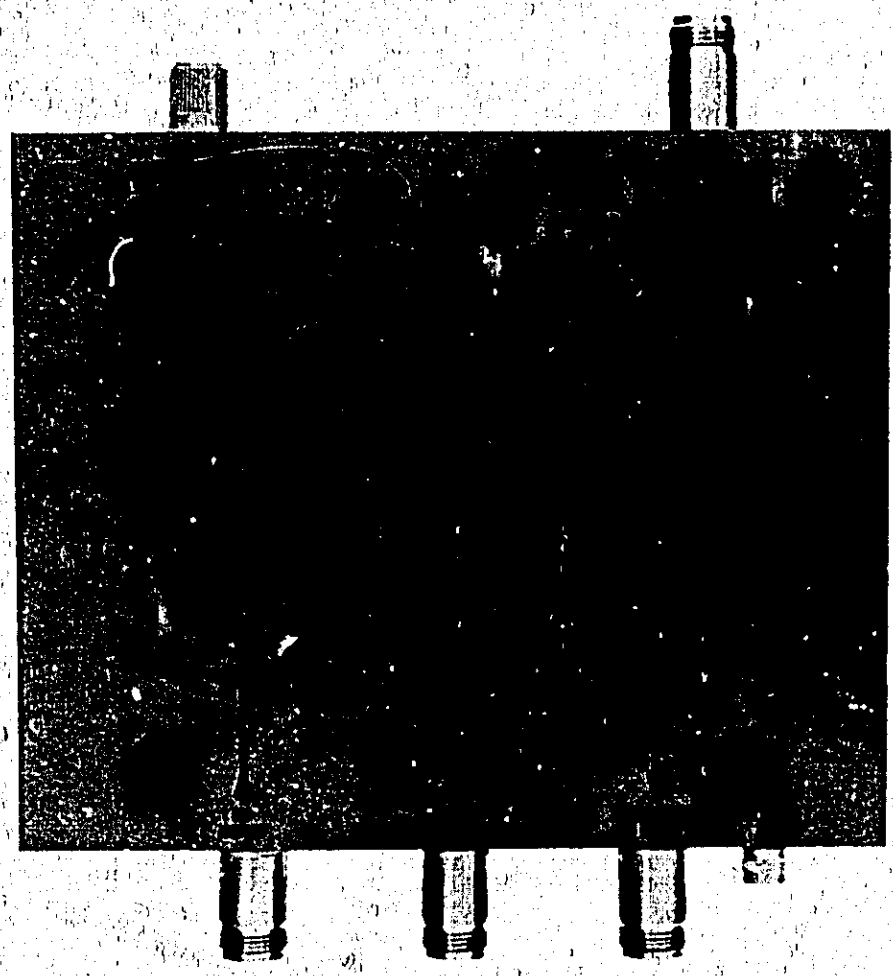


Figure 4. 8502A Front and Rear Panel Controls, Connectors and Case Bottom (1 of 2)

CASE BOTTOM



1. **RF INPUT ATTENUATION dB knob.** Selects attenuation in test signal path.

2. **TEST connector J1.** Provides mainline output signal to unit under test. Reflected signals from unit under test are also routed back through TEST port.

3. **BIAS INPUT connector J2.** Provides means to bias center conductor of TEST port when bias required by unit under test.

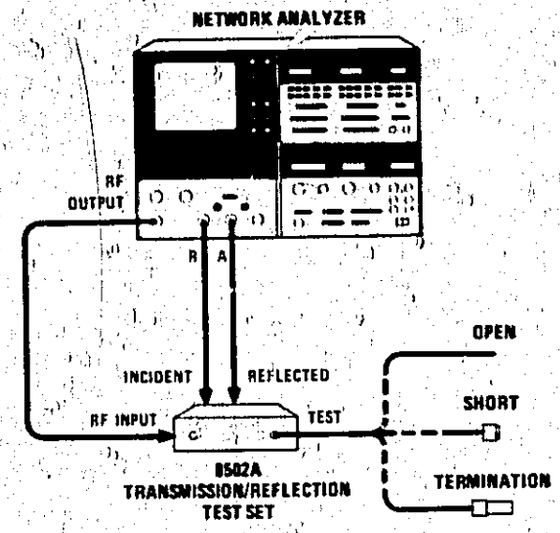
4. **REFLECTED TO INPUT A connector J3.** Output signal from this port is proportional to the signal reflected back into the TEST port by the device under test.

5. **INCIDENT TO INPUT R connector J4.** Output signal from this port is incident with main line signal and provides reference signal for ratio measurements.

6. **RF INPUT connector J5.** Signal source connected to this port.

Figure 4. 8502A Front and Rear Panel Controls, Connectors and Case Bottom (2 of 2)

INCOMING INSPECTION TEST



EQUIPMENT:

Network Analyzer	HP 8505A
Type N Male Short	HP 11512A
50Ω Type N Male Termination with <1.005 SWR*	HP 909A Option 012 and H69

*Part of HP 85032A 50Ω Type N Calibration Kit.

PROCEDURE:

a. Set 8505A controls as follows:

A1 Source/Converter:

OUTPUT LEVEL dBm	−10
OUTPUT LEVEL Vernier	0
INPUT LEVEL MAX	−10

A2 Frequency Control:

RANGE MHz	LIN .5 − 1300
MODE	LIN FULL
WIDTH	START/STOP
SCAN TIME SEC	1 − .1
TRIGGER	AUTO
MARKER Switch	1
MARKER Vernier	Mid-range
FREQUENCY MHz START	0
FREQUENCY MHz STOP	1300

Figure 5. Incoming Inspection Test (1 of 3)

INCOMING INSPECTION TEST

PROCEDURE (Cont'd):

A3 Signal Processor:
Channel 1:
INPUT . . . . . A/R
MODE . . . . . MAG
SCALE/DIV . . . . . 20 dB

Channel 2:
MODE . . . . . OFF

Electrical Length:
MODE . . . . . OFF

b. Set 8502A RF INPUT ATTENUATION control to 0 dB.

c. Connect equipment as shown in test setup with TEST port open.

d. On 8505A CRT display, depress REF LINE POSN pushbutton. Adjust CH 1 control until trace is positioned to center of screen. Press REF LINE POSN pushbutton again to return system to normal operation.

e. Place 8505A Frequency Control MARKER 1 on center graticule.

f. To calibrate the system for directivity measurements, attach short directly to 8502A TEST port. On 8505A Signal Processor Channel 1 press DISPLAY MKR then ZRO pushbuttons to place marker on reference line and to zero digital readout.

NOTE

The termination must be properly seated in the connector with the tightening nut correctly aligned. If the termination is not properly seated, low directivity will be measured, and the measurement will not be repeatable.

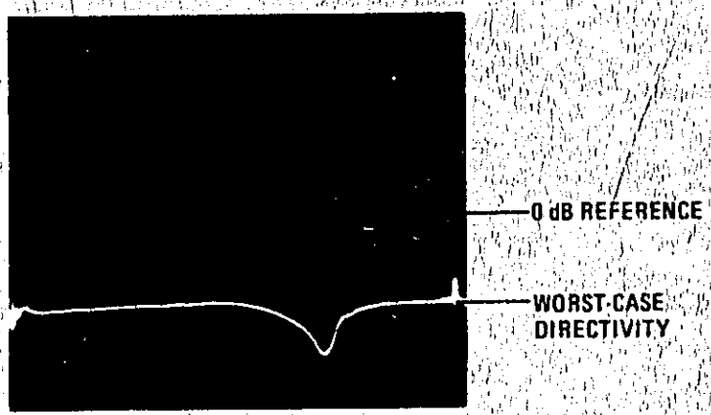
g. To measure the directivity of the 8502A, remove the short and replace it with a 50Ω termination HP 909A, Option 012 and H69. The SWR of the termination must be ≤1.005 (≥52 dB Return Loss).

(1) Move 8505A Frequency Control MARKER 1 control to worst-case directivity as indicated on CRT (the point closest to calibration line as shown in the waveform).

(2) Read worst-case directivity from 8505A Signal Processor Channel 1 digital display. The indication should be ≥40 dB below the 0 dB reference level (−40 dB or below).

Figure 5. Incoming Inspection (2 of 3)

INCOMING INSPECTION TEST



NOTE

If the worst-case directivity appears to be less than 40 dB, then remove the termination. Observe the 8505A digital marker readings with the TEST port open, then shorted. The average value between the digital marker readings (open and shorted) is the true reference at that frequency. Replace the termination. The directivity is the difference between the true reference and the digital reading taken with the termination.

Figure 5. Incoming Inspection Test (3 of 3)

PERFORMANCE CHECK

35. PERFORMANCE TESTS

36. Introduction

37. The procedures in this section test the electrical performance of the instrument using the specifications of Table 1 as the performance standards. All tests can be performed without access to the interior of the instrument. A simpler incoming inspection test is included in Paragraph 33.

38. The performance test procedures should be performed in the sequence given. If a function fails to operate, go to Paragraph 71, Troubleshooting to find which major assembly or cable has failed.

39. Equipment Required

40. Equipment required for the performance tests is listed in the Recommended Test Equipment in Table 3. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model.

41. Test Record

42. Results of the performance tests may be tabulated on the Test Record at the end of the procedures (Table 6). 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 troubleshooting and after repairs.

PERFORMANCE TESTS

NOTE

Allow one hour warm-up time on 8505A Network Analyzer before making the Performance Tests.

43. DIRECTIVITY TEST

SPECIFICATION:

Directivity: ≥40 dB

DESCRIPTION:

Directivity is tested using the internal coupler to measure the reflection coefficient of a standard termination. The termination return loss is much greater than the directivity, therefore the resultant measurement is the approximate coupler directivity.

The Directivity Test has been used for the Incoming Inspection Test. The test setup, equipment and procedures needed to test the directivity specifications are found in Figure 5, Incoming Inspection Test.

44. TRANSMISSION FREQUENCY RESPONSE TEST

SPECIFICATION:

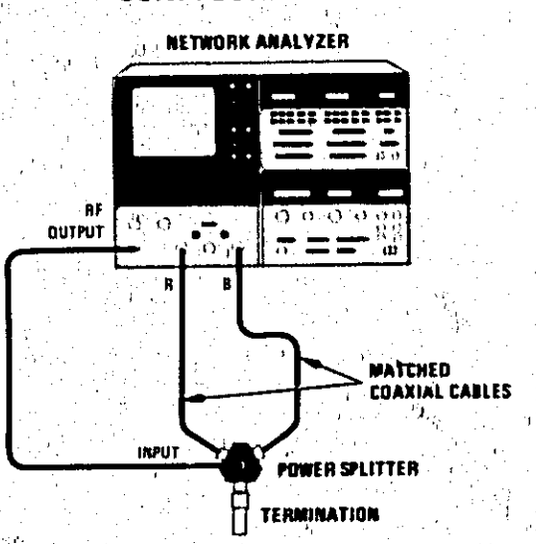
Transmission Frequency Response: ≤±0.8 dB Mag
≤±8° Phase (± degress tested as deviation from linear phase)

44. TRANSMISSION FREQUENCY RESPONSE TEST (Cont'd)

DESCRIPTION:

The frequency response of the 8505A Network Analyzer System is first recorded with a grease pencil on the CRT display. The 8502A is connected and the transmission frequency response is superimposed over the reference grease pencil trace. The difference in the two traces is the transmission frequency response of the 8502A.

CONFIGURATION A



CONFIGURATION B

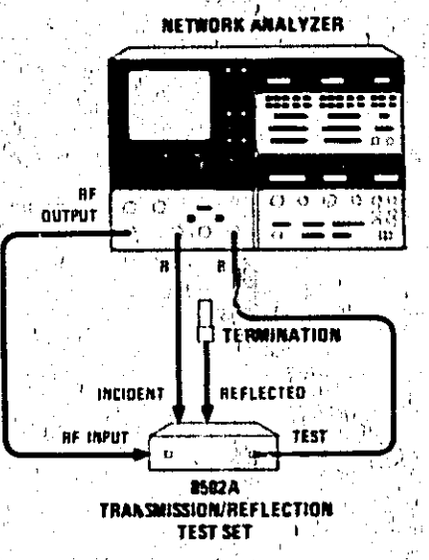


Figure 6. Transmission Frequency Response Test Setup

44. TRANSMISSION FREQUENCY RESPONSE TEST (Cont'd)

EQUIPMENT:

Network Analyzer	HP 8505A
3-Way Power Splitter	HP 11850A
50Ω Type N Male Termination	HP 909A Option 012
Matched Type N Male Coaxial Cable Kit	HP 11851A

PROCEDURE:

a. Set 8505A controls as follows:

A1 Source/Converter:

OUTPUT LEVEL dBm	−10
OUTPUT LEVEL Vernier	0
INPUT LEVEL MAX	−10

A2 Frequency Control:

RANGE MHz	5 – 1300
MODE	LIN FULL
WIDTH	START/STOP 1
SCAN TIME SEC	1 – .1
TRIGGER	AUTO
MARKERS Switch	1
MARKER Vernier	Mid-range
FREQUENCY MHz START	0
FREQUENCY MHz STOP	1300
SCAN TIME SEC Vernier	Mid Position

A3 Signal Processor:

Channel 1:

INPUT	B/R
MODE	MAG
SCALE/DIV	.2 dB

Channel 2:

INPUT	B/R
MODE	PHASE
SCALE/DIV	90 DEG

Electrical Length:

INPUT	B
MODE	X10

Display Section:

BW	10 kHz
Video Filter	OFF

b. Connect equipment as shown in Figure 6, Configuration A.

44. TRANSMISSION FREQUENCY RESPONSE TEST (Cont'd)

c. On 8505A CRT display, depress REF LINE POSN pushbutton. Adjust CH 1 and CH 2 controls until traces are positioned to center of screen. Press REF LINE POSN pushbutton again to return system to normal operation.

d. On 8505A Signal Processor turn Channel 2 MODE switch to OFF.

e. To determine the magnitude frequency response of the Network Analyzer, place 8505A Frequency Control MARKER 1 on center graticule:

(1) On the 8505A Signal Processor Channel 1 press DISPLAY MKR and ZRO pushbuttons to place marker on reference line and to zero digital readout.

(2) Grease pencil the trace on the CRT.

f. To measure the transmission magnitude frequency response of the 8502A connect equipment as shown in Figure 6, Configuration B.

(1) Set 8502A RF INPUT ATTENUATION control to zero dB.

(2) On 8505A Signal Processor Channel 1 press REF OFFSET pushbuttons to center the display around the grease pencil magnitude trace.

(3) Measure the maximum difference between the grease pencil trace and the display trace (Figure 7). This measured value should be ≤0.8 dB.

g. To determine the phase frequency response of the Network Analyzer connect equipment as shown in Figure 6, Configuration A:

(1) Remove CRT grease pencil traces from previous test.

(2) Turn 8505A Signal Processor Channel 1 MODE switch to OFF and Channel 2 MODE switch to PHASE.

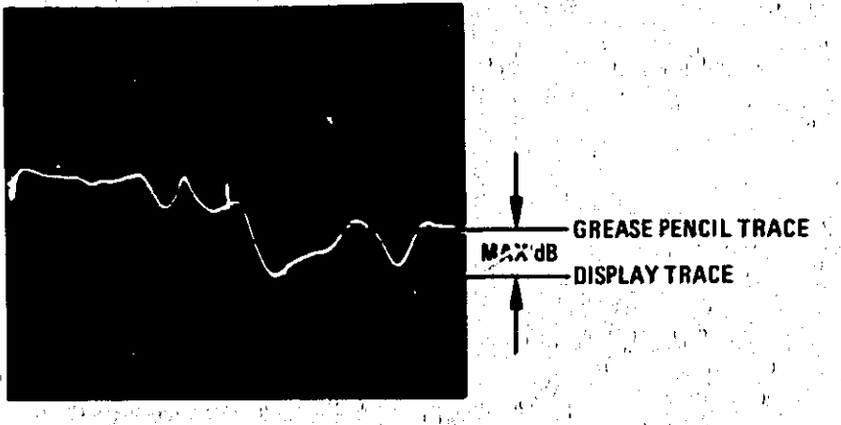


Figure 7. Transmission Frequency Response Magnitude

44. TRANSMISSION FREQUENCY RESPONSE TEST (Cont'd)

(3) On the 8505A Signal Processor Electrical Length, press the LENGTH pushbuttons and adjust VERNIER B control to display a horizontal trace on the CRT.

(4) Set 8505A Signal Processor Channel 2 SCALE/DIV switch to 2 DEG.

(5) On the 8505A Signal Processor Channel 2 press DISPLAY MKR and ZRO pushbuttons to place marker on reference line and to zero digital readout.

(6) Grease pencil the trace on the CRT.

h. To measure the transmission phase frequency response of the 8502A connect equipment as shown in Figure 6, Configuration B.

(1) Set 8505A Signal Processor Channel 2 SCALE/DIV switch to 90 DEG.

(2) On 8505A Signal Processor Electrical Length press the LENGTH pushbuttons and adjust VERNIER B control to display a horizontal trace on the CRT.

(3) Set 8505A Signal Processor Channel 2 SCALE/DIV switch to 2 DEG and repeat step h (2).

(4) On 8505A Signal Processor Channel 2 press MKR and ZRO pushbuttons.

(5) On 8505A Signal Processor Channel 2 press the REF OFFSET pushbuttons to center the display around the grease pencil phase trace.

(6) Measure the maximum difference between the grease pencil trace and the display trace (Figure 8). This measured value should be $<8°$.

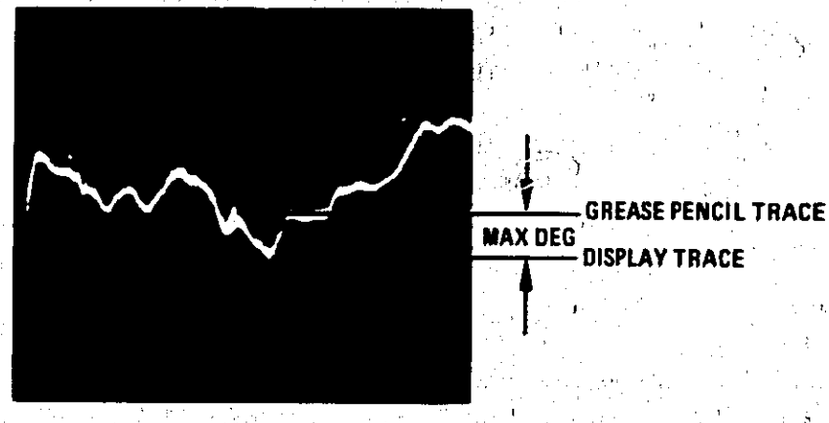


Figure 8. Transmission Frequency Response Phase

45. REFLECTION FREQUENCY RESPONSE TEST

SPECIFICATION:

<±1.5 dB Mag from 0.5 to 1300 MHz
<±15° Phase from 0.5 to 1300 MHz
<±10° Phase from 2 to 1300 MHz

DESCRIPTION:

The reflection frequency response of the 8505A Network Analyzer system is first recorded with a grease pencil on the CRT display. The 8502A is connected and the reflection frequency response is superimposed over the reference grease pencil trace. The difference in the two traces is the reflection frequency response of the 8502A.

CONFIGURATION A

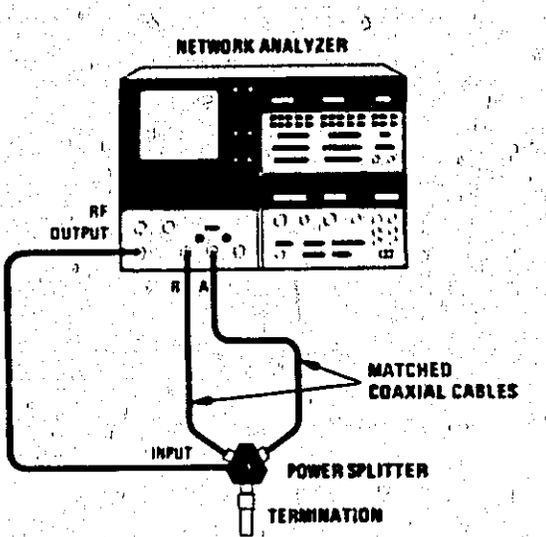


Figure 9. Reflection Frequency Response Test Setup (1 of 2)

45. REFLECTION FREQUENCY RESPONSE TEST (Cont'd)

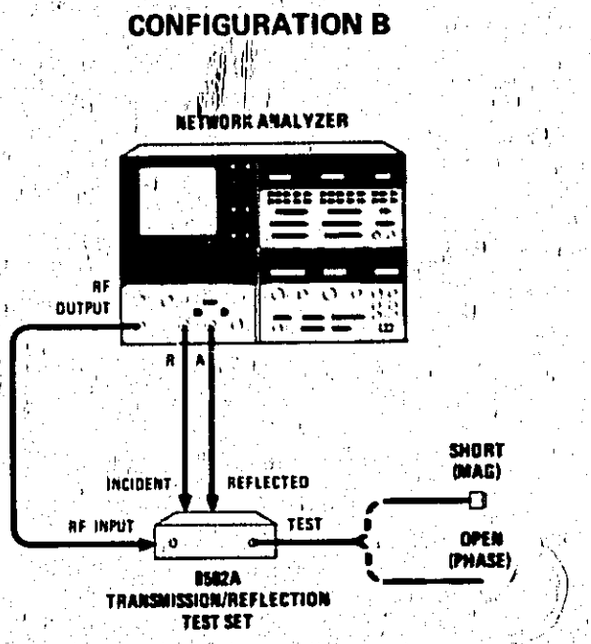


Figure 9. Reflection Frequency Response Test Setup (2 of 2)

EQUIPMENT:

Network Analyzer	HP 8505A
3-Way Power Splitter	HP 11850A
50Ω Type N Male Termination	HP 909A Option 012
Matched Type N Male Coaxial Cable Kit	HP 11851A
Type N Male Short	HP 11512A

PROCEDURE:

a. Set 8505A controls as follows:

A1 Source/Converter:

OUTPUT LEVEL dBm	−10
OUTPUT LEVEL Vernier	0
INPUT LEVEL MAX	−10

45. REFLECTION FREQUENCY RESPONSE TEST (Cont'd)

A2 Frequency Control:
- RANGE MHz ..... .5 – 1300
- MODE ..... LIN FULL
- WIDTH ..... START/STOP 1
- SCAN TIME SEC ..... .1 – .01
- TRIGGER ..... AUTO
- MARKERS Switch 1
- MARKER Vernier ..... Mid-range
- FREQUENCY MHz START 0
- FREQUENCY MHz STOP 1300

A3 Signal Processor:

Channel 1:
- INPUT ..... A/R
- MODE ..... MAG
- SCALE/DIV ..... .5 dB

Channel 2:
- INPUT ..... A/R
- MODE ..... PHASE
- SCALE/DIV ..... 90 DEG

Electrical Length:
- INPUT ..... A
- MODE X1

b. Connect equipment as shown in Figure 9, Configuration A.

c. On 8505A CRT display, depress REF LINE POSN pushbutton. Adjust CH 1 and CH 2 controls until traces are positioned to center of screen. Press REF LINE POSN pushbutton again to return system to normal operation.

d. On 8505A Signal Processor turn Channel 2 MODE switch to OFF.

e. To determine the magnitude frequency response of the Network Analyzer move 8505A Frequency Control MARKER 1 to center graticule:

(1) On the 8505A Signal Processor Channel 1 press DISPLAY MKR and ZRO pushbuttons to place marker on reference line and to zero digital readout.

(2) Grease pencil the trace on the CRT.

f. To measure the reflection magnitude frequency response of the 8502A connect equipment as shown in Figure 9, Configuration B with TEST port shorted.

(1) Set 8502A RF INPUT ATTENUATION control to 0 dB.

(2) On 8505A Signal Processor Channel 1 press REF OFFSET pushbuttons to center the display around the grease pencil magnitude trace.

45. REFLECTION FREQUENCY RESPONSE TEST (Cont'd)

(3) Measure the maximum difference between the grease pencil trace and the display trace (Figure 10). This measured value should be ≤1.5 dB for the entire 0.5 to 1300 MHz frequency range.

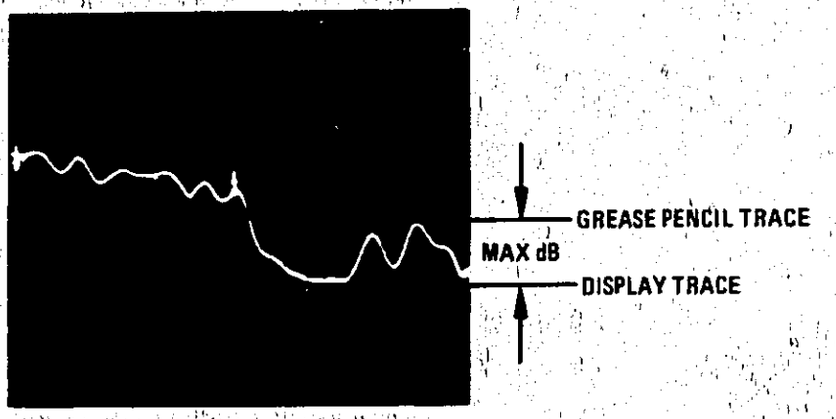


Figure 10. Reflection Frequency Response Magnitude

g. To determine the phase frequency response of the Network Analyzer for the full 0.5 to 1300 MHz frequency range connect equipment as shown in Figure 9, Configuration A:

(1) Remove CRT grease pencil trace from previous test.

(2) Turn 8505A Signal Processor Channel 1 MODE switch to OFF and Channel 2 MODE switch to PHASE.

(3) On the 8505A Signal Processor Electrical Length, press the LENGTH pushbuttons and adjust VERNIER A control to display a horizontal trace on the CRT.

(4) Set 8505A Signal Processor Channel 2 SCALE/DIV switch to 5 DEG and repeat step g (3).

(5) On the 8505A Signal Processor Channel 2 press DISPLAY MKR and ZRO pushbuttons to place marker on reference line and to zero digital readout.

(6) Grease pencil the trace on the CRT.

h. To measure the reflection phase frequency response of the 8502A connect equipment as shown in Figure 9, Configuration B with TEST port open.

(1) Set 8505A Signal Processor Channel 2 SCALE/DIV switch to 90 DEG.

(2) On 8505A Signal Processor ELECTRICAL LENGTH press the LENGTH pushbuttons and adjust VERNIER A control to display a horizontal trace on the CRT.

(3) Set 8505A Signal Processor Channel 2 SCALE/DIV switch to 5 DEG and repeat step h (2).

(4) On 8505A Signal Processor Channel 2 press MKR and ZRO pushbuttons.

45. REFLECTION FREQUENCY RESPONSE TEST (Cont'd)

(5) On 8505A Signal Processsor Channel 2 press the REF OFFSET pushbuttons to center the display around the grease pencil phase trace.

(6) Measure the maximum difference between the grease pencil trace and the display trace (Figure 11). This measured value should be $<15°$ for the entire 0.5 to 1300 MHz frequency range.

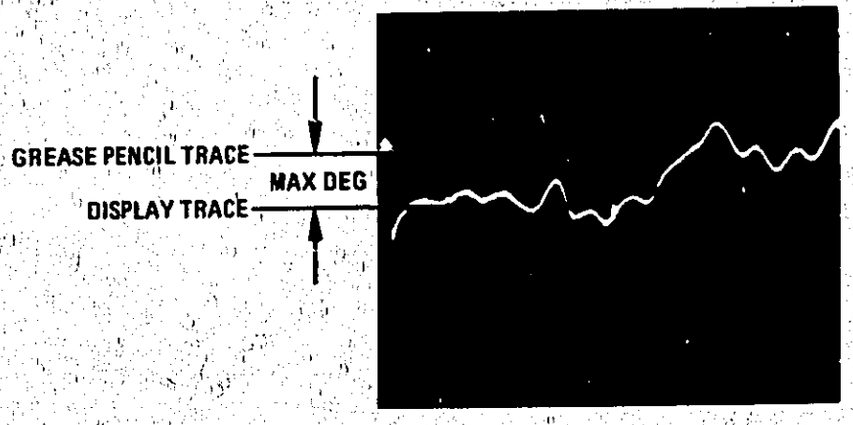


Figure 11. Reflection Frequency Response Phase

i. To determine the phase frequency response of the Network Analyzer for the 2 to 1300 MHz frequency range, connect equipment as shown in Figure 9, Configuration A:

(1) Remove CRT grease pencil trace from previous test.

(2) On 8505A Frequency Control set MODE switch to LIN EXPAND.

(3) Set 8505A Frequency Control FREQUENCY MHz START control to 2 and FREQUENCY MHz STOP control to 1300.

(4) Set 8505A Signal Processor Channel 2 SCALE/DIV switch to 90 DEG.

(5) Repeat steps g (3) through g (6).

j. To measure the reflection phase frequency response of the 8502A connect equipment as shown in Figure 9, Configuration B with TEST port open.

(1) Repeat steps h (1) through h (5).

(2) Measure the maximum difference between the grease pencil trace and the display trace (Figure 11). This measured value should be $<10°$ for the 2 to 1300 MHz frequency range.

(3) Remove grease pencil trace from CRT.

46. TEST PORT OPEN/SHORT RATIO TEST

SPECIFICATION:

Test Port Open/Short Ratio:

≤±0.9 dB Mag and ≤±7.5° Phase from 1000 to 1300 MHz
≤±0.75 dB Mag and ≤±6° Phase from 2 to 1000 MHz
≤±1.25 dB Mag and ≤±10° Phase from 0.5 to 2 MHz

DESCRIPTION:

Magnitude open/short ratio and Phase open/short ratio for frequencies above 2 MHz are measured using the reflections generated by a short through a 6-ft. coaxial cable which is connected to the 8502A TEST port. Peak-to-peak readings are taken from the CRT trace to determine the actual open/short ratio while the effect of the return loss of the cable used is accounted for. To compensate for the added line length on the 8502A TEST port, a 12-ft. coaxial cable is connected from the 8502A INCIDENT port to the 8505A R Channel. For frequencies below 2 MHz, the TEST port is directly shorted, then opened, and this ratio is read directly from the CRT trace.

CONFIGURATION A
(Frequency Range: 2 – 1300 MHz)

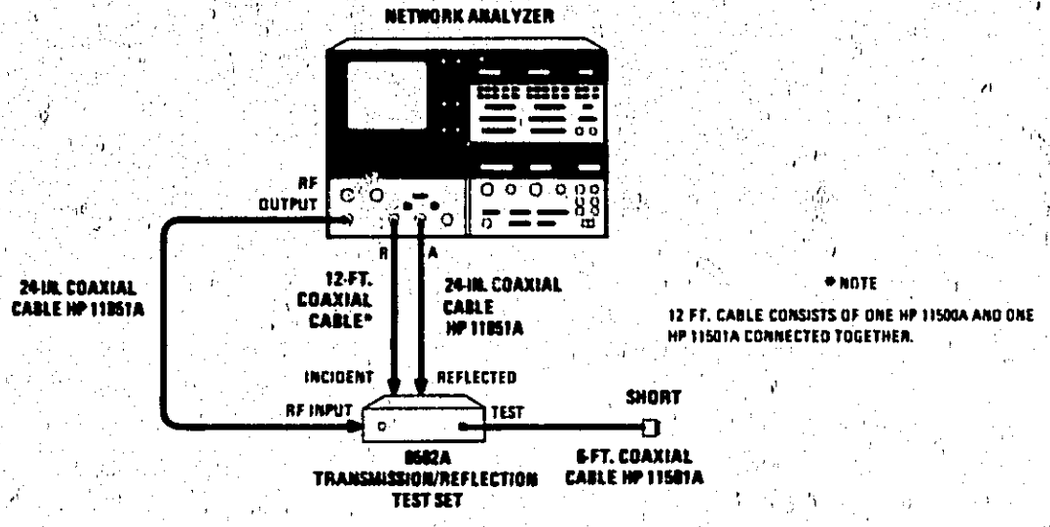


Figure 12. TEST Port Open/Short Ratio Test (1 of 2)

46. TEST PORT OPEN/SHORT RATIO TEST (Cont'd)

CONFIGURATION B
(Frequency Range: 0.5 – 2 MHz)

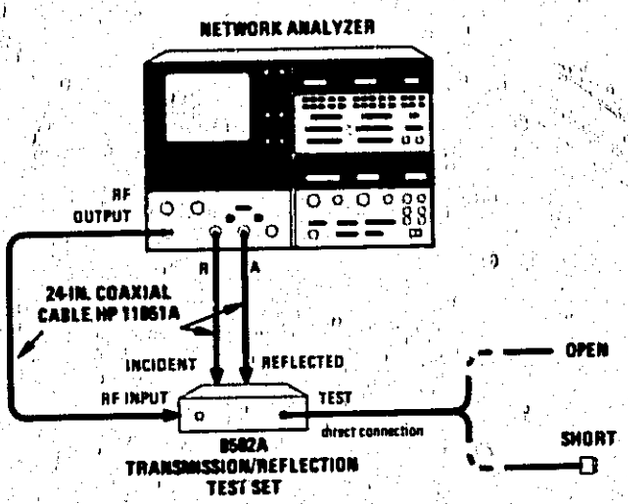


Figure 12. TEST Port Open/Short Ratio Test (2 of 2)

EQUIPMENT:

Network Analyzer	HP 8505A
Type N Male Short	HP 11512A
6-Ft. Coaxial Cable, Type RG-214, with Type N Male Connector on One End and Type N Female Connector on the Other end (2 required)	HP 11501A
6-Ft. Coaxial Cable, Type RG-214, with Type N Male Connectors on Each End	HP 11500A
24-In. 50Ω Matched Coaxial Cable with Type N Male Connectors on Each End (3 required)	HP 11851A

PROCEDURE:

a. Set 8505A controls as follows:

A1 Source/Converter:

OUTPUT LEVEL dBm	−10
OUTPUT LEVEL Vernier	0
INPUT LEVEL MAX	−10

46. TEST PORT OPEN/SHORT RATIO TEST (Cont'd)

A2 Frequency Control:
- RANGE MHz ..... .5 — 1300 MHz
- MODE ..... LIN EXPAND
- WIDTH ..... START/STOP 1
- SCAN TIME SEC ..... 1 — .1
- TRIGGER ..... AUTO
- FREQUENCY MHz START 1000
- FREQUENCY MHz STOP 1300
- MARKER Vernier ..... Clockwise

A3 Signal Processor:

Channel 1:
- INPUT ..... A/R
- MODE ..... MAG
- SCALE/DIV ..... .5 dB

Channel 2:
- INPUT ..... A/R
- MODE ..... PHASE
- SCALE/DIV ..... 5 DEG

Electrical Length:
- INPUT ..... A
- MODE X10

b. Set 8502A RF INPUT ATTENUATION control to 20 dB.

c. Connect equipment as shown in Figure 12, Configuration A.

d. On 8505A CRT display, depress REF LINE POSN pushbutton. Adjust CH 1 and CH 2 controls until traces are positioned to center of screen. Press REF LINE POSN pushbutton again to return system to normal operation.

e. On 8505A Signal Processor turn Channel 2 MODE switch to OFF.

f. To measure the TEST port open/short magnitude ratio between 1000 and 1300 MHz move 8505A Frequency Control MARKER 1 to center graticule.

(1) On the 8505A Signal Processor Channel 1 press DISPLAY MKR and ZRO pushbuttons to place marker on reference line and to zero digital readout.

46. TEST PORT OPEN/SHORT RATIO TEST (Cont'd)

(2) Measure the maximum peak-to-peak variation on the display (Figure 13) and record the results:

Magnitude: 1000 to 1300 MHz =_____dB

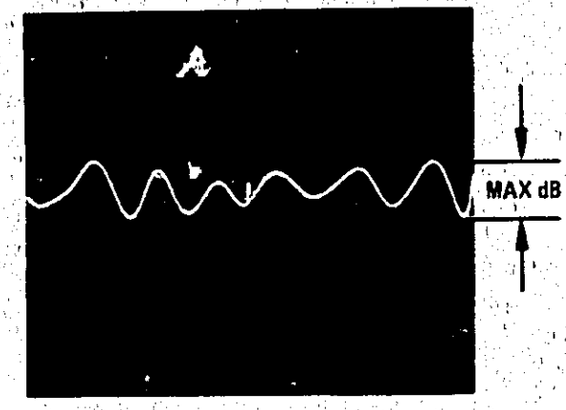


Figure 13. TEST Port Open/Short Ratio Magnitude >2 MHz

NOTE

If a peak-to-peak measurement is made in an area where there is some slope, a corrected reading can be obtained by connecting two adjacent upper peaks with a dotted line. Extend a vertical line up from the lower peak until it intersects the dotted line. This constructed vertical line is the averaged or corrected peak-to-peak measurement to be used (Figure 14). Avoid making peak-to-peak measurements at extreme slope changes.

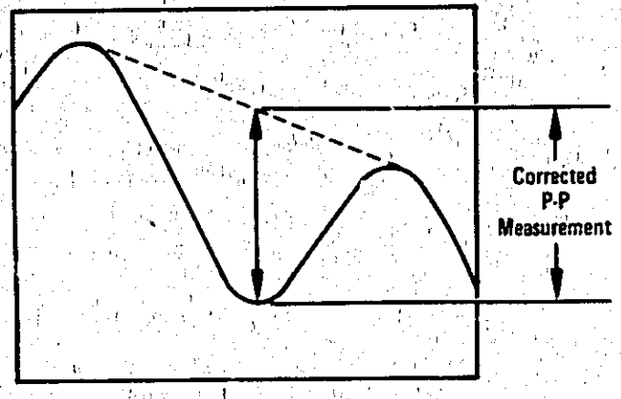


Figure 14. Slope Peak-To-Peak Measurement

46. TEST PORT OPEN/SHORT RATIO TEST (Cont'd)

g. Calculate the actual maximum open/short magnitude ratio for the 1000 to 1300 MHz frequency range by dividing the measured value (recorded previously) by the reflection coefficient of the test cable used (Table 5, Column 1000 MHz), or:

$$\frac{\text{MEASURED VALUE dB}}{\text{REFLECTION COEFFICIENT OF TEST CABLE}} = \text{ACTUAL OPEN/SHORT RATIO MAGNITUDE}$$

The actual open/short ratio magnitude for 1000 to 1300 MHz should be ≤1.8 dB (≤±.9 dB).

Table 5. Loss of Typical Coaxial Cable Used for 6-Ft. "Test" Cable

Cable Type	600 MHz	1000 MHz
	ρ for 12-Ft. (out & back)	ρ for 12 Ft. (out & back)
RG-214/u	0.91	0.88
RG-58/u	0.91	0.88
RF-218/u	0.96	0.95

h. To measure the TEST port open/short phase ratio between 1000 and 1300 MHz:

(1) Set 8505A Signal Processor Channel 1 MODE switch to OFF and Channel 2 MODE switch to PHASE.

(2) On 8505A Signal Processor Channel 2 press DISPLAY MKR and ZRO pushbuttons to place marker on reference line and to zero digital readout.

(3) On 8505A Signal Processor ELECTRICAL LENGTH, press the LENGTH pushbuttons and adjust VERNIER A control to display a horizontal trace on the CRT. If necessary you can change 8505A Signal Processor Channel 2 SCALE/DIV switch to a lower sensitivity to position trace to a horizontal position, then return it to PHASE 5 DEG setting before going on with test.

(4) On 8505A Signal Processor Channel 2, press REF OFFSET pushbuttons to move trace to a readable position on the CRT.

46. TEST PORT OPEN/SHORT RATIO TEST (Cont'd)

(5) Measure the maximum peak-to-peak variation on the display (Figure 15) and record the results (See Figure 14):

PHASE: 1000 to 1300 MHz = _____ DEG

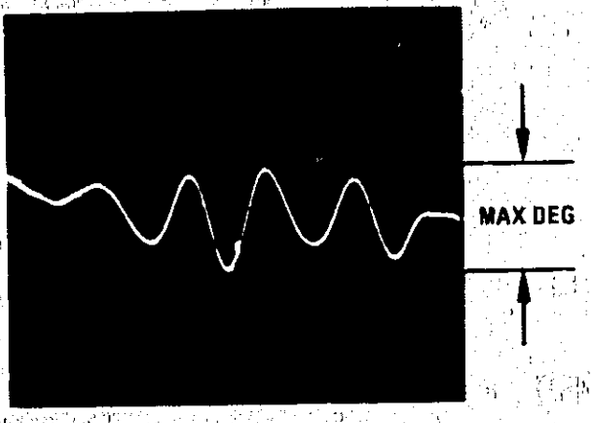


Figure 15. TEST Port Open/Short Ratio Phase >2 MHz

i. Calculate the actual maximum open/short ratio phase for the 1000 to 1300 MHz frequency range by dividing the measured value (recorded above) by the reflection coefficient of the test cable used (Table 5, Column 1000 MHz), or:

$$\frac{\text{MEASURED VALUE DEG}}{\text{REFLECTION COEFFICIENT OF TEST CABLE}} = \text{ACTUAL OPEN/SHORT RATIO PHASE}$$

The actual open/short ratio phase for 1000 to 1300 MHz should be ≤15° (≤7.5°).

j. To measure the TEST port open/short magnitude ratio between 2 and 1000 MHz:

(1) Set 8505A Frequency Control FREQUENCY MHz START control to 2 and FREQUENCY MHz STOP control to 1000.

(2) Set 8505A Signal Processor Channel 2 MODE switch to OFF and Channel 1 MODE switch to MAG.

(3) Repeat step f except that the measured value for the frequency range 2 to 1000 MHz = _____dB.

(4) To calculate the actual open/short magnitude for the 2 to 1000 MHz frequency range, repeat step g except use the 600 MHz column in Table 5 to find the reflection coefficient of the test cable used. The actual open/short ratio magnitude for 2 to 1000 MHz should be ≤1.5 dB (≤±.75 dB).

46. TEST PORT OPEN/SHORT RATIO (Cont'd)

k. To measure the TEST port open/short ratio phase between 2 and 1000 MHz:

(1) Repeat step h except that the measured value for the frequency range 2 to 1000 MHz = _____ dB.

(2) To calculate the actual open/short ratio phase for 2 to 1000 MHz frequency range, repeat step i except use the 600 MHz column in Table 5 to find the reflection coefficient of the test cable used. The actual open/short ratio phase for 2 to 1000 MHz should be ≤12° (≤±6°).

l. To measure magnitude and phase open/short ratios below 2 MHz connect equipment as shown in Figure 12, Configuration B with TEST port open.

(1) Set 8505A Frequency Control RANGE MHz switch to .5 — 13.

(2) Set 8505A Frequency Control FREQUENCY MHz START control to 00.50 and FREQUENCY MHz STOP control to 02.00.

(3) Set 8505A Signal Processor Channel 2 MODE switch to PHASE.

(4) On 8505A CRT display, depress REF LINE POSN pushbutton. Adjust CH 1 and CH 2 controls until traces are positioned to center of screen. Press REF LINE POSN pushbutton again to return system to normal operation.

(5) On 8505A Signal Processor Channel 1 and Channel 2 press MKR then ZRO pushbuttons to bring trace to on-screen position.

(6) On 8505A Frequency Control set Frequency Counter MHz MARKER 1 to beginning of sweep on CRT.

(7) On 8505A Signal Processor Channel 1 and Channel 2 press MKR then ZRO pushbuttons to place marker on reference line and to zero digital readout.

(8) Set 8505A Signal Processor Channel 2 MODE switch to OFF.

m. To measure the TEST port open/short ratio magnitude between 0.5 and 2 MHz:

(1) Attach short directly to TEST port.

(2) 8505A Signal Processor Channel 1 MKR digital display should indicate ≤2.50 dB (≤±1.25 dB).

n. To measure the TEST port open/short ratio phase between 0.5 and 2 MHz:

(1) Remove the short from the 8502A TEST port.

(2) Set 8505A Signal Processor Channel 1 MODE switch to OFF and Channel 2 MODE switch to PHASE.

46. TEST PORT OPEN/SHORT RATIO TEST (Cont'd)

(3) On 8505A Signal Processor Electrical Length, press the LENGTH pushbuttons and adjust VERNIER A control to display a horizontal trace on the CRT. If necessary, change 8505A Signal Processor Channel 2 SCALE/DIV switch to a lower sensitivity to position trace to a horizontal position, then return it to PHASE 5 DEG setting before going on with test.

(4) On 8505A Signal Processor Channel 2 press MKR then ZRO then DISPLAY REF pushbuttons.

(5) On 8505A Signal Processor Channel 2 press REF OFFSET pushbuttons to indicate +180 DEG on digital display.

(6) On 8505A Signal Processor Channel 2 press DISPLAY MKR pushbutton.

(7) Attach short directly to 8502A TEST port.

(8) Digital display should indicate $\leq 20°$ ($\leq \pm 10°$).

47. TEST PORT RETURN LOSS TEST

SPECIFICATION:

TEST port return loss: $\geq$26 dB from 2 to 1300 MHz
$\geq$20 dB from 0.5 to 2 MHz

DESCRIPTION:

Perform the Directivity (Incoming Inspection Test, Figure 5) and the Open/Short Ratio (Paragraph 46) Tests. These two tests confirm that the TEST port Return Loss of the 8502A is within specification. If a more direct and accurate test is required for the TEST port Return Loss specification, refer to the 8507A Accuracy Enhancement Program (AIM) procedure for the method of making an error-corrected return loss measurement. An 8542B Automatic Network Analyzer may also be used to make this measurement between 100 and 1300 MHz.

48. PORT RETURN LOSS TESTS

SPECIFICATIONS:

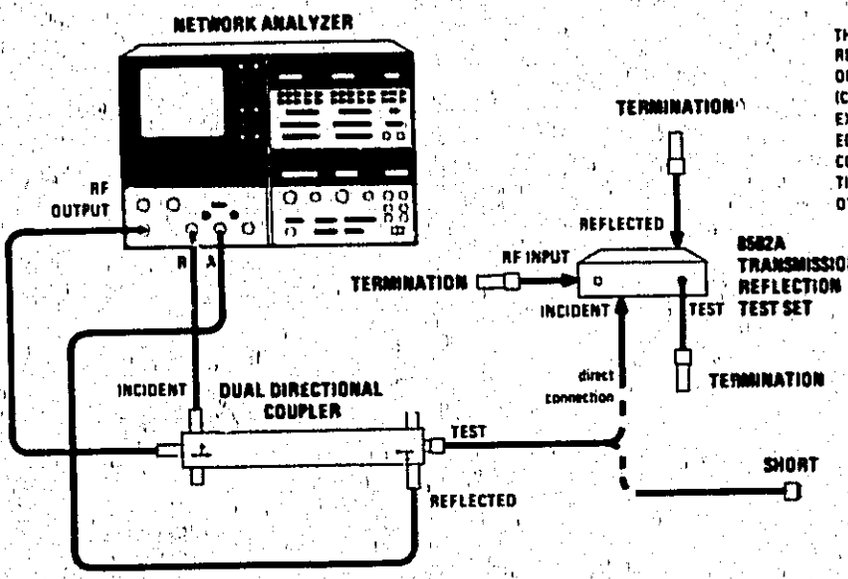
INCIDENT Port Return Loss:	≥ 23 dB from 1000 — 1300 MHz ≥ 25 dB from 100 — 1000 MHz ≥ 25 dB from 2 — 100 MHz ≥ 23 dB from 0.5 — 2 MHz
REFLECTED Port Return Loss:	≥ 23 dB from 1000 — 1300 MHz ≥ 25 dB from 100 — 1000 MHz ≥ 25 dB from 2 — 100 MHz ≥ 23 dB from 0.5 — 2 MHz
RF INPUT Port Return Loss:	≥ 23 dB from 100 — 1300 MHz ≥ 23 dB from 0.5 — 100 MHz

DESCRIPTION:

The system is calibrated by shorting or opening the main line TEST port of the Directional Coupler to establish a 0 dB reference line on the CRT display. The INCIDENT, REFLECTED or RF INPUT port of the 8502A is then connected in place of the short to the Dual Directional Coupler or Directional Bridge with all other ports terminated in 50 ohms. The Return Loss is measured directly with the 8505A MARKER digital display and the CRT trace. When using this method to measure Return Loss, ambiguity due to "imperfect" directivity of the directional device is introduced. The ambiguity of the measurement may be as great as ±2 dB. If a more direct and accurate test is required to the port Return Loss specifications, refer to the 8507A Accuracy Enhancement Program (AIM) procedure for the method of making an error-corrected Return Loss measurement.

48. PORT RETURN LOSS TESTS (Cont'd)

CONFIGURATION A
(Frequency Range: 100 – 1300 MHz)



NOTE

THE TEST SETUP SHOWN IS FOR INCIDENT PORT RETURN LOSS MEASUREMENTS. FOR REFLECTED OR RF INPUT PORT MEASUREMENTS THE SETUPS (CONFIGURATIONS A AND B) ARE IDENTICAL EXCEPT THAT THE PORT TO BE MEASURED IS DIRECTLY CONNECTED TO THE DUAL DIRECTIONAL COUPLER (CONFIGURATION A) OR THE DIRECTIONAL BRIDGE (CONFIGURATION B) WITH ALL OTHER PORTS TERMINATED IN 50 OHMS.

CONFIGURATION B
(Frequency Range: 0.5 – 100 MHz)

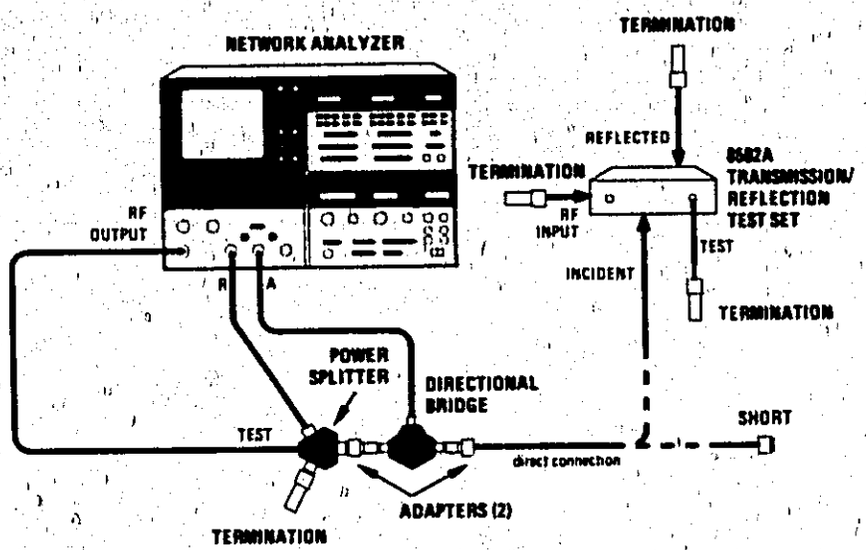


Figure 16. INCIDENT, REFLECTED, and RF INPUT Port Return Loss Test Setups

48. PORT RETURN LOSS TESTS (Cont'd)

EQUIPMENT:

Network Analyzer	HP 8505A
Dual Directional Coupler	HP 778D
Directional Bridge*	HP 8721A
3-Way Power Splitter	HP 11850A
Type N Female Short	HP 11511A
50Ω Type N Male Termination (4 required)	HP 909A Option 012
Type N Male to BNC Male Adapter (2 required)	HP 1250-1473*

*Part of HP 11652A Transmission/Reflection Kit.
**Part of HP 11854A 50Ω BNC Accessory Kit.

PROCEDURE:

a. Set 8505A controls as follows:

A1 Source/Converter

OUTPUT LEVEL dBm	−10
OUTPUT LEVEL Vernier	0
INPUT LEVEL MAX	−10

A2 Frequency Control

RANGE MHz	0.5 − 1300 MHz
MODE	LIN EXPAND
WIDTH	START/STOP 1
SCAN TIME SEC	.1 − .01
VERNIER	Counterclockwise
TRIGGER	AUTO
MARKERS Switch	1
FREQUENCY MHz START	100
FREQUENCY MHz STOP	1300
MARKER 1	1000

A3 Signal Processor:

Channel 1:

INPUT	A/R
MODE	MAG
SCALE/DIV	20 dB

Channel 2:

MODE	OFF

Electrical Length:

MODE	OFF

b. Set 8502A RF INPUT ATTENUATION control to 20 dB.

c. For INCIDENT port return loss measurements connect equipment as shown in Figure 16, Configuration A with no connection to mainline TEST port of Directional Coupler.

48. PORT RETURN LOSS TESTS (Cont'd)

d. On 8505A display, depress REF LINE POSN pushbutton. Adjust CH 1 control until trace is positioned to center of screen. Press REF LINE POSN pushbutton again to return system to normal operation.

e. Set 8505A Frequency Control MARKERS switch to 2.

f. Place 8505A Frequency Control MARKER 2 on center graticule.

g. To calibrate the system for Return Loss measurement, attach short directly to Dual Directional Coupler mainline TEST port. On 8505A Signal Processor Channel 1, press DISPLAY MKR then ZRO pushbuttons to place MARKER 2 on reference line and to zero digital readout.

h. To measure the INCIDENT port return loss for the frequency range 1000 to 1300 MHz:

(1) Remove short and connect Dual Directional Coupler directly to 8502A INCIDENT port with RF INPUT, REFLECTED, and TEST ports terminated.

(2) Move 8505A Frequency Control MARKER 2 control to worst-case, Return Loss between 1000 and 1300 MHz as indicated on CRT. (This is the point closest to calibration line right of 1000 MHz MARKER 1 as shown in Figure 17.)

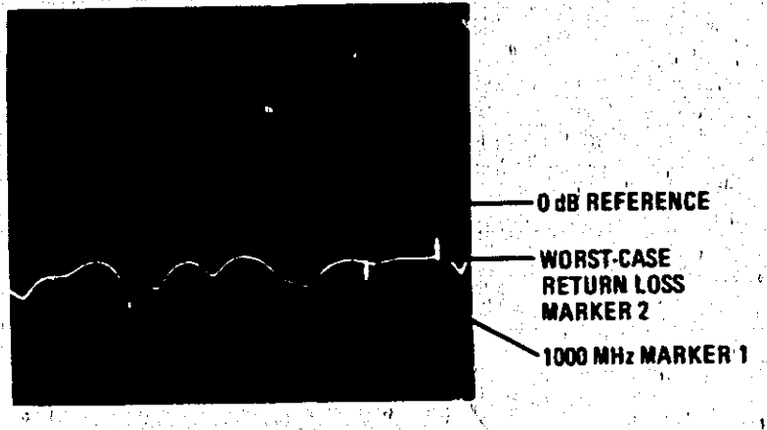


Figure 17. INCIDENT Port Return Loss (1000 to 1300 MHz)

(3) Read worst-case Return Loss from 8505A Signal Processor Channel 1 digital display. The indication should be >23 dB below the zero dB reference level for the frequency range 1000 to 1300 MHz.

i. To measure the INCIDENT port Return Loss for the frequency range 100 to 1000 MHz:

(1) Move 8505A Frequency Control MARKER 2 control to worst-case Return Loss between 100 and 1000 MHz as indicated on CRT. (The point closest to calibration line to left of 1000 MHz MARKER as shown in Figure 18.)

48. PORT RETURN LOSS TESTS (Cont'd)

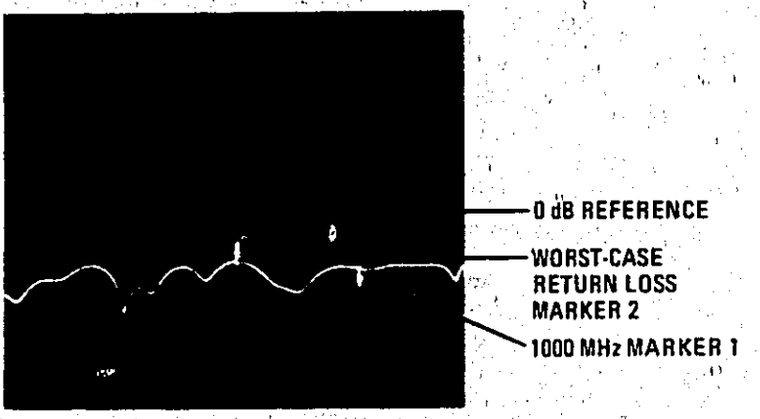


Figure 18. INCIDENT Port Return Loss (100 to 1000 MHz)

(2) Read worst-case Return Loss from 8505A Signal Processor Channel 1 digital display. The indications should be ≥25 dB below the zero dB reference level for the frequency range 100 to 1000 MHz.

j. To determine the INCIDENT port Return Loss for the frequency range 2 to 1000 MHz connect equipment as shown in Figure 16, Configuration B with LOAD port on Directional Bridge shorted. Set 8505A Frequency Control RANGE MHz switch to .5 — 130. Adjust FREQUENCY MHz START control to 002.0 and FREQUENCY MHz STOP control to 100.0.

k. To calibrate the system for Return Loss measurements:

(1) On 8505A CRT display, push REF LINE POSN pushbutton and adjust CH1 control until trace is positioned to center of screen. Press REF LINE POSN pushbutton again to return system to normal operation.

(2) Set 8505A Frequency Control MARKERS switch to 1 and adjust MARKER 1 control to center graticule.

(3) On 8505A Signal Processor Channel 1 press DISPLAY MKR and ZRO pushbuttons to place MARKER 1 on reference line and to zero digital readout.

l. To measure the INCIDENT port Return Loss for 2 to 100 MHz:

(1) Connect 8502A INCIDENT port directly to Directional Bridge LOAD Port with TEST, RF INPUT, and REFLECTED ports terminated.

(2) Move 8505A Frequency Control MARKER 1 control to worst-case Return Loss between 2 and 100 MHz as indicated on CRT. (This is the point closest to calibration line as shown in Figure 19.)

48. PORT RETURN LOSS TESTS (Cont'd)

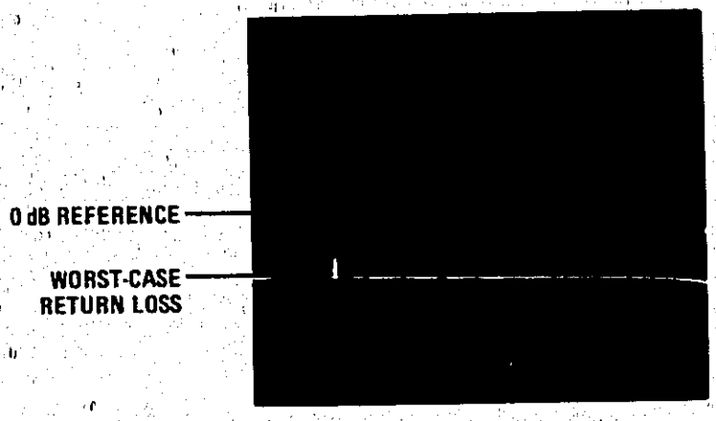


Figure 19. INCIDENT Port Return Loss (2 to 100 MHz)

(3) Read worst-case Return Loss from 8505A Signal Processor Channel 1 digital display. The indications should be ≥25 dB below the zero dB reference level for the frequency range 2 – 100 MHz.

m. To determine INCIDENT port Return Loss for the frequency range 0.5 to 2 MHz:

(1) Set 8505A Frequency Control RANGE MHz switch to .5 to 13. Adjust FREQUENCY START control to 00.50 and FREQUENCY STOP control to 02.00.

(2) Repeat steps k through l except that the indication should be ≥23 dB below the zero dB reference level for the frequency range .5 to 2 MHz (Figure 20).

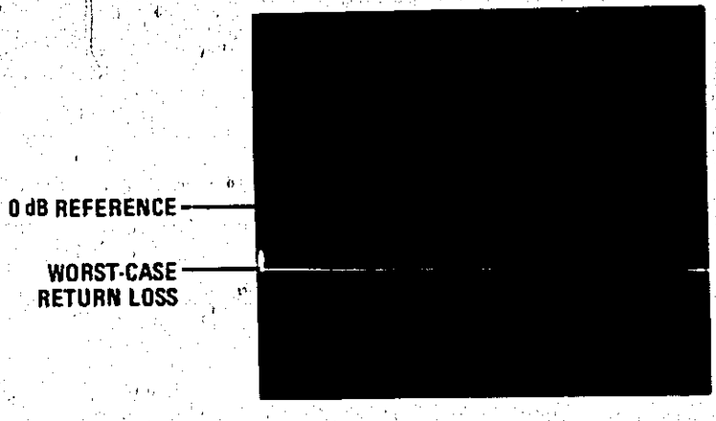


Figure 20. INCIDENT Port Return Loss (0.5 to 2 MHz)

48. PORT RETURN LOSS TESTS (Cont'd)

n. For REFLECTED port Return Loss measurements repeat steps a — m, except directly connect the REFLECTED port to the Dual Directional Coupler (Figure 16, Configuration A) or the Directional Bridge (Figure 16, Configuration B) with RF INPUT, INCIDENT, and TEST ports terminated in 50 ohms. The worst-case Return Loss measurements should be:

≥ 23 dB from 1000 — 1300 MHz
≥ 25 dB from 100 — 1000 MHz
≥ 25 dB from 2 — 100 MHz
≥ 23 dB from 0.5 — 2 MHz

o. For RF INPUT port Return Loss measurements repeat steps a — m, except directly connect the RF INPUT port to the Dual Directional Coupler (Figure 16, Configuration A) or the Directional Bridge (Figure 16, Configuration B) with REFLECTED, INCIDENT, and TEST ports terminated in 50 ohms. The worst-case Return Loss measurements should be:

≥ 23 from 100 — 1300 MHz
≥ 23 from 0.5 — 100 MHz

Table 6. Model 8502A Performance Test Record

Hewlett-Packard Model 8502A
Transmission/Reflection Test Set

Test Performed By: _____

Serial Number: _____ Date: _____

Para. No.	Description	Lower Limit	Measured Value	Upper Limit
43.	**DIRECTIVITY TEST**	40 dB	_____	
44.	**TRANSMISSION FREQUENCY RESPONSE TEST**			
	f.(3) MAG:		_____	0.8 dB
	h.(6) PHASE:		_____	8°
45.	**REFLECTION FREQUENCY RESPONSE TEST**			
	f.(3) MAG: 0.5 – 1300 MHz		_____	1.5 dB
	h.(6) PHASE: 0.5 – 1300 MHz		_____	15°
	j.(2) PHASE: 2 – 1300 MHz		_____	10°
46.	**TEST PORT OPEN/SHORT RATIO TEST**			
	g. MAG: 1000 – 1300 MHz		_____	1.8 dB
	i. PHASE: 1000 – 1300 MHz		_____	15°
	j.(4) MAG: 2 – 1000 MHz		_____	1.5 dB
	k.(2) PHASE: 2 – 1000 MHz		_____	12°
	m.(2) MAG: 0.5 – 2 MHz		_____	2.5 dB
	n.(8) PHASE: 0.5 – 2 MHz		_____	20°
47.	**TEST PORT RETURN LOSS TEST**			
	2 – 1300 MHz	26 dB	_____	
	0.5 – 2 MHz	20 dB	_____	
48.	**PORT RETURN LOSS TESTS**			
	Incident Port			
	h.(3) 1000 – 1300 MHz	23 dB	_____	
	i.(2) 100 – 1000 MHz	25 dB	_____	
	l.(3) 2 – 100 MHz	25 dB	_____	
	m.(2) 0.5 – 2 MHz	23 dB	_____	
	Reflected Port			
	h.(3) 1000 – 1300 MHz	23 dB	_____	
	i.(2) 100 – 1000 MHz	25 dB	_____	
	l.(3) 2 – 100 MHz	25 dB	_____	
	m.(2) 0.5 – 2 MHz	23 dB	_____	
	RF Input Port			
	h.(3), i.(2) 100 – 1300 MHz	23 dB	_____	
	l.(3), m.(2) 0.5 – 100 MHz	23 dB	_____	

PARTS LIST

49. ADJUSTMENTS

50. No adjustments are necessary for the HP Model 8502A Transmission/Reflection Test Set.

51. REPLACEABLE PARTS

52. Replaceable parts are listed in Table 7 and identified in Figure 21. Parts of Type N Connector Assembly (J3, J4, and J5) are shown in Figure 22. 8502A attaching hardware (screws, washers, etc.) is listed and identified in Figure 23.

53. Ordering Instructions

54. To order a part listed in Table 7 or Figure 23, quote the Hewlett-Packard part number, indicate quantity desired, and address the order to the nearest Hewlett-Packard office. Do not try to replace any parts not listed.

AUTION

The 50-ohm Bridge/Power Splitter Assembly A1 and the Input Step Attenuator Assembly A2 are not field repairable and each must be replaced as an assembly.

Table 7. 8502A Replaceable Parts

Reference Designation	HP Part Number	Qty	Description
A1	5086-7228	1	50 Ohm Bridge/Power Splitter
A2	08558-60003	1	0 — 70 dB Input Step Attenuator
	08495-60004		Restored 08558-60003, Requires Exchange
J2	1250-0083	1	Connector: RF BNC
J3, J4, J5	08502-60001	3	Connector: Assembly, Type N Female (See Figure 22)
MP1	0370-2874	1	Knob
MP2-MP5	08411-4003	4	Foot
MP6	08502-00002	1	Panel: Front
MP7	08502-00003	1	Deck: Main
MP8	08502-00004	1	Panel: Rear Sub
MP9	08502-00005	1	Panel: Rear
MP10	08502-20001	1	Case: Bottom Cover
MP11	08502-20002	1	Case: Top Cover
MP12, MP13	08502-20007	2	Trim: Cabinet (Zipper Lock)
MP14	08503-20008	1	Washer: Dress
MP15-MP18	08502-20010	4	Spring Clip
W1	08502-20005	1	Cable: RF Reflected
W2	08502-20004	1	Cable: RF Incident
W3	08502-20003	1	Cable: RF Input
		1	
W4	08502-20011		Cable: RF Attenuator
W5	08502-20006	1	Cable: RF Attenuator/Bridge

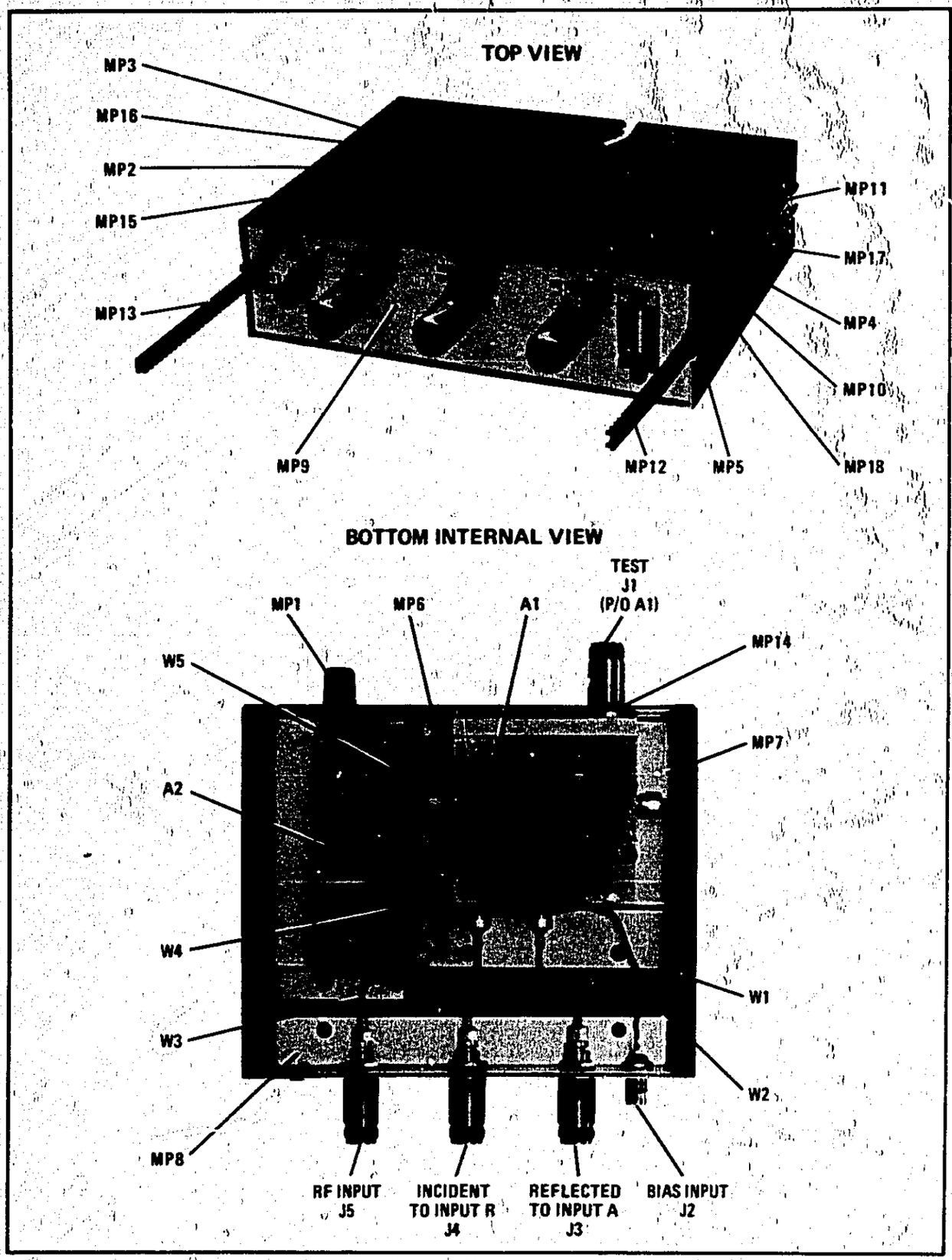
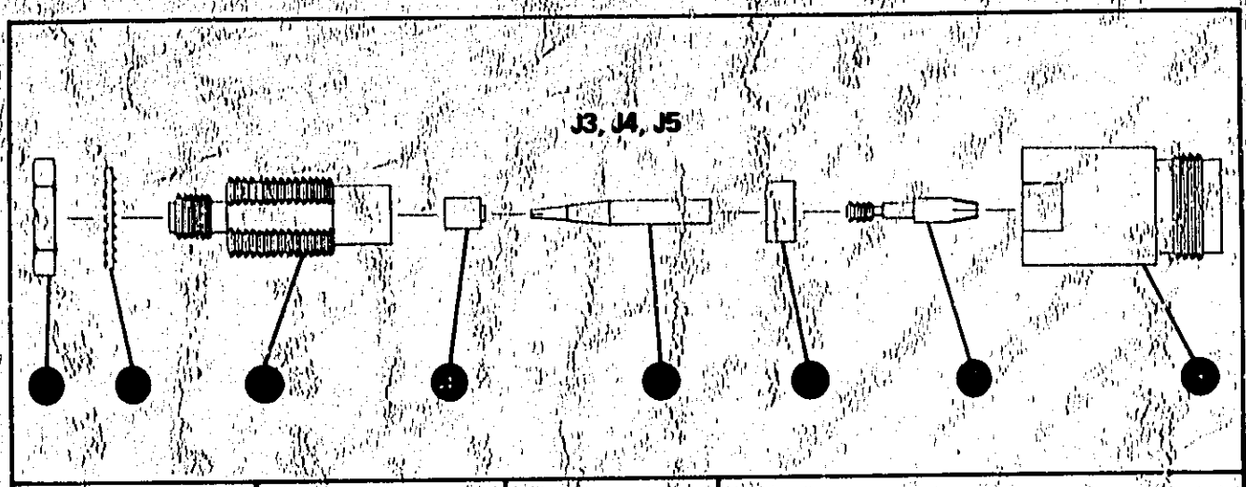


Figure 21. Major Assemblies and Parts Locations



Reference Designation	HP Part Number	Qty	Description
	2950-0132	1	Nut: Hex 7/16-28
	2190-0104	1	Washer: Lock
	08555-20094	1	Body: Bulkhead
	08761-2037	1	Insulator
	08555-20093	1	Contact: Jack
	5040-0306	1	Insulator
	1250-0914	1	Contact: RF Connector
	1250-0914	1	Body: RF Connector

Figure 22. Type N Connector Assembly (08502-60001), Exploded View

Reference Designation	HP Part Number	Qty	Description
	3030-0221	4	No. 4 Allen Screw
	2360-0331	4	No. 6 Screw
	2190-0815	4	No. 6 Flat Washer
	2950-0001	1	Nut
	2190-0016	1	Internal Lock Washer
	2190-0104	3	Internal Lock Washer
	2950-0132	3	Nut
	2200-0103	6	No. 4 Posi-Screw
	3050-0105	8	No. 4 Flat Washer
	2200-0105	2	No. 4 Posi-Screw

Figure 23. 8502A Attaching Hardware (1 of 2)

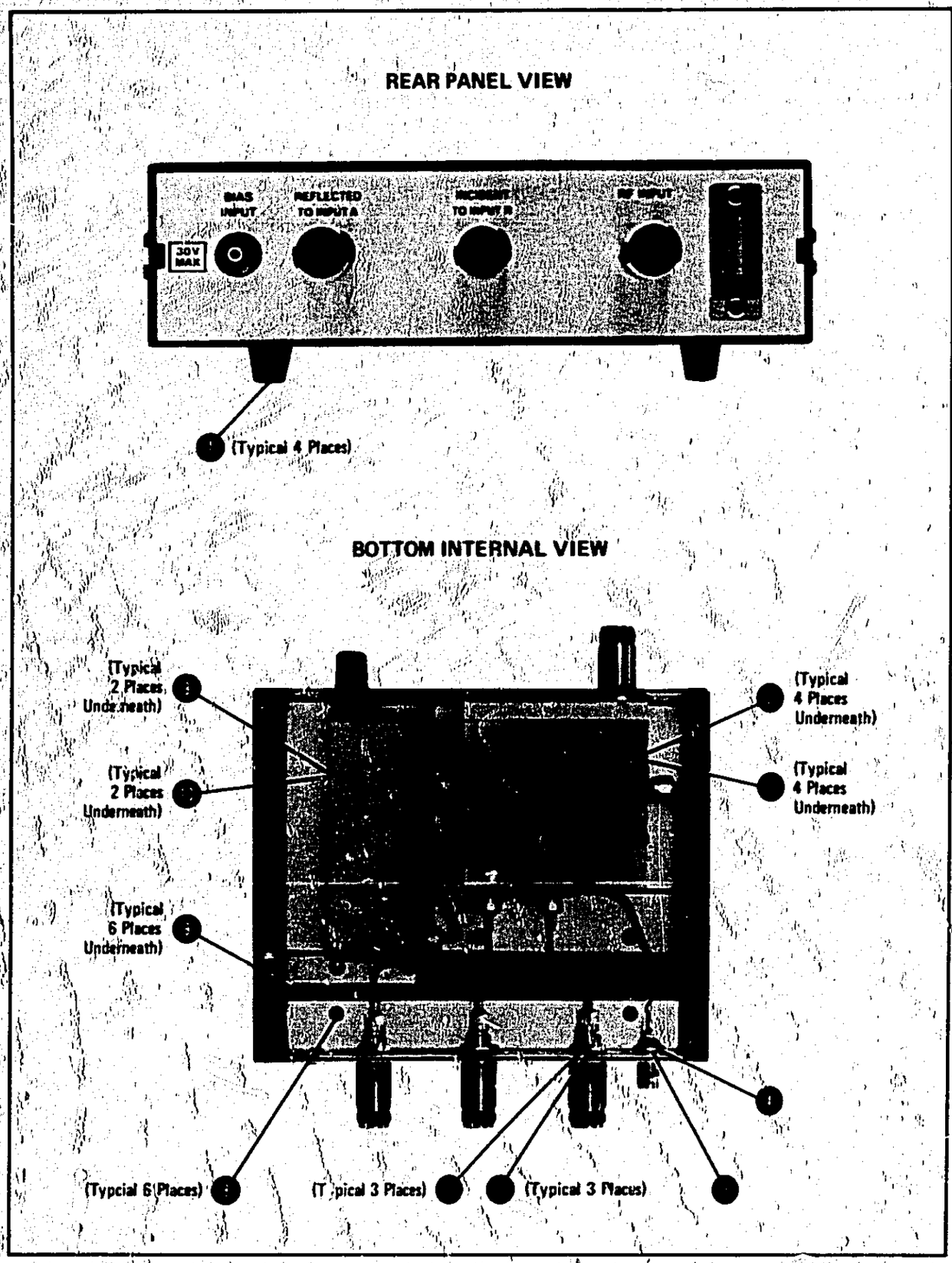


Figure 23. 8502A Attaching Hardware (2 of 2)

SERVICE INFORMATION

55. SERVICE

56. Module Exchange Program

57. Factory repaired exchange modules are available for modules that are not field-repairable. In addition, repaired exchange modules are available for major sub-assemblies as an alternate method of repair. The factory repaired modules are available at a considerable savings in cost over the cost of a new model.

58. Those exchange modules should be ordered from the nearest Hewlett-Packard Sales/Service office using the part numbers in Table 7, Replaceable Parts.

59. Case Disassembly

60. Place the HP Model 8502A top side down on a flat surface. Squeeze top and bottom of case together by applying pressure at end being opened. Using a small screw driver, push each "zipper" lock toward the rear panel (Figure 24) until you are able to grasp it firmly with your thumb and index finger. Pull the "zippers" from the 8502A case, then lift the case bottom from the instrument.

61. To reassemble the HP Model 8502A, replace the case bottom and squeeze top and bottom of case together at end being "zipped." Slide the "zippers" into their slots from the rear panel toward the front panel.

62. Step Attenuator and Directional Bridge Removal Procedure

63. Disassemble case as described in Paragraph 59 and proceed as follows:

a. Remove attenuator knob using a .050 allen wrench.

b. Remove RF connector body (outer shell) and dress washer from TEST port using a special 9/16 open-end wrench (HP Part Number 8710-0877).

c. Remove four pozi-drive screws from Main Deck (MP7).

d. Remove cables W1, W2, and W3 from Directional Bridge A1. (See Figure 21.) Use 5/16 open-end wrench to loosen cable connectors.

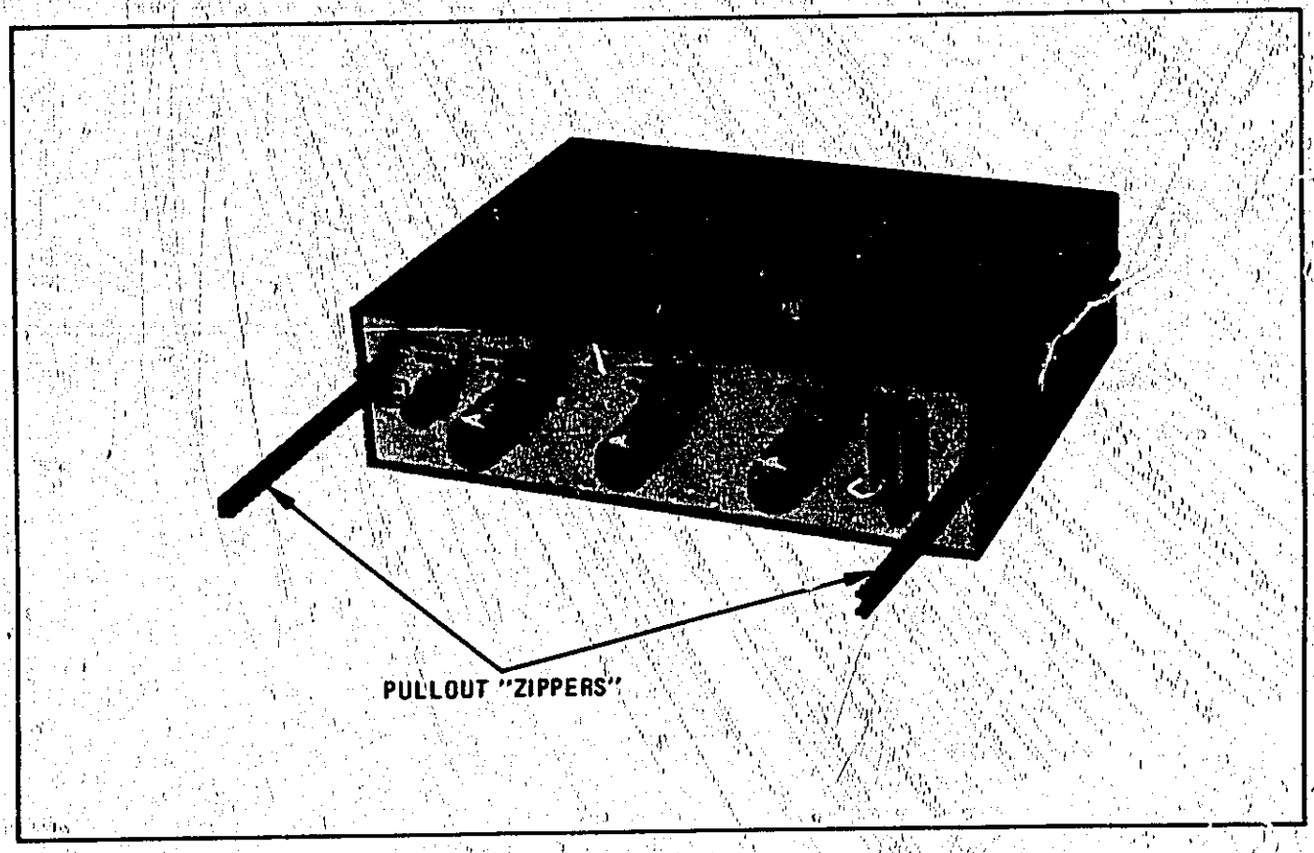


Figure 24. Model 8502A Case Disassembly

e. Carefully slide Main Deck assembly out far enough to clear the three RF cables and turn it over.

f. Remove four pozi-drive screws from Directional Bridge A1 and two pozi-drive screws from Step Attenuator A2.

g. Carefully remove Main Deck with Front Panel attached and set it aside.

h. Remove cables W4 and W5 from Directional Bridge A1 and Step Attenuator A2. (See Figure 21.)

i. If replacing Directional Bridge A1, unsolder bias input lead at terminal on A1.

64. Step Attenuator and Directional Bridge Installation Procedure

65. This procedure assumes that the 8502A has been disassembled as described in Paragraph 63. To reassemble 8502A, proceed as follows:

a. Connect cable W4 (longest of the two U-shaped cables) to connector farthest from control shaft on Step Attenuator A2. Do not tighten connection.

b. Connect cable W5 to connector closest to control shaft on Step Attenuator A2. Do not tighten connection.

c. Connect cables W4 and W5 to Directional Bridge A1 with control shaft of Step Attenuator and TEST port (J1) of Directional Bridge facing the same direction. Tighten the four connectors on W4 and W5 with fingers only.

d. Position Main Deck over top of A1/A2 assemblies and align Step Attenuator mounting holes on Main Deck. Fasten Step Attenuator using two 4-40 screws (HP Part Number 2200-0105) and two flat washers (HP Part Number 3050-0105). Make certain that bias input lead is not pinched between Step Attenuator and Main Deck.

e. Install dress washer and RF connector body (outer shell) on TEST port and tighten with special 9/16 open-end wrench.

f. Loosely fasten Directional Bridge to Main Deck using four 6-32 screws (HP Part Number 2360-0331) and four flat washers (HP Part Number 2190-0815).

g. With thumb on end of TEST port and fingers at rear edge of Main Deck, apply a squeezing force to make certain that Front Panel is held tightly against Main Deck. Tighten Directional Bridge mounting screws while still squeezing.

h. Turn Main Deck assembly over and carefully slide it into the 8502A top case (upside down on flat surface).

i. Connect cables W1, W2, and W3 to Directional Bridge A1. (See Figure 21).

j. Carefully tighten all RF connectors on A1 and A2 assemblies using a 9/16 open-end wrench.

CAUTION

Avoid damaging connectors. Tighten connector nuts until snug; do NOT overtighten.

k. Fasten Main Deck to 8502A case using four 4-40 screws (HP Part Number 2200-0103) and four flat washers (HP Part Number 3050-0105). Make certain that bias input lead is not pinched between Main Deck and case.

l. Solder bias input lead to terminal on Directional Bridge (feed-through capacitor) if not already connected.

m. Install knob on front-panel RF INPUT ATTENUATION dB control. If position of control is unknown, tighten one set screw in knob and rotate control to fully clockwise position. Loosen set screw and set knob pointer to 0. Tighten both set screws in knob.

n. To reassemble 8502A case, refer to Paragraph 61.

69. The reflected signal from the unit under test is transmitted back through the 8502A TEST port and is coupled by an internal directional bridge to the REFLECTION port of the 8502A. This reflected current contains information such as source match, return loss, etc., of the unit under test.

70. A DC BIAS INPUT port can provide bias to the unit under test when bias is needed by coupling a DC signal to the center conductor of the TEST port.

71. Troubleshooting

72. A troubleshooting flow diagram (Figure 26) provides a step-by-step procedure to isolate the cause of a malfunction and identify the defective assembly or component. An equivalent circuit diagram (Figure 27), and major assemblies locator (Figure 28), aid in troubleshooting to the component level.

73. After the defective component or assembly has been repaired or replaced, perform the incoming inspection test in Paragraph 33 (Figure 5) to confirm that the Model 8502A is again functioning properly.

74. Test equipment and accessories required to troubleshoot and maintain the Model 8502A are listed in Table 3. If the equipment listed is not available, equipment that meets the minimum specifications shown may be substituted.

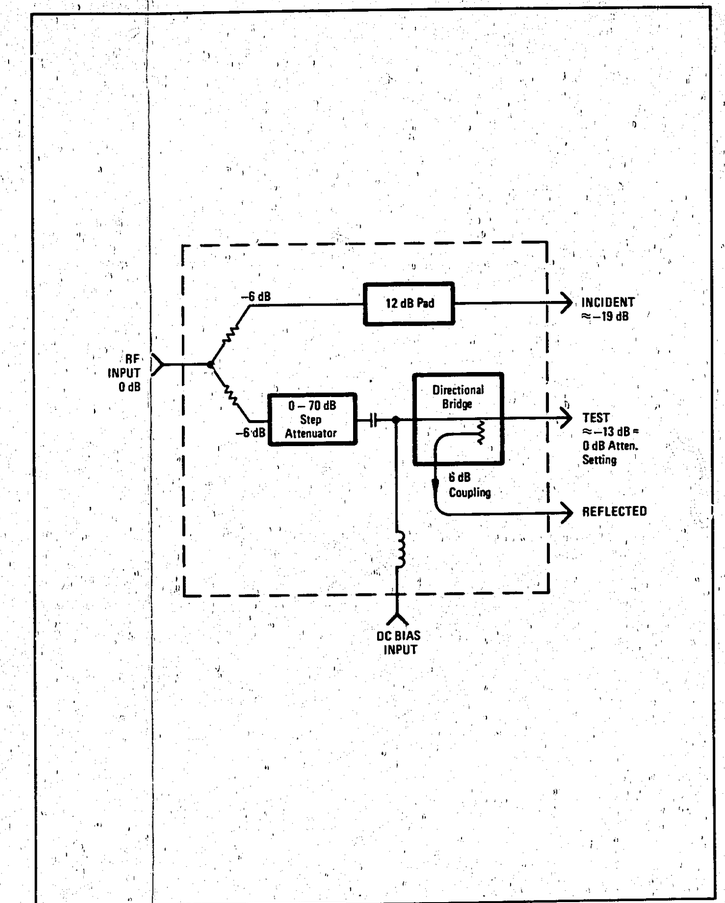
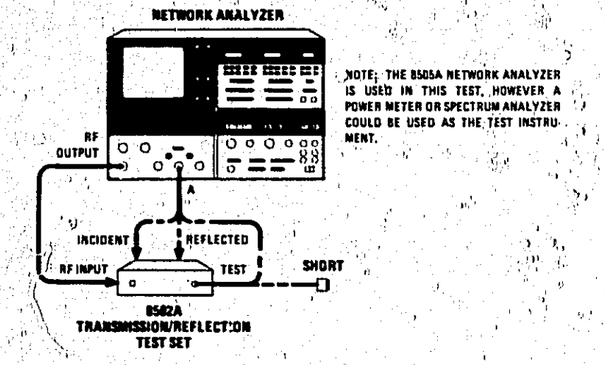


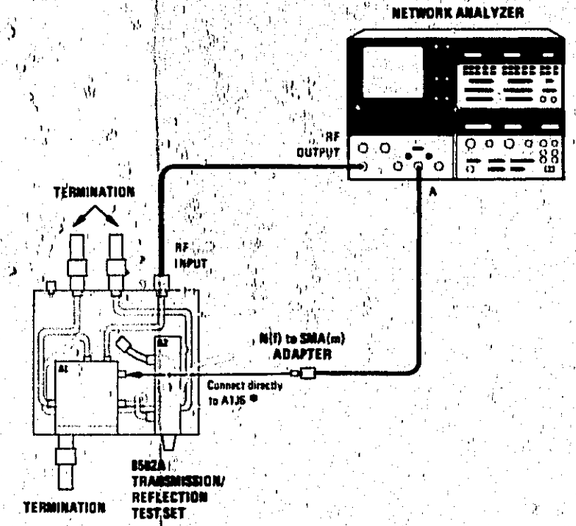
Figure 25. Model 8502A Simplified Block Diagram

TEST SETUP A

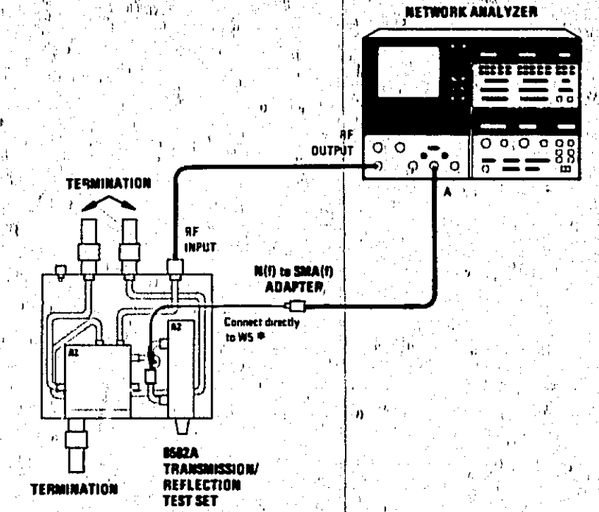


NOTE: THE 8505A NETWORK ANALYZER IS USED IN THIS TEST. HOWEVER A POWER METER OR SPECTRUM ANALYZER COULD BE USED AS THE TEST INSTRUMENT.

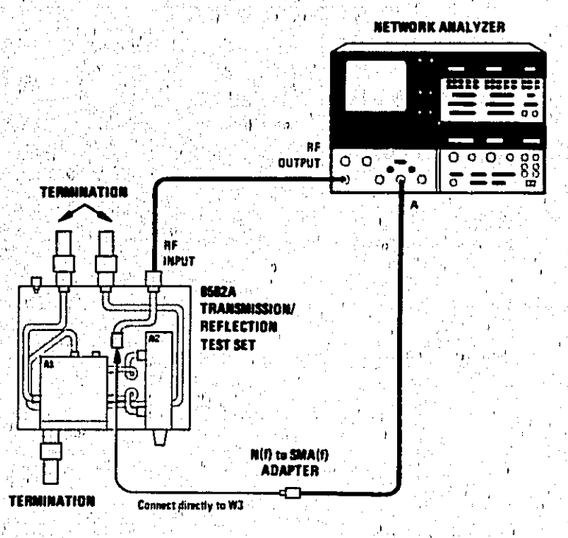
TEST SETUP B



TEST SETUP C

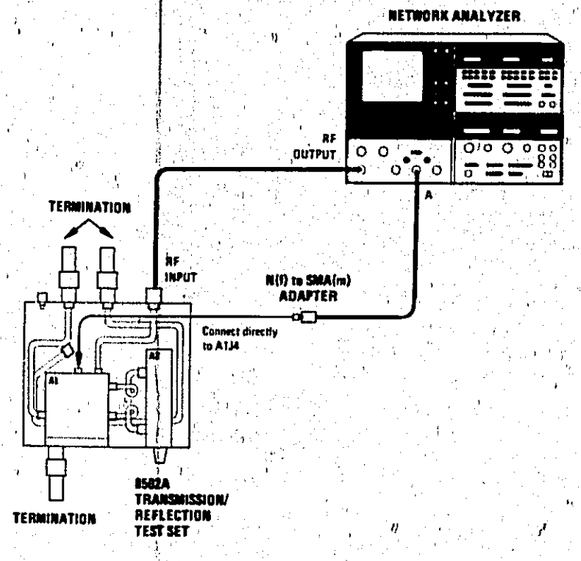


TEST SETUP D



*See Step Attenuator and Directional Bridge Removal Procedure (See Paragraph 62)

TEST SETUP E



TEST SETUP F

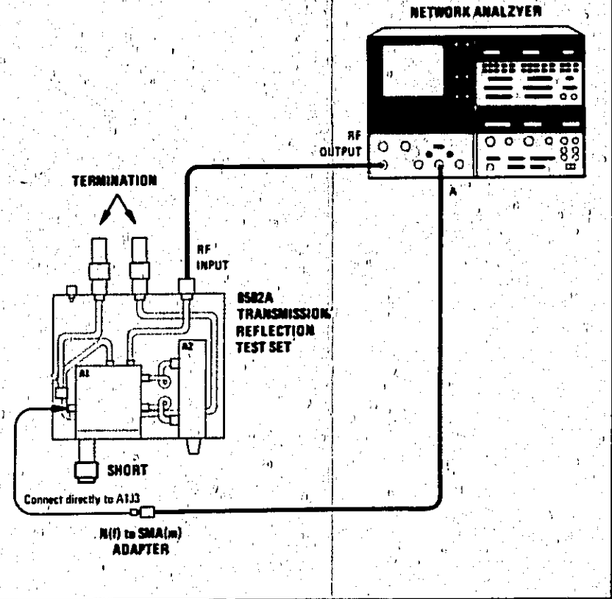


Figure 26. 8502A Transmission/Reflection Test Set Troubleshooting Procedure (1 of 2)

SIMPLIFIED BLOCK DIAGRAM

EQUIPMENT:

Network Analyzer	HP 8505A
Type N Female to SMA Male Adapter	Cablewave Systems No. 718
Type N Female to SMA Female Adapter	Cablewave Systems No. 721
Type N Male Short	HP 11512A
50Ω Type N Male Termination (3 required)	HP 909A, Option 012

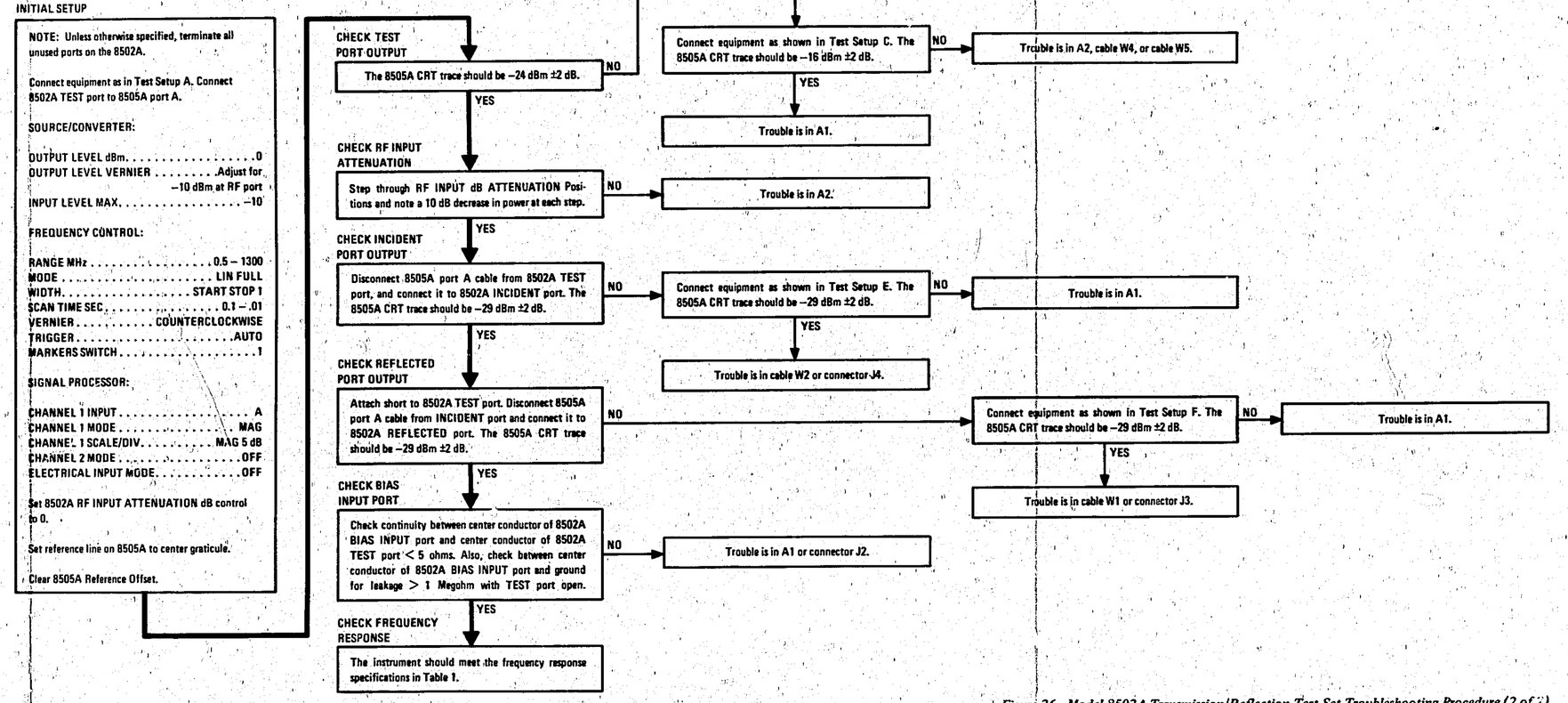


Figure 26. Model 8502A Transmission/Reflection Test Set Troubleshooting Procedure (2 of 2)

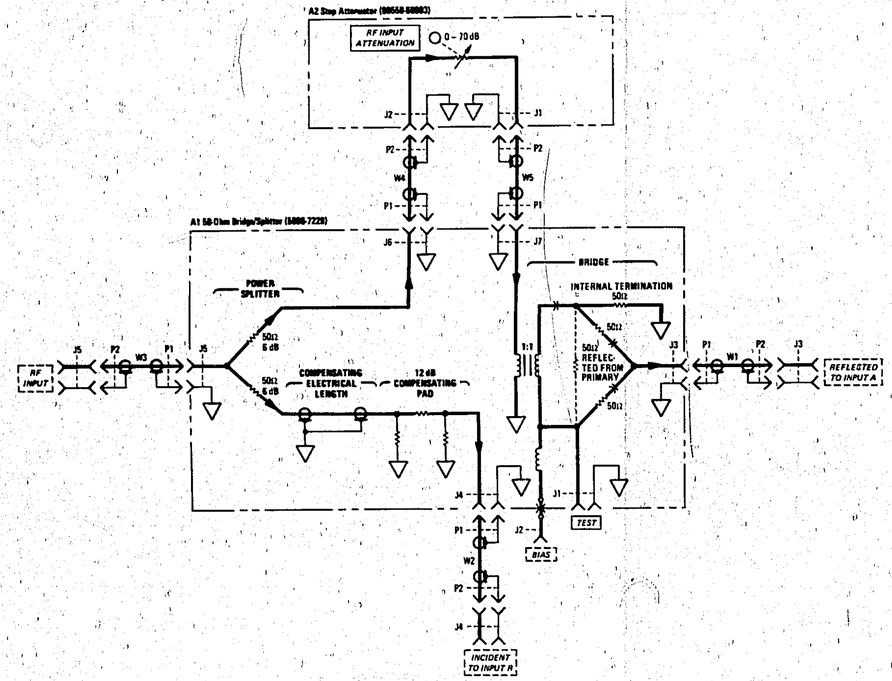


Figure 27. Model 8502A Transmission/Reflection Test Set Equivalent Circuit

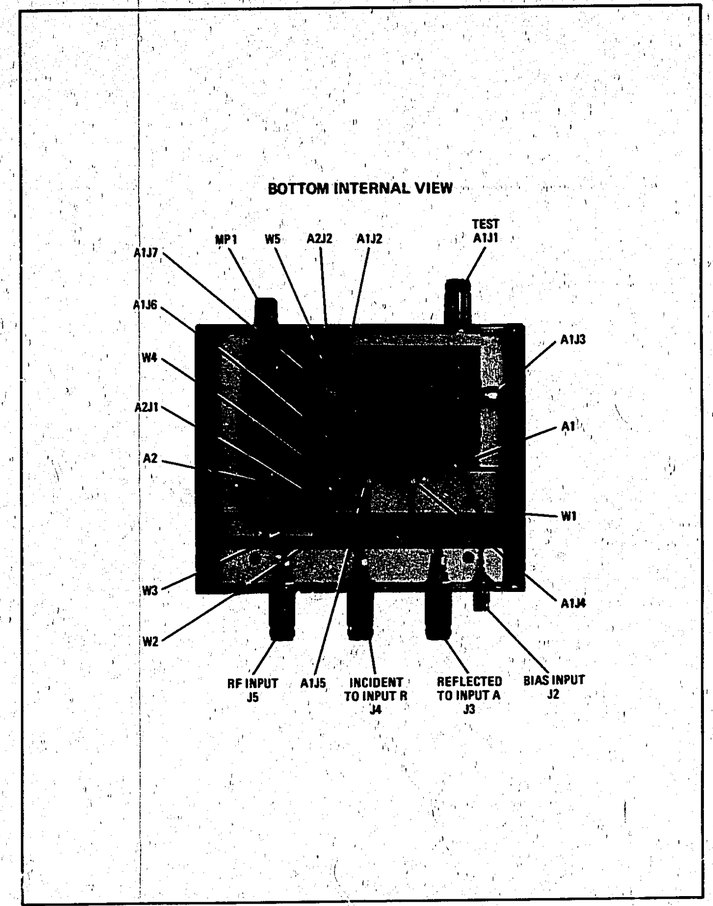


Figure 28. Model 8502A Transmission/Reflection Test Set Major Assemblies Locations

MANUAL CHANGES

MANUAL CHANGES

MANUAL IDENTIFICATION
Model Number: 8502A
Date Printed: October 1979
Part Number: 08502-90001

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

To use this supplement, make all ERRATA corrections and all appropriate serial number related changes indicated in the tables below.

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
2025A and 2028A	1
2420A	1,2

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES

►NEW ITEM

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.

Printed in U.S.A.

28 MAY 1986
6 pages

HEWLETT PACKARD

ERRATA

▶ Page 1, Paragraph 11:
Change this paragraph to read: Hewlett-Packard Cable Accessory Set 11851A, shown in Figure 3, contains four cables. Three of these are phase matched to a standard, and are available individually. These cables help provide accurate measurements when using the HP 8505A Network Analyzer and other instruments.

Page 2, Table 1:
Under Port Match: Change "Test Port Return Loss*:" to "Test Port Equivalent Source Match (Ratio Mode)*:".

Page 3, Figure 3:
Replace Figure 3 with the HP 11851A Cable Accessory Set figure supplied in this Change Sheet.

Page 28. PERFORMANCE TESTS:
Change test heading 47 to read: TEST PORT EQUIVALENT SOURCE MATCH (RATIO MODE).
Change the second sentence in the Description of Performance Test 47 to read as follows: "These two tests confirm that the Test Port Equivalent Source Match (Ratio Mode) of the 8502A is within specification."

Page 38. Table 7:
Change A2 (first listing) to HP Part Number 5086-7363. CD9.
Change A2 (second listing) description to: "Restored 5086-7363. Requires Exchange"

▶ Change MP8 to HP Part Number 08502-00017, Qty. 1, Panel: Rear Sub.
Note: When ordering a replacement for the obsolete rear sub panel having HP Part Number 08502-00004, order the Rear Panel Replacement Kit having HP Part Number 08502-60004. This kit consists of the newer MP8 and MP9, required when replacing the obsolete MP8 or MP9.

▶ Change MP9 to HP Part Number 08502-00016, Qty. 1, Panel: Rear.
Note: When ordering a replacement for the obsolete rear panel having HP Part Number 08502-00005, order the Rear Panel Replacement Kit having HP Part Number 08502-60004. This kit consists of the newer MP8 and MP9, required when replacing the obsolete MP8 or MP9.

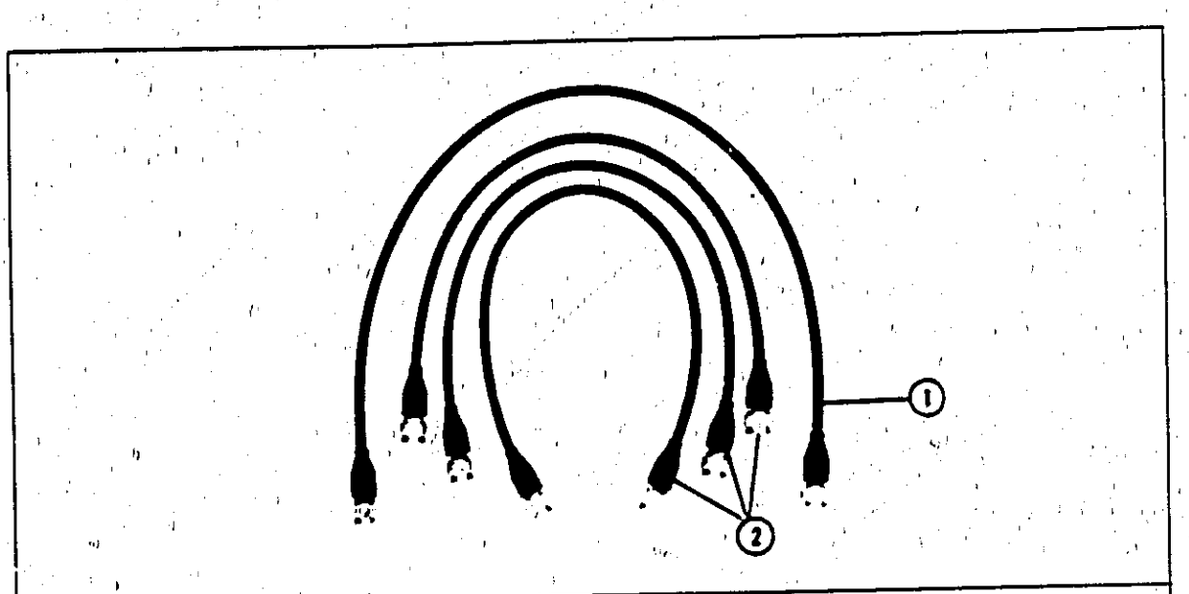
CHANGE 1

Page 38. Table 7:
Change MP6 to 08502-00013. CD4.
Change MP7 to 08502-00012. CD3.

CHANGE 2

Page 38. Table 7:
Add C2. having HP Part Number 0160-4833. CD5. CAPACITOR-FXD .022UF ±10% 100VDC CER.
Add F1. having HP Part Number 2110-0424. CD9. FUSE .75A 125V NTD .25X.27.
Add R1. having HP Part Number 0757-0394. CD0. RESISTOR 51.1 1% .125W F TC=0±100.
Add R2. having HP Part Number 0698-8827. CD4. RESISTOR 1M 1% .125W F TC=0±100.
Change MP7 to HP Part Number 08502-00018. CD9.
Change MP8 to HP Part Number 08502-00017. CD8.
Change MP9 to HP Part Number 08502-00016. CD7.
Add MP19. having HP Part Number 1400-0110. CD4. FUSEHOLDER-BIPIN SKT 5A 125V.
Add MP20. having HP Part Number 1400-0111. CD5. FUSEHOLDER NUT FOR USE WITH HP P/N 1400-0110.
Add MP21. having HP Part Number 1400-0112. CD6. FUSEHOLDER CAP FOR USE WITH HP P/N 1400-0110.

Page 47/48. Figure 27:
Replace Figure 27 with the Model 8502A Transmission/Reflection Test Set Equivalent Circuit diagram supplied in this change sheet.



Item	Name	Qty	HP Part No.	Description
1	RF Cable	1	8120-2793	86 cm. (34 in.) RF Cable with 50-ohm Type N male connectors on each end.
2	Phase Matched RF Cables	3	8120-2292	61 cm. (24 in.) 50-ohm RF Cables Phase Matched to a standard within ±2 Percent at 1300 MHz, with Type N male connectors on each end.

Figure 3. HP 11851A Cable Accessory Set (ERRATA)

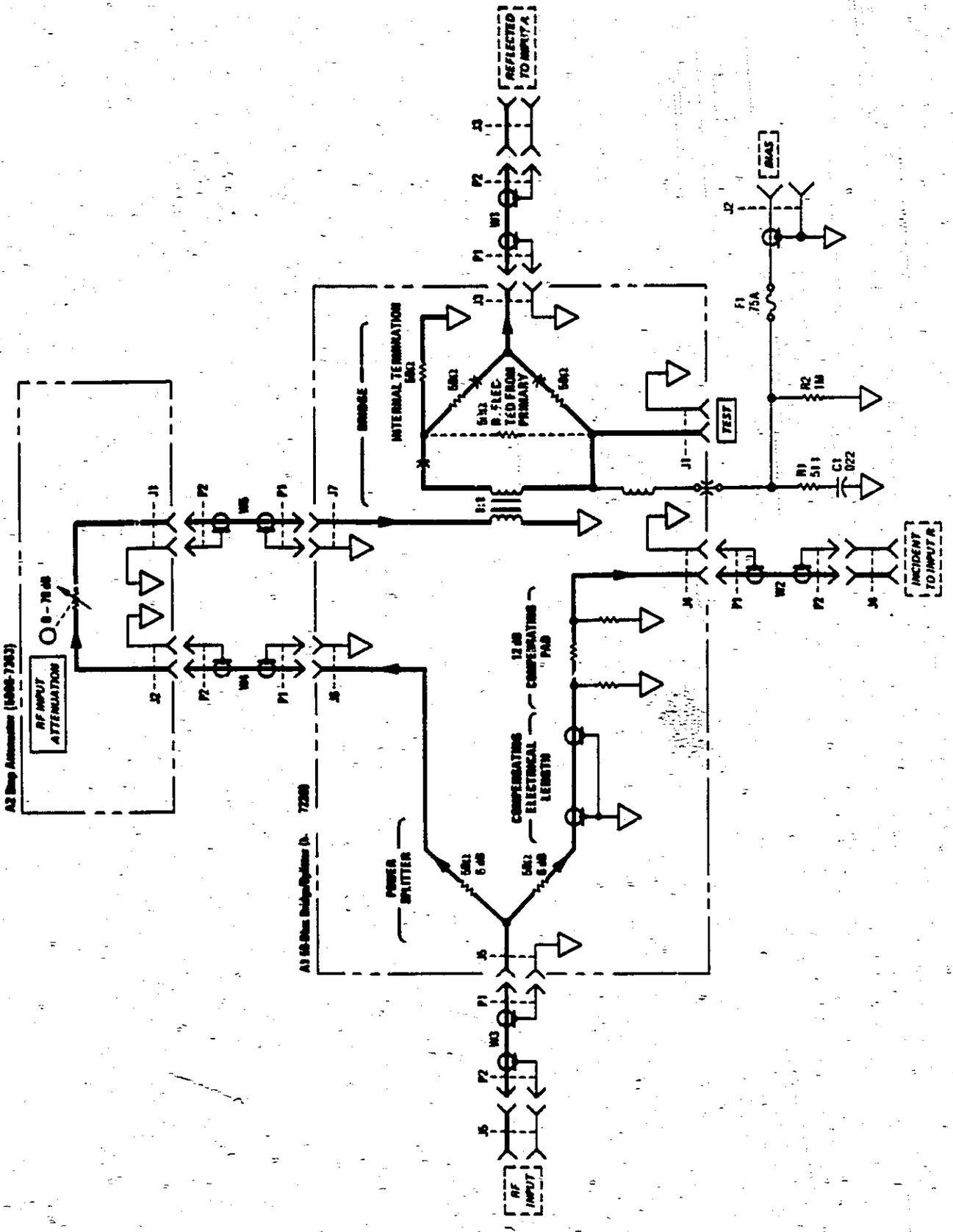


Figure 27. Model 8502A Transmission/Reflection Test Set Equivalent Circuit (CHANGE 2)