System Verification and Performance Test Guide

HP 8753D Network Analyzer

HEWLETT PACKARD

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System Verification and Performance Tests

How to Test the Performance of Your Analyzer

To obtain the same quality of performance testing that Hewlett-Packard has administered at the factory, you must perform:

- the system verification procedure

AND

- *all* of the performance test procedures.

This quality of performance testing guarantees that the analyzer is performing within *all* of the published specifications. Hewlett-Packard will issue a Certificate of Calibration for your analyzer if two conditions are met:

1. Your analyzer passes all the performed tests.
2. The equipment and standards that you used to perform the tests are traceable to a national standards institute.

Note If you have a particular type of measurement application that does not use all of the analyzer's measurement capabilities, you may ask your nearest Hewlett-Packard Sales and Service Office for a subset of specifications that you want verified. However, this does create a potential for making incorrect measurements, by using a different application than what was specified.

Sections in this Chapter

- **System Verification**
  - Automated Mode
  - Manual Mode
- **Performance Tests**
  1. Test Port Output Frequency Range and Accuracy
  2. External Source Mode Frequency Range
  3. Test Port Output Power Accuracy
  4. Test Port Output Power Range and Linearity
  5. Minimum R Channel Level
  6. Test Port Input Noise Floor Level
  7. Test Port Input Frequency Response
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  10. System Trace Noise (Only for Analyzers *without* Option 006)
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  15. Test Port Receiver Magnitude Compression
  16. Test Port Receiver Phase Compression
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  18. Test Port Output/Input Harmonics (Option 002 Analyzers *with* Option 006 only)

Performance Test Record

Find and use the appropriate "Performance Test Record" in the following subchapters:

- **Performance Test Record For Analyzers with a Frequency Range of 30 kHz to 3 GHz**
- **Performance Test Record For Analyzers with a Frequency Range of 30 kHz to 6 GHz**

System Verification Cycle and Kit Re-certification

Hewlett-Packard recommends that you verify your network analyzer measurement system every six months. Hewlett-Packard also suggests that you get your verification kit re-certified annually. Refer to *HP 85029B 7 mm Verification Kit Operating and Service Manual* for more information.

Note The system verification procedures DO NOT APPLY to analyzers with Option 075 (75 ohm analyzers).

How to Select the System Verification Procedure

Check to see how the verification kit floppy disk is labeled:

- If the disk is labeled `HP 8753D Verification Data Disk`, proceed with the "HP 8753D Automated Mode System Verification."
- If the disk is labeled `HP 8753 Verification Data Disc`, proceed with the "HP 8753D Manual Mode System Verification" procedure, located later in this chapter.

Note If your verification disk is not labeled `HP 8753D Verification Data Disk`, you may send your HP 85029B 7-mm verification kit to the nearest service center for recertification, which includes a data disk that you can use with the HP 8753D.

HP 8753D Automated Mode System Verification

Equipment Required

Calibration Kit, 7 mm ..... HP 85031B
Verification Kit, 7 mm ..... HP 85029B
Test Port Extension Cable Set, 7 mm ..... HP 11857D
Printer ..... HP ThinkJet/DeskJet/LaserJet

Analyzer warm-up time: **1 hour**

This system verification consists of three separate procedures:

1. Initialization
2. Measurement Calibration
3. Device Verification

Initialization

1. Connect the equipment as shown in Figure 1-1. Let the analyzer warm up for one hour.

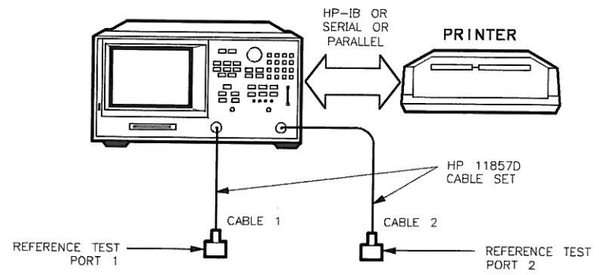

Figure 1-1. System Verification Test Setup

2. While the equipment is warming up, review the "Connector Care Quick Reference" information in the "Service Equipment and Analyzer Options" chapter of the *HP 8753D Network Analyzer Service Guide*. Good connections and clean, undamaged connectors are critical for accurate measurement results.
3. Insert the verification kit disk into the analyzer disk drive.
4. Press (PRESET) (SAVE/RECALL) `SELECT DISK` `INTERNAL DISK`.
5. If you want a printout of the verification data for all the devices, press (SYSTEM) `SERVICE MENU` `TEST OPTIONS` `RECORD ON`.

Note If you switch on the record function, you *CANNOT* switch it off during the verification procedure.

6. Position the paper in the printer so that printing starts at the top of the page.
7. If you have difficulty with the printer:
   - If the interface on your printer is HP-IB, verify that the printer address is set to 1 (or change the setting in the analyzer to match the printer).
   - If the interface on your printer is serial or parallel, be sure that you selected the printer port and the printer type correctly (refer to the *HP 8753D Network Analyzer User's Guide* for more information on how to perform these tasks).
8. Press (SYSTEM) `SERVICE MENU` `TESTS` `SYS VER TESTS` `EXECUTE TEST`.
9. The analyzer displays `Sys Ver Init DONE`, the initialization procedure is complete.

Caution *DO NOT* press (PRESET) or recall another instrument state. You must use the instrument state that you loaded during the initialization procedure.

Measurement Calibration

10. Press (CAL) CAL KIT CAL KIT:7mm RETURN CALIBRATE MENU FULL 2-PORT.
11. Press ISOLATION OMIT ISOLATION ISOLATION DONE.
12. Press REFLECTION.
13. Connect the "open" end of the open/short combination (supplied in the calibration kit) to reference test port 1, as shown in Figure 1-2.

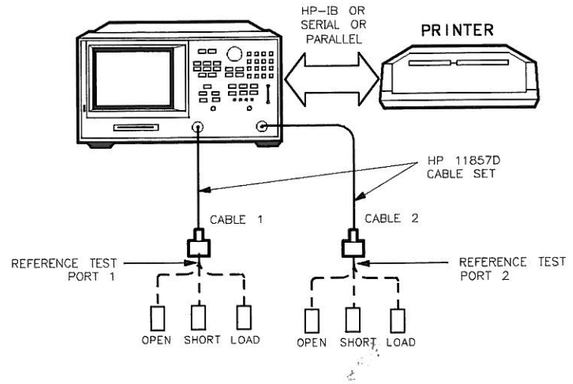

Figure 1-2. Connections for Measurement Calibration Standards

14. Press FORWARD:OPEN.
15. When the analyzer finishes measuring the standard, connect the "short" end of the open/short combination to reference test port 1.
16. Press FORWARD:SHORT.
17. When the analyzer finishes measuring the standard, connect the 50 ohm termination (supplied in the calibration kit) to reference test port 1.
18. Press FORWARD:LOAD.
19. When the analyzer finishes measuring the standard, connect the "open" end of the open/short combination to reference test port 2.
20. Press REVERSE:OPEN.
21. When the analyzer finishes measuring the standard, connect the "short" end of the open/short combination to reference test port 2.
22. Press REVERSE:SHORT.
23. When the analyzer finishes measuring the standard, connect the 50 ohm termination to reference test port 2.

24. Press REVERSE:LOAD.
25. When the analyzer finishes measuring the standard, press STANDARDS DONE.
    The analyzer briefly displays COMPUTING CAL COEFFICIENTS.
26. Connect the test port cables as shown Figure 1-3.

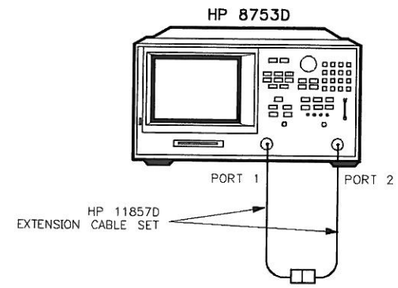

Figure 1-3. Transmission Calibration Setup

27. Press TRANSMISSION FWD TRANS THRU.
28. When the analyzer finishes the measurement, press FWD MATCH THRU.
29. When the analyzer finishes the measurement, press REV TRANS THRU.
30. When the analyzer finishes the measurement, press REV MATCH THRU.
31. When the analyzer displays PRESS 'DONE' IF FINISHED WITH STD(s), press STANDARDS DONE DONE 2-PORT CAL.
32. Press (SAVE/RECALL) SELECT DISK INTERNAL MEMORY RETURN SAVE STATE to save the calibration into the analyzer internal memory.
33. When the analyzer finishes saving the instrument state, press SELECT DISK INTERNAL DISK.

Device Verification

34. Press SYSTEM SERVICE MENU TESTS 28 x1 EXECUTE TEST .

35. At the prompt, connect the 20 dB attenuator (supplied in the verification kit) as shown in Figure 1-4.

36. Press CONTINUE to run the test:

    - If you switched OFF the record function, you have to press CONTINUE after each S-parameter measurement.
    - If you switched ON the record function, the analyzer measures all S-parameters (magnitude and phase) without pausing. Also, the analyzer only displays and prints the PASS/FAIL information for the S-parameter measurements that are valid for system verification.

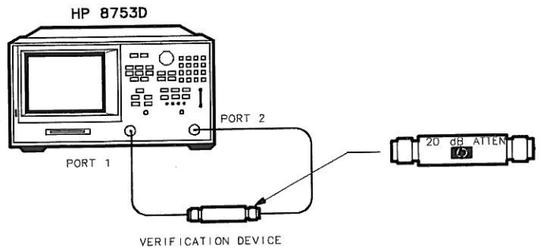

Figure 1-4. Connections for the 20 dB Verification Device

37. When the analyzer finishes all the measurements, connect the 50 dB attenuator (supplied in the verification kit), as shown in Figure 1-5.

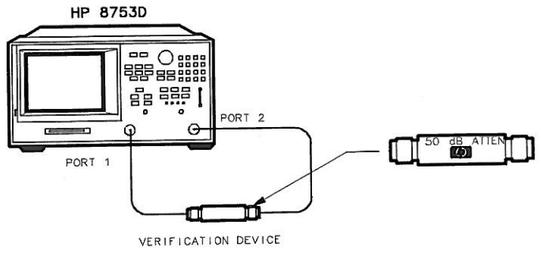

Figure 1-5. Connections for the 50 dB Verification Device

38. Press ↑ 29 x1 EXECUTE TEST CONTINUE .

39. When all measurements are complete, replace the verification device with the verification mismatch, as shown in Figure 1-6. Be sure that you connect Port A of the verification mismatch to reference test port 1.

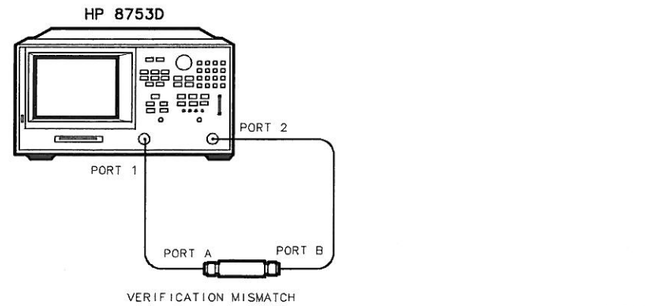

Figure 1-6. Mismatch Device Verification Setup

40. Press RETURN TESTS 30 x1 EXECUTE TEST CONTINUE .

41. When the analyzer finishes all the measurements, connect the mismatch verification device, as shown in Figure 1-7. Notice that Port B is now connected to reference test port 1.

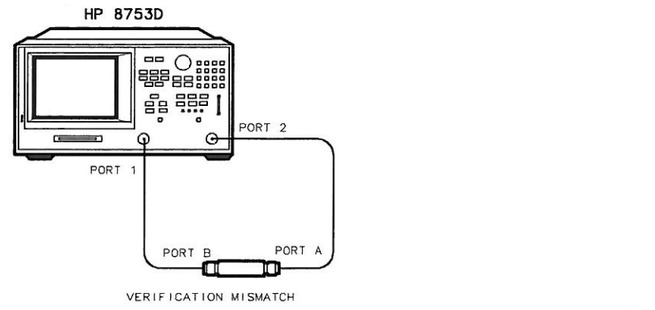

Figure 1-7. Mismatch Device Verification Setup

42. Press RETURN TESTS 31 x1 EXECUTE TEST CONTINUE .

43. You have completed the system verification procedure when the analyzer displays Ver Def 4 DONE.

In Case of Difficulty

1. Inspect all connections. *DO NOT* disconnect the cables from the analyzer test ports. Doing so *WILL INVALIDATE* the calibration that you have done earlier.
2. Press (PRESET) (SAVE/RECALL) SELECT DISK INTERNAL MEMORY RETURN. Using the front panel knob, highlight the title of the full 2-Port calibration that you have done earlier, then press RECALL STATE.
3. Repeat the "Device Verification" procedure.
4. If the analyzer still fails the test, check the measurement calibration as follows:
   a. Press (PRESET).
   b. Recall the calibration by pressing (SAVE/RECALL) SELECT DISK INTERNAL MEMORY RETURN.
   c. Use the front panel knob to highlight the calibration you want to recall and press RECALL STATE.
   d. Connect the short to reference test port 1.
   e. Press (MEAS) S11 (MENU) TRIGGER MENU CONTINUOUS.
   f. Press (SCALE/REF) SCALE/DIV (.05) (x1).
   g. Check that the trace response is 0.00 ± 0.05 dB.
   h. Disconnect the short and connect it reference test port 2.
   i. Press (MEAS) Refl: REV S22(B/R).
   j. Check that the trace response is 0.00 ± 0.05 dB.
   k. If any of the trace responses are out of the specified limits, repeat the "Measurement Calibration" and "Device Verification" procedures.
5. Refer to the "Start Troubleshooting Here" chapter of the *HP 8753D Network Analyzer Service Guide* for more troubleshooting information.

HP 8753D Manual Mode System Verification

Equipment Required

Calibration Kit, 7 mm	HP 85031B
Verification Kit, 7 mm	HP 85029B
Test Port Extension Cable Set, 7 mm	HP 11857D
Printer	HP ThinkJet/DeskJet/LaserJet

Analyzer warm-up time: **1 hour**

This system verification consists of three separate procedures:

1. Initialization
2. Measurement Calibration
3. Device Verification

Initialization

1. Connect the equipment as shown in Figure 1-8. Let the analyzer warm up for one hour.

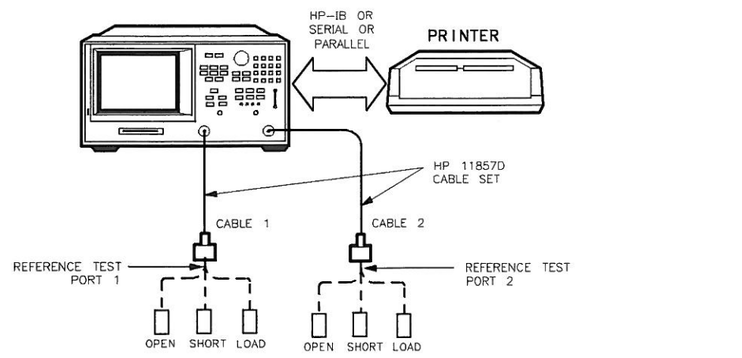

Figure 1-8. System Verification Test Setup

2. While the equipment is warming up, review the "Connector Care Quick Reference" information in the "Service Equipment and Analyzer Options" chapter of the *HP 8753D Network Analyzer Service Guide*. Good connections and clean, undamaged connectors are critical for accurate measurement results.
3. Set up the system to print the verification data:
   a. Press (LOCAL) SYSTEM CONTROLLER.
   b. Press SET ADDRESSES PRINTER PORT.
   c. Press the softkey that corresponds to your printer port.

d. If you have difficulty with the printer:

- If the interface on your printer is HP-IB, verify that the printer address is set to 1.
- If the interface on your printer is serial or parallel, be sure that you correctly selected the printer port AND printer type (refer to the *HP 8753D Network Analyzer User's Guide* for more information on how to do these tasks).

4. Insert the verification kit disk into the analyzer disk drive.
5. Press (PRESET) (SAVE/RECALL) SELECT DISK INTERNAL DISK.
6. Press (SYSTEM) SERVICE MENU TESTS SYS VER TESTS EXECUTE TEST.
7. When the analyzer displays Sys Ver Init DONE, the test is complete.

Caution Do *NOT* press (PRESET) or recall another instrument state. You must use the instrument state that you loaded during the initialization procedure.

Measurement Calibration

8. Press (MENU) POWER (-2) (x1) to set the analyzer test port power to −2 dBm.
9. Press (CAL) CAL KIT:7mm RETURN CALIBRATE MENU FULL 2-PORT.
10. Press ISOLATION OMIT ISOLATION ISOLATION DONE.
11. Press REFLECTION.
12. Connect the "open" end of the open/short combination (supplied in the calibration kit) to reference test port 1, as shown in Figure 1-8.
13. Press FORWARD:OPEN.
14. When the analyzer finishes measuring the standard, connect the "short" end of the open/short combination to reference test port 1.
15. Press FORWARD:SHORT.
16. When the analyzer finishes measuring the standard, connect the 50 ohm termination (supplied in the calibration kit) to reference test port 1.
17. Press REFLECTION FORWARD:LOAD.
18. When the analyzer finishes measuring the standard, connect the "open" end of the open/short combination to reference test port 2, as shown in Figure 1-8.
19. Press REVERSE:OPEN.
20. When the analyzer finishes measuring the standard, connect the "short" end of the open/short calibration standard to reference test port 2.
21. Press REVERSE:SHORT.
22. When the analyzer finishes measuring the standard, connect the 50 ohm termination to reference test port 2.
23. Press REVERSE: LOAD.
24. When the analyzer finishes measuring the standard, press STANDARDS DONE.
25. Connect the test port cables together as shown in Figure 1-9.

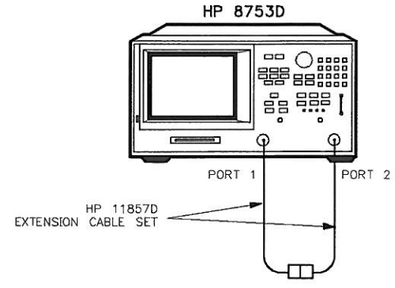

Figure 1-9. Transmission Calibration Setup

26. Press TRANSMISSION FWD TRANS THRU .
27. When the analyzer finishes measuring the standard, press FWD MATCH THRU .
28. When the analyzer finishes measuring the standard, press REV TRANS THRU .
29. When the analyzer finishes measuring the standard, press REV MATCH THRU .
30. When the analyzer finishes measuring the standard, press STANDARDS DONE DONE 2-PORT CAL .
31. Press (SAVE/ RECALL) SELECT DISK INTERNAL MEMORY RETURN SAVE STATE to save the measurement calibration into the analyzer internal memory.
32. Press SELECT DISK INTERNAL DISK .

Device Verification

33. Press (SYSTEM) SERVICE MENU TESTS (28) (x1) EXECUTE TEST .
34. Connect the 20 dB attenuator (supplied in the verification kit) as shown in Figure 1-10.

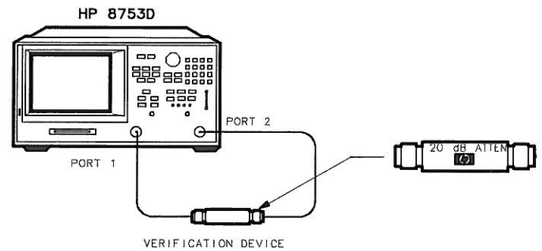

Figure 1-10. Connections for the 20 dB Verification Device

35. Press CONTINUE to run the test.

    Ignore the error message CAUTION: CALIBRATION REQUIRED.
36. Press (MENU) POWER (-2) (x1) (CAL) CORRECTION ON .
37. Press (COPY) PRINT MONOCHROME to obtain the graphical representation of the measurement.
38. Press (COPY) LIST PRINT ALL MONOCHROME if you prefer a tabular representation of the measurement.
39. Press (SYSTEM) SERVICE MENU TEST OPTIONS CONTINUE TEST .

    Ignore the error message CAUTION: CALIBRATION REQUIRED.
40. Press (MENU) POWER (-2) (x1) (CAL) CORRECTION ON .

Note For those S-parameter measurements with upper and lower point limits shown on the analyzer display, you will notice that when you press the CORRECTION ON softkey, the measurement test status changes from FAIL to PASS.

If the test status remains FAIL after you presses CORRECTION ON , refer to "In Case of Difficulty" at the end of this test for more troubleshooting information.

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41. Repeat steps 37 through 40 until you have made all the S-parameter measurements for the verification device.

Note For each verification device, there are a total of eight measurements (magnitude and phase for the four S-parameters).

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42. When the analyzer displays Ver Dev 1 FAIL, proceed to the next step only if ALL the tested S-parameter measurements show a PASS status after you activate error correction in step 40. Otherwise, refer to "In Case of Difficulty" at the end of this procedure.
43. Connect the 50 dB attenuator (supplied in the verification kit) as shown in Figure 1-11.

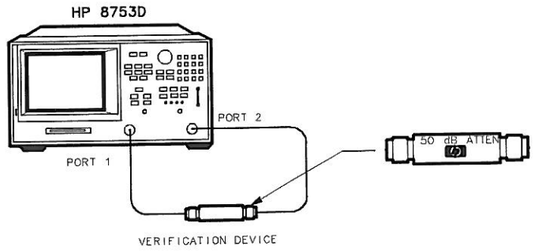

Figure 1-11. Connections for the 50 dB Verification Device

44. Press TESTS 29 x1 EXECUTE TEST CONTINUE.

    Ignore the error message.

45. Press MENU POWER -2 x1 CAL CORRECTION ON.

46. Repeat steps 37 through 40 until you made all the S-parameter measurements for the verification device.

47. When the analyzer displays `Ver Dev 2  FAIL`, proceed to the next step only if *all* S-parameter measurements show a PASS status under the same condition mentioned in step 42.

48. Connect the verification mismatch (supplied in the kit) as shown in Figure 1-12. Be sure port A of the verification mismatch is connected to reference test port 1.

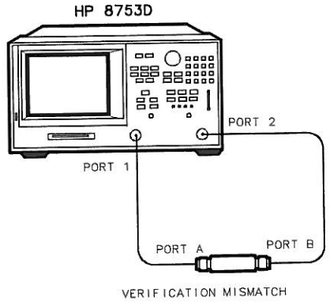

Figure 1-12. Mismatch Device Verification Setup

49. Press TESTS 30 x1 EXECUTE TEST CONTINUE.

    Ignore the error message.

50. Press MENU POWER -2 x1 CAL CORRECTION ON.

51. Repeat steps 37 through 40 until you have made all the S-parameter measurements for the verification device.

52. When the analyzer displays `Ver Dev 3  FAIL` proceed to the next step only if *all* S-parameter measurements show a PASS status under the same condition mentioned in step 42.

53. Connect the verification mismatch as shown in Figure 1-13. Notice that port B of the verification mismatch is now connected to the reference test port 1.

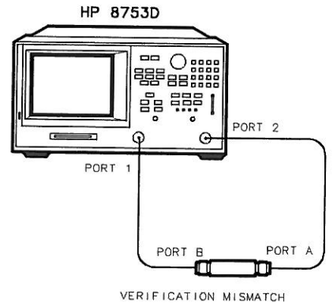

Figure 1-13. Mismatch Device Verification Setup

54. Press TESTS 31 x1 EXECUTE TEST CONTINUE.

    Ignore the displayed error message.

55. Press MENU POWER -2 x1 CAL CORRECTION ON.

56. Repeat steps 37 through 40 until you have made all the S-parameter measurements for the verification device.

57. The test is complete when the analyzer displays `Ver Def 4  FAIL` and *all* S-parameter measurements show a PASS status under the same condition mentioned in step 42.

In Case of Difficulty

1. Inspect all connections. DO NOT disconnect the cables from the analyzer test ports. Doing so WILL INVALIDATE the calibration done earlier.
2. Press (PRESET) (SAVE/RECALL) SELECT DISK INTERNAL MEMORY RETURN. Using the front panel knob, highlight the full 2-Port cal done earlier and press RECALL STATE.
3. Repeat the "Device Verification" procedure.
4. If the test still fails, do the following to check the calibration:
   a. Press (PRESET) (SAVE/RECALL) SELECT DISK INTERNAL MEMORY RETURN.
   b. Use the front panel knob to highlight the calibration you want to recall and press RECALL STATE.
   c. Press (MENU) TRIGGER MENU CONTINUOUS to trigger the continuous sweeps.
   d. Connect the short to reference test port 1.
   e. Press (MEAS) S11 (MENU) TRIGGER MENU CONTINUOUS.
   f. Press (SCALE/REF) SCALE/DIV (.05) (x1).
   g. Check to be sure the trace response is 0.00 ± 0.05 dB.
   h. Disconnect the short and connect it the reference test port 2.
   i. Press (MEAS) Refl: REV S22(B/R).
   j. Check to be sure the trace response is 0.00 ± 0.05 dB.
   k. If any of the trace responses are out of the specified limits, repeat the "Measurement Calibration" and "Device Verification" procedures.
5. Refer to the "Start Troubleshooting Here" chapter of the *HP 8753D Network Analyzer Service Guide* for more troubleshooting information.

1. Test Port Output Frequency Range and Accuracy

Specifications

Frequency Range	Frequency Accuracy[1]
30 kHz to 3 GHz	±10 ppm
3 GHz to 6 GHz[2]	±10 ppm

1 At 25° C ±5° C.

2 Only for analyzers with Option 006.

Required Equipment

Frequency Counter ..... HP 5343A
Cable, 50Ω Type-N, 24-inch ..... HP P/N 8120-4781
Adapter, APC-3.5 (f) to Type-N (f) ..... HP P/N 1250-1745
Adapter, APC-7 to Type-N (f) ..... HP P/N 11524A
Adapter, Type-N (f) to BNC (m) ..... HP P/N 1250-1477

Additional equipment needed for an HP 8753D with Option 075

Minimum Loss Pad, 50Ω to 75Ω ..... HP 11852B

Analyzer warm-up time: **30 minutes**

Perform this test to verify the frequency accuracy of the HP 8753D over its entire operating frequency range.