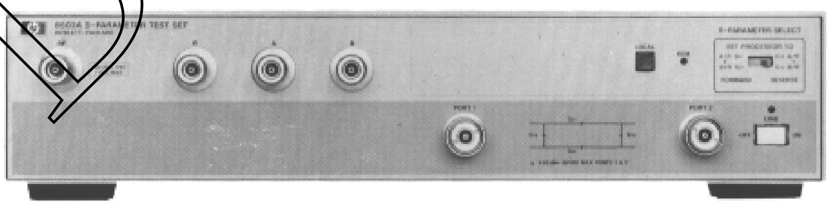
HP 8503A

OPERATING AND SERVICE MANUAL

8503A
S-PARAMETER TEST SET
500 kHz to 1.3 GHz



HEWLETT hp PACKARD

HP 8503A

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OPERATING AND SERVICE MANUAL

8503A
S-PARAMETER TEST SET
Includes Option 001

SERIAL NUMBERS

This manual applies directly to HP Model 8503A S-Parameter Test Set having serial prefix number 1620A.

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

MANUAL PART NO. 08503-90001
Microfiche Part No. 08503-90002
Operating Information Supplement Part No. 08503-90003

Printed: August 1976

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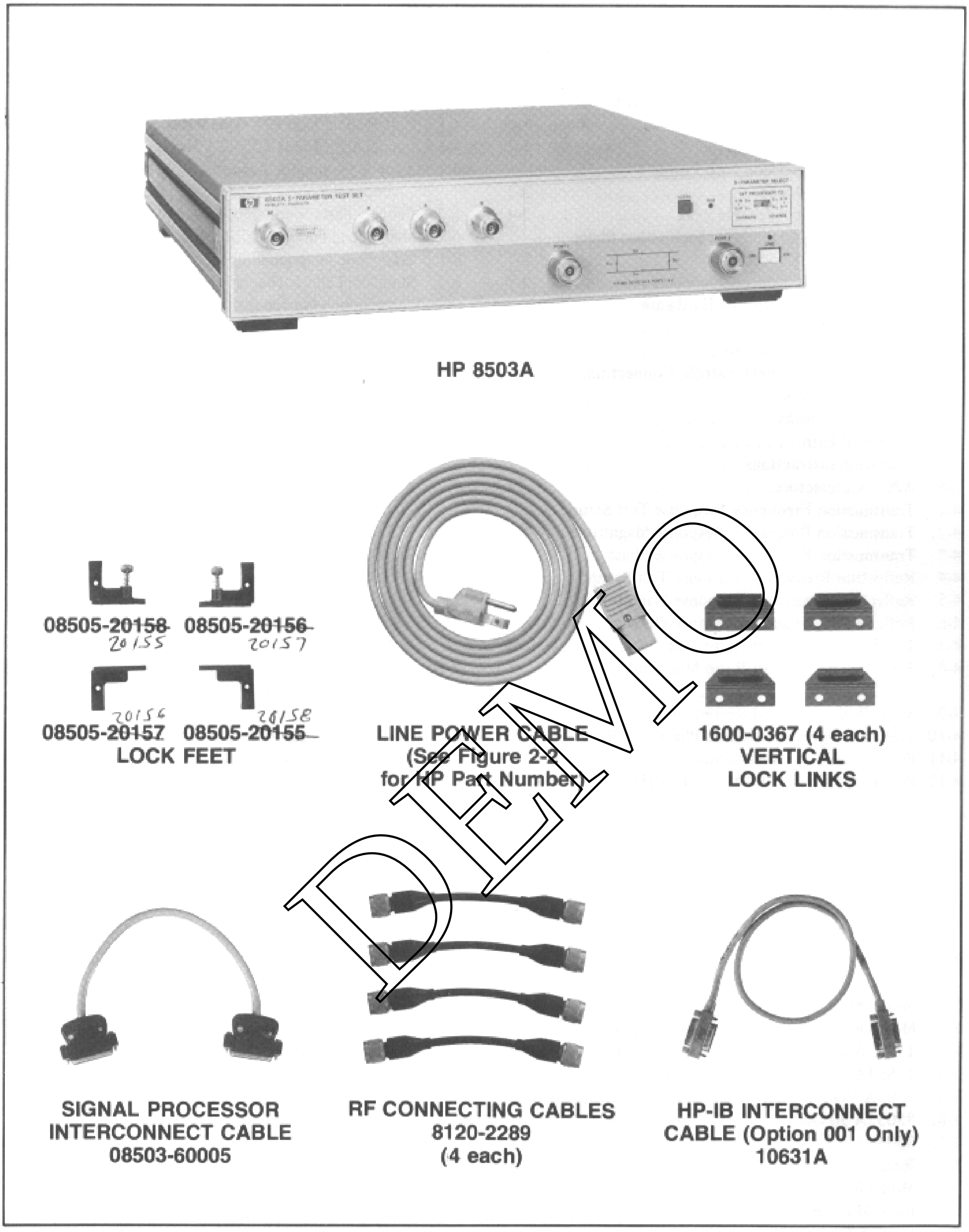


Figure 1-1. Model 8503A S-Parameter Test Set with Accessories Supplied

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This Operating and Service Manual contains information required to install, operate, test, adjust, and service the Hewlett-Packard Model 8503A. Figure 1-1 shows the instrument and accessories supplied. This section covers instrument identification, description, options, accessories, specifications, and other basic information.

1-3. Supplied with this manual is an Operating Information Supplement. The Supplement is a copy of the first three sections of the manual, and should be kept with the instrument for use by the operator. Additional copies of the Operation Information Supplement can be ordered separately through your nearest Hewlett-Packard office. The part number is listed on the title page.

1-4. Also listed on the title page of this manual is a Microfiche part number. This number can be used to order 4 x 6-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.

1-5. SPECIFICATIONS

1-6. Instrument specifications are listed in Table 1-1. These [illegible] the performance

tics. Supplemental characteristics are not specifications but are typical characteristics included as additional information for the user.

1-7. SAFETY CONSIDERATIONS

1-8. General

1-9. This is a Safety Class I instrument and has been manufactured and tested according to international safety standards.

1-10. Operation

1-11. BEFORE APPLYING POWER make sure the instrument's ac input is set for the available ac line voltage, that the correct fuse is installed, and that all normal safety precautions have been taken. (See Warnings below).

1-12. Safety Symbols

⚠ Instruction manual symbol: The apparatus will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the appartus against damage.

Indicates dangerous voltages

⏚ Earth Terminal

WARNING The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction

CAUTION sign until the indicated conditions are fully understood and met.

1-13. Service

1-14. Although this instrument has been manufactured in accordance with international safety standards, this manual contains information, cautions, and warnings which must be followed to insure safe operation. Service should be performed only by qualified service personnel, and the following warnings should be observed:

WARNINGS

Any maintenance or repair of the opened instrument under voltage should be avoided as much as possible, and when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

When it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

If this instrument is to be energized via an auto-transformer (for voltage reduction) make sure the common terminal is connected to the earthed pole of the power source.

BEFORE SWITCHING ON THE INSTRUMENT, the protective earth terminals of the instrument must be connected to the protective conductor of the mains power cord. The mains plug shall only be inserted in a socked outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cord) without a protective conductor (grounding). Grounding one conductor of a two conductor outlet is not sufficient protection.

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal is likely to make this instrument dangerous.

CAUTIONS

BEFORE SWITCHING ON THIS INSTRUMENT, make sure instrument's ac input is set to the voltage of the ac power source (see Figure 2-1).

BEFORE SWITCHING ON THIS INSTRUMENT, make sure the ac line fuse is of the required current rating and type (normal-blow, time delay, etc.).

1-15. INSTRUMENTS COVERED BY MANUAL

1-16. Attached to the instrument is a serial number plate (Figure 1-2). 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.

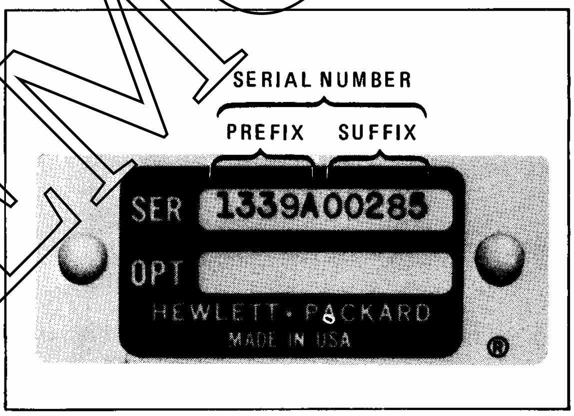


Figure 1-2. Typical Serial Number Plate

1-17. An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates the instrument is different from those described in this manual. The manual for this newer instrument is accompanied by a yellow Manual Changes supplement. This supplement contains "change information" that explains how to adapt the manual to the newer instrument.

Table 1-1. Model 8503A Specifications

SPECIFICATIONS

Frequency Range: 500 kHz to 1.3 GHz

Directivity: ⩾40 dB

Frequency Response:

Transmission[1] (S_{21}, S_{12}): ±1 dB, ±12° from 0.5 to 1300 MHz.

Reflection[1] (S_{11}, S_{22}): ±2 dB, ±20° from 0.5 to 1300 MHz; ±15° from 2 to 1300 MHz.

Port Match[2]:

Test Port 1 and 2:

Frequency Range (MHz)	Return Loss
0.5 to 2	⩾20 dB (⩽1.22 SWR)
2 to 1300	⩾26 dB (⩽1.11 SWR)

Test Port 1 and 2 Open/Short Ratio:

Frequency Range (MHz)	Magnitude	Phase
0.5 to 2	⩽±1.25 dB	⩽±10°
2 to 1000	⩽±0.75 dB	⩽±6°
1000 to 1300	⩽±0.9 dB	⩽±7.5°

Reference and Return Ports (R, A, B):

Frequency Range (MHz)	Return Loss
0.5 to 2	⩾20 dB (⩽1.22 SWR)
2 to 1000	⩾23 dB (⩽1.15 SWR)
1000 to 1300	⩾20 dB (⩽1.22 SWR)

RF Input Port: ⩾20 dB Return Loss from 0.5 to 1300 MHz (⩽1.22 SWR).

Maximum Operating Level: +20 dBm (100 mW)

[1] ±Degrees specified as deviation from Linear Phase.
[2] Effective Port match for ratio measurement.

Table 1-2. Model 8503A Supplemental Characteristics

SUPPLEMENTAL CHARACTERISTICS

NOTE: Values in this table are not specifications but are typical characteristics included for user information.

Insertion Loss:
- **Input to Port 1 & 2:** 13 dB Nominal
- **Input to Port A, B, or R:** 19 dB Nominal

Tracking Between Reference and Test Port 1 and 2:
- **Transmission S_{21},S_{12}):** $\leqslant\pm0.5$ dB Magnitude and $\leqslant\pm4°$ Phase (deviation from Linear Phase).
- **Reflection (S_{11},S_{22}):** $\leqslant\pm0.75$ dB Magnitude and $\leqslant\pm6°$ Phase (deviation from Linear Phase).
- **RF Input to Test Port 1 or 2:** $\leqslant\pm1.5$ dB.

Impedance: 50Ω

Connectors:
- **Test Ports:** APC-7
- **All Other RF Ports:** 50Ω Type N Female
- **DC Bias Inputs:** BNC Female

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

Damage Level: 1 watt (+30 dBm) CW

Power: Selection of 100, 120, 220, or 240 V +5% −10%, 50 or 60 Hz. Approximately 10 watts.

Dimensions: 432 mm wide, 90 mm high, 495 mm deep (17 in. x 3 1/2 in. x 19 1/2 in.)

Weight: Net, 9, 1 kg (20 lb). Shipping, 11,3 kg (25 lb)

1-18. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is identified with this manual's print date and part number, both of which appear on the manual's title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-19. For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

[illegible]

1-21. The HP Model 8503A S-Parameter Test Set is designed to interface with the HP Model 8505A Network Analyzer. The 8503A together with the 8505A provides a convenient means of measuring reflection and transmission coefficients (scattering parameters) of a one-port or two-port device operating within the frequency range of 500 kHz to 1.3 GHz.

1-22. OPTIONS

1-23. Option 001 HP-IB

1-24. Option 001 provides the 8503A S-Parameter Test Set with Hewlett-Packard Interface Bus (HP-IB). The HP-IB option permits communication between instruments when used with HP Model 8507A calculator-based Automatic Network Analyzer.

1-25. Option 907 Front Handle Kit

1-26. Option 907, HP Part Number 5061-0088, contains front handles and necessary hardware for attaching the handles. See Figure 2-3 for installation procedure.

1-27. Option 908 Rack Flange Kit

[illegible] contains flanges and hardware required to mount the 8503A in an equipment rack with 482, 6mm (19 inches) horizontal spacing. See Figure 2-3 for installation procedure.

1-29. Option 909 Rack Flange/Front Handle Kit

1-30. Option 909, HP Part Number 5061-0082, consists of one Option 907 Front Handle Kit and one Option 908 Rack Flange Kit (see descriptions above.) See Figure 2-3 for installation procedure.

1-31. Option 910 Additional Operating and Service Manuals

1-32. Option 910 provides additional Operating and Service manual (s). The number of additional manuals depends on quantity of Option 910's ordered. To obtain additional Operating and Service manuals after initial shipment, order by manual part number (refer to title page or rear cover of manual).

1-33. ACCESSORIES SUPPLIED

1-34. Figure 1-1 shows the HP Model 8503A S-Parameter Test Set, line power cable, Signal Processor interconnect cable, HP-IB interconnect cable, and four 19 cm (7-1/2 inch) RF connecting cables.

1-35. EQUIPMENT REQUIRED BUT NOT SUPPLIED

1-36. To have a complete measurement system, the Model 8503A must be used with a Network Analyzer such as the HP Model 8505A.

1-37. EQUIPMENT AVAILABLE

1-38. HP Model 11600B Option 003 Transistor Fixture

1-39. The 11600B Transistor Fixture provides a convenient and accurate configuration for measuring s-parameters of bipolar and field-effect transistors, or other circuit elements such as diodes or resistor. Accepts TO-18/TO-72 packages.

1-40. HP Model 11602B Option 003 Transistor Fixture

1-41. The 11602B Transistor Fixture provides a [illegible]

field-effect transistors, or other circuit elements such as diodes or resistors. Accepts TO-5/TO-12 packages.

1-42. HP Model 11608A Transistor Fixture

1-43. The 11608A Transistor Fixture provides capability of completely characterizing stripline transistors in a 50 ohm stripline configuration. Three different package-style options are available. One of these three package-style options must be specified when ordering an 11608A.

1-44. HP Model 11608A Option 001. This package-style option has a through-line microstrip and bolt-in grounding structure machinable by the customer to fit the required package.

1-45. HP Model 11608A Option 002. Accepts TO-51 packages (6.350 mm diameter).

1-46. HP Model 11608A Option 003. Accepts HPAC-200 packages (5.207 mm diameter).

1-47. HP Model 11851A RF Cable Kit

1-48. The 11851A cable kit includes four 61 cm (24 inch) cables which are phase matched to a standard within ±2° at 1300 MHz. These cables may be used to provide RF connections between 8505A and 8503A when S-Parameter Test Set is positioned on top of Network Analyzer or off to one side.

1-49. HP Model 11853A 50 Ohm Type N Accessory Kit

1-50. The 11853A Accessory Kit furnishes the RF components generally required when measuring devices having 50 ohm type N connectors (see Table 1-3). The HP Model 85032A Calibration Kit is also required for use with the 11853A Accessory Kit.

Table 1-3. 11853A 50 Ohm Type N Accessory Kit

Qty	Description	HP Part Number
1	Type N Female Short	11511A
1	Type N Male Short	11512A
2	Type N Male Barrel	1250-1475
[illegible]	Type N Female Barrel	1250-1472

1-51. HP Model 11854A 50 Ohm BNC Accessory Kit

1-52. The 11854A Accessory Kit furnishes the RF components generally required when measuring devices having 50 ohm BNC connectors (see Table 1-4). The HP Model 85032A Calibration Kit is also required for use with the 11854A Accessory Kit.

Table 1-4. 11854A 50 Ohm BNC Accessory Kit

Qty	Description	HP Part Number
2	Type N Male to BNC Female Adapter	1250-1476
2	Type N Male to BNC Male Adapter	1250-1473
2	Type N Female to BNC Male Adapter	1250-1477
2	Type N Female to BNC Female Adapter	1250-1474
1	BNC Male Short	1250-0929
1	Storage Case	

1-53. HP Model 11857A Test Port Extension Cables

1-54. The 11857A Test Port Extension Cables set contains two precision 61 cm (24-inch) cables with APC-7 connectors on both ends. These cables are designed to adapt the 8503A test port spacing to almost any two port coaxial device.

1-55. HP Model 11858A Rigid Interconnect Adapter

1-56. The 11858A Rigid Interconnect Adapter provides a rigid RF cable interconnection (horizontal to vertical test port orientation) between the 8503A and the 11600B/11602 Transistor Fixture.

1-57. HP Model 85030A Accuracy Improved Measurement (AIM) Program

1-58. The AIM Program substantially improves measurement accuracy by removing mismatch, directivity, and frequency tracking errors for both one and two port components. The 85030A AIM Program includes cassette and operating manual for use with the 8507A Automatic Network Analyzer.

1-59. HP Model 85031A Verification and APC-7 Calibration Kit

1-60. The 85031A Verification and Calibration Kit is furnished with the 8507A Automatic Network Analyzer. This kit includes the RF components and test data required to verify and calibrate the Automatic Network Analyzer system (see Table 1-5).

Table 1-5. 8503A Verification and APC-7 Calibration Kit

Qty	Description	HP Part Number
1	APC-7 50Ω Termination <1.005 SWR at 2 GHz	909A-H68
1	APC-7 Short	11565A
1	APC-7 3 dB Attenuator	8492A Opt 003
1	APC-7 50 dB Attenuator	8492A Opt 050
1	Storage Case	

1-61. HP Model 85032A 50 Ohm Type N Calibration Kit

1-62. The 85032A Calibration Kit is recommended for measurement of devices having Type N RF connectors. (See Table 1-6).

Table 1-6. 85032A 50 Ohm Type N Calibration Kit

Qty	Description	HP Part Number
2	APC-7 to Type N Female Adapter	11524A
2	APC-7 to Type N Male Adapter	11525A
1	50Ω Type N Female Termination <1.005 SWR at 2 GHz	909A-H70
1	50Ω Type N Male Termination <1.005 SWR at 2 GHz	909A-H69
1	Type N Female Short	11511A
1	Type N Male Short	11512A
1	Storage Case	

1-63. HP Model 85033A SMA Calibration Kit

1-64. The 85033A Calibration Kit is recommended for measurement of devices having SMA RF connectors. (See Table 1-7).

Table 1-7. 85033A SMA Calibration Kit

Qty	Description	HP Part Number
2	APC-7 to SMA Male Adapter	1250-1007
2	APC-7 to SMA Female Adapter	1250-1012
1	50Ω SMA Female Termination	0960-0050
1	50Ω SMA Male Termination	0960-0053
1	SMA Female Short	0960-0054
1	SMA Male Short	0960-0055
1	Storage Case	

1-65. RECOMMENDED TEST EQUIPMENT

1-66. Equipment required for incoming inspection, performance testing and troubleshooting of the Hewlett-Packard Model 8503A S-Parameter Test Set is listed in Table 1-8. Other equipment may be substituted if it meets or exceeds the critical specifications listed in the table.

Table 1-8. Recommended Test Equipment

Instrument	Critical Specifications	Recommended Model	Use*
Network Analyzer	Frequency Range: 0.5 – 1300 MHz	HP 8505A	P,T,I
Multimeter	Range: AC: 0 to 300V; DC: 0 to 50V Ohms: X100	HP 3490A	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 (2 required)	Impedance: 50Ω with APC-7 connector	HP 909A	P
Termination[4]	Impedance: 50Ω with APC-7 connector	HP 909A–H68	T,I
Termination (4 required)	Impedance: 50Ω with Type N male connector	HP 909A, Opt. 012	P
Termination[2]	Impedance: 50Ω with Type N male connector SWR: ⩽ 1.005	HP 909A – H69	P
Short	APC-7 Connector	HP 11565A	P,T,I
Short	Type N female connector	HP 11511A	P
Short	Type N male connector	HP 11512A	P,T
Adapter	APC-7 to Type N female	HP 11524A	P
Adapter	APC-7 to Type N male	HP 11525A	P
Adapter (2 required)	Type BNC male to N male	HP 1250-1473	P
Adapter	Type BNC male to Type N female	HP 1250-1477	P
Adapter	Type N female to SMA female	Cablewave Systems No. 721	T
Adapter[3] (2 required)	Type N female to SMA male	Cablewave Systems No. 718	T
Adapter	Type N female to Type N female	HP 1250-0777	P
Cable (2 required)	6 ft 50Ω [illegible] RG 214 with [illegible] Type N female connector on other end	HP 11500A	P
Cable Set	Four 24 in. 50Ω coaxial cables phase matched to a standard with ±2° at 1300 MHz with Type N male connectors on both ends	HP 11851A	P
Cable	24 in. 50Ω coaxial cable with APC-7 connectors	HP 11857A	P

* P = Performance; T = Troubleshooting; I = Incoming Inspection
[1] This part is included in HP 11652A Transmission/Reflection Kit
[2] Included in HP 85032A 50Ω Type N Calibration Kit.
[3] Part of HP 11854A 50Ω BNC Accessory Kit
[4] Part of HP 85031A Verification and APC-7 Calibration Kit.

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section includes information on the initial inspection, preparation for use, and storage/shipment instructions for the HP Model 8503A.

2-3. INITIAL INSPECTION

2-4. 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. 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 nearest Hewlett-Packard office. If 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 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. The Model 8503A requires a power source of 100, 120, 220, or 240 Vac +5% −10%, 50 or 60 Hz single phase. Power consumption is less than 10 volt-amperes.

2-8. Line Voltage and Fuse Selection

WARNING

BEFORE THIS INSTRUMENT IS SWITCHED ON, its protective earth terminals must be connected to the protective conductor of the mains power cable (cord). The mains power cable plug shall only be inserted in a socket outlet provided with a protective earth contact. DO NOT negate the earth-grounding protection by using an extension cable, power cable, or autotransformer without a protective ground conductor. Failure to ground the instrument properly can result in serious personal injury.

CAUTION

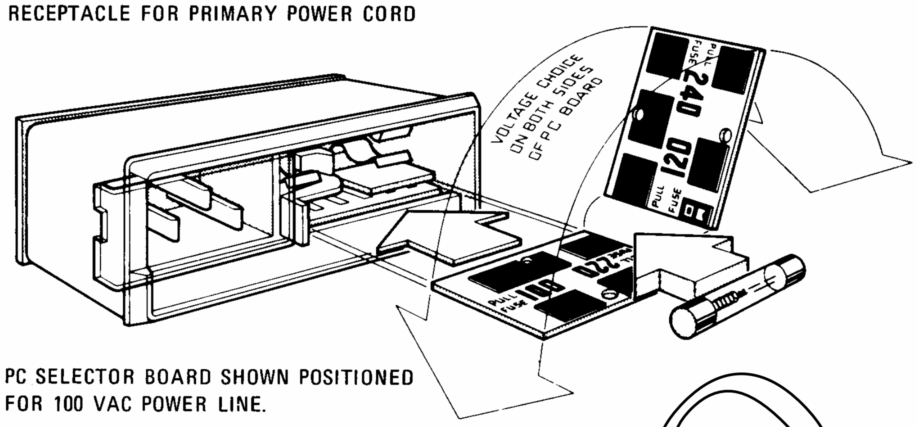
BEFORE SWITCHING ON THIS INSTRUMENT, make sure it is adapted to the voltage of the ac power source. You must set the voltage selector card correctly to adapt the 8503A to the power source. Failure to set the ac power input of the instrument for the correct voltage level could cause damage to the instrument when switched on.

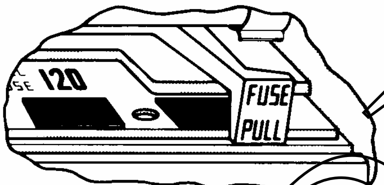
2-9. Select the line voltage and fuse as follows:

a. Measure the ac line voltage.

b. Refer to Figure 2-1. At the instrument's rear panel power line module, select the line voltage (100V, 120V, 220V, 240V) closest to the voltage you measured in step a. Line voltage must be within +5% or −10% of the voltage setting. If it is not, you must use an autotransformer between the ac source and the 8503A.

c. Make sure the correct fuse is installed in the fuse holder. The required fuse rating for each line voltage selection is indicated below the power line module.





SELECTION OF OPERATING VOLTAGE

1. SLIDE OPEN POWER MODULE COVER DOOR AND PUSH FUSE-PULL LEVER TO LEFT TO REMOVE FUSE.
2. PULL OUT VOLTAGE-SELECTOR PC BOARD. POSITION PC BOARD SO THAT VOLTAGE NEAREST ACTUAL LINE VOLTAGE LEVEL IS ON TOP-LEFT SIDE OF BOARD. PUSH BOARD BACK INTO ITS SLOT.
3. PUSH FUSE-PULL LEVER INTO ITS NORMAL RIGHT-HAND POSITION.
4. CHECK FUSE TO MAKE SURE IT IS OF CORRECT RATING AND TYPE FOR INPUT AC LINE VOLTAGE. FUSE RATINGS FOR DIFFERENT LINE VOLTAGES ARE INDICATED BELOW POWER MODULE.
5. INSERT CORRECT FUSE IN FUSEHOLDER.

Figure 2-1. Line Voltage Selection with Power Module PC Board

2-10. Cable Connections

2-11. Power Cable. In accordance with international safety standards this instrument is equipped with a three-wire power cable. When connected to an appropriate power line outlet, this cable grounds the instrument cabinet. Figure 2-2 shows the styles of mains plugs available on power cables supplied with HP instruments. The numbers for the plugs are part numbers for complete power cables.

WARNING

If this instrument is to be energized through an autotransformer, make sure the common terminal of the auto transformer is connected to the protective earth contact of the power source outlet socket.

Any interruption of the protective ground, inside or outside of the 8503A can make the 8503A a shock hazard.

2-12. Signal Processor Interconnect Cable. Connect Signal Processor interconnect cable (HP Part Number 08503-60005) from 8503A rear-panel SIGNAL PROCESSOR INTERCONNECT (A10J2) to 8505A rear-panel TEST SET INTERCONN. (A3J3).

2-13. HP-IB Cable (Option 001 Only). Connect HP-IB cable (HP Part Number 10631A) from 8503A Option 001 rear-panel HP-IB connector (A10J3) to 8505A Option 001 rear-panel HP-IB connector.

2-14. RF Connecting Cables. Connect four short cables (HP Part Number 8120-2289) between 8503A and 8505A corresponding front-panel connectors; i.e., RF to RF, R to R, A to A, and B to B.

NOTE

If use of X1 MODE (8505A Electrical Length) is required for higher resolution, refer to Section VIII, Table 8-1 for proper cable configuration.

NOTE

If RFI is a critical consideration, use semi-rigid coax for RF connecting cables.

2-15. Mating Connectors

2-16. A list of connectors on the front and rear panels of the Model 8503A is given in Table 2-1.

Table 2-1. Model 8503A Mating Connectors

Connector on Instrument	Mating Connector		
	Industry Identification	HP Part No.	Alternate Sources
J1 RF J2 R J3 A J4 B	Type N, male connector, UG-21G/U	1250-0882	Amphenol Bendix Specialty Connector
A2J1 Port 1 A3J1 Port 2	Type APC-7 connector	1250-1183	Amphenol
J5 Bridge Bias 1 J6 Bridge Bias 2	Type BNC, male connector UG-88/U	1250-0256	Amphenol Bendix Specialty Connector
A10J2 Interconnect cable connector	Series D, 25 contact, male connector	1251-0063	Cinch Cannon
A10J3 HP-IB	HP-IB Cable	10631A/B/C*	None

*HP-IB cable 10631A is approximately 1 metre long; 10631B, 2 metres long; 10631C, 4 metres long.

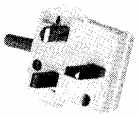
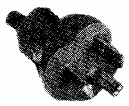
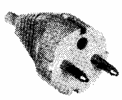
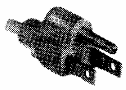
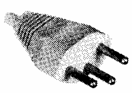
Plug Type	HP Part Number	Plug Description	Cable Length (inches)	Cable Color	For Use In Country
	8120-1351 8120-1703	Straight 90°	90 90	Mint Gray Mint Gray	Great Britian Cyprus, Nigeria Rhodesia Singapore So. Africa, India
	8120-1369 8120-0696	Straight 90°	79 87	Gray Gray	Australia New Zealand
	8120-1689 8120-1692	Straight 90°	79 79	Mint Gray Mint Gray	East and West Europe, Saudi Arabia, United Arab Republic (unpolarized in many nations)
	8120-1348 8120-1398 8120-1754	Straight 90° Straight	80 80 36	Black Black Black	United States Canada Japan (100 or 200V) Mexico Phillippines Taiwan
	8120-1378 8120-1521 8120-1676	Straight 90° Straight	80 80 36	Jade Gray Jade Gray Jade Gray	
	8120-2104	Straight	79	Gray	Switzerland

Figure 2-2. AC Power Cables Available

2-17. Operating Environment

2-18. The operating environment should be within the following limitations:

Temperature .... 0°C to +55°C
Humidity .... Up to 95% relative
Altitude .... 4572 metres (15,000 feet)

2-19. Installation Instructions

2-20. General. When used with the 8505A Network Analyzer, the S-Parameter Test Set may be positioned on bottom or on top of network analyzer (bottom is preferred position). Where test set is on bottom, use four short (19 cm) RF connecting cables, HP Part Number 8120-2289, supplied with the 8503A. When test set is on top, the 11851A cable kit is required to provide RF connectings between 8505A and 8503A.

2-21. 8505A Operating Instruction Sheet. When the 8503A is positioned on the bottom of the network analyzer and the short RF connecting cables are used, the 8505A Operating Instruction Sheet must be removed from the bottom of the 8505A and installed on the bottom of the 8503A. To accomplish this, proceed as follows:

a. Set the 8505A on its left side (facing the front panel) and remove the two plastic feet from the right side of the instrument as shown in Figure 2-3. To remove feet, lift tabs and slide in direction of arrows.

b. Remove 8505A Operating Instruction Sheet (in its housing) and reinstall the two plastic feet which were removed in step a. Make certain that the tabs are all the way down against the bottom cover before returning the 8505A to its normal position.

c. Set the 8503A on its left side and remove the two plastic feet from the right side of the instrument as shown in Figure 2-3.

d. With the 8505A Operating Instruction Sheet (and its housing) oriented so the instruction sheet will pull out toward the front of the 8503A, insert the two bottom metal tabs on the instruction sheet housing under the two bottom feet of the 8503A (the tab near the front panel is inserted in the small slot between the front frame and the plastic foot). See Figure 2-3.

e. Reinstall the two plastic feet which were removed in step c. Make certain that the tabs are all the way down against the bottom cover and that the operating instruction sheet housing is secured by all four feet before returning the 8503A to its normal position.

2-22. Locking Units Together. If it is desired to lock the 8503A and the 8505A together, use the hardware provided and proceed as follows:

a. Remove the 8503A front frame top trim strip (see Figure 6-2, item 5).

b. Fasten the four lock links (HP Part Number 1600-0367) to the 8503A front frame using the eight 6-32 pozidrive screws provided (there are eight threaded holes in the front frame). The hook-shaped protrusions of the lock links must extend toward the rear of the 8503A.

c. Remove the two bottom rear feet from the 8505A (lower unit) and replace with two lock feet which contain thumb screws. There is a left one (HP Part Number 08505-20156) and a right one (HP Part Number 08505-20158). See Figure 2-4 for proper placement.

d. Set the 8505A on its side and remove the four bottom feet. To remove feet, lift tabs and slide in direction of arrows.

e. Remove the two top rear feet from the 8503A and replace with top left rear lock foot (HP Part Number 08505-20155) and top right rear lock foot (HP Part Number 08505-20157). See Figure 2-4 for proper placement.

f. Set the 8505A Network Analyzer on top of the 8503A S-Parameter Test Set with the front edge of the 8505A overhanging the front edge of the 8503A approximately 1/4 inch.

g. Slide the 8505A back until its front edge is even with the front edge of the 8503A. This should lock the fronts of the two units together. Make sure they are locked by carefully lifting the front of the 8505A.

h. Tighten the thumb screws on the bottom rear lock feet of the 8505A into the top rear lock feet of the 8503A.

2-23. Bench Operation

2-24. The instrument cabinet has plastic feet and foldaway tilt stands for convenience in bench operation. the tilt stands raise the front of the instrument for easier viewing of the control panel, and the plastic feet are shaped to make full width modular instruments self-aligning when stacked.

2-25. Rack Mounting (Option 908/909)

2-26. Instruments with Option 908 contain Rack Flange Kit. This kit supplies necessary hardware and installation instructions for preparing the instrument to be mounted on a rack of 482,6 mm (19 inch) spacing. Installation instructions are also given in Figure 2-5. See Table 2-2 for HP Part Numbers.

2-27. Instruments with Option 909 contain Rack Flange Front Handle Kit. This kit supplies necessary hardware and installation instructions for preparing instrument, with the addition of front handles, to be mounted on a rack of 482,6 mm(19 inch) spacing. Installation instructions are also given in Figure 2-5.

2-28. Front Handles (Option 907)

2-29. Instruments with Option 907 contain front Handle Kit. This kit supplies necessary hardware and installation instructions for mounting front handles on the instrument. Installation instructions are also given in Figure 2-5.

2-30. INCOMING INSPECTION TEST

2-31. This test is designed to meet the needs of incoming inspection. The procedures shown in Figure 2-6 test the critical specifications of the HP Model 8503A S-Parameter Test Set. Equipment required to perform the incoming inspection is listed in Table 1-8. If substitution is necessary for any of the equipment, the alternate models must meet or exceed the critical specifications listed in Table 1-8.

2-32. The incoming inspection test varifies only the critical specifications of the instrument. If complete certification is required, use the more detailed procedures in Section IV which test all of the specifications of the instrument.

2-33. STORAGE AND SHIPMENT

2-34. Environment

2-35. The instrument should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment.

Temperature . . . . −40°C + 75°C
Humidity . . . . Up to 95% relative
Altitude . . . . 15240 metres (50,000 feet)

Table 2-2. Rack-Mounting Kits for 8503A

Description	HP Part Number	Quantity
OPTION 908		
Rack Flange	5020-8861	2
Machine Screw, Pan Head, 8-32 x 0.375 inch	2510-0193	6
OPTION 909		
Handle Assembly	5060-9898	2
Rack Flange	5020-8873	2
Machine Screw, Pan Head, 8-32 x 0.625 inch	2510-0194	6

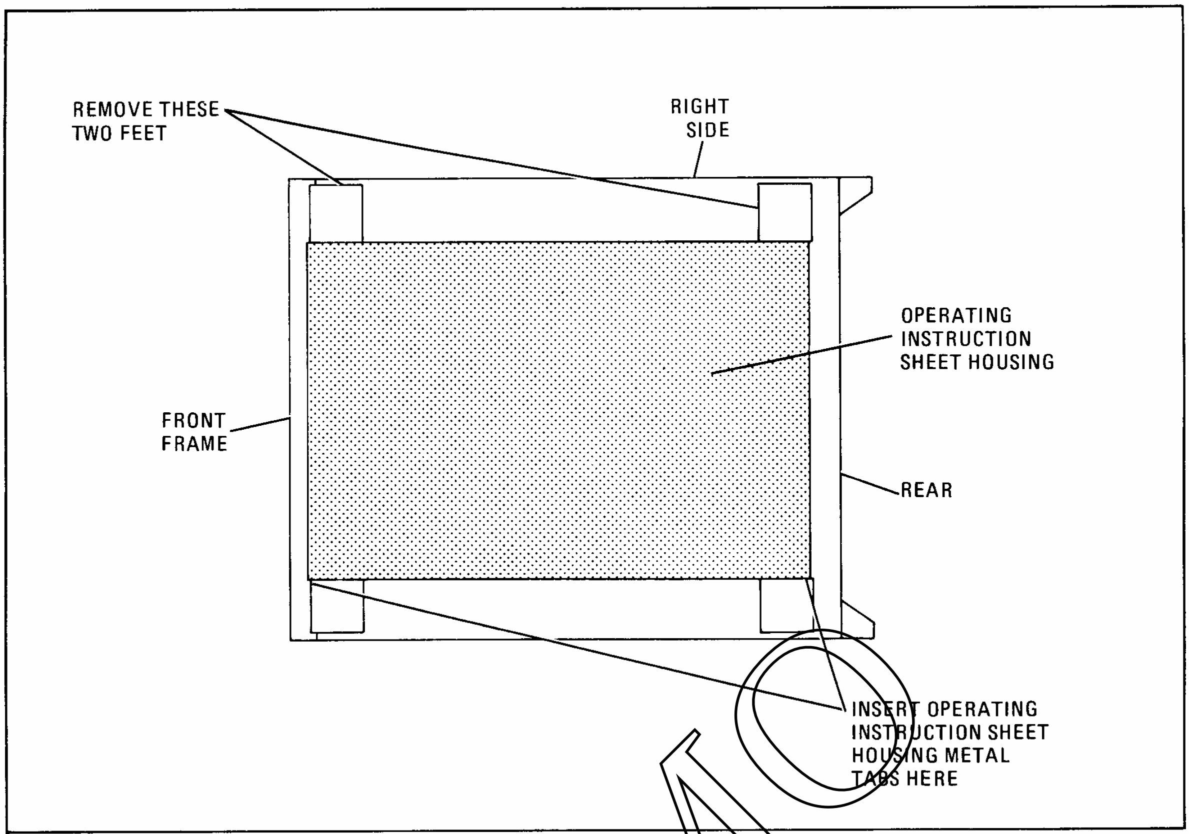


Figure 2-3. Changing 8505A Operating Instruction Sheet to Bottom of 8503A

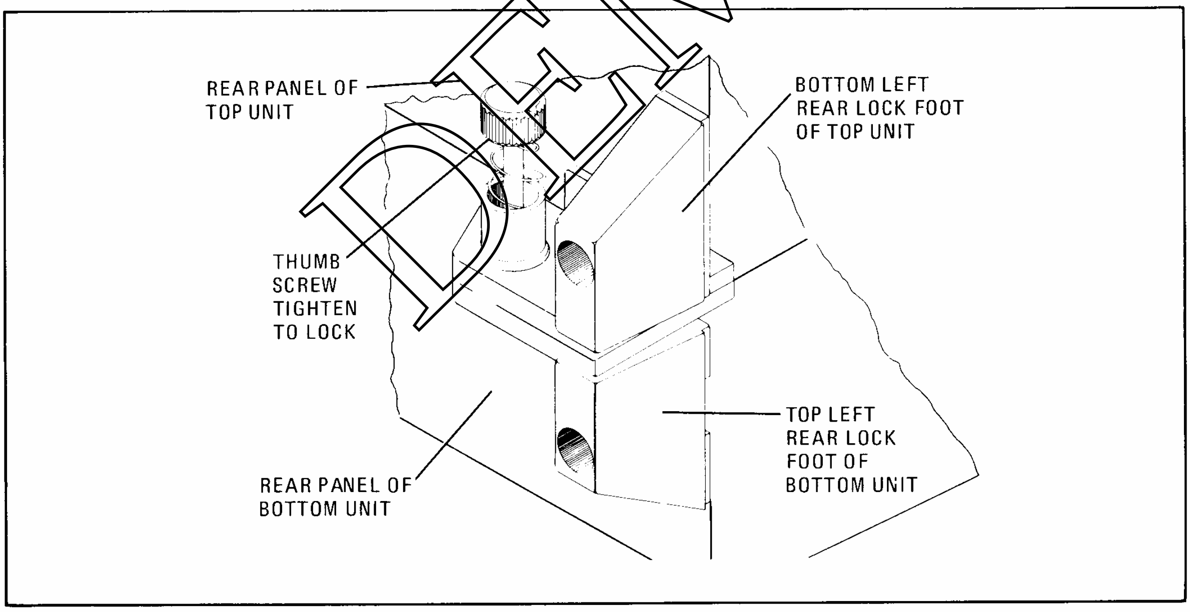


Figure 2-4. Lock Feet, Left Side

2-36. Packaging

2-37. 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.

2-38. Other Packaging. The following general instructions should be used for repackaging with commercially available materials.

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

b. Use a strong shipping container. A double-wall carton made of 275 pound bursting strength corrugated single-wall box is sufficient.

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 control panel with cardboard.

d. Seal the shipping container securely.

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

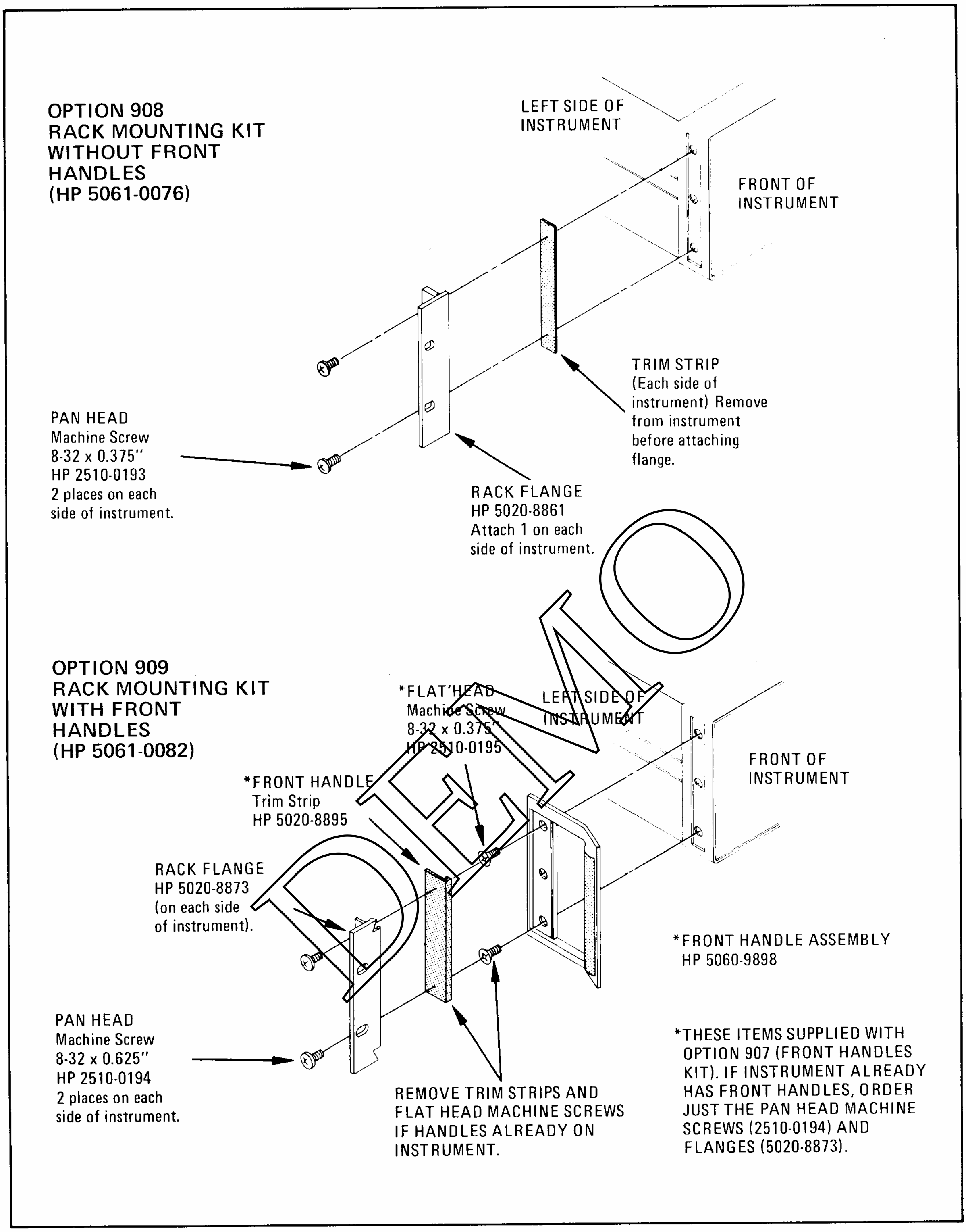
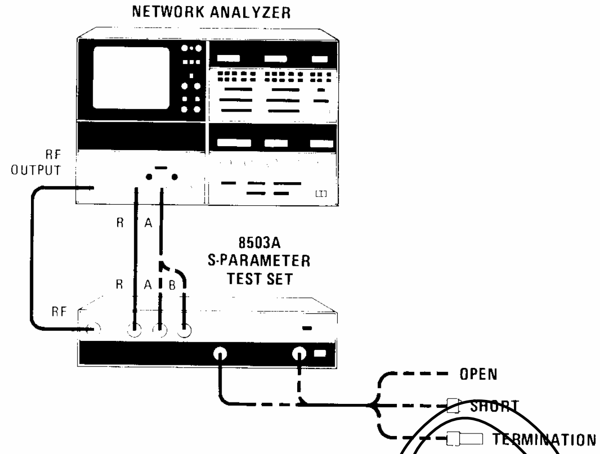


Figure 2-5. Attaching Rack Mounting Hardware and Handles

INCOMING INSPECTION TEST



EQUIPMENT:

Network Analyzer	HP 8505A
APC-7 Short	HP 11565A
50Ω APC-7 Termination with ≤1.005 SWR*	HP 909A-H68

*Part of HP 85031A Verification and APC-7 Calibration Kit.

PROCEDURE:

a. Set 8503A controls as follows:

S-PARAMETER SELECT	FORWARD
LINE	ON

b. Set 8505A controls as follows:

A1 Source/Converter:

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

Figure 2-6. Incoming Inspection Test (1 of 3)

INCOMING INSPECTION TEST

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 1	Mid-range
START FREQUENCY	0 MHz
STOP FREQUENCY	1300 MHz

A3 Signal Processor:

Channel 1:

INPUT	A/R
MODE	MAG
SCALE/DIV	20 dB

Channel 2:

MODE	OFF

Electrical Length:

MODE	OFF..

c. Connect equipment as shown in test setup with PORT 1 and PORT 2 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 line.

f. To calibrate the system for directivity measurements, connect coaxial short directly to PORT 1 of the 8503A. On 8505A Signal Processor Channel 1, press DISPLAY MKR then ZRO pushbuttons to place marker on reference line and to zero digital readout.

NOTE

In the following step, 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 mesurement will not be repeatable.

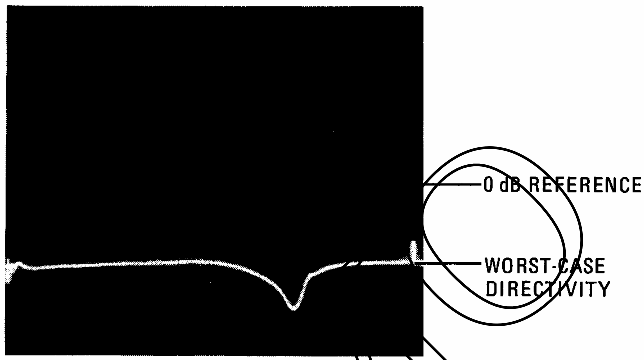
Figure 2-6. Incoming Inspection Test (2 of 3)

INCOMING INSPECTION TEST

g. To measure the directivity of the 8503A, remove coaxial short and replace it with a 50Ω termination (HP 909A-H68). The SWR of the termination must be ≤1.005 (52 dB Return Loss).

   (1) Set 8505A Frequency Control MARKER 1 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.



NOTE

If the worst-case directivity appears to be less than 40 dB, remove termination. Observe the 8505A digital marker readings with 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 connected.

h. Connect 8503A Port B to 8505A INPUT A.

i. Set 8503A S-PARAMETER SELECT switch to REVERSE.

j. Repeat steps e through g for PORT 2 (connect short to PORT 2 instead of PORT 1 in step f).

Figure 2-6. Incoming Inspection Test (3 of 3)

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This operating section explains the function of the controls and indicators of the Model 8503A S-Parameter Test Set. It also describes typical operating modes in a measurement system.

3-3. PANEL FEATURES

3-4. Front and rear panel features are described in Figure 3-1. Description numbers match the numbers on the illustration.

3-5. OPERATOR'S CHECKS

3-6. The Operator's Checks (Figure 3-2) allow the operator to quickly evaluate the instrument's main functions prior to use.

3-7. OPERATING INSTRUCTIONS

3-8. Figure 3-3 shows the RF signal path when measuring the four different s-parameters. Figure 3-4 shows general operating procedures using the 8503A S-Parameter Test Set with 8505A Network Analyzer. When used in the 8507A Automatic Network Analyzer system, the procedures are the same except that the 8503A Option 001 transfer switch (FORWARD/REVERSE) can be controlled by the HP-IB.

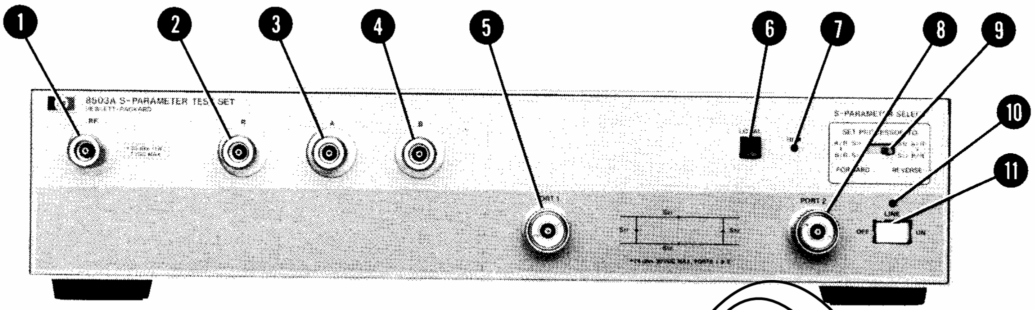
3-9. OPERATOR'S MAINTENANCE

3-10. Fuses. The 8503A has three fuses, two of which are internal. Only the ac line fuse located at the back of the instrument may be replaced by the operator. The ac line cord should be disconnected from the power source, then the other end disconnected from the instrument. With the power cord removed, access may be gained to the fuse compartment by sliding open the power module cover door. The fuse may be removed by pulling the lever inside the fuse compartment. Replace with fuse of correct rating and type for ac line voltage selected. Fuse ratings for different voltages are indicated below the power module. Access to the other two fuses requires removing the instrument top cover. The internal fuses should only be replaced by a qualified service technician.

3-11. APC/7 Connectors. Figure 3-5 shows use and care of APC-7 connectors.

FRONT AND REAR PANEL FEATURES

FRONT



REAR

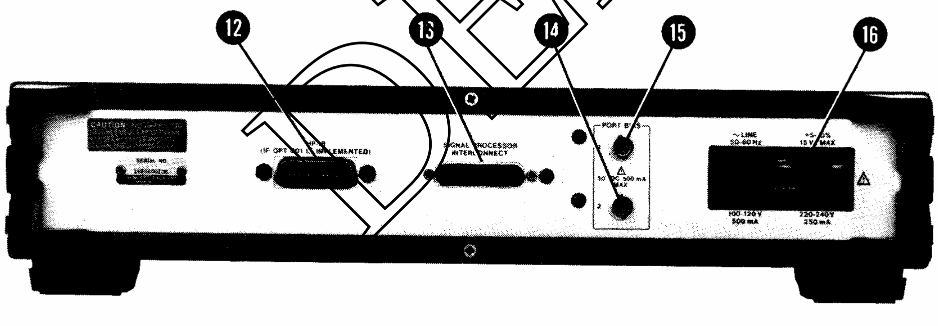


Figure 3-1. Front and Rear Panel Controls, Connectors, and Indicators (1 of 3)

FRONT AND REAR PANEL FEATURES

1 RF Input Connector. The RF input connector provides input connection for RF signal from 8505A Source/Converter or similar RF source.

CAUTION

Do not exceed +30 dBm (1 watt) or 7 Vdc maximum input to the RF input connector. If these levels are exceeded, severe damage to the instrument may result.

2 R Port. The R port (Port R) provides reference signal to port R of 8505A Source/Converter or to the reference port of a similar type network analyzer.

3 A Port. Port A provides an RF signal to port A of 8505A Source/Converter. The RF signal at 8503A port A is dependent on position of S-PARAMETER SELECT switch 9 or calculator program (8503A Option 001). The port A output may also be used as a measurement channel input for a similar type network analyzer.

4 B Port. Port B provides signal to port B of 8505A Source/Converter. The RF signal at 8503A port B is dependent on position of S-PARAMETER SELECT switch 9 or calculator program (8503A Option 001). The port B output may also be used as a measurement channel input for a similar type network analyzer.

5 PORT 1. The device under test is connected directly or indirectly (through special cables or fixtures) to PORT 1 (or PORT 2 8, or both test ports 5 and 8).

CAUTION

Do not exceed +26 dBm or 30 Vdc maximum input to PORT 1 or PORT 2. If these levels are exceeded, severe damage to instrument may result.

6 LOCAL Pushbutton Switch. This switch is functional only in instruments with Option 001. The function of this pushbutton switch is to over ride the REM (remote) signal line from the calculator and return the 8503A Option 001 to LOCAL mode. Once the LOCAL pushbutton switch is pressed, the 8503A Option 001 will remain in LOCAL mode until programmed to REMote by the operator.

7 REM Indicator. This indicator is functional only in instruments with Option 001. The REM indicator is on when the 8503A Option 001 is in REMote mode. In the REM Mode, the transfer switch (FORWARD/REVERSE) is controlled by the calculator rather than the S-PARAMETER SELECT switch 9.

8 PORT 2. The device under test is connected directly or indirectly (through special cables or fixtures) to PORT 2 (or PORT 1 5, or both test port 5 and 8). PORT 2 adjusts laterally to allow for slightly different port spacing of test fixtures.

Figure 3-1. Front and Rear Panel Controls, Connectors, and Indicators (2 of 3)

FRONT AND REAR PANEL FEATURES

CAUTION

Do not exceed +26 dBm or 30 Vdc maximum input to PORT 1 or PORT 2. If these levels are exceeded, severe damage to instrument may result.

9 **S-PARAMETER SELECT Switch.** This slide switch selects s-parameters to be measured (FORWARD direction or REVERSE direction).

10 **LINE-ON Indicator.** This indicator is lit when ac power is applied to the 8503A through the LINE OFF-ON switch 11 (ON Position) and the +5 Vdc power supply is providing +5 volts.

11 **LINE OFF-ON Switch.** In the ON position (right side of switch pressed), ac power is applied to the 8503A and the LINE ON indicator 10 is lit. In the OFF position (left side of switch pressed), no ac power is applied to the 8503A through the LINE OFF-ON switch and the LINE ON indicator 10 is not lit.

12 **HP-IB Connector A10J3.** The rear-panel HP-IB connector is functional only in instruments with Option 001. Ths connector provides for connection of cable (HP 10631A) from 8503A Option 001 to other HP-IB instruments.

13 **SIGNAL PROCESSOR INTERCONNECT Connector A10J2.** This connector provides an interface between the 8503A and the 8505A Signal Processor. With the Signal Processor Interconnect Cable (HP Part Number 08503-60005) connected properly, the 8505A "remembers" the settings and calibrations of the 8503A to provide current and stored information on the 8505A CRT display.

14 **PORT BIAS 1 BNC Connector.** This connector provides for dc bias to PORT 1 5 . The dc source applied at this connector is used to bias device under test connected to PORT 1.

CAUTION

Do not exceed 30 Vdc or 500 mA maximum input to PORT BIAS connector. If these levels are exceeded, damage to the instrument may result.

15 **PORT BIAS 2 BNC Connector.** This connector provides for dc bias to PORT 2 8. The dc source applied at this connector is used to bias device under test connected to PORT 2.

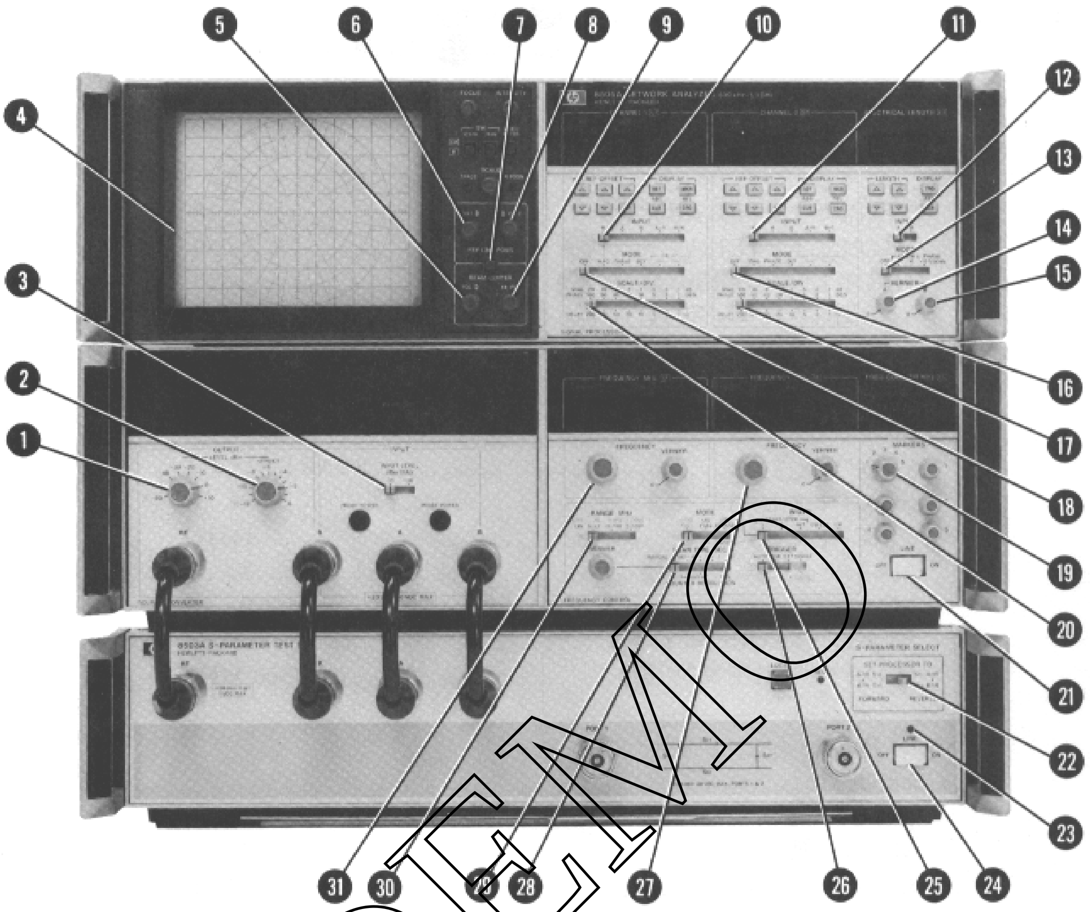
CAUTION

Do not exceed 30 Vdc or 500 mA maximum input to PORT BIAS connector. If these levels are exceeded, damage to the instrument may result.

16 **Power Line Module FL1 and Fuse F1.** Line Voltage Selector PC board allows selection of 100, 120, 220, or 240 VAC OPERATION. Instructions for line voltage selection and changing fuses are in Figure 2-1.

Figure 3-1. Front and Rear Panel Controls, Connectors, and Indicators (3 of 3)

OPERATOR'S CHECKS



1. Connect cables as described in Section II, Paragraphs 2-11 through 2-14.

WARNING

BEFORE CONNECTING LINE POWER TO THIS INSTRUMENT, ensure that all line-powered devices connected to this instrument are connected to the protective (earth) ground.

BEFORE SWITCHING ON THIS INSTRUMENT, ensure that the line power(mains) plug is conected to a three-conductor line power outlet that has a protective (earth) ground. (Grounding one conductor of a two-conductor outlet is not sufficient.)

Figure 3-2. Operator's Checks (1 of 5)

OPERATOR'S CHECKS

2. Set 8505A and 8503A LINE switches (21) and (24) to ON. On 8505A, LED displays should be lit. On 8503A, LINE ON indicator (23) should be lit.

3. Set 8505A controls as follows:

A1 Source/Converter:

OUTPUT LEVEL dBm (1)	−10
OUTPUT LEVEL Vernier (2)	0
INPUT LEVEL dBm MAX (3)	−10

A2 Frequency Control:

RANGE MHz (30)	.5 — 1300
MODE (29)	LIN FULL
WIDTH (25)	START/STOP 1
SCAN TIME SEC (28)	.1 — .01
TRIGGER (26)	AUTO
MARKERS Switch (19)	1
MARKER 1	Mid-Range
START FREQUENCY (31)	0 MHz
STOP FREQUENCY (27)	1300 MHz

A3 Signal Processor:

Channel 1:

INPUT (10)	A/R
MODE (18)	MAG
SCALE/DIV (20)	1 dB

Channel 2:

INPUT (11)	A/R
MODE (16)	PHASE
SCALE/DIV (17)	90 DEG

Electrical Length:

INPUT (12)	A
MODE (13)	X10

4. Set 8503A S-PARAMETER SELECT switch (22) to FORWARD.

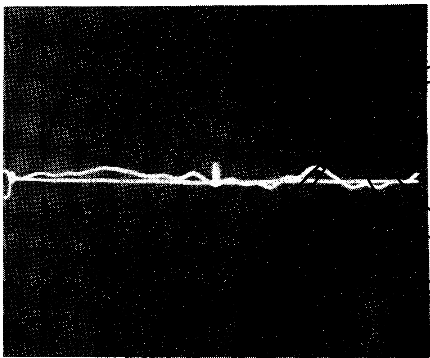
Figure 3-2. Operator's Checks (2 of 5)

OPERATOR'S CHECKS

5. On 8505A CRT display, press REF LINE POSN pushbutton 7. Adjust CH 1 and CH 2 controls 5 and 9 until traces are positioned to center of screen. Press REF LINE POSN pushbutton again to return system to normal operation.

6. On 8505A Signal Processor Electrical Length, press LENGTH pushbuttons and adjust VERNIER A control 14 to display a horizotal trace of phase on CRT 4.

7. On 8505A Signal Processor, press DISPLAY MRK then ZRO for Channel 1 and Channel 2. The CRT display should be similar to that shown in the following waveform.



Waveform Showing Magnitude and Phase of S_{11}

8. On 8505A Signal Processor, set Channel 1 and Channel 2 INPUT switches 10 and 11 to B/R and set Electrical Length INPUT switch 12 to B.

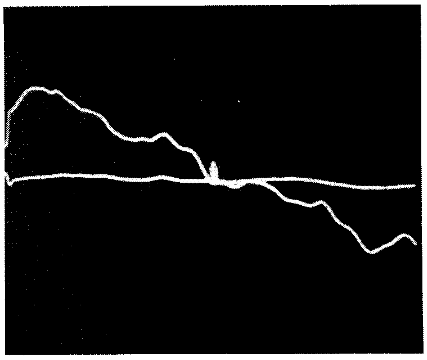
9. On 8503A, set S-PARAMETER SELECT switch 22 to REVERSE.

10. On 8505A Signal Processor Electrical Length, press LENGTH Pushubttons and adjust VERNIER B control 15 to display a horizontal trace of phase on CRT 4.

11. On 8505A Signal Processor, press DISPLAY MKR then ZRO for Channel 1 and Channel 2. The CRT display should be similar to that shown in the following waveform.

Figure 3-2. Operator's Checks (3 of 5)

OPERATOR'S CHECKS

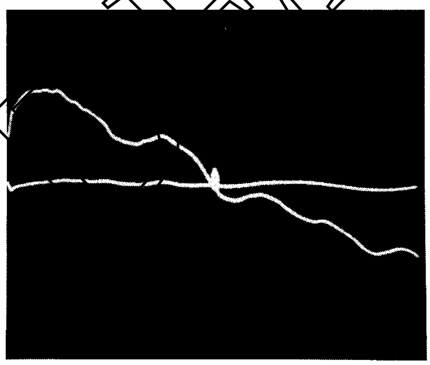


Waveform Showing Magnitude and Phase of S_{22}

12. Connect thru line (HP Model 11857A) from PORT 1 to PORT 2 of 8503A. Set S-PARAMETER SELECT switch 22 to FORWARD.

13. On 8505A Signal Processor Electrical Length, press LENGTH pushbuttons and adjust VERNIER B control 15 to display a horizontal trace of phase on CRT 4.

14. On 8505A Signal Processor, press DISPLAY MKR then ZRO for Channel 1 and Channel 2. The CRT display should be similar to that shown in the following waveform.



Waveform Showing Magnitude and Phase of S_{21}

Figure 3-2. Operator's Checks (4 of 5)

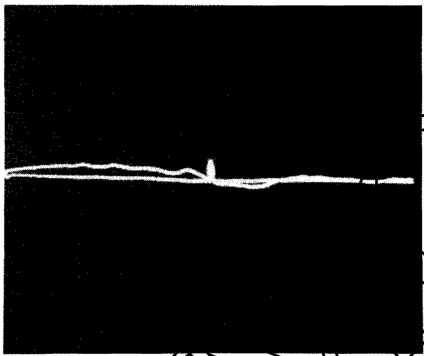
OPERATOR'S CHECKS

15. On 8505A Signal Processor, set Channel 1 and Channel 2 INPUT switches 10 and 11 to A/R and set Electrical Length INPUT switch 12 to A.

16. On 8503A, set S-PARAMETER SELECT switch 22 to REVERSE.

17. On 8505A Signal Processor Electrical Length, press LENGTH pushbuttons and adjust VERNIER A control 14 to display a horizontal trace of phase on CRT 4.

18. On 8505A Signal Processor, press DISPLAY MKR then ZRO Channel 1 and Channel 2. The CRT display should be similar to that shown in the following waveform.



Waveform Showing Magnitude and Phase of S_{12}

Figure 3-2. Operator's Checks (5 of 5)

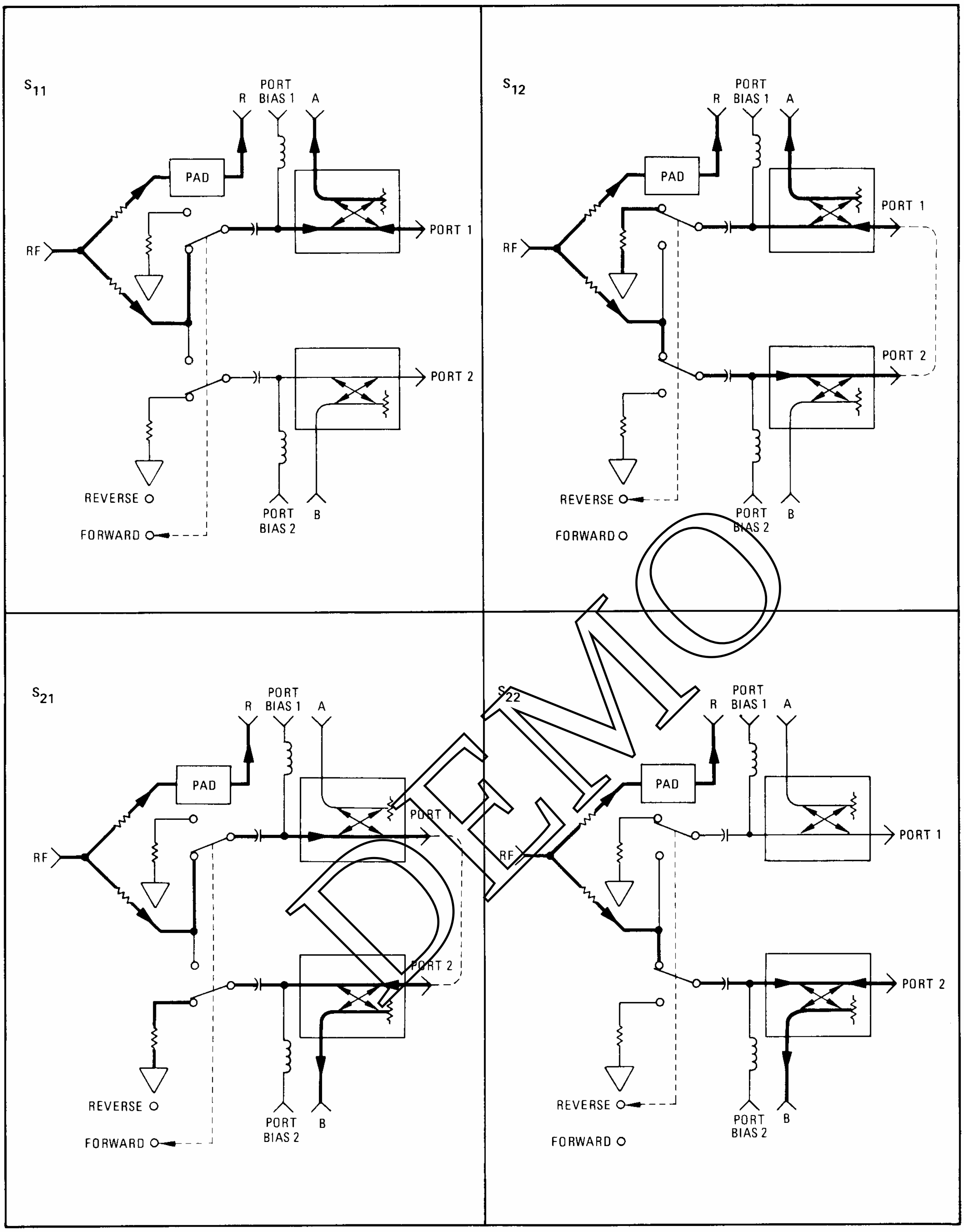
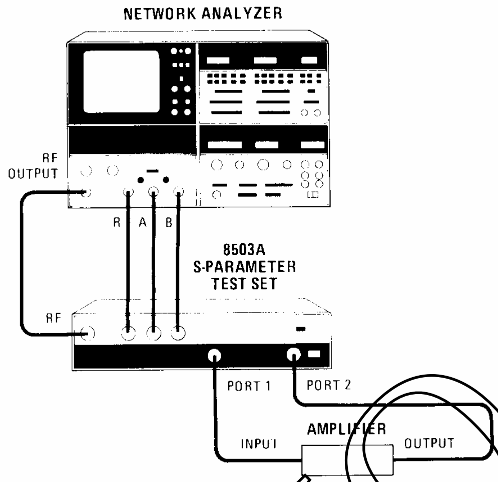


Figure 3-3. RF Signal Path

OPERATING INSTRUCTIONS

AMPLIFIER MEASUREMENT
LOCAL OPERATION



WARNINGS

BEFORE CONNECTING LINE POWER TO THIS INSTRUMENT, ensure that all line-powered devices connected to this instrument are connected to the protective (earth) ground.

BEFORE SWITCHING ON THIS INSTRUMENT ensure that the line power (mains) plug is connected to a three-conductor line power outlet that has a protective (earth) ground. (Grounding one conductor of a two-conductor outlet is not sufficient.)

1. Connect cables as described in Seciton II, Paragraphs 2-11 through 2-14.

2. Set 8505A and 8503A LINE switches to ON and allow at least 30 minutes warm-up time.

3. Set 8503A controls as follows:

A1 Source/Converter:

OUTPUT LEVEL dBm .... −20
OUTPUT LEVEL Vernier 0
INPUT LEVEL dBm MAX .... −10

Figure 3-4. Operating Instructions (1 of 14)

OPERATING INSTRUCTIONS

AMPLIFIER MEASUREMENT
LOCAL OPERATION

A2 Frequency Control:
- RANGE MHz .... Desired frequency reange
- MODE .... LIN EXPAND
- WIDTH .... START/STOP 1
- SCAN TIME SEC .... .1 — .01
- VERNIER .... Fully Counterclockwise
- TRIGGER .... AUTO
- MARKERS Switch 1
- MARKER 1 .... Mid-Range
- START FREQUENCY .... Lowest frequency desired
- STOP FREQUENCY................ Highest frequency desired

A3 Signal Processor:

Channel 1:
- INPUT .... A/R
- MODE .... MAG
- SCALE/DIV .... 10 dB

Channel 2:
- MODE .... OFF

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

4. To measure parameter S_{11} of the amplifier (input reflection characteristic) proceed as follows:

   a. With 8503A PORT 1 and PORT 2 open (amplifier not connected), set S-PARAMETER SELECT switch to FORWARD.

   b. 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.

   c. Press Channel 1 DISPLAY MKR then ZRO pushbuttons to place marker on reference line and to zero digital readout.

   d. Connect amplifier as shown in test setup:

   e. Set MARKER 1 to desired measurement frequency or frequencies and read the magnitude value(s) from Channel 1 MKR digital readout.

   f. On 8505A Signal Processor, set Channel 1 MODE switch to PHASE. Disconnect amplifier from 8503A test ports.

Figure 3-4. Operating Instructions (2 of 14)

FRONT AND REAR PANEL FEATURES

❶ **RF Input Connector.** The RF input connector provides input connection for RF signal from 8505A Source/Converter or similar RF source.

CAUTION

Do not exceed +30 dBm (1 watt) or 7 Vdc maximum input to the RF input connector. If these levels are exceeded, severe damage to the instrument may result.

❷ **R Port.** The R port (Port R) provides reference signal to port R of 8505A Source/Converter or to the reference port of a similar type network analyzer.

❸ **A Port.** Port A provides an RF signal to port A of 8505A Source/Converter. The RF signal at 8503A port A is dependent on position of S-PARAMETER SELECT switch ❾ or calculator program (8503A Option 001). The port A output may also be used as a measurement channel input for a similar type network analyzer.

❹ **B Port.** Port B provides signal to port B of 8505A Source/Converter. The RF signal at 8503A port B is dependent on position of S-PARAMETER SELECT switch ❾ or calculator program (8503A Option 001). The port B output may also be used as a measurement channel input for a similar type network analyzer.

❺ **PORT 1.** The device under test is connected directly or indirectly (through special cables or fixtures) to PORT 1 (or PORT 2 ❽, or both test ports ❺ and ❽).

CAUTION

Do not exceed +26 dBm or 30 Vdc maximum input to PORT 1 or PORT 2. If these levels are exceeded, severe damage to instrument may result.

❻ **LOCAL Pushbutton Switch.** This switch is functional only in instruments with Option 001. The function of this pushbutton switch is to over ride the REM (remote) signal line from the calculator and return the 8503A Option 001 to LOCAL mode. Once the LOCAL pushbutton switch is pressed, the 8503A Option 001 will remain in LOCAL mode until programmed to REMote by the operator.

❼ **REM Indicator.** This indicator is functional only in instruments with Option 001. The REM indicator is on when the 8503A Option 001 is in REMote mode. In the REM Mode, the transfer switch (FORWARD/REVERSE) is controlled by the calculator rather than the S-PARAMETER SELECT switch ❾.

❽ **PORT 2.** The device under test is connected directly or indirectly (through special cables or fixtures) to PORT 2 (or PORT 1 ❺, or both test port ❺ and ❽). PORT 2 adjusts laterally to allow for slightly different port spacing of test fixtures.

Figure 3-1. Front and Rear Panel Controls, Connectors, and Indicators (2 of 3)

FRONT AND REAR PANEL FEATURES

CAUTION

Do not exceed +26 dBm or 30 Vdc maximum input to PORT 1 or PORT 2. If these levels are exceeded, severe damage to instrument may result.

9 **S-PARAMETER SELECT Switch.** This slide switch selects s-parameters to be measured (FORWARD direction or REVERSE direction).

10 **LINE-ON Indicator.** This indicator is lit when ac power is applied to the 8503A through the LINE OFF-ON switch 11 (ON Position) and the +5 Vdc power supply is providing +5 volts.

11 **LINE OFF-ON Switch.** In the ON position (right side of switch pressed), ac power is applied to the 8503A and the LINE ON indicator 10 is lit. In the OFF position (left side of switch pressed), no ac power is applied to the 8503A through the LINE OFF-ON switch and the LINE ON indicator 10 is not lit.

12 **HP-IB Connector A10J3.** The rear-panel HP-IB connector is functional only in instruments with Option 001. Ths connector provides for connection of cable (HP 10631A) from 8503A Option 001 to other HP-IB instruments.

13 **SIGNAL PROCESSOR INTERCONNECT Connector A10J2.** This connector provides an interface between the 8503A and the 8505A Signal Processor. With the Signal Processor Interconnect Cable (HP Part Number 08503-60005) connected properly, the 8505A "remembers" the settings and calibrations of the 8503A to provide current and stored information on the 8505A CRT display.

14 **PORT BIAS 1 BNC Connector.** This connector provides for dc bias to PORT 1 5. The dc source applied at this connector is used to bias device under test connected to PORT 1.

CAUTION

Do not exceed 30 Vdc or 500 mA maximum input to PORT BIAS connector. If these levels are exceeded, damage to the instrument may result.

15 **PORT BIAS 2 BNC Connector.** This connector provides for dc bias to PORT 2 8. The dc source applied at this connector is used to bias device under test connected to PORT 2.

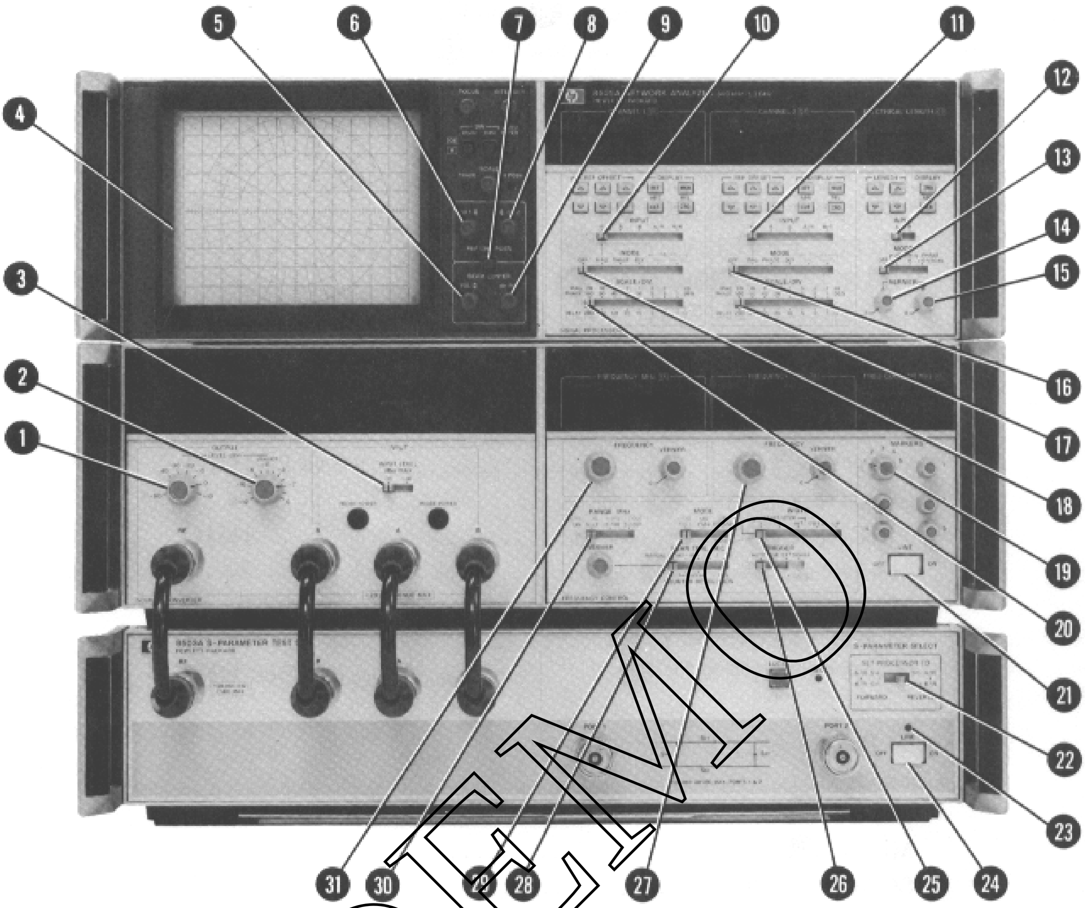
CAUTION

Do not exceed 30 Vdc or 500 mA maximum input to PORT BIAS connector. If these levels are exceeded, damage to the instrument may result.

16 **Power Line Module FL1 and Fuse F1.** Line Voltage Selector PC board allows selection of 100, 120, 220, or 240 VAC OPERATION. Instructions for line voltage selection and changing fuses are in Figure 2-1.

Figure 3-1. Front and Rear Panel Controls, Connectors, and Indicators (3 of 3)

OPERATOR'S CHECKS



1. Connect cables as described in Section II, Paragraphs 2-11 through 2-14.

WARNING

BEFORE CONNECTING LINE POWER TO THIS INSTRUMENT, ensure that all line-powered devices connected to this instrument are connected to the protective (earth) ground.

BEFORE SWITCHING ON THIS INSTRUMENT, ensure that the line power(mains) plug is conected to a three-conductor line power outlet that has a protective (earth) ground. (Grounding one conductor of a two-conductor outlet is not sufficient.)

Figure 3-2. Operator's Checks (1 of 5)

OPERATOR'S CHECKS

2. Set 8505A and 8503A LINE switches (21) and (24) to ON. On 8505A, LED displays should be lit. On 8503A, LINE ON indicator (23) should be lit.

3. Set 8505A controls as follows:

   A1 Source/Converter:

   - OUTPUT LEVEL dBm (1) .... −10
   - OUTPUT LEVEL Vernier (2) 0
   - INPUT LEVEL dBm MAX (3) .... −10

   A2 Frequency Control:

   - RANGE MHz (30) .... .5 — 1300
   - MODE (29) .... LIN FULL
   - WIDTH (25) .... START/STOP 1
   - SCAN TIME SEC (28) .... .1 — .01
   - TRIGGER (26) .... AUTO
   - MARKERS Switch (19) 1
   - MARKER 1 .... Mid-Range
   - START FREQUENCY (31) .... 0 MHz
   - STOP FREQUENCY (27) .... 1300 MHz

   A3 Signal Processor:

   Channel 1:

   - INPUT (10) .... A/R
   - MODE (18) .... MAG
   - SCALE/DIV (20) .... 1 dB

   Channel 2:

   - INPUT (11) .... A/R
   - MODE (16) .... PHASE
   - SCALE/DIV (17) .... 90 DEG

   Electrical Length:

   - INPUT (12) .... A
   - MODE (13) X10

4. Set 8503A S-PARAMETER SELECT switch (22) to FORWARD.

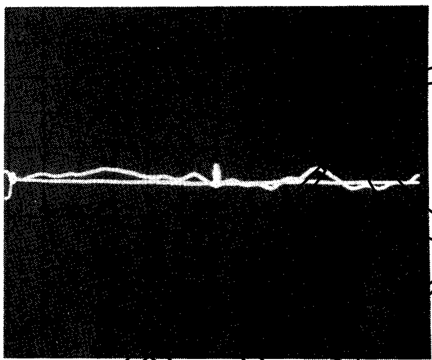
Figure 3-2. Operator's Checks (2 of 5)

OPERATOR'S CHECKS

5. On 8505A CRT display, press REF LINE POSN pushbutton 7. Adjust CH 1 and CH 2 controls 5 and 9 until traces are positioned to center of screen. Press REF LINE POSN pushbutton again to return system to normal operation.

6. On 8505A Signal Processor Electrical Length, press LENGTH pushbuttons and adjust VERNIER A control 14 to display a horizotal trace of phase on CRT 4.

7. On 8505A Signal Processor, press DISPLAY MRK then ZRO for Channel 1 and Channel 2. The CRT display should be similar to that shown in the following waveform.



Waveform Showing Magnitude and Phase of S_{11}

8. On 8505A Signal Processor, set Channel 1 and Channel 2 INPUT switches 10 and 11 to B/R and set Electrical Length INPUT switch 12 to B.

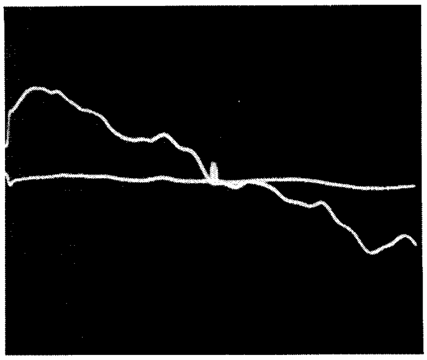
9. On 8503A, set S-PARAMETER SELECT switch 22 to REVERSE.

10. On 8505A Signal Processor Electrical Length, press LENGTH Pushubttons and adjust VERNIER B control 15 to display a horizontal trace of phase on CRT 4.

11. On 8505A Signal Processor, press DISPLAY MKR then ZRO for Channel 1 and Channel 2. The CRT display should be similar to that shown in the following waveform.

Figure 3-2. Operator's Checks (3 of 5)

OPERATOR'S CHECKS



Waveform Showing Magnitude and Phase of S_{22}

12. Connect thru line (HP Model 11857A) from PORT 1 to PORT 2 of 8503A. Set S-PARAMETER SELECT switch 22 to FORWARD.

13. On 8505A Signal Processor Electrical Length, press LENGTH pushbuttons and adjust VERNIER B control 15 to display a horizontal trace of phase on CRT 4.

14. On 8505A Signal Processor, press DISPLAY MKR then ZRO for Channel 1 and Channel 2. The CRT display should be similar to that shown in the following waveform.

Waveform Showing Magnitude and Phase of S_{21}

Figure 3-2. Operator's Checks (4 of 5)

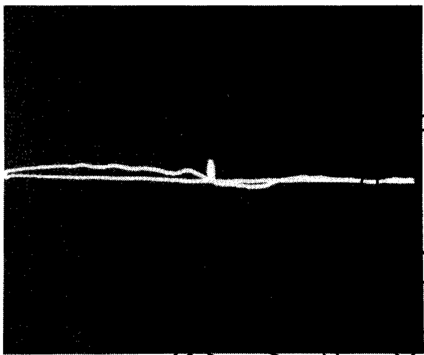
OPERATOR'S CHECKS

15. On 8505A Signal Processor, set Channel 1 and Channel 2 INPUT switches 10 and 11 to A/R and set Electrical Length INPUT switch 12 to A.

16. On 8503A, set S-PARAMETER SELECT switch 22 to REVERSE.

17. On 8505A Signal Processor Electrical Length, press LENGTH pushbuttons and adjust VERNIER A control 14 to display a horizontal trace of phase on CRT 4 .

18. On 8505A Signal Processor, press DISPLAY MKR then ZRO Channel 1 and Channel 2. The CRT display should be similar to that shown in the following waveform.



Waveform Showing Magnitude and Phase of S_{12}

Figure 3-2. Operator's Checks (5 of 5)

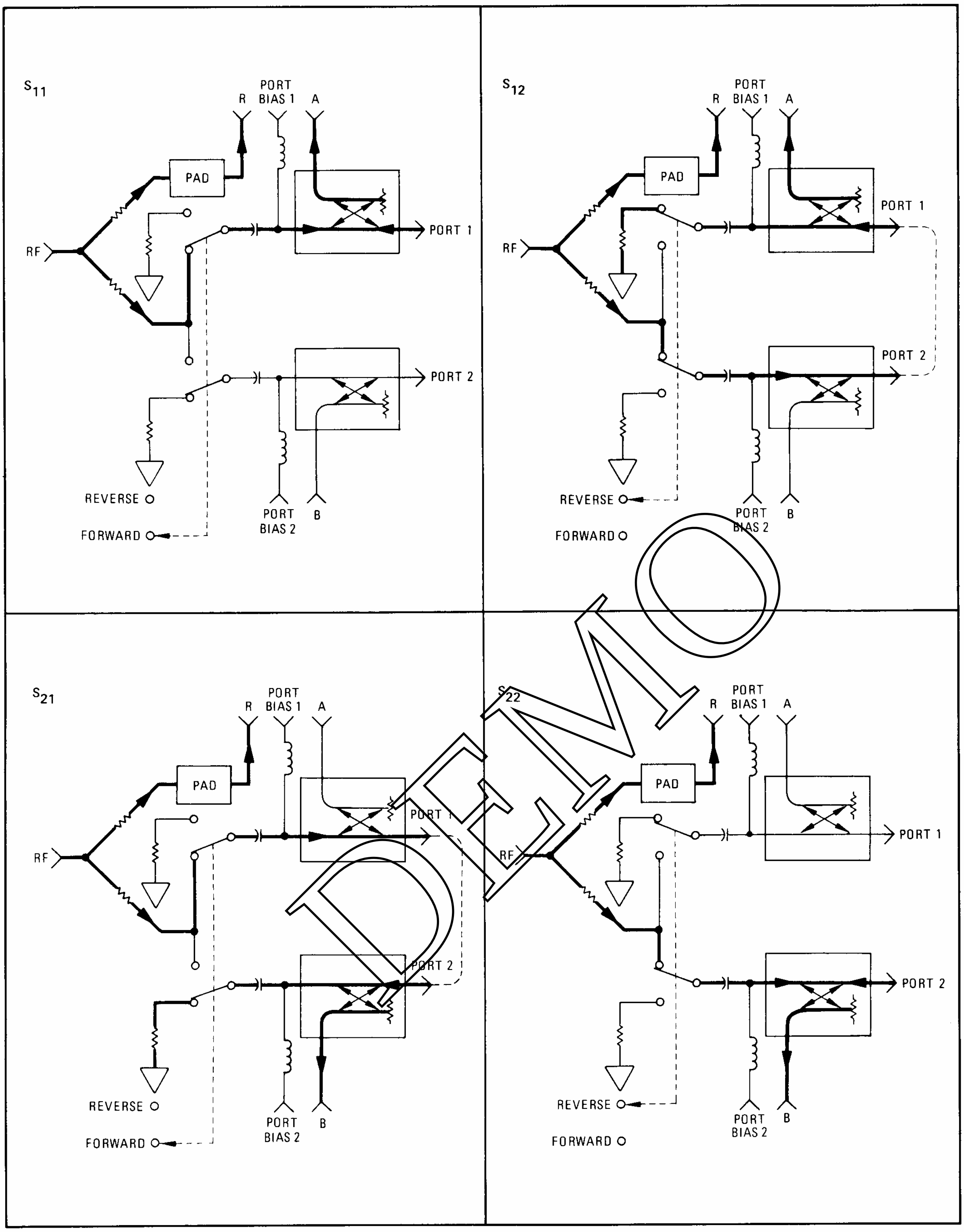
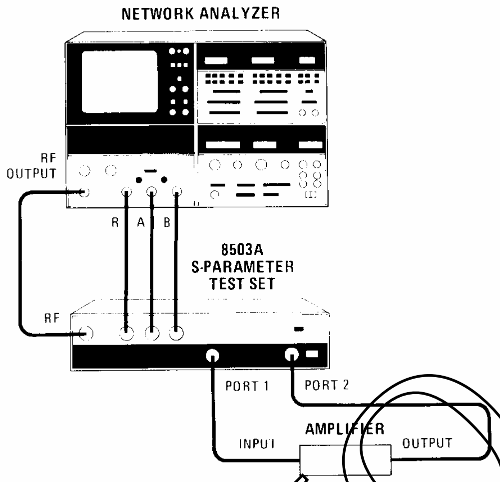


Figure 3-3. RF Signal Path

OPERATING INSTRUCTIONS

AMPLIFIER MEASUREMENT
LOCAL OPERATION



WARNINGS

BEFORE CONNECTING LINE POWER TO THIS INSTRUMENT, ensure that all line-powered devices connected to this instrument are connected to the protective (earth) ground.

BEFORE SWITCHING ON THIS INSTRUMENT ensure that the line power (mains) plug is connected to a three-conductor line power outlet that has a protective (earth) ground. (Grounding one conductor of a two-conductor outlet is not sufficient.)

1. Connect cables as described in Seciton II, Paragraphs 2-11 through 2-14.
2. Set 8505A and 8503A LINE switches to ON and allow at least 30 minutes warm-up time.
3. Set 8503A controls as follows:

A1 Source/Converter:

OUTPUT LEVEL dBm .... −20
OUTPUT LEVEL Vernier 0
INPUT LEVEL dBm MAX .... −10

Figure 3-4. Operating Instructions (1 of 14)

OPERATING INSTRUCTIONS

AMPLIFIER MEASUREMENT
LOCAL OPERATION

A2 Frequency Control:
- RANGE MHz .... Desired frequency reange
- MODE .... LIN EXPAND
- WIDTH .... START/STOP 1
- SCAN TIME SEC .... .1 — .01
- VERNIER .... Fully Counterclockwise
- TRIGGER .... AUTO
- MARKERS Switch 1
- MARKER 1 .... Mid-Range
- START FREQUENCY .... Lowest frequency desired
- STOP FREQUENCY............... Highest frequency desired

A3 Signal Processor:

Channel 1:
- INPUT .... A/R
- MODE .... MAG
- SCALE/DIV .... 10 dB

Channel 2:
- MODE .... OFF

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

4. To measure parameter S_{11} of the amplifier (input reflection characteristic) proceed as follows:

   a. With 8503A PORT 1 and PORT 2 open (amplifier not connected), set S-PARAMETER SELECT switch to FORWARD.

   b. 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.

   c. Press Channel 1 DISPLAY MKR then ZRO pushbuttons to place marker on reference line and to zero digital readout.

   d. Connect amplifier as shown in test setup:

   e. Set MARKER 1 to desired measurement frequency or frequencies and read the magnitude value(s) from Channel 1 MKR digital readout.

   f. On 8505A Signal Processor, set Channel 1 MODE switch to PHASE. Disconnect amplifier from 8503A test ports.

Figure 3-4. Operating Instructions (2 of 14)

OPERATING INSTRUCTIONS

AMPLIFIER MEASUREMENT
LOCAL OPERATION

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

h. Set 8505A Channel 2 SCALE/DIV switch to 5 DEG and readjust LENGTH and VERNIER A control, if necessary, to position average slope of trace parallel to horizontal graticule lines.

i. Reconnect amplifier as shown in test setup.

j. Set MARKER 1 to desired frequency or frequencies and read the phase value(s) from Channel 1 MKR digital readout.

5. To measure parameter S_{12} of the amplifier (reverse transmission characteristic), set 8503A S-PARAMETER SELECT switch to REVERSE and disconnect amplifier from 8503A test ports. Connect through line (HP 11857A cable) from PORT 1 to PORT 2 and perform steps 1 through 3 and steps 4b through 4j.

6. To measure parameter S21 of the amplifier (forward transmission characteristics; gain), proceed as follows:

NOTE

If amplifier gain is greater than 30 dB, reduce RF input to avoid measurement error due to signal compression.

a. Perform steps 1 through 3 except set Channel 1 INPUT switch to B/R and set Electrical Length INPUT switch to B. Set S-PARAMETER SELECT switch to FORWARD and connect through line (HP 11857A cable) from PORT 1 to PORT 2.

b. Perform steps 4b through 4j.

7. To measure parameter S_{22} of the amplifier (output reflection characteristic), proceed as follows:

a. Perform steps 1 through 3 except set Channel 1 INPUT switch to B/R and set Electrical Length INPUT switch to B.

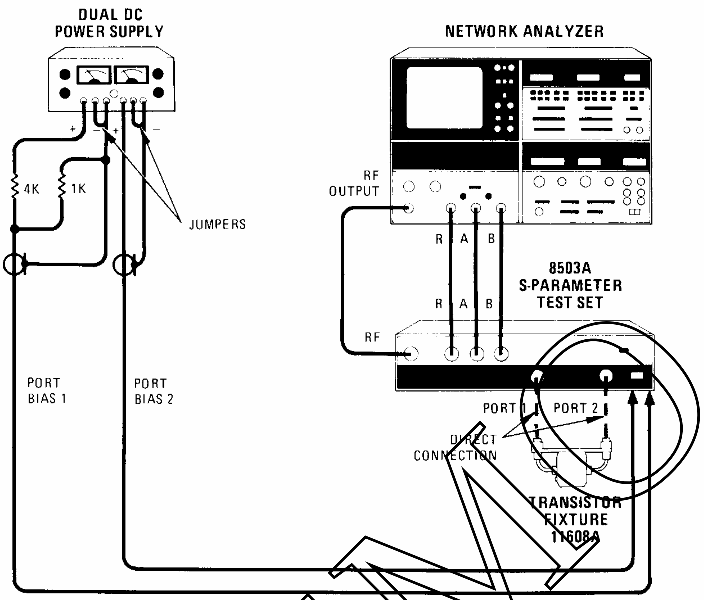
b. Set 8503A S-PARAMETER SELECT switch to REVERSE and disconnect amplifier from test ports.

c. Perform steps 4b through 4j.

Figure 3-4. Operating Instructions (3 of 14)

OPERATING INSTRUCTIONS

TRANSISTOR MEASUREMENT
LOCAL OPERATION



Initial Settings:

1. Connect cables as described in Section II, Paragraphs 2-11 through 2-14.
2. Set 8505A and 8503A LINE switches to ON and allow at least 30 minutes warm-up time.
3. Set 8505A controls as follows:

   A1 Source/Converter:
   - OUTPUT LEVEL dBm .... −20
   - OUTPUT LEVEL Vernier 0
   - INPUT LEVEL dBm MAX .... −10

Figure 3-4. Operating Instructions (4 of 14)

OPERATING INSTRUCTIONS

TRANSISTOR MEASUREMENT
LOCAL OPERATION

A2 Frequency Control:

RANGE MHz	.5 — 1300
MODE	LIN FULL
WIDTH	START/STOP 1
SCAN TIME SEC	1 — .1
VERNIER	Fully Clockwise
TRIGGER	AUTO
MARKERS Switch	1
MARKER 1	Mid-range
START FREQUENCY	0 MHz
STOP FREQUENCY	1300 MHz

A3 Signal Processor:

Channel 1:

INPUT	A/R
MODE	POLAR MAG
SCALE/DIV	10 dB

Channel 1:

MODE	OFF

Electrical Length:

INPUT	A
MODE	X10
VERNIER A	0
VERNIER B	0

4. Connect Transistor Fixture to test ports of 8503A. PORT 2 adjusts laterally to properly align with the Transistor Fixture ports.

5. Connect dual dc power supply (HP Model 6205B) to 8503A rear-panel PORT BIAS inputs as shown in test setup. Construct a voltage divider/current limiter by connecting approximate values of 4K and 1K ohm resistors (1/8 W) across terminals of bias supply for PORT 1 BIAS as shown in test setup.

6. Turn power supply on and set both outputs to zero volts.

CAUTION

If bias voltage is present when transistor is inserted in the Transistor Fixture, damage to transistor may result.

7. On 8505A CRT display, depress POLAR BEAM CENTER pushbutton. Adjust BEAM CENTER position controls to center dot on screen. Push POLAR BEAM CENTER pushbutton again to return system to normal operation.

Figure 3-4. Operating Instructions (5 of 14)

OPERATING INSTRUCTIONS

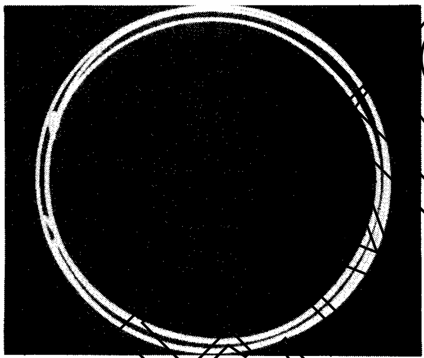
TRANSISTOR MEASUREMENT
LOCAL OPERATION

Calibration:

8. Place short supplied with 11608A in Transistor Fixture.

9. Set 8503A S-PARAMETER SELECT switch to FORWARD and calibrate for S_{11} measurement as follows:

   a. On 8505A Signal Processor Channel 1, press DISPLAY MKR then ZRO. This places magnitude calibration for S_{11} in 8505A memory. CRT display should be similar to display shown in the following waveform.



   b. Set Channel 1 MODE switch to POLAR PHASE. Press LENGTH pushbuttons until trace is gathered into smallest possible grouping. Press Electrical Length DISPLAY ZRO.

   c. On 8505A Signal Processor Channel 1, press DISPLAY MKR then ZRO then REF. Press REF OFFSET pushbuttons until ±180 DEG is indicated on digital readout. Press Channel 1 DISPLAY ZRO. This places phase calibration for S_{11} in 8505A memory. CRT display should be similar to display shown in the following waveform.

Figure 3-4. Operating Instructions (6 of 14)

OPERATING INSTRUCTIONS

TRANSISTOR MEASUREMENT
LOCAL OPERATION

10. Set 8503A S-PARAMETER SELECT switch to REVERSE and calibrate for S_{22} as follows:

    a. Set 8505A Channel 1 INPUT switch to B/R and set MODE to POLAR MAG.

    b. Press Channel 1 DISPLAY MKR then ZRO. This places magnitude calibration for S_{22} in 8505A memory.

    c. Set 8505A Channel 1 MODE switch to POLAR PHASE. Set Electrical Length INPUT switch to B. Press LENGTH pushbuttons until trace is gathered into smallest possible grouping. Press Electrical Length DISPLAY ZRO pushbutton.

    d. On 8505A Channel 1, press DISPLAY MKR then ZRO then REF. Press REF OFFSET pushbuttons until ±180 DEG is indicated on digital readout. Press DISPLAY ZRO. This places phase calibration for S_{22} in 8505A memory.

11. Remove short from Transistor Fixture and replace it with a "thru".

12. Calibrate for S_{12} measurement as follows:

    a. Set 8505A Channel 1 INPUT switch to A/R and set MODE switch to POLAR MAG.

    b. Press Channel 1 DISPLAY MKR then ZRO. This places magnitude calibration for S_{12} in 8505A memory.

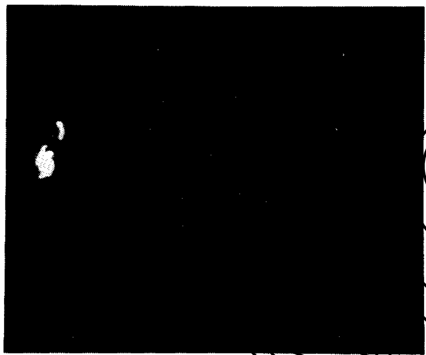
Figure 3-4. Operating Instructions (7 of 14)

OPERATING INSTRUCTIONS

TRANSISTOR MEASUREMENT
LOCAL OPERATION

c. Set 8505A Channel 1 MODE switch to POLAR PHASE. Set Electrical Length INPUT switch to A. Press Electrical Length pushbuttons until trace is gathered into smallest possible grouping. Press Electrical Length DISPLAY ZRO pushbutton.

d. On 8505A Channel 1, press DISPLAY MKR then ZRO (no offset is needed for "thru" calibration). This places phase calibration for S_{12} in 8505A memory. CRT display should be similar to display shown in the following waveform.



13. Set S-PARAMETER SELECT switch to FORWARD and calibrate for S_{21} as follows:

a. Set 8505A Channel 1 INPUT switch to B/R and set MODE switch to POLAR MAG.

b. Press Channel 1 DISPLAY MKR then ZRO. This places magnitude calibration for S_{21} in 8505A memory.

c. Set Channel 1 MODE switch to POLAR PHASE. Set Electrical Length INUT switch to B. Press LENGTH pushbuttons until trace is gathered into smallest possible grouping. Press Electrical Length DISPLAY ZRO pushbutton.

d. On 8505A Channel 1, press DISPLAY MKR then ZRO. This places phase calibration for S_{21} in 8505A memory.

Figure 3-4. Operating Instructions (8 of 14)

OPERATING INSTRUCTIONS

TRANSISTOR MEASUREMENT
LOCAL OPERATION

14. The 8505A now has all of the calibration information stored in its memory including Electrical Length for each measurement as well as magnitude and phase information.

Measurement:

CAUTION

Ensure that power supply outputs are set to zero volts. If bias voltage is present when transistor is inserted in Transistor Fixture, damage to transistor may result.

15. Remove "thru" from Transistor Fixture and insert transistor (HP 35821E) with HP logo facing upward and small diagonally cut lead toward PORT 2 of 8503A S-Parameter Test Set. This places the transistor in a common-emitter configuration with its input (base) at PORT 1 and its output (collector) at PORT 2.

16. Set 8505A Channel 1 INPUT switch to B/R and set MODE switch to POLAR MAG. Set Electrical Length INPUT switch to B.

17. Set PORT 2 bias supply (right side of dual power supply) to +10V. Set Dual dc power supply to read PORT 2 bias supply current (.075A scale).

NOTE

If unable to set +10 Volts, reduce supply voltage to zero and reset transistor in Transistor Fixture. Then repeat step 17.

18. Slowly increase PORT 1 bias supply until PORT 2 bias supply current reaches approximately 10 mA.

CAUTION

Do not exceed 15 mA of collector current or damage to HP 35821E transistor may result.

19. The transistor may now be completely characterized using the 8505A to measure its scattering parameters.

Figure 3-4. Operating Instructions (9 of 14)

OPERATING INSTRUCTIONS

HP-IB OPTION 001
REMOTE OPERATION

Capability:

The 8503A Option 001 with Hewlett-Packard Interface Bus allows remote programming of the S-PARAMETER SELECT switch.

Operation:

WARNING

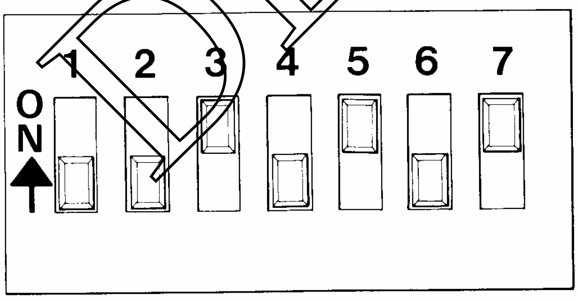
In the following procedure, the instrument's top cover must be removed. Before removing top cover, disconnect all power from 8503A. DO NOT RECONNECT POWER UNTIL TOP COVER HAS BEEN REINSTALLED.

The HP-IB Assembly A8 in the 8503A Option 001 contains a switch A8SW1 which must be set for the proper Listen/Talk address.

The preset ASCII address code for the test set is:

TALK = 1
LISTEN = 4

The five-digit binary address code for the test set is then 10100. The decimal equivalent of this five-bit binary number is 20. Switch A8SW1 consists of seven miniature toggles. They are preset to the five-digit binary number as shown below.



NOTE

Switch positions 6 and 7 not used.

Figure 3-4. Operating Instructions (10 of 14)

OPERATING INSTRUCTIONS

HP-IB OPTION 001
REMOTE OPERATION

If some other address code is desired, refer to Table 3-3 for cross-reference between ASCII code, five-bit binary equivalent, and decimal equivalent.

9830A/B CALCULATOR:

For the Model 9830A or B Calculator, the program format for addressing the test set is as follows:

Table 3-1. Factory Set Address Codes, (9830A/B)

INSTRUMENT	TALK	LISTEN
9830A/B Calculator	U	5
8503A Test Set	T	4

To program the S-Parameter Select Switch to either FORWARD – "1," or REVERSE "2," use the following format:

10 CMD "?U4," "1"	Commands unlisten, then calculator talk and test set listen. Then it commands the test set switch to position "1" – FORWARD. (REVERSE is "2.")

To "LEARN" the state of the S-Parameter Selector switch, the following program may be used:

10 CMD "?U4" 20 FORMAT 3B 30 OUTPUT (13, 20) 256, 1, 512,	Procedure to "GO to local"
40 CMD "?T5" 50 ENTER (13, *) T	Commands the calculator to take the switch position data from the test set and store it in "T."
60 PRINT T	Print the position of the Test Set S-Parameter Select switch stored in "T." "1" is FORWARD and "2" is REVERSE.

Figure 3-4. Operating Instructions (11 of 14)

OPERATING INSTRUCTIONS

HP-IB OPTION 001
REMOTE OPERATION

9825A CALCULATOR:

For Model 9825A Calculator, the program format for addressing the test set is as follows:

Table 3-2. Factory Set Address Codes, 9825A

Instrument	HP-IB Interface Select Code	Decimal Equiv. of 5-Bit Binary Number
25A Calculator	7	21
8503A Test Set	7	20

To program the S-Parameter Select Switch to either FORWARD – "1," or REVERSE – "1," use the following format:

wrt 720, "1"	Commands the calculator to "write" to the test set a command to set the FORWARD/REVERSE switch to position "1" (FORWARD). Position "2" is REVERSE.

To "LEARN" the state of the S-Parameter Selector switch, use the following program:

lcl 720	Commands 8503A to go to local.
red 720, T	Commands the calculator to read the position of the FORWARD/REVERSE switch in the test set and store the switch number (1 or 2) in T.
prt T	Commands the calculator to print the switch position stored in "T."

Figure 3-4. Operating Instructions (12 of 14)

OPERATING INSTRUCTIONS

HP-IB OPTION 001
REMOTE OPERATION

HP-IB OPERATION TEST:

To check that the test set FORWARD/REVERSE switch is actually changing, the following procedure should be followed:

1. Connect the test set to the 8505A network analyzer in a normal setup with nothing connected to port 1 and 2 of the test set. Set 8505A Channel 1 INPUT switch to "A" and set the power output from source to −20 dBm.

2. Command the test set switch to go to "FORWARD" position.

   a. For Model 9830A/B Calculator:
      CMD "?U4," "1"

   b. For Model 9825A Calculator:
      wrt 720, "1"

3. Verify that the "A" signal displayed on the 8505A CRT is −39 dBm ±5.50 dB. Set the 8505A Channel 1 INPUT switch to "B" and the signal should be at −130 dBm ±25 dB (noise level).

4. Command the test set switch to go to "REVERSE" position.

   a. For Model 9830A/B Calculator:
      CMD "?U4," "2"

   b. For Model 9825A Calculator:
      wrt 720, "2"

5. Verify that the "B" displayed on the 8505A CRT is −39 dBm ±5.5 dB. Set the 8505A Channel 1 INPUT switch to "A" and the signal should at −130 dBm ±25 dB (noise level).

Figure 3-4. Operating Instructions (13 of 14)

OPERATING INSTRUCTIONS

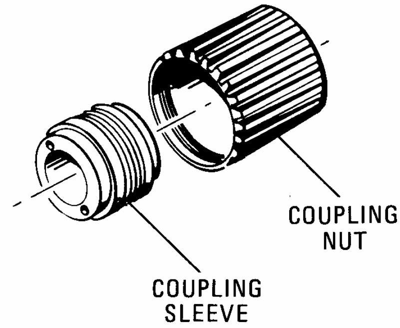
HP-IB OPERATION 001
REMOTE OPERATION

Table 3-3. Cross-reference Between ASCII, Decimal, and Binary Address Codes

ASCII CHARACTER		5 BIT DECIMAL VALUE	5 BIT BINARY EQUIVALENT
@	SP	00	00000
A	!	01	00001
B	"	02	00010
C	#	03	00011
D	$	04	00100
E	%	05	00101
F	&	06	00110
G	'	07	00111
H	(	08	01000
I	)	09	01001
J	*	10	01010
K	+	11	01011
L	,	12	01100
M	—	13	01101
N	.	14	01110
0	/	15	01111
P	Ø	16	10000
Q	1	17	10001
R	2	18	10010
S	3	19	10011
T	4	20	10100
U	5	21	10101
V	6	22	10110
W	7	23	10111
X	8	24	11000
Y	9	25	11001
Z	:	26	11010
[	;	27	11011
/	<	28	11100
]	=	29	11101
⌢	>	30	11110

Figure 3-4. Operating Instructions (14 of 14)

APC-7 CONNECTORS



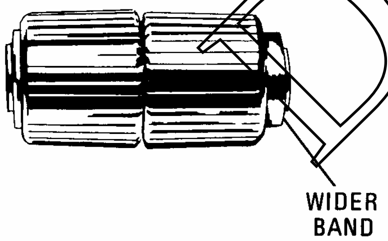
USE

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. Leave the other coupling nut in the original position: closing the gap between coupling nuts tends to loosen the electrical connection.

To Disconnect:

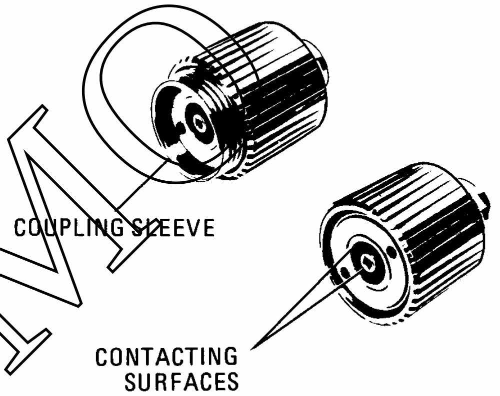
1. Loosen the coupling nut of the connector showing the wider gold band.



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

CARE

1. Keep contacting surfaces smooth and clean. Irregularities and foreign particles can degrade electrical performance.



2. Protect the contacting surfaces when the connector is not in use by leaving the coupling sleeve extended.
3. Use lintless material and/or firm-bristled brush such as toothbrush for cleaning. If a cleaning fluid is needed use isopropyl alcohol. IMPORTANT: Do not use aromatic or chlorinated hydrocarbons, esters, ethers, terpenes, higher alcohols, ketones, or ether-alcohols such as benzene, toluene, turpentine, dioxane, gasoline, cellosolve acetate, or carbon tetrachloride. Keep exposure of the connector parts to both the cleaning fluid and its vapors as brief as possible.

Figure 3-5. APC-7 Connectors

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. The procedures in this section test the electrical performance of the instrument using the specifications of Table 1-1 as the performance standards. All tests can be performed without access to the interior of the instrument. A simpler test is included in Section II under Incoming Inspection Test.

4-3. The performance test procedures must be performed in the sequence given, since some procedures rely on satisfactory test results in foregoing steps. If a test measurement is slightly out of tolerance, or if a function fails to operate, go to Section VIII and perform troublehooting.

4-4. EQUIPMENT REQUIRED

4-5. Equipment required for the performance tests is listed in the Recommended Test Equipment in Section I. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model.

4-6. TEST RECORD

4-7. 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.

PERFORMANCE TESTS

NOTE

Allow one hour warm-up time for 8505A Network Analzyer before beginning Performance Tests.

4-8. 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 Section II, Figure 2-6, Incoming Inspection Test.

PERFORMANCE TESTS

4-9. TRANSMISSION FREQUENCY RESPONSE TEST

SPECIFICATION:

Transmission Frequency Response (S_{21}, S_{12}): ±1 dB, ±12° from 0.5 to 1300 MHz (± degrees specified as deviation from Linear Phase).

DESCRIPTION:

The frequency response of the 8505A Network analyzer System is first recorded with a grease pencil on the CRT display. The 8503A 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 8503A.

CONFIGURATION A

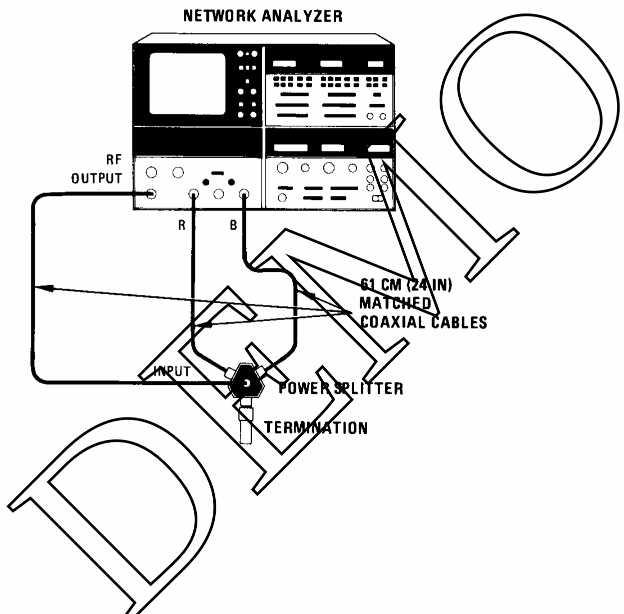


Figure 4-1. Transmission Frequency Response Test Setup (1 of 2)

PERFORMANCE TESTS

4-9. TRANSMISSION FREQUENCY RESPONSE TEST (Cont'd)

CONFIGURATION B

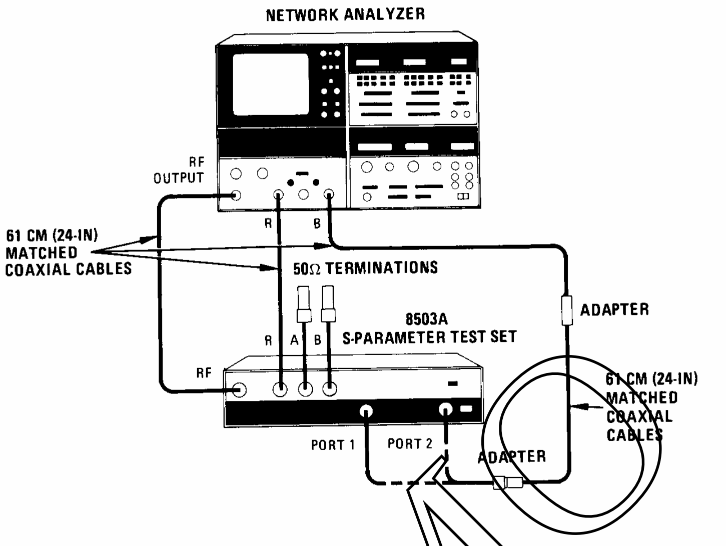


Figure 4-1. Transmission Frequency Response Test Setup (2 of 2)

EQUIPMENT:

Network Analyzer	HP 8505A
3-Way Power Splitter	HP 11850A
50Ω Type N Male Termination (2 required)	HP 909A Option 012
Matched Type N Male Coaxial Cable Kit	HP 11851A
Adapter, APC-7 to Type N Female	HP 11524A
Adapter, Type N Female to Type N Female	HP 1250-0777

PROCEDURE:

a. Set 8505A controls as follows:

A1 Source/Converter:

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

4-9. TRANSMISSION FREQUENCY RESPONSE TEST (Cont'd)

A2 Frequency Control:

RANGE MHz	.5 — 1300
MODE	LIN FULL
WIDTH	START/STOP 1
SCAN TIME SEC	1 — .1
VERNIER	Fully clockwise
TRIGGER	AUTO
MARKERS Switch	1
MARKER 1	Mid-range
START FREQUENCY	0 MHz
STOP FREQUENCY	1300 MHz

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

b. Connect equipment as shown in Figure 4-1, 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, set Channel 2 MODE switch to OFF.

e. To record the magnitude frequency response of the Network Analyzer, place 8505A Frequency control MARKER 1 on center graticule line.

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

(2) Grease pencil the trace on the CRT.

f. To measure the transmission magnitude frequency response of the 8503A connect equipment as shown in Figure 4-1, Configuration B with 8503A PORT 1 connected to 8505A INPUT B. Set 8503A S-PARAMETER SELECT switch to FORWARD.

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

4-9. TRANSMISSION FREQUENCY RESPONSE TEST (Cont'd)

h. Measure the maximum difference between the grease pencil trace and the display trace (Figure 4-2.) This measured value should be ⩽±1 dB.

i. Connect 8503A PORT 2 to 8505A INPUT B and set S-PARAMETER SELECT switch to REVERSE. Repeat steps g and h.

j. To record the phase frequency response of the Network Analyzer connect equipment as shown in Figure 4-1, 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.

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

(5) Set 8505A Signal Processor Channel 2 SCALE/DIV switch to 2 DEG and readjust LENGTH and VERNIER B control, if necessary, to position average slope of trace parallel to horizontal graticule lines.

(6) Grease pencil the trace on the CRT.

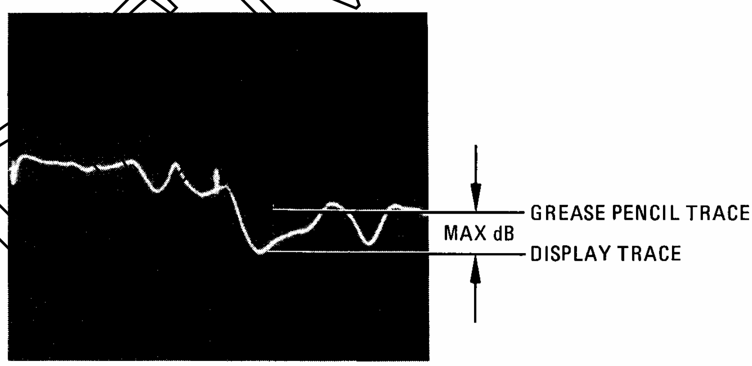


Figure 4-2. Transmission Frequency Response Magnitude

4-9. TRANSMISSION FREQUENCY RESPONSE TEST (Cont'd)

k. To measure the transmission phase frequency response of the 8503A connect equipment as shown in Figure 4-1, Configuration B with 8503A PORT 2 connected to 8505A INPUT B.

l. Set 8505A Signal Processor Channel 2 SCALE/DIV switch to 90 DEG.

m. On 8505A Signal Processor Electrical Length press the LENGTH pushbuttons and adjust VERNIER B control to display a horizontal trace on the CRT. If necessary, press Channel 2 REF OFFSET Pushbuttons to display horizontal trace.

n. Set 8505A Signal Processor Channel 2 SCALE/DIV switch to 2 DEG and readjust LENGTH and VERNIER B control, if necessary, to position average slope of trace parallel to horizontal graticule lines.

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

p. Measure the maximum difference between the grease pencil trace and the display trace (Figure 4-3). This measured value should be ≤±12°.

q. Connect 8503A PORT 1 to 8505A INPUT B and set S-PARAMETER SELECT switch to FORWARD. Repeat steps n through p.

r. Remove 50 ohm terminations from 8503A Ports A and B.

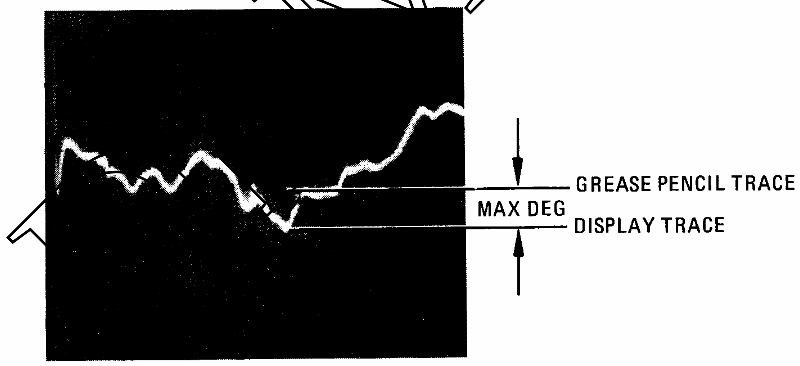


Figure 4-3. Transmission Frequency Response Phase

PERFORMANCE TESTS

4-10. REFLECTION FREQUENCY REPONSE TEST

SPECIFICATION:

Reflection Frequency Response (S_{11}, S_{22}): ±2 dB, ±20° from 0.5 to 1300 MHz
±15° 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 8503A 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 8503A.

CONFIGURATION A

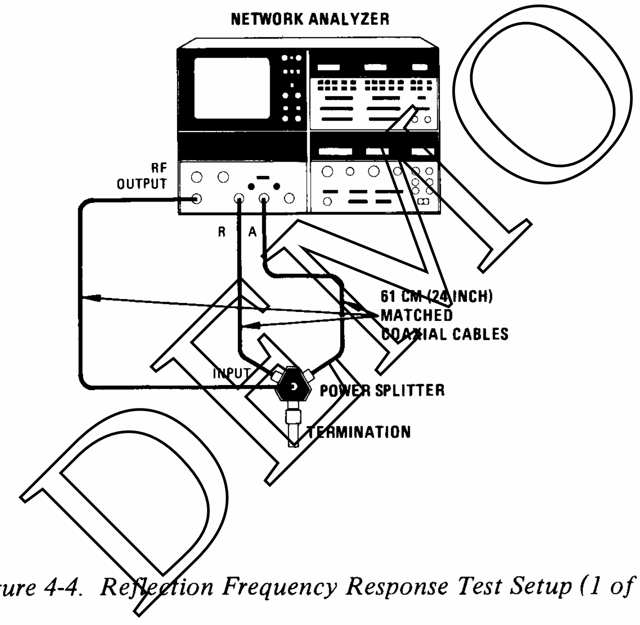


Figure 4-4. Reflection Frequency Response Test Setup (1 of 2)

4-10. REFLECTION FREQUENCY REPONSE TEST (Cont'd)

CONFIGURATION B

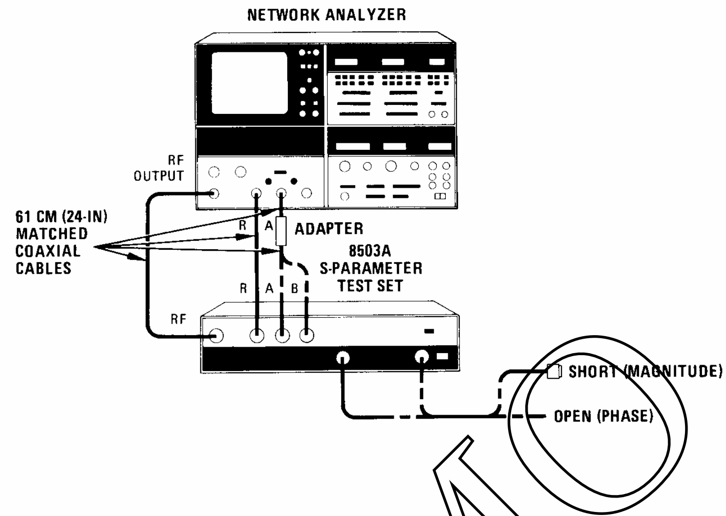


Figure 4-4. Reflection Frequency Response Test Setup (2 of 2)

EQUIPMENT:

Network Analyzer	HP 8505A
3-Way Power Splitter	HP 11850A
50Ω APC-7 Termination	HP 909A
Matched Type N Male Coaxial Cable Kit	HP 11851A
APC-7 Short	HP 11565A
Adapter, Type N Female to Type N Female	HP 1250-0777

PROCEDURE:

a. Set 8505A controls as follows:

A1 Source /Converter:

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

PERFORMANCE TESTS

4-10. REFLECTION FREQUENCY REPONSE TEST (Cont'd)

A2 Frequency Control:

RANGE MHz	.5 — 1300
MODE	LIN FULL
WIDTH	START/STOP 1
SCAN TIME SEC	1 — .1
VERNIER	Fully clockwise
TRIGGER	AUTO
MARKERS Switch	1
MARKER 1	Mid-range
START FREQUENCY	0 MHz
STOP FREQUENCY	1300 MHz

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	X10

b. Connect equipment as shown in Figure 4-4, 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, set Channel 2 MODE switch to OFF.

e. To record the magnitude frequency response of the network Analyzer move 8505A Frequency Control MARKER 1 to approximately 650 MHz.

(1) On the 8505A Signal Processor Channel 1, press DISPLAY MKR then 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 8503A connect equipment as shown in Figure 4-4, Configuration B with 8503A port A connected to 8505A INPUT A. Connect short to 8503A PORT 1. Set S-PARAMETER SELECT switch to FORWARD.

4-10. REFLECTION FREQUENCY REPONSE TEST (Cont'd)

g. On 8505A Signal Processor Channel 1 press REF OFFSET Pushbuttons to center the display around the grease pencil trace.

h. Measure the maximum difference between the grease pencil trace and the display trace (Figure 4-5). This measured value should be $\leq \pm 2$ dB for the entire 0.5 to 1300 MHz frequency range.

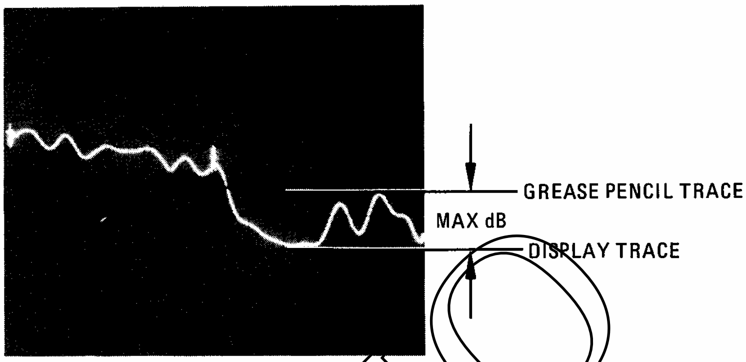


Figure 4-5. Reflection Frequency Response Magnitude

i. Connect 8503A port B to 8505A INPUT A and connect short to 8503A PORT 2. Set S-PARAMETER SELECT switch to REVERSE.

j. Repeat steps g and h.

k. To record the phase frequency response of the Network Analyzer for the full 0.5 to 1300 MHz frequency range connect equipment as shown in Figure 4-4, Configuration A:

(1) Remove CRT grease pencil trace from previous test and remove short from 8503A PORT 2.

(2) Set 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.

PERFORMANCE TESTS

4-10. REFLECTION FREQUENCY REPONSE TEST (Cont'd)

(5) On the 8505A Signal Processor Channel 2, press DISPLAY MKR then ZRO pushbuttons to place marker on reference line and to zero digital readout. Readjust LENGTH and VERNIER A control, if necessary, to positon average slope of trace parallel to horizontal graticule lines.

(6) Grease pencil the trace on the CRT.

l. To measure the reflection phase frequency response of the 8503A connect equipment as shown in Figure 4-4, Configuration B with 8503A port B connected to 8505A INPUT A and 8503A PORT 2 open.

(1) On 8505A Signal Processor Electrical Length, press the LENGTH pushbuttons and adjust VERNIER A control to position average slope of trace parallel to horizontal graticule lines.

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

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

(4) Measure the maximum difference between the grease pencil trace and the display trace (Figure 4-6). This measured value should be $\leq \pm 20°$ for the 0.5 to 1300 MHz frequency range.

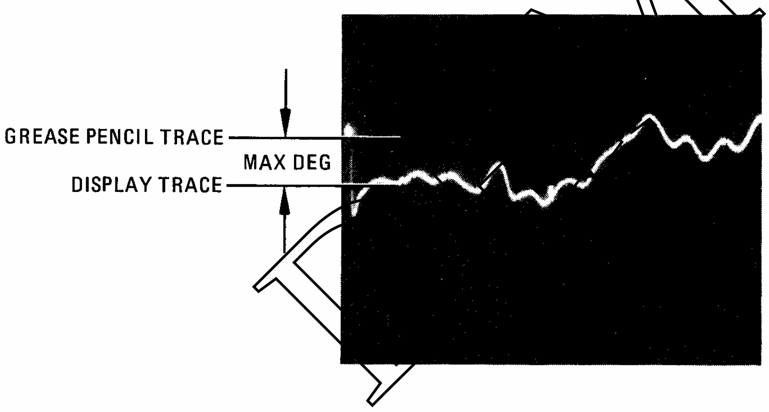


Figure 4-6. Reflection Frequency Response Phase

4-10. REFLECTION FREQUENCY REPONSE TEST (Cont'd)

m. Connect 8503A port A to 8505A INPUT A. Set S-PARAMETER SELECT switch to FORWARD. With 8503A Port 1 open, repeat steps l (1) through l (4).

n. To record the phase frequency response of the Network Analyzer for the 2 to 1300 MHz frequency range, connect equipment as shown in Figure 4-4, 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 START FREQUENCY to 2 MHz and STOP FREQUENCY to 1300 MHz.

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

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

o. To measure the reflection phase frequency response of the 8503A connect equipment as shown in Figure 4-4, Configuration B with 8503A port A connected to 8505A INPUT A and 8503A PORT 1 open. Set S-PARAMETER SELECT switch to FORWARD.

(1) Repeat steps l (1) through l (3).

(2) Measure the maximum difference between the grease pencil trace and the display trace (Figure 4-6). This measured value should be $\leqslant \pm 15°$ for the 2 to 1300 MHz frequency range.

(3) Connect 8503A port B to 8505A INPUT A. Set S-PARAMETER SELECT switch to REVERSE and repeat steps l (1) through l (3).

(4) Measure the maximum difference between the grease pencil trace and the display trace. This measured value should be $\leqslant \pm 15°$ (2 to 1300 MHz).

(5) Remove grease pencil trace from CRT.

4-11. TEST PORT OPEN/SHORT RATIO TEST

SPECIFICATION:

Test Port 1 and 2 Open/Short Ratio:

$\leqslant \pm 0.9$ dB Mag and $\leqslant \pm 7.5°$ Phase from 1000 to 1300 MHz
$\leqslant \pm 0.75$ dB Mag and $\leqslant \pm 6°$ Phase from 2 to 1000 MHz
$\leqslant \pm 1.25$ dB Mag and $\leqslant \pm 10°$ Phase from 0.5 to 2 MHz

PERFORMANCE TESTS

4-11. TEST PORT OPEN/SHORT RATIO TEST (Cont'd)

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 8503A PORT 1 or PORT 2. Peak-to-peak readings are taken from the CRT trace. The effect of the return loss of the cable used is then accounted for to determine the actual open/short ratio. To compensate for the added line length on the 8503A Test port, a 12-ft. coaxial cable is connected from 8503A port R to 8505A INPUT R. For frequencies below 2 MHz, PORT 1 or PORT 2 is directly shorted, then opened, and this ratio is read directly from the CRT trace.

CONFIGURATION A
(Frequency Range: 2 — 1300 MHz)

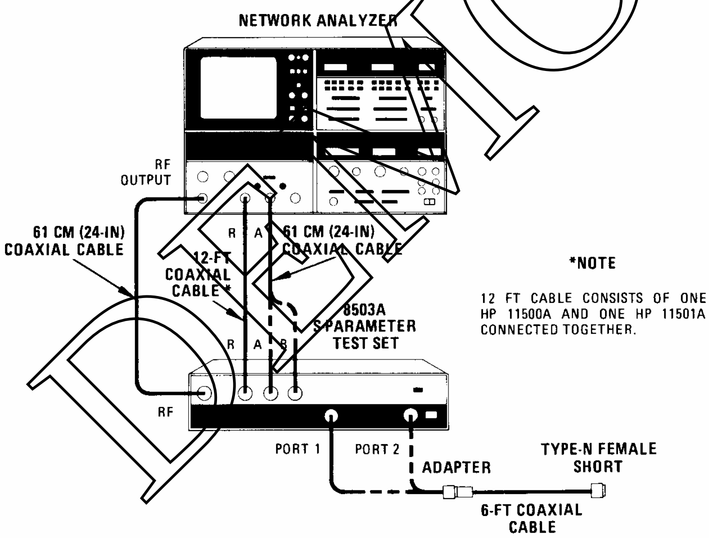


Figure 4-7. Test Port Open/Short Ratio Test (1 of 2)