HP 8560 E-Series Calibration Guide Supplement

Using Performance Tests When an HP 3335A Source Is Not Available

HEWLETT PACKARD

Manufacturing Part Number: 08560-calsup

Printed in USA

October 1999

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General Safety Considerations

WARNING ***Before this instrument is switched on,*** **make sure it has been properly grounded through the protective conductor of the ac power cable to a socket outlet provided with protective earth contact.**

Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal can result in personal injury.

WARNING **There are many points in the instrument which can, if contacted, cause personal injury. Be extremely careful.**

Any adjustments or service procedures that require operation of the instrument with protective covers removed should be performed only by trained service personnel.

CAUTION *Before this instrument is switched on*, make sure its primary power circuitry has been adapted to the voltage of the ac power source.

Failure to set the ac power input to the correct voltage could cause damage to the instrument when the ac power cable is plugged in.

Contents

1 Using Performance Tests: Introduction

Introduction

The HP 3335A Synthesizer Level Generator signal source has become obsolete because parts used in the manufacture of this instrument are no longer available from suppliers. To meet the need of our customers, HP has created new performance verification tests and adjustment tests that use alternative signal sources.

The calibration and service guides are being revised to add additional procedures that do not use the HP 3335A. The changes include the addition of signal sources required to replace the 3335A, changes to the test equipment setup illustrations, and changes in the steps required to execute the procedures.

Because all of our customers will not need to replace the HP3335A immediately, we are releasing the changes to the calibration guide and service guides in the form of two manual supplements. HP is making these procedure revisions available to you at this time in electronic form, only. You will be able to download this manual supplement, and add it to your current manual as needed. You will not be required to replace your manuals just to incorporate these changes. These changes will be incorporated in new manuals shipped in the future.

To add these changes to your existing manuals, refer to "Implementation Instructions," on page 3.

Implementation Instructions

Update your calibration guide by performing the following steps:

Step 1. After down loading this supplement, print a hard copy of the entire document.

Step 2. Remove page 2-1 and 2-2 from your Calibration guide.

Step 3. Insert page 2-1 and 2-2 from the supplement into the calibration guide.

Step 4. Remove the performance tests procedures from the supplement, and insert them into your calibration guide as Chapter 2a immediately after Chapter 2.

2 Using Performance Test

What You'll Find in This Chapter

These procedures test the electrical performance of the spectrum analyzer against the specifications. None of the test procedures requires removing the cover of the instrument. This chapter also provides instructions for using the HP 85629B test and adjustment module functional tests. The HP 85629B is not compatible with the HP 8564E or HP 8565E.

Chapter 2a, "Using Performance Tests: HP 3335A Source not Available," provides instructions and procedures for conducting performance verification tests when the HP 3335A Synthesizer Level Generator is not available. In the event that the HP 3335A is not available, substitute those procedures for the procedures of the same number and name found in this chapter.

What Is Performance Verification?

The highest-level testing, called **performance verification**, verifies that the analyzer performance meets all specifications. Performance verification consists of executing all of the performance tests. It is time-consuming and requires extensive test equipment. Table 2-1 is a complete listing of those tests.

NOTE Refer to specifications listed in this manual for exact specifications for your model number spectrum analyzer.

Performance Tests versus Operation Verification

Operation verification tests are a subset of performance tests and check only the most critical specifications of the analyzer. These tests are software controlled for the HP 8560 E-Series. They require much less time and equipment to run than doing all the performance verification tests. Operation verification testing is recommended for verification of overall instrument operation, either as part of incoming inspection or after repair. Table 1-1 of Chapter 1 of "Using Operation Verification Software" in the *HP 8560 E-Series and EC-Series Spectrum Analyzers Calibration Guide* lists the performance tests and test equipment used for operation verification.

Before You Start

There are three things you must do *before* starting performance verification or operation verification:

1. Switch the analyzer on and let it warm up in accordance with warm-up requirements in the specifications chapter.
2. After the analyzer has warmed up as specified, perform “Trace Alignment Procedure and Reference Level Calibration” in the user's guide.
3. Read the rest of this section before you start any of the tests.

Test Equipment You'll Need

Table 2-2 lists the recommended test equipment for the performance tests. Any equipment that meets the critical specifications given in the table can be substituted for the recommended model (s). The table also lists the recommended equipment for the analyzer adjustment procedures. The adjustment procedures are located in the service guide.

Recording Test Results

Record test results in the performance test record located in Chapter 3. The test record lists test specifications and acceptable limits. We recommend that you make a copy of this table, record the complete test results on the copy, and keep the copy for your calibration test record. This record could prove invaluable in tracking gradual changes in test results over long periods of time.

If the Analyzer Doesn't Meet Specifications

If the analyzer doesn't meet one or more of the specifications during testing, complete any remaining tests and record all test results on a copy of the test record. Refer to the user's guide chapter “If You Have A Problem”. If an error message is displayed, press **PRESET CAL**, and select **REALIGN LO & IF**. If the error message persists after the automatic RF, LO, and IF adjustments are completed, refer to the troubleshooting information in the user's guide.

Calibration Cycle

The performance tests should be used to check the spectrum analyzer against its specifications every two years for the HP 8560E, HP 8561E, HP 8562E, and HP 8563E, and every one year for the HP 8564E and HP 8565E.

The frequency reference must be adjusted and checked at the same time. Refer to the “10 MHz Frequency Reference Adjustment” in the service guide.

2a Using Performance Tests: HP 3335A Source not Available

What You'll Find in This Chapter

These procedures test the electrical performance of the spectrum analyzer against the specifications. None of the test procedures requires removing the cover of the instrument.

The HP 3335A Synthesizer Level Generator has been discontinued and will neither be available from Hewlett-Packard nor will technical support be available after October of the year 2000. Because of the unavailability of the HP 3335A, new performance test procedures were required that use different signal sources. In the event that the HP 3335A is not available, substitute these procedures for those of the same number found in Chapter 2, “Using Performance Tests”.

Before You Start

There are three things you must do *before* starting performance verification or operation verification:

1. Switch the analyzer on and let it warm up in accordance with warm-up requirements in the specifications chapter.
2. After the analyzer has warmed up as specified, perform “Trace Alignment Procedure and Reference Level Calibration” in the user's guide.
3. Read the rest of this section before you start any of the tests.

Test Equipment You'll Need

Table 2-2 lists the recommended test equipment for the performance tests. Any equipment that meets the critical specifications given in the table can be substituted for the recommended model (s). The table also lists the recommended equipment for the analyzer adjustment procedures. The adjustment procedures are located in the service guide.

Recording Test Results

Record test results in the performance test record located in Chapter 2 of volume II, of the *HP 8560 E-Series and EC-Series Spectrum Analyzers Calibration Guide*. The test record lists test specifications and acceptable limits. We recommend that you make a copy of this table, record the complete test results on the copy, and keep the copy for your calibration test record. This record could prove invaluable in tracking gradual changes in test results over long periods of time.

If the Analyzer Doesn't Meet Specifications

If the analyzer doesn't meet one or more of the specifications during testing, complete any remaining tests and record all test results on a copy of the test record. Refer to the user's guide chapter “If You Have A Problem”. If an error message is displayed, press **PRESET CAL**, and select **REALIGN LO & IF**. If the error message persists after the automatic RF, LO, and IF adjustments are completed, refer to the troubleshooting information in the user's guide.

Calibration Cycle

The performance tests should be used to check the spectrum analyzer against its specifications every two years for the HP 8560E/EC, HP 8561E/EC, HP 8562E/EC, and HP 8563E/EC, and every one year for the HP 8564E/EC and HP 8565E/EC.

The frequency reference must be adjusted and checked at the same time. Refer to the “10 MHz Frequency Reference Adjustment” in the service guide.

Table 2-1 Required Performance Tests: HP 3335A Source Not Available

Test	HP 8560E/ EC	HP 8561E/ EC	HP 8562E/ EC	HP 8563E/ EC	HP 8564E/ EC	HP 8565E/ EC
11. Resolution Bandwidth Switching and IF Alignment Uncertainty	√	√	√	√	√	√
12. Resolution Bandwidth Accuracy and Selectivity	√	√	√	√	√	√
13. Input Attenuator Switching Uncertainty	√	√	√	√		
14. Input Attenuator Switching Uncertainty					√	√
15. IF Gain Uncertainty	√	√	√	√	√	√
16. Scale Fidelity	√	√	√	√	√	√
33. Second Harmonic Distortion	√					
34. Second Harmonic Distortion		√				
36. Frequency Response	√					
37. Frequency Response		√				
38. Frequency Response			√			
39. Frequency Response				√		
40. Frequency Response					√	
41. Frequency Response						√
43. Third Order Intermodulation Distortion	√					
44. Third Order Intermodulation Distortion		√				
45. Third Order Intermodulation Distortion			√	√		
46. Third Order Intermodulation Distortion					√	√

Required Test Equipment

The following table lists the test equipment required to execute the performance test in this chapter. These test originally required the use of the HP 3335A Synthesizer Level Generator. For test equipment used in performance tests other than those listed in this chapter, refer to Table 10-1 in Volume II of the calibration guide.

Table 2-2 Recommended Test Equipment

Instrument	Critical Specifications for Equipment Substitution	Recommended Model	Use
Sources			
4. Synthesized Signal Generator	Frequency range: 250 kHz to 3 GHz Frequency resolution: 1 Hz Attenuator resolution: 0.02 dB Level accuracy: ±0.5 dB External 10 MHz Ref. Input	HP E4421 or HP E4422, HP E4432, HP E4433	P,A
Synthesized sweeper	Frequency range: HP 8560E, 10 MHz to 12.0 GHz HP 8561E, 10 MHz to 12.0 GHz HP 8562E, 10 MHz to 13.2 GHz HP 8563E, 10 MHz to 26.5 GHz Frequency accuracy (CW): 1×10^{-9}/day Leveling modes: Internal &External Modulation modes: AM &Pulse Power level range: –80 to +16 dBm	HP 83640B* HP 83630A Opt 001, 008	P,A,T, M,V
Synthesized sweeper *(for HP 8564E and HP 8565E)*	Frequency range: HP 8564E, 10 MHz to 40.0 GHz HP 8565E, 10 MHz to 50.0 GHz Frequency accuracy (CW): 1×10^{-9}/day Leveling mode: Internal Power level range: –35 to +16 dBm	HP 83650A Opt 001, 008	P,A,T, V
Function Generator	Frequency Range: 100 kHz to 250 kHz Frequency Accuracy: ±0.02%	HP 3324A or HP 33120A	P

Table 2-2 Recommended Test Equipment (Continued)

Instrument	Critical Specifications for Equipment Substitution	Recommended Model	Use
Receivers			
Measuring receiver	Compatible w/power sensors dB relative mode Resolution: 0.01 dB Reference accuracy: <±1.2%	HP 8902A*	P,A,T, M,V
Sensors			
Power sensor *(for HP 8560E, HP 8561E or HP 8562E)*	Frequency range: 10 MHz to 13.2 GHz Maximum SWR: 1.40 (10 to 30 MHz) 1.18 (30 to 50 MHz) 1.10 (50 MHz to 2 GHz) 1.18 (2 to 13.2 GHz)	HP 8481A*	P,A,T, M,V
Power sensor	Frequency range: 100 kHz to 2.9 GHz Maximum SWR: 1.1 (1 MHz to 2.0 GHz) 1.30 (2.0 GHz to 2.9 GHz)	HP 8482A*	P,A,T, M,V
Power sensor *(for HP 8563E)*	Frequency range: 50 MHz to 26.5 GHz Maximum SWR: 1.15 (50 to 100 MHz) 1.10 (100 MHz to 2 GHz) 1.15 (2.0 to 12.4 GHz) 1.20 (12.4 to 18 GHz) 1.25 (18 to 26.5 GHz)	HP 8485A*	P,A,T, M,V

Table 2-2 Recommended Test Equipment (Continued)

Instrument	Critical Specifications for Equipment Substitution	Recommended Model	Use
Power sensor *(for HP 8564E and HP 8565E)*	Frequency range: 50 MHz to 50 GHz Maximum SWR: 1.15 (50 to 100 MHz) 1.10 (100 MHz to 2 GHz) 1.15 (2.0 to 12.4 GHz) 1.20 (12.4 to 18 GHz) 1.25 (18 to 26.5 GHz) 1.30 (26.5 to 40 GHz) 1.50 (40 to 50 GHz)	HP 8487A	P,V
Other Equipment			
Digital voltmeter	Range: –15 Vdc to +120 Vdc Accuracy: <±1 mV on 10 V range Input impedance: ≥1 M Ω	HP 3458A*	A,T
Probes			
DVM test leads	≥36 inches, alligator clips, probe tips	HP 34118A	A,T
Accessories			
Directional bridge	Frequency range: 1 to 80 MHz Coupling: 6 dB (nominal) Maximum coupling deviation: <1 dB (nominal) Directivity: 40 dB minimum Impedance: 50 Ω (nominal)	HP 8721A	P
Directional coupler *(for HP 8561E)* *(two required)*	Frequency range: 2.0 to 6.5 GHz Coupling: 16.0 dB (nominal) Maximum coupling deviation: ±1 dB (nominal) Directivity: 14 dB minimum Flatness: 0.75 dB maximum VSWR: <1.45 Insertion loss: <1.3 dB	0955-0098	P

Table 2-2 Recommended Test Equipment (Continued)

Instrument	Critical Specifications for Equipment Substitution	Recommended Model	Use
Directional coupler *(for HP 8562E, HP 8563E, HP 8564E, and HP 8565E)* *(two required)*	Frequency range: 2.0 to 8.1 GHz Coupling: 16.0 dB (nominal) Maximum coupling deviation: ±1 dB (nominal) Directivity: 14 dB minimum Flatness: 0.75 dB maximum VSWR: <1.45 Insertion loss: <1.3 dB	0955-0098	P
10 dB step attenuator	Attenuation range: 30 dB Frequency range: dc to 80 MHz Connectors: Type N(f)	HP 8496G Option 001	P,V
1 dB step attenuator	Attenuation range: 12 dB Frequency range: dc to 80 MHz Connectors: Type N (f)	HP 8494G Option 001	P,V
Attenuator Driver	Compatible with the HP 8496G and HP 8494G step attenuators.	HP 11713A	P,V
Attenuator Interconnector Kit	Type-N For HP 8496G and HP 8494G attenuators.	HP 11716A or HP 11716C	P,V
20 dB fixed attenuator	Frequency range: dc to 18 GHz Attenuation accuracy: <±1 dB Maximum SWR: 1.2 (dc to 2.9 GHz)	HP 8491B Option 020	P,V
10 dB fixed attenuator	Frequency range: dc to 18 GHz Attenuation accuracy: <±0.6 dB Maximum SWR: 1.2 (dc to 2.9 GHz)	HP 8491B Option 010	P,V
Termination *(for HP 8560E)*	Frequency range: dc to 2.9 GHz Impedance: 50 Ω Maximum SWR: <1.10 Connector: Type N (m)	HP 908A	P,M,V
Low-pass filter	Cutoff frequency: 50 MHz Rejection at 65 MHz: >40 dB Rejection at 75 MHz: >60 dB	0955-0306	P,M,V

Table 2-2 Recommended Test Equipment (Continued)

Instrument	Critical Specifications for Equipment Substitution	Recommended Model	Use
Low-pass filter *(two required for HP 8561E, HP 8562E, HP 8563E, HP 8564E, and HP 8565E)*	Cutoff frequency: 4.4 GHz Rejection at 5.5 GHz: >40 dB	HP 11689A RLC F-2634 HP 9135-0005	P
Power splitter *(for HP 8560E or HP 8561E)*	Frequency range: 1 kHz to 12 GHz Insertion loss: 6 dB (nominal) Output tracking: <0.25 dB Equivalent output SWR: <1.22	HP 11667A	P,A,M, V
Power splitter *(for HP 8562E and HP 8563E)*	Frequency range: dc to 26.5 GHz Output tracking: <0.25 dB Insertion loss: 6 dB (nominal) Equivalent output SWR: <1.22	HP 11667B	
Power splitter *(for HP 8564E and HP 8565E)*	Frequency range: dc to 50 GHz Output tracking: <0.25 dB Insertion loss: 6 dB (nominal) Equivalent output SWR: <1.22	HP 11667C	
Cables			
Cable	Connectors: SMA (m) Length: 24 to 36 inches	8120-1578	P
Cable, 50 Ω coaxial *(four required)*	Connectors: BNC (m) Length: ≥ 122 cm (48 in.)	HP 10503A	P,A,V
Cable *(two required)*	Frequency range: 30 Hz to 26.5 GHz Maximum SWR: <1.4 at 26.5 GHz Maximum insertion loss: 3 dB Connectors: APC 3.5 (m), both ends Length: ≥ 61 cm (24 in.)	8120-4921	P,A,M, V
Adapters			
Adapter *(four required)*	Type N (m)-to-BNC (f)	1250-1476	P,A,V
Adapter	Type N (m)-to-N (m)	1250-1475	P

Table 2-2 Recommended Test Equipment (Continued)

Instrument	Critical Specifications for Equipment Substitution	Recommended Model	Use
Adapter *(two required)*	Type N (m)-to-APC 3.5 (m)	1250-1743	P,M,V
Adapter	Type N (m)-to-APC 3.5 (f)	1250-1744	P,V
Adapter	Type N (m)-to-BNC (m)	1250-1473	P
Adapter	Type N (m)-to-N (f)	1250-1472	P
Adapter *(two required)*	Type N (f)-to-APC 3.5 (f)	1250-1745	P,V
Adapter *(two required)*	Type N (m)-to-SMA (f)	1250-1250	P,V
Adapter *(two required)*	Type N (m)-to-SMA (m)	1250-1636	P,V
Adapter	Type N (f)-to-SMA (f)	1250-1772	P
Adapter	BNC tee (f) (m) (f)	1250-0781	P,A,M,V
Adapter	SMA (m)-to-SMA (m)	1250-1159	P,A,V
Adapter	BNC (f)-to-dual banana plug	1251-2816	A,T
Adapter	BNC (f)-to-dual banana plug	1251-1477	A,T
Adapter *(two required)*	APC 3.5 (f)-to-APC 3.5 (f)	5061-5311	P,M,V
Adapter *(two required)*	APC 3.5 (f)-to-APC 3.5 (f)	1250-1749	P,V
Adapter	APC 3.5 (f)-to-2.4 mm (f)	HP 11901B	P
Adapter	Type N (f)-to-2.4 mm (f)	HP 11903B	P,A,T,V

* Part of microwave workstation

P = performance tests; A = adjustments; M = test & adjustment module; T = troubleshooting; V = operation verification

Using HP 11713A, HP 8494G, and HP 8496G

When using the programmable version of the 1 dB and 10 dB step attenuator—HP 8494G and HP 8496G, respectively—the HP 11713A attenuator/Switch Driver must be used to control the attenuators. The HP 8594G 1 dB step attenuator should be connected as Attenuator X and the HP 8496G 10 dB step attenuator should be connected as Attenuator Y.

Use Table 2-3 to determine the settings for Attenuator X and Attenuator Y to achieve the desired attenuation value. In the Attenuator X and Attenuator Y columns, a “1” indicates that the selection is on—the LED in the button will be lit. An “0” in these columns indicates that the selection is off and the LED will be off. For example, if the 1 dB step attenuator is to be set 2 dB and the 10 dB step attenuator is to be set to 60 dB for a total of 62 db, then sections 2,6, and 7 should be on(lit) and all other sections should be off.

Table 2-3 HP 11713A Settings for HP 8494G and HP 8496G

1 dB Step Attenuator (dB)	Attenuator X				10 dB Step Attenuator (dB)	Attenuator Y			
	1	2	3	4		5	6	7	8
0	0	0	0	0	0	0	0	0	0
1	1	0	0	0	10	1	0	0	0
2	0	1	0	0	20	0	1	0	0
3	1	1	0	0	30	1	1	0	0
4	0	0	1	0	40	0	0	1	0
5	1	0	1	0	50	1	0	1	0
6	0	1	1	0	60	0	1	1	0
7	1	1	1	0	70	1	1	1	0
8	0	0	1	1	80	0	0	1	1
9	1	0	1	1	90	1	0	1	1
10	0	1	1	1	100	0	1	1	1
11	1	1	1	1	110	1	1	1	1

11a. Resolution Bandwidth Switching and IF Alignment Uncertainty

Instrument Under Test

All HP 8560 E-Series and EC-Series except Option EMI

Related Specifications

Resolution Bandwidth Switching Uncertainty
IF Alignment Uncertainty

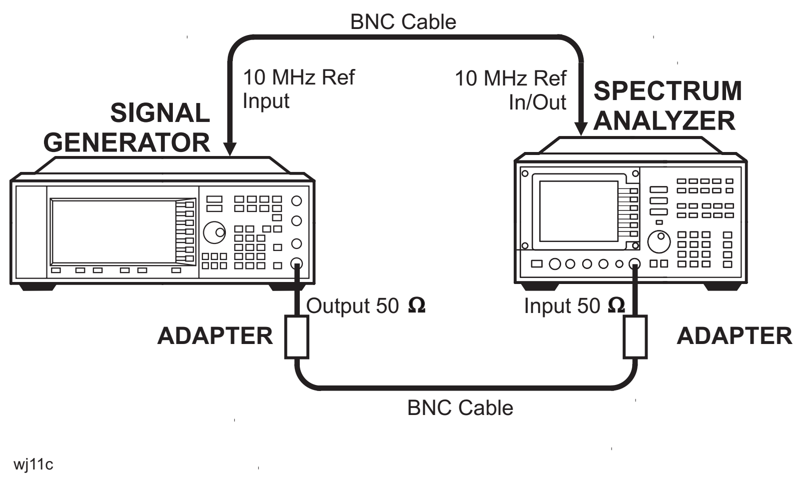
Related Adjustment

There is no related adjustment procedure for this performance test.

Description

A signal source is applied to the input of the spectrum analyzer, and an amplitude reference is set with the RES BW at 300 kHz. At each of the analyzer resolution bandwidth settings, the amplitude of the source is adjusted to place the signal at the analyzer reference level. The source amplitude is compared with the amplitude at the analyzer 300 kHz RES BW setting. The difference between the settings equals the RES BW switching uncertainty. For the 300 Hz resolution bandwidth setting, the difference between settings equals the sum of the resolution bandwidth switching uncertainty and IF alignment uncertainty.

Figure 2-1 Resolution BW Switching and IF Alignment Uncertainty Test Setup



Equipment

Signal Generator . . . . HP E4421B

Adapters

Type N (m) to BNC (f) (*2 required*) 1250-1476

Type N (f) to 2.4 mm (f). . . . . HP 11903B
(*for HP 8564E and HP 8565E*)

Cable

BNC, 122 cm (48 in.) *(2 required)*. . . . . HP 10503A

Procedure

1. Connect the equipment as shown in Figure 2-1. The spectrum analyzer provides the frequency reference for the HP E4421B.
2. Set the HP E4421B controls as follows:

   Frequency . . . . 50 MHz

   Amplitude. . . . . –5 dBm

   Amplitude increment . . . . 0.02 dB

3. Press **PRESET**, **CAL,** and **FULL IF ADJ** on the spectrum analyzer. Wait for the IF ADJUST STATUS: message to disappear, then set the controls as follows:

   Center frequency . . . . 50 MHz

   Span . . . . 1 MHz

   Log dB/division. . . . . .1 dB

   Resolution BW . . . . .300 kHz

4. On the spectrum analyzer, press **CAL** and **IF ADJ OFF**. Press **PEAK SEARCH, MKR** →, and **MARKER** → **REF LVL**. Wait for the completion of a new sweep.
5. Press **PEAK SEARCH** and **MARKER DELTA**.
6. Set the spectrum analyzer controls as follows:

   Span . . . . 10 MHz

   Resolution BW . . . . 2 MHz

   Video BW/Resolution BW ratio 0.100

7. On the spectrum analyzer, press **CAL** and **ADJ CURR IF STATE**. Wait for the IF ADJUST STATUS message to disappear.
8. On the spectrum analyzer, press **PEAK SEARCH**.

9. On the HP E4421B, press **Amplitude** and use the increment ⇓ and ⇑ keys to adjust the amplitude until the marker amplitude displayed on the spectrum analyzer reads 0 dB ±0.05 dB.

10. If the peak is still off the screen, repeat step 8 and step 9.

11. Record the HP E4421B amplitude setting in Table 2-4.

12. Calculate the amplitude difference by subtracting the HP E4421B Amplitude setting from –5 dBm. Record the result as the amplitude difference in Table 2-4.

    Amplitude difference = HP E4421B Amplitude setting – (–5 dBm)

13. On the spectrum analyzer, set the span and resolution bandwidth to the next settings listed in Table 2-4.

14. Repeat step 7 through step 13 for the remaining spectrum analyzer SPAN and RES BW settings in Table 2-4. The 3 Hz and 1 Hz RES BW settings are not available in analyzers with Option 103.

Table 2-4 Resolution Bandwidth Switching and IF Alignment Uncertainty

Spectrum Analyzer Settings		Signal Generator Amplitude (dBm) E4421B	Amplitude Difference (dB)	Measurement Uncertainty (dB)
Span	Res BW			
1 MHz	300 kHz	−5 (Ref.)	0 (Ref.)	±0.05
10 MHz	2 MHz			±0.05
5 MHz	1 MHz			±0.05
500 kHz	100 kHz			±0.05
100 kHz	30 kHz			±0.05
50 kHz	10 kHz			±0.05
10 kHz	3 kHz			±0.05
5 kHz	1 kHz			±0.05
1 kHz	300 Hz			±0.05
500 Hz	100 Hz			±0.05
100 Hz	30 Hz			±0.05
100 Hz	10 Hz			±0.05
100 Hz	3 Hz*			±0.05
100 Hz	1 Hz*			±0.05

*These bandwidths are not available in spectrum analyzers with Option 103.

12a. Resolution Bandwidth Accuracy and Selectivity

Instrument Under Test

All HP 8560 E-Series and EC-Series, except Option EMI

Related Specifications

Resolution Bandwidth Accuracy
Resolution Bandwidth Selectivity

Related Adjustment

There is no related adjustment procedure for this performance test.

Description

The output of a signal source is connected to the input of the spectrum analyzer through a precision step attenuator set. The spectrum analyzer is set to a span approximately twice the resolution bandwidth setting (for measuring the –3 dB bandwidth). The actual span error is determined by moving the source frequency and comparing the measured frequency difference to the actual difference between the two source frequencies.

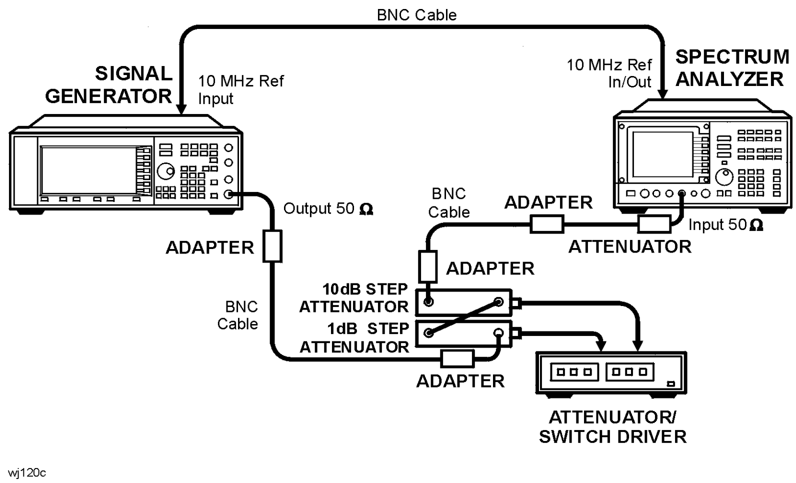
The signal to the analyzer is then reduced in amplitude by 3 dB to determine the actual –3 dB point. A marker reference is set and the signal amplitude is increased by 3 dB to its previous level. A sweep is then taken and the markers are used to measure the 3 dB bandwidth. The measured bandwidth is then corrected for the span error and a percent error between the ideal bandwidth and the corrected bandwidth is calculated and recorded.

The span error is not measured in the narrower spans. To measure the span error accurately, the span-to-resolution bandwidth ratio should be approximately 100:1 with a resolution bandwidth ≥300 Hz. This criteria cannot be met in the narrower spans.

The –60 dB bandwidths are measured in a similar manner, with the span set to about 15 to 20 times the resolution bandwidth setting. The ratio between the –60 dB and –3 dB bandwidths is calculated and recorded.

RES BW settings ≤100 Hz are not measured. These bandwidths are digitally-derived; therefore, their accuracy and shape are guaranteed by design.

Figure 2-2 Resolution Bandwidth Accuracy and Selectivity Test Setup



Equipment

Signal Generator . . . . HP E4421B

Attenuator/Switch Driver . . . . HP 11713A

1 dB Precision Step Attenuator . . . . HP 8494G, Option 001

10 dB Precision Step Attenuator . . . . HP 8496G, Option 001

Attenuator Interconnector Kit . . . . HP 11716A

Adapter

BNC (f) to type N (m) (*3 required*) 1250-1476

Type N (f) to 2.4 mm (f). . . . . HP 11903B

(*for HP 8564E/EC and HP 8565E/EC*)

Cable

BNC, 122 cm (48 in.) *(3 required)*. . . . . HP 10503A

Procedure

1. Connect the equipment as shown in Figure 2-2. The spectrum analyzer provides the frequency reference for the signal generator.

NOTE The 11713A Attenuator/Switch Driver enables all attenuators upon powering up the device. In order to view the signal, the Switch Driver AttenuatorX and Attenuator Y buttons must be off.

2. Set the HP E4421B controls as follows:

   Frequency . . . . 50 MHz

   Amplitude . . . .–5 dBm

3. Set the 1 dB and 10 dB step attenuators as follows:

   Step Attenuators . . . . .0 dB

4. On the spectrum analyzer, press **PRESET**, **SAVE, SAVELOCK OFF, CAL**, and **FULL IF ADJ**. Wait for the `IF ADJUST STATUS:` message to disappear. Press **IF ADJ OFF**. Set the controls as follows:

   Center frequency. . . . . 50 MHz

   Span . . . . 4 MHz

   Log dB/division . . . . 1 dB

   Resolution BW. . . . . 2 MHz

   Video BW . . . . 300 Hz

Resolution Bandwidth Accuracy

5. Adjust the HP E4421B output amplitude to place the signal two to three divisions (2 dB to 3 dB) below the reference level.
6. On the spectrum analyzer, press **CAL** and **ADJ CURR IF STATE**. Wait for the `IF ADJUST STATUS:` message to disappear before continuing.
7. If the RES BW setting is 3 kHz or less, proceed directly to step 14.
8. Set the HP E4421B frequency to F1 as indicated in Table 2-5 for the current RES BW setting of the analyzer.
9. On the spectrum analyzer, press **SAVE, SAVE STATE,** and **STATE 0**, then press **AUTO COUPLE, ALL**, **PEAK SEARCH**, and **MARKER DELTA**.
10. Set the HP E4421B frequency to F2 as indicated in Table 2-5 for the current RES BW setting of the analyzer.

11. On the spectrum analyzer, press **PEAK SEARCH**. Record the Δ MKR frequency reading as the actual SPAN measurement in Table 2-6 for the RES BW setting to be measured.

12. On the spectrum analyzer, press **RECALL**, **RECALL STATE**, and **STATE 0**.

13. Set the HP E4421B frequency to 50 MHz.

14. Increase the 1 dB step attenuation to 3 dB. Note the 3 dB attenuator error by subtracting the ideal attenuation from the attenuator calibration value (actual attenuation):

    dB error = Actual attenuation – Ideal attenuation

    Example: –0.041 dB error = 2.959 dB – 3 dB
    dB error = ________

15. On the spectrum analyzer, press **PEAK SEARCH** and **MARKER DELTA**.

16. Decrease the 1 dB step attenuation 3 dB.

17. On the spectrum analyzer, press **SGL SWP** and wait for the completion of a new sweep.

18. Press **MKR** on the spectrum analyzer. Rotate the RPG knob counterclockwise until the Δ MKR amplitude reads 0 dB plus the attenuation error calculated in step 14 ±0.02 dB.

    The marker should be on the left-hand skirt of the signal.

    If the marker cannot be set exactly to 0 dB plus the attenuator error calculated in step 13, note whether the marker is just above or just below the actual –3 dB point.

19. Press **MARKER DELTA**, then rotate the RPG knob clockwise until the Δ MKR amplitude reads 0 dB plus the attenuator error in step 13 ±0.02 dB.

    The active marker should be on the right-hand skirt of the signal.

    If the marker was set just above –3 dB in the previous step, set the marker just below the –3 dB point.

    If the marker was set just below the –3 dB point in the previous step, set the marker just above the –3 dB point.

20. If the RES BW setting is 3 kHz or less, record the Δ MKR frequency reading as the corrected –3 dB bandwidth in Table 2-6 and continue with step 23. There is no need to correct for span accuracy.

21. Record the Δ MKR frequency reading as the measured –3 dB bandwidth in Table 2-6 for the current RES BW setting.

22. Calculate the corrected –3 dB bandwidth as shown below and record the result in Table 2-6.

    Corr –3 dB BW = (actual span / ideal span) × measured –3 dB BW

    Example:

    Resolution BW Setting = 1 MHz
    Ideal Span = 1.0 MHz
    Actual Span = 1.05 MHz
    Measured –3 dB BW = 913 kHz

    Corr –3 dB BW = (1.05/1.00) × 913 kHz = 958.65 kHz

23. Record the corrected –3 dB bandwidth in Table 2-6 for the current RES BW setting.

24. Calculate the 3 dB BW error shown below and record the result in Table 2-6 for the current RES BW setting.

    3 dB BW error = 100 × (corr'd –3 dB BW – RES BW setting)/RES BW setting

    Following the example above:

    3 dB BW error = 100 × (0.95865 MHz – 1.0 MHz RES BW setting)/1.0 MHz RES BW setting = –4.135%

25. On the spectrum analyzer, press **MKR**, **MARKERS OFF, TRIG**, and **SWEEP CONT**.

26. Repeat step 6 through step 25 for the remaining RES BW and SPAN settings listed in Table 2-5 and Table 2-6.

Resolution Bandwidth Selectivity

27. Set the spectrum analyzer controls as follows:

    Span . . . . 20 MHz

    Resolution BW. . . . . 2 MHz

    Video BW . . . . 300 Hz

    Log dB/division . . . . 10 dB

28. Set the HP E4421B as follows:

    Amplitude . . . .–3 dBm

    Amplitude increment . . . . 1 dB

29.On the spectrum analyzer, press **CAL** and **ADJ CURR IF STATE**. Wait for the IF ADJUST STATUS: message to disappear before continuing. Press **PEAK SEARCH**.

30.Adjust the HP E4421B Amplitude until the spectrum analyzer MKR amplitude reads 0 dBm ±1.00 dB.

31.Set the HP E4421B frequency to F1 as indicated in Table 2-7 for the current spectrum analyzer RES BW setting.

32.On the spectrum analyzer, press **MKR**, **MARKERS OFF**, **SAVE**, **SAVE STATE, STATE 0, AUTO COUPLE**, and **ALL**. If the RES BW setting is now less than 300 Hz, press **BW**, 300, and **Hz**.

33.Press **PEAK SEARCH** and **MARKER DELTA**.

34.Set the HP E4421B frequency to F2 as indicated in Table 2-7 for the current spectrum analyzer RES BW setting.

35.Press **PEAK SEARCH** on the spectrum analyzer. Record the Δ MKR frequency as the Actual SPAN Measurement in Table 2-8 for the current RES BW setting.

36.On the spectrum analyzer, press **RECALL**, **RECALL STATE**, **STATE 0**.

37.Set the HP E4421B frequency to 50 MHz.

38.Increase the 10 dB step attenuation to 60 dB. Note the 60 dB attenuator error by subtracting the ideal attenuation from the attenuator calibration value (actual attenuation):

dB error = Actual attenuation – Ideal attenuation

Example: –0.175 dB error = 60.175 dB – 60 dB

39.On the spectrum analyzer, press **PEAK SEARCH** and **MARKER DELTA**.

40.Decrease the 10 dB step attenuation to 0 dB.

41.On the spectrum analyzer, press **SGL SWP** and wait for the completion of a new sweep.

42.Press **MKR** on the spectrum analyzer. Rotate the RPG knob counterclockwise until the Δ MKR amplitude reads 0 dB plus the error calculated in step 37 ±0.8 dB. The marker should be on the left-hand skirt of the signal. If the marker cannot be set to exactly 0 dB, note whether the marker is just above or just below the actual –60 dB point.

43. Press **MARKER DELTA** on the spectrum analyzer. Rotate the RPG knob clockwise until the Δ MKR amplitude reads 0 dB plus the attenuation error calculated in step 38 ±0.8 dB. The active marker should be on the right-hand skirt of the signal. If the marker was set just above the –60 dB point in the previous step, set the marker just below the –60 dB point. If the marker was set just below the –60 dB point in the preceding step, set the marker above the –60 dB point.
44. Record the Δ MKR reading as the Measured –60 dB bandwidth in Table 2-8 for the current RES BW setting.
45. Calculate the corrected –60 dB bandwidth as shown below, then record the result in Table 2-8.

    Corr –60 dB BW = (actual span/ideal span) × measured –60 dB BW

    Example:

    RES BW setting = 1 MHz
    Ideal span = 16 MHz
    Actual span = 17 MHz
    Measured -60 dB BW = 9.82 MHz

    Corr-60 dB BW = (17/16) x 9.82 MHz = 10.43
46. Record the corrected –60 dB BW in Table 2-8 for the current RES BW setting.
47. Calculate the selectivity by dividing the corrected –60 dB BW by the corrected –3 dB BW from Table 2-6, then record the result in Table 2-8.

    Selectivity = corr –60 dB BW / corr –3 dB BW

    Example:

    Selectivity = 10.43 MHz / 0.9415 MHz = 11.08
48. On the spectrum analyzer, press **MKR**, **MARKERS OFF, TRIG**, and **SWEEP CONT**.
49. Repeat step 29 through step 48 for the remaining RES BW and SPAN settings listed in Table 2-7 and Table 2-8.

Table 2-5 –3 dB Bandwidth Instrument Settings

Spectrum Analyzer Settings		Signal Generator Frequencies		Measurement Uncertainty (%)
RES BW	SPAN	F1 (MHz)	F2 (MHz)	
2 MHz	4 MHz	49.0	51.0	±1.33
1 MHz	2 MHz	49.5	50.5	±1.33
300 kHz	500 kHz	49.85	50.15	±1.33
100 kHz	200 kHz	49.95	50.05	±1.33
30 kHz	50 kHz	49.985	50.015	±1.33
10 kHz	20 kHz	49.995	50.005	±1.33
3 kHz	5 kHz	N/A	N/A	±1.33
1 kHz	2 kHz	N/A	N/A	±1.33
300 Hz	600 Hz	N/A	N/A	±1.33

Table 2-6 –3 dB Bandwidth Measurement Data

RES BW Setting	Span Measurement		–3 dB BW Measurement		3 dB BW Error (%)
	Ideal	Actual	Measured	Corrected	
2 MHz	2 MHz	MHz	MHz	MHz	
1 MHz	1.0 MHz	MHz	Hz	MHz	
300 kHz	300 kHz	kHz	KHz	kHz	
100 kHz	100 kHz	kHz	KHz	kHz	
30 kHz	30 kHz	kHz	KHz	kHz	
10 kHz	10 kHz	kHz	KHz	kHz	
3 kHz*	N/A	N/A	KHz	N/A	
1 kHz*	N/A	N/A	Hz	N/A	
300 Hz*	N/A	N/A	Hz	N/A	
*Span Error Measurement not required for RES BW settings of 3 kHz and less.					

Table 2-7 –60 dB Bandwidth Instrument Settings

Spectrum Analyzer Settings		Signal Generator Frequencies		Measurement Uncertainty (%)
RES BW	SPAN	F1 (MHz)	F2 (MHz)	
2 MHz	20 MHz	45.0	55.0	±2.8
1 MHz	20 MHz	42.0	58.0	±2.8
300 kHz	5 MHz	48.0	52.0	±2.8
100 kHz	2 MHz	49.2	50.8	±2.8
30 kHz	500 kHz	49.8	50.2	±2.8
10 kHz	200 kHz	49.92	50.08	±2.8
3 kHz	50 kHz	49.98	50.02	±2.8
1 kHz	20 kHz	49.992	50.008	±2.8
300 Hz	5 kHz	49.998	50.002	±2.8

Table 2-8 –60 dB Bandwidth Measurement Data

RES BW Setting	Span Measurement		–60 dB Bandwidth		Selectivity
	Ideal	Actual	Measured	Corrected	
2 MHz	10 MHz	MHz	MHz	MHz	
1 MHz	16 MHz	MHz	MHz	MHz	
300 kHz	4 MHz	MHz	MHz	MHz	
100 kHz	1.6 MHz	MHz	Hz	Hz	
30 kHz	400 kHz	kHz	kHz	kHz	
10 kHz	160 kHz	kHz	kHz	kHz	
3 kHz	40 kHz	kHz	kHz	kHz	
1 kHz	16 kHz	kHz	kHz	kHz	
300 Hz	4 kHz	kHz	kHz	kHz	

13a. Input Attenuator Switching Uncertainty: HP 8560E/EC, 8561E/EC, 8562E/EC, 8563E/EC

Instrument Under Test

HP 8560E/EC
HP 8561E/EC
HP 8562E/EC
HP 8563E/EC

Related Specification

Input Attenuator Switching Uncertainty

Related Adjustment

There is no related adjustment procedure for this performance test.

Description

This test measures the input attenuator switching uncertainty over the full 70 dB range at 50 MHz. The signal generator is phase-locked to the spectrum analyzer 10 MHz reference. Switching uncertainty is referenced to the 10 dB attenuator setting. The calibrated precision step attenuators are the measurement standard.

The input attenuator switching uncertainty at 2.9 GHz is measured using IF substitution. The IF gains are characterized at 50 MHz.

Figure 2-3 Input Attenuator Test Setup, 50 MHz

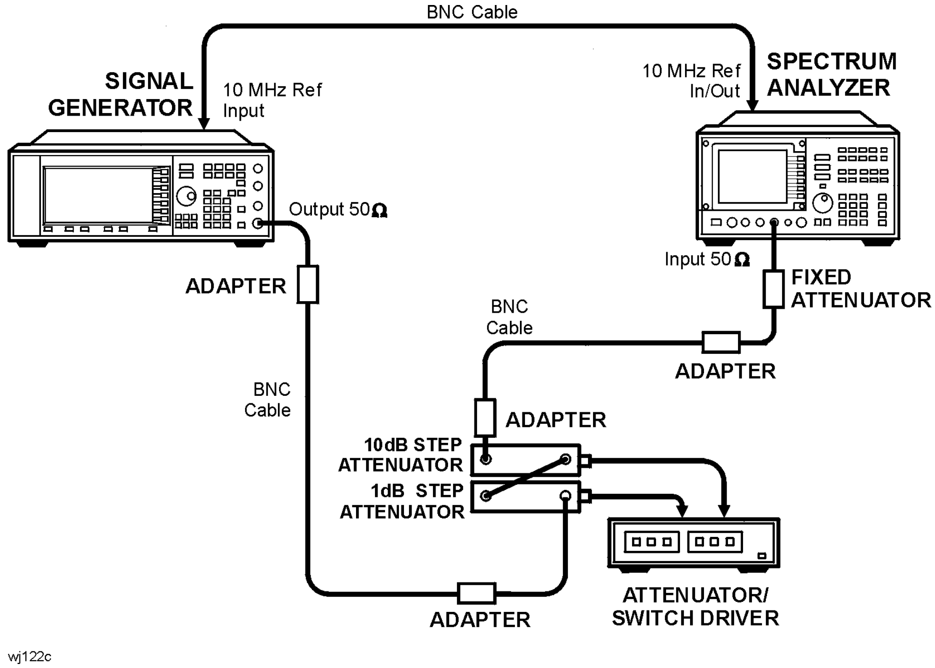
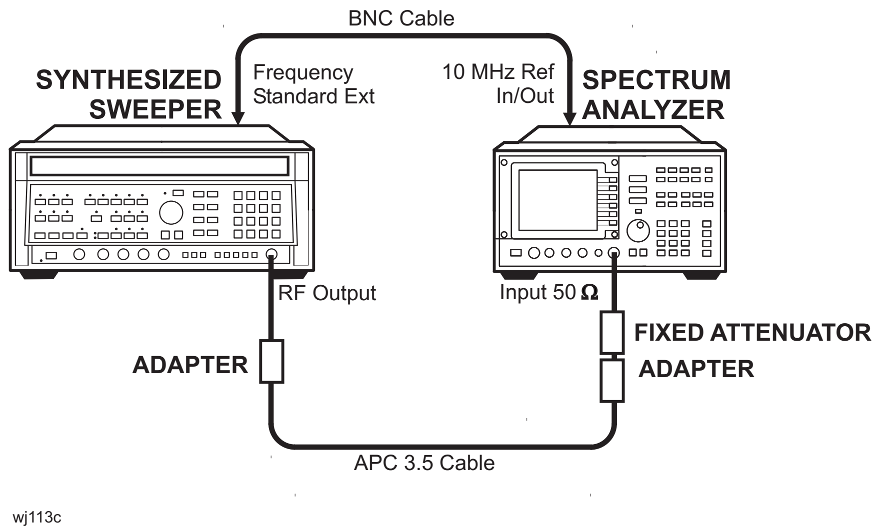


Figure 2-4 Input Attenuator Test Setup, >50 MHz



Equipment

Synthesized sweeper . . . . HP 83640B

Signal Generator . . . . .HP E4421B

Attenuator/Switch Driver . . . . HP 11713A

1 dB Precision Step Attenuator. . . . . HP 8494G, Option 001

10 dB Precision Step Attenuator. . . . . HP 8496G, Option 001

Attenuator Interconnector Kit . . . . HP 11716A

20 dB coaxial fixed attenuator . . . . .HP 8491B (Option 020)

10 dB coaxial fixed attenuator . . . . .HP 8491B (Option 010)

Adapters

Type N (m) to BNC (f) (*4 required*) 1250-1476

Type N (m) to APC 3.5 (f) 1250-1744

APC 3.5 (f) to APC 2.4 (f) . . . . HP 11901B

Cables

BNC, 122 cm (48 in.) *(3 required)*. . . . . HP 10503A

APC 3.5 mm (36 in.) 8120-4921

Procedure

Attenuator Switching Uncertainty (50 MHz)

1. Connect the equipment as shown in Figure 2-3 using the HP 8491B Option 020. The spectrum analyzer provides the frequency reference for the HP E4421B.
2. Set the HP E4421B controls as follows:

   Frequency . . . . .50 MHz

   Amplitude . . . . 10 dBm

   Step Attenuators . . . . .60 dB
3. On the spectrum analyzer, press **PRESET, CAL** and **REALIGN LO &IF**. Wait for adjustments to complete. Then, set the controls as follows:

   Center frequency . . . . .50 MHz

   Span . . . . .0 Hz

   Reference level . . . . –70 dBm

   Log dB/division. . . . . .1 dB

   Resolution BW . . . . .3 kHz

   Video BW . . . . .1 Hz

4. Set the 1 dB step attenuator to 0 dB.
5. Adjust the source amplitude to place the signal 2 to 3 dB (two to three divisions) below the spectrum analyzer reference level.
6. Enter the actual attenuation for the 10 dB attenuator setting (calibration data) into Table 2-9.

   For the 40 dB attenuator setting, use the attenuator calibration data section 4 setting and data.
7. To determine the values to be entered for each ideal Δ MKR reading in Table 2-9, subtract the actual attenuation value from the attenuation value of the 10 dB step attenuator recorded for the 60 dB step.
8. On the spectrum analyzer, press **SGL SWP** and **SGL SWP**.
9. Wait for a new sweep to finish. Press **MKR** and **MARKER DELTA**.
10. Set the 10 dB step attenuator to the next setting, as indicated under 10 dB step attenuator setting in Table 2-9.
11. On the spectrum analyzer, set the reference level and the input attenuation to the next settings as indicated in Table 2-9 as follows:
    a. Press **AMPLITUDE** and **REF LVL,** then enter the indicated value and press –**dBm**.
    b. Press **ATTEN**, then enter the indicated value and press **dB**.
12. On the spectrum analyzer, press **SGL SWP**.
13. Wait for a sweep to finish. Record the Δ MKR amplitude in Table 2-9 as the actual Δ MKR reading.
14. Subtract the 10dB step actual attenuator setting from the 10dB step attenuator actual value and add the difference to the actual Δ MKR reading, then record the sum as the corrected Δ MKR reading in Table 2-9.
15. Repeat step 10 through step 14 for each 10 dB step attenuator setting in Table 2-9.
16. For each analyzer attenuator setting in Table 2-9, other than 10 dB, subtract the corrected Δ MKR reading from the ideal Δ MKR reading and record the result as the cumulative switching uncertainty (CSU).

    CSU = ideal Δ MKR reading – corrected Δ MKR reading
17. For each analyzer attenuator setting from 20 dB through 70 dB in Table 2-9, subtract the CSU value of the preceding setting from the current CSU value and record the result in incremental switching uncertainty (ISU) column.

    ISU = current CSU – previous CSU

18. Set the HP E4421B controls as follows:

    Frequency50 MHz

    Amplitude+5 dBm

    Step Attenuators0 dB

    RF OutputOn

19. On the spectrum analyzer, press **PRESET**, **CAL, REALIGN LO AND IF**. Wait for adjustments to complete. Then, set the controls as follows:

    Center frequency . . . . 50 MHz

    Span . . . . .0 Hz

    Reference level . . . . –10 dBm

    Attenuation . . . . .0 dB

    Log dB/division. . . . . .1 dB

    Resolution BW . . . . .1 kHz

    Video BW . . . . .1 Hz

20. Set the 1 dB step attenuator to 5 dB and replace the HP 8491B Option 020 with the HP 8491B Option 010 10 dB attenuator.

21. Adjust the source amplitude to place the signal 2 to 3 dB (two to three divisions) below the reference level.

22. On the spectrum analyzer, press **MKR** and **MARKER DELTA**.

23. Enter the actual 10 dB step attenuator values in Table 2-10 using the attenuator calibration data.

    For the 40 dB attenuator step, use the attenuator calibration data section 4 setting and data.

24. Set the 10 dB step attenuator and the spectrum analyzer **REF LVL** according to Table 2-10. Record the spectrum analyzer Δ MKR reading for each setting as the actual Δ MKR reading.

25. For each 10 dB step attenuator setting in Table 2-10, add the Δ MKR reading to the actual 10 dB step attenuator value. Record the result as the IF gain deviation.

Calculating IF Gain Correction

26. Calculate and record the IF gain correction factors in Table 2-11 as described in the following steps:
27. For each IF gain correction entry, there is a pair of numbers in parentheses. These numbers represent spectrum analyzer REF LVL settings from Table 2-10.
28. Look up the IF gain deviation values in Table 2-10 that correspond to these REF LVL settings.
    a. Substitute test values for the numbers in parentheses in the IF gain correction entry and calculate the correction value.
29. As an example, when calculating the IF gain correction for the 20 dB ATTEN setting, look up the IF gain deviation values listed in Table 2-10 for the –30 dBm and –20 dBm REF LVL settings.

    If the IF gain deviation for the –30 dBm REF LVL is +0.2 dB and the IF gain deviation for the –20 dBm REF LVL is –0.3 dB, then the IF gain correction for the 20 dB ATTEN setting is:

$$(+0.2) - (-0.3) = +0.5 \text{ dB}$$

Input Attenuator Switching Uncertainty, 2.9 GHz

30. Connect the equipment as shown in Figure 2-4 using the HP 8491B Option 010 10 dB attenuator. The spectrum analyzer provides the frequency reference for the HP 83640B.
31. On the spectrum analyzer, press **FREQUENCY**, 2.9, and **GHz**.
32. On the spectrum analyzer, press **AMPLITUDE,** 10, –**dBm, ATTEN,** 10, **+dBm**, **MKR**, and **MARKERS OFF**.
33. On the HP 83640B, press **INSTR PRESET** and set the controls as follows:

    CW frequency . . . . 2.9 GHz

    Power level . . . . .0 dBm

34. On the spectrum analyzer, press **MKR**.
35. Adjust the HP 83640B **POWER LEVEL** for a spectrum analyzer MKR amplitude reading of –13 dBm ±0.05 dB.
36. On the spectrum analyzer, press **MKR**, **MARKER DELTA**, **AMPLITUDE, ATTEN,** 20, **dB**.
37. After a new sweep has finished, record the spectrum analyzer Δ MKR amplitude reading in Table 2-11 as the Δ MKR Reading.
38. Set the spectrum analyzer **ATTEN** to the settings indicated in Table 2-11. Repeat step 37 for each ATTEN setting.

39. For each ATTEN setting in Table 2-11, subtract the IF gain correction from the Δ MKR reading and record the result as the CSU.

40. For each analyzer attenuator setting from 20 dB through 70 dB, subtract the CSU value of the preceding setting from the current CSU value and record the result in Table 2-11 as the ISU.

ISU = current CSU – previous CSU

Table 2-9 Input Attenuator Switching Accuracy, 50 MHz

10 dB Step Attenuator Setting	Spectrum		10 dB Step Attenuator Actual Attenuation	Δ MKR Reading			Uncertainty		
	REF LVL	Atten		Ideal	Actual	Corrected	CSU	ISU	Measurement
(dB)	(dBm)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)
60	−70	10		0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)
50	−60	20							±0.14
40	−50	30							±0.14
30	−40	40							±0.12
20	−30	50							±0.12
10	−20	60							±0.12
0	−10	70							±0.12

Table 2-10 IF Gain Deviation

Spectrum Analyzer Ref Lvl (dBm)	10 dB Step Attenuator Setting (dB)	10 dB Step Attenuator Actual (dB)	Δ MKR Reading (dB)	IF Gain Deviation (dB)
–10	0	0 (Ref.)	0 (Ref.)	0 (Ref.)
–20	10			
–30	20			
–40	30			
–50	40			
–60	50			
–70	60			
–80	70			

Table 2-11 Input Attenuator Switching Uncertainty, 2.9 GHz

Spectrum Analyzer ATTEN (dB)	Δ MKR Reading (dB)	IF Gain Correction (dB)	Uncertainty		
			CSU (dB)	ISU (dB)	Measurement (dB)
10	0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)
20		[(–30)– (–20)]			±0.23
30		[(–40)– (–20)]			±0.23
40		[(–50)– (–20)]			±0.23
50		[(–60)– (–20)]			±0.23
60		[(–70)– (–20)]			±0.24
70		[(–80)– (–20)]			±0.24

14a. Input Attenuator Switching Uncertainty: HP 8564E/EC, 8565E/EC

Instrument Under Test

HP 8564E/EC
HP 8565E/EC

Related Specification

Input Attenuator Switching Uncertainty

Related Adjustment

There is no related adjustment procedure for this performance test.

Description

This test measures the input attenuator switching uncertainty over the full 70 dB range at 50 MHz. The signal generator is phase-locked to the spectrum analyzer 10 MHz reference. Switching uncertainty is referenced to the 10 dB attenuator setting. The calibrated precision step attenuators are the measurement standard.

The input attenuator switching uncertainty at 2.9 GHz is measured using IF substitution. The IF gains are characterized at 50 MHz.

Figure 2-5 Input Attenuator Test Setup, 50 MHz

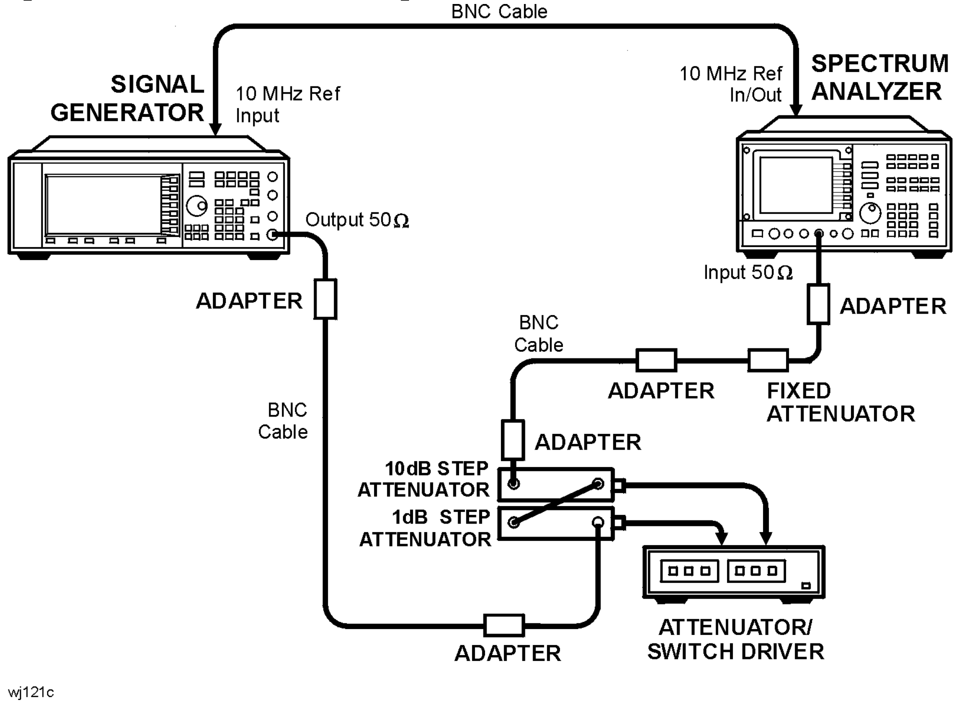
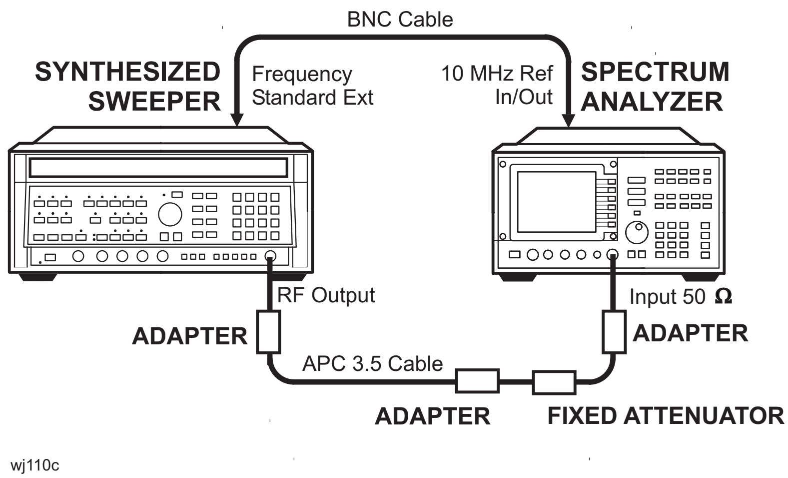


Figure 2-6 Input Attenuator Test Setup, >50 MHz



Equipment

Synthesized sweeper . . . . HP 83640B

Signal Generator . . . . .HP E4421B

Attenuator/Switch Driver . . . . HP 11713A

1 dB Precision Step Attenuator. . . . . HP 8494G, Option 001

10 dB Precision Step Attenuator. . . . . HP 8496G, Option 001

Attenuator Interconnector Kit . . . . HP 11716A

20 dB coaxial fixed attenuator . . . . .HP 8491B (Option 020)

10 dB coaxial fixed attenuator . . . . .HP 8491B (Option 010)

Adapters

Type N (m) to BNC (f) (*4 required*) 1250-1476

Type N (m) to APC 3.5 (f) 1250-1744

APC 2.4 (f) to APC 3.5 (f) . . . . HP 11901B

Type N (f) to 2.4 mm (f). . . . . HP 11903B

Cables

BNC, 122 cm (48 in.) *(3 required)*. . . . . HP 10503A

APC 3.5 mm. 8120-4921

Procedure

Attenuator Switching Uncertainty (50 MHz)

1. Connect the equipment as shown in Figure 2-5 using the HP 8491B Option 020. The spectrum analyzer provides the frequency reference for the HP E4421B.
2. Set the HP E4421B controls as follows:

   Frequency . . . . 50 MHz

   Amplitude. . . . . .10 dBm

   RF Output. . . . . On
3. Set the step attenuators as follows:

   Step Attenuators . . . . .50 dB

4. On the spectrum analyzer, press **PRESET**, **CAL,** and **REALIGN LO &IF**. Wait for adjustments to complete. Then, set the controls as follows:

   Center frequency . . . . 50 MHz

   Span . . . . 0 Hz

   Reference level . . . . –60 dBm

   Log dB/division . . . . 1 dB

   Resolution BW . . . . 3 kHz

   Video BW . . . . 1 Hz

5. Set the 1 dB step attenuator to 0 dB.

6. Adjust the source amplitude to place the signal 2 to 3 dB (two to three divisions) below the spectrum analyzer reference level.

7. Enter the actual attenuation for the 10 dB attenuator setting (calibration data) into Table 2-12.

   For the 40 dB attenuator setting, use the attenuator calibration data section 4 setting and data.

8. To determine the values to be entered for each ideal Δ MKR reading in Table 2-12, subtract the 10dB attenuation actual value from the 10dB step attenuator actual value recorded for the 50 dB step.

9. On the spectrum analyzer, press **SWP**, and **SGL SWP**.

10. Wait for a new sweep to finish. Press **MKR** and **MARKER DELTA**.

11. Set the 10 dB step attenuator to the next setting, as indicated under 10 dB step attenuator setting in Table 2-9.

12. On the spectrum analyzer, set the reference level and the input attenuation to the next settings as indicated in Table 2-12 as follows:

    a. Press **AMPLITUDE** and **REF LVL,** then enter the indicated value and press –**dBm**.

    b. Press **ATTEN**, then enter the indicated value and press **dB**.

13. On the spectrum analyzer, press **SGL SWP**.

14. Wait for a sweep to finish. Record the Δ MKR amplitude in Table 2-12 as the actual Δ MKR reading.

15. Subtract the 10dB step attenuation actual attenuator value from the 10 dB step attenuator setting and add the difference to the actual Δ MKR reading, then record the sum as the corrected Δ MKR reading in Table 2-12.

16. Repeat step 11 through step 14 for each row of instrument settings in Table 2-12.

17. For each analyzer attenuator setting in Table 2-12, other than 10 dB, subtract the corrected Δ MKR reading from the ideal Δ MKR reading and record the result as the cumulative switching uncertainty (CSU).

    CSU = ideal Δ MKR reading – corrected Δ MKR reading

18. For each analyzer attenuator setting from 20 dB through 70 dB in Table 2-12, subtract the CSU value of the preceding setting from the current CSU value and record the result in incremental switching uncertainty (ISU) column.

ISU = current CSU – previous CSU

19. Set the HP E4421B controls as follows:

Frequency . . . . 50 MHz

Amplitude . . . . +5 dBm

Step Attenuators . . . . 0 dB

RF Output. . . . . On

20. On the spectrum analyzer, press **PRESET**, **CAL**, and **REALIGN LO AND IF**. When adjustments are complete, set the controls as follows:

Center frequency . . . . 50 MHz

Span . . . . 0 Hz

Reference level . . . . –10 dBm

Attenuation . . . . 0 dB

Log dB/division. . . . . 1 dB

Resolution BW . . . . 1 kHz

Video BW . . . . 1 Hz

21. Set the 1 dB attenuator to 5 dB and replace the HP 8491B Option 020 with the HP 8491B Option 010 10 dB attenuator.

22. Adjust the source amplitude to place the signal 2 to 3 dB (two to three divisions) below the reference level.

23. On the spectrum analyzer, press **MKR** and **MARKER DELTA**.

24. Enter the actual 10 dB step attenuator values in Table 2-13 using the attenuator calibration data.

    For the 40 dB attenuator step, use the attenuator calibration data section 4 setting and data.

25. Set the 10 dB step attenuator and the spectrum analyzer **REF LVL** according to Table 2-13. Record the spectrum analyzer Δ MKR reading for each setting as the actual Δ MKR reading.

26. For each 10 dB step attenuator setting in Table 2-13, add the Δ MKR reading to the actual 10 dB step attenuator value. Record the result as the IF gain deviation.

    a. Repeat Step 23-25 for each row of instrument settings in table 2a-12.

Calculating IF Gain Correction

27. Calculate and record the IF gain correction factors in Table 2-14 as described in the following steps:

    a. For each IF gain correction entry, there is a pair of numbers in parentheses. These numbers represent spectrum analyzer REF LVL settings from Table 2-13.

    b. Look up the IF gain deviation values in Table 2-13 that correspond to these REF LVL settings.

    c. Substitute test values for the numbers in parentheses in the IF gain correction entry and calculate the correction value.

       As an example, when calculating Table 2-14 IF gain correction for the 20 dB ATTEN setting, look up the IF gain deviation values listed in Table 2-13 for the –30 and –20 dBm REF LVL settings.

       If the IF gain deviation for the –30 dBm REF LVL is +0.2 dB and the IF gain deviation for the –20 dBm REF LVL is –0.3 dB, then the IF gain correction for the 20 dB ATTEN setting is:

$$(+0.2) - (-0.3) = +0.5 \text{ dB}$$

Input Attenuator Switching Uncertainty, 2.9 GHz

28. Connect the equipment as shown in Figure 2-6 using the HP 8491B Option 010 10 dB attenuator. The spectrum analyzer provides the frequency reference for the HP 83640B.
29. On the spectrum analyzer press, **MKR** and **MARKERS OFF**.
30. On the spectrum analyzer press:

    Frequency . . . . 2.9 GHz

    Amplitude. . . . . –10 dBm

    Attenuation . . . . 10 dBm
31. On the HP 83640B, press **INSTR PRESET** and set the controls as follows:

    CW frequency . . . . 2.9 GHz

    Power level . . . . 0 dBm
32. On the spectrum analyzer, press **MKR**.
33. Adjust the HP 83640B **POWER LEVEL** for a spectrum analyzer MKR amplitude reading of –13 dBm ±0.05 dB.
34. On the spectrum analyzer, press **MKR**, **MARKER DELTA**, **AMPLITUDE, ATTEN,** 20, and **dB**.
35. After a new sweep has finished, record the spectrum analyzer ∆ MKR amplitude reading in Table 2-14 as the ∆ MKR Reading (column 2).
36. Set the spectrum analyzer **ATTEN** to the settings indicated in Table 2-14. Repeat step 30 for each ATTEN setting.
37. For each ATTEN setting in Table 2-14, subtract the IF gain correction from the actual ∆ MKR reading and record the result as the CSU.
38. For each attenuator setting from 20 through 60 dB, subtract the CSU value of the preceding setting from the current CSU value and record the result in Table 2-14 as the incremental switching uncertainty (ISU).

    ISU = current CSU – previous CSU

Table 2-12 Input Attenuator Switching Accuracy, 50 MHz

10 dB Step Attenuator Setting	Spectrum		10 dB Step Attenuator Actual Attenuation	Δ MKR Reading			Uncertainty		
	REF LVL	Atten		Ideal	Actual	Corrected	CSU	ISU	Measurement
(dB)	(dBm)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)
60	−70	10		0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)
50	−60	10		0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)
40	−50	20							±0.14
30	−40	30							±0.12
20	−30	40							±0.12
10	−20	50							±0.12
0	−10	60							±0.12

Table 2-13 IF Gain Deviation

Spectrum Analyzer Ref Lvl (dBm)	10 dB Step Attenuator Setting (dB)	10 dB Step Attenuator Actual (dB)	∆ MKR Reading (dB)	IF Gain Deviation (dB)
−10	0	0 (Ref.)	0 (Ref.)	0 (Ref.)
−20	10			
−30	20			
−40	30			
−50	40			
−60	50			
−70	60			

Table 2-14 Input Attenuator Switching Uncertainty, 2.9 GHz

Spectrum Analyzer ATTEN (dB)	∆ MKR Reading (dB)	IF Gain Correction (dB)	Uncertainty		
			CSU	ISU	Measurement
10	0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)
20		[(−30)− (−20)]			±0.23
30		[(−40)− (−20)]			±0.23
40		[(−50)− (−20)]			±0.23
50		[(−60)− (−20)]			±0.23
60		[(−70)− (−20)]			±0.24

15a. IF Gain Uncertainty

Instrument Under Test

All HP 8560 E-Series and EC-Series

Related Specification

IF Gain Uncertainty

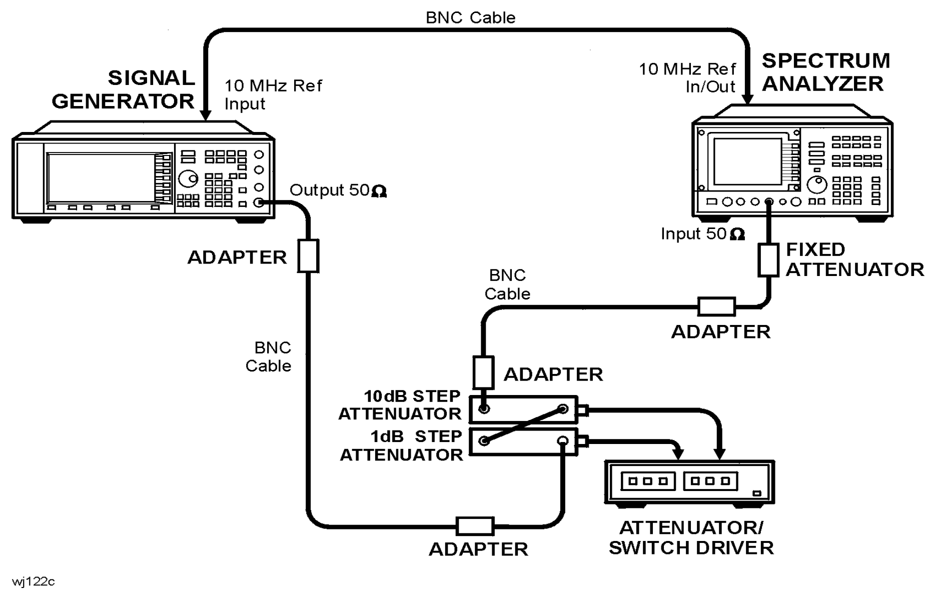
Related Adjustment

IF Amplitude Adjustment

Description

This test measures the log (10 dB and 1 dB) and linear IF gain uncertainties. A 0 dBm signal is displayed near the reference level for each test. The input signal level is decreased as the spectrum analyzer reference level is decreased (IF gain increased). Since the signal level decreases in accurate steps, any error between the reference level and the signal level is caused by the analyzer IF gain. The signal generator is phase-locked to the spectrum analyzer 10 MHz reference.

Figure 2-7 IF Gain Uncertainty Test Setup



Equipment

Signal generator . . . . HP E4421B

10 dB coaxial fixed attenuator . . . . HP 8491B, Option 010

Attenuator/Switch Driver. . . . . HP 11713A

1 dB Precision Step Attenuator . . . . HP 8494G, Option 001

10 dB Precision Step Attenuator . . . . HP 8496G, Option 001

Attenuator Interconnector Kit . . . . HP 11716A

Adapter

Type N (m) to BNC (f) (*4 required*) 1250-1476

Type N (f) to 2.4 mm (f). . . . . HP 11903B

(*for HP 8564E/EC and HP 8565E/EC*)

Cable

BNC, 122 cm (48 in.) *(3 required)*. . . . . HP 10503A

Procedure

1. Connect the equipment as shown in Figure 2-7. The spectrum analyzer under test provides the frequency reference for the HP E4421B.

Log Gain Uncertainty (10 dB Steps)

2. Set the HP E4421B controls as follows:

   Frequency . . . . 50 MHz

   Amplitude . . . .+10 dB

   RF Output. . . . . On

3. On the spectrum analyzer, press **PRESET, CAL,** and **REALIGN LO &IF**. Wait for the adjustments to finish.

4. Set the controls as follows:

   Center frequency . . . . 50 MHz

   Span . . . . 0 Hz

   Log dB/division . . . . 1 dB

   Resolution BW. . . . . 1 kHz

   Video BW . . . . 1 Hz

5. Set the step attenuators to 0 dB attenuation.
6. On the spectrum analyzer, press **MKR**.
7. Adjust the source amplitude to place the peak of the signal 2 to 3 dB (two to three divisions) below the spectrum analyzer reference level.
8. On the spectrum analyzer, press **SGL SWP**, **SGL SWP, MKR,** and **MARKER DELTA**.
9. Increase the 10 dB step attenuator setting by 10 dB.
10. Set spectrum analyzer reference level: **AMPLITUDE, REF LVL**, 10, –**dBm**, and **SGL SWP**. Wait for the sweep to finish.
11. Record the spectrum analyzer Δ MKR amplitude reading in Table 2-15 as the actual Δ MKR reading.
12. Repeat step 9 through step 11 for the remaining spectrum analyzer REF LVL settings listed in Table 2-15.
13. Enter the calibrated attenuation values as the actual 10 dB attenuation in Table 2-15 using the appropriate calibration data for the 10 dB step attenuator.

    For the 40 dB attenuator step, use the attenuator calibration data section 4 setting and data.
14. Calculate the values for the corrected delta marker entries in Table 2-15 as follows:
    a. Calculate the attenuation error by subtracting the delta marker reading from the step attenuator setting.
       Atten Error = 10 dB step atten setting – Actual atten
    b. Calculate the corrected delta marker by subtracting the attenuation error from the actual delta marker reading.

       Corrected Δ marker = Actual Δ marker reading – Atten error
    c. Record this value as the corrected Δ marker value in Table 2-15

Log Gain Uncertainty (1 dB Steps)

15. On the HP E4421B, set the amplitude to 10 dB.
16. Set the step attenuators to 0 dB.
17. Set the spectrum analyzer controls as follows:

    Marker . . . . normal

    Reference level . . . . 0 dBm

    Log dB/division. . . . . .1 dB

    Trigger . . . . Continuous

18. Adjust the HP E4421B in 1 dB steps to place the signal 2 dB to 3 dB (two to three divisions) below the spectrum analyzer reference level.
19. On the spectrum analyzer, press **SGL SWP**, **SGL SWP**, **MKR**, and **MARKER DELTA**.
20. Increase the step attenuator setting by 1 dB.
21. On the spectrum analyzer, press **AMPLITUDE,** ⇓, and **SGL SWP**. Wait for the sweep to finish.
22. Record the spectrum analyzer Δ MKR amplitude reading in Table 2-16 as the actual Δ MKR reading.
23. Repeat step 20 through step 22 for the remaining spectrum analyzer REF LVL settings listed in Table 2-16.
24. Enter the calibrated attenuation values as the actual 1 dB attenuation in Table 2-16 using the appropriate calibration data for the 1 dB step attenuator.

    For the 40 dB attenuator step, use the attenuator calibration data section 4 setting and data.
25. Calculate the values for the corrected delta marker entries in Table 2-16 as follows:
    a. Calculate the attenuation error by subtracting the delta marker reading from the step attenuator setting.
       Atten Error = 1 dB step atten setting – Actual atten
    b. Calculate the corrected delta marker by subtracting the attenuation error from the actual delta marker reading.

       Corrected Δ marker = Actual Δ marker reading – Atten error
    c. Record this value as the corrected Δ marker value in Table 2-16

Linear Gain Uncertainty

26. On the HP E4421B, set the amplitude to 10 dB
27. Set the step attenuators to 0 dB.
28. Set the controls on the spectrum analyzer under test to the following:

Marker . . . . normal
Reference level . . . . 0 dBm
Amplitude scale . . . . linear
Amplitude . . . . dBm
Trigger . . . . Continuous

29. Adjust the HP E4421B amplitude in 1 dB steps to place the signal two to three divisions below the spectrum analyzer reference level. The marker should read between –2 dBm and –3 dBm.
30. On the spectrum analyzer, press **SGL SWP, SGL SWP**, **MKR,** and **MARKER DELTA**.
31. Increase the 10 dB step attenuator setting by 10 dB.
32. Set the spectrum analyzer REF LVL to –10 dBm.
33. On the spectrum analyzer, press **SGL SWP**.
34. Record the spectrum analyzer Δ MKR amplitude reading in Table 2-17 as the actual Δ MKR reading.
35. Repeat step 31 through step 34 for the remaining spectrum analyzer REF LVL settings listed in Table 2-17.
36. Enter the calibrated attenuation values as the actual 10 dB attenuation in Table 2-17 using the appropriate calibration data for the 10 dB step attenuator.

    For the 40 dB attenuator step, use the attenuator calibration data section 4 setting and data.
37. Calculate the values for the corrected delta marker entries in Table 2-17 as follows:
    a. Calculate the attenuation error by subtracting the delta marker reading from the step attenuator setting.
       Atten Error = 10 dB step atten setting – Actual atten
    b. Calculate the corrected delta marker by subtraction the attenuation error from the actual delta marker reading.

       Corrected Δ marker = Actual Δ marker reading – Atten Error
    c. Record this value as the corrected Δ marker value in Table 2-17

Table 2-15 Log IF Gain Uncertainty (10 dB Steps)

Spectrum Analyzer REF LVL	10 dB Step Attenuator		Δ MKR Reading		Measurement Uncertainty
	Setting	Actual Attenuation	Actual	Corrected	
(dBm)	(dB)	(dB)	(dB)	(dB)	(dB)
0	0	0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)
−10	10				±0.11
−20	20				±0.11
−30	30				±0.11
−40	40				±0.11
−50	50				±0.12
−60	60				±0.12
−70	70				±0.12
−80	80				±0.12

Table 2-16 Log IF Gain Uncertainty (1 dB Steps)

Spectrum Analyzer REF LVL	1 dB Step Attenuator		Δ MKR Reading		Measurement Uncertainty
	Setting	Actual Attenuation	Actual	Corrected	
(dBm)	(dB)	(dB)	(dB)	(dB)	(dB)
0	0	0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)
−1	1				±0.11
−2	2				±0.11
−3	3				±0.11
−4	4				±0.11
−5	5				±0.12
−6	6				±0.12
−7	7				±0.12
−8	8				±0.12
−9	9				±0.12
−10	10				±0.12
−11	11				±0.12
−12	12				±0.12

Table 2-17 Linear IF Gain Uncertainty

Spectrum Analyzer REF LVL (dBm)	10 dB Step Attenuator		Δ MKR Reading		Measurement Uncertainty (dB)
	Setting (dB)	Actual Attenuation (dB)	Actual (dB)	Corrected (dB)	
0	0	0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)
−10	10				±0.11
−20	20				±0.11
−30	30				±0.11
−40	40				±0.11
−50	50				±0.12
−60	60				±0.12
−70	70				±0.12
−80	80				±0.12

16a. Scale Fidelity

Instrument Under Test

All HP 8560 E-Series and EC-Series

Related Specification

Log Fidelity
Linear Fidelity

Related Adjustment

IF Amplitude Adjustments
Log Amplifier Adjustments

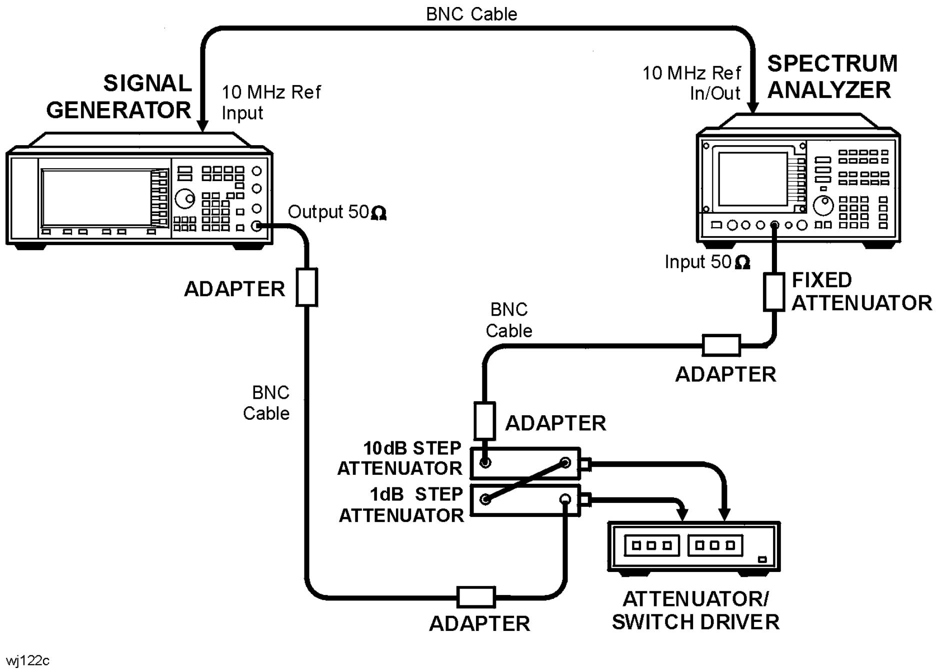
Description

The 10 dB/div, 2 dB/div, and linear scales are tested for fidelity. The 10 dB/div scale is tested in RES BW settings of 10 Hz and 300 Hz. A signal is set to the reference level for each scale. As the signal amplitude is decreased, the displayed signal amplitude is compared to the reference level.

Incremental log fidelity is calculated from the cumulative log fidelity data. The nominal difference between the cumulative log fidelity data points selected is 12 dB for the 10 dB/div scale and 2 dB for the 2 dB/div scale. These differences ensure that the uncertainty due to the marker amplitude resolution is less than one-fourth of the specification.

The spectrum analyzer provides the 10 MHz reference to the signal generator.

Figure 2-8 Scale Fidelity Test Setup



Equipment

Signal generator. . . . . .HP E4421B

10 dB coaxial fixed attenuator . . . . .HP 8491B, Option 010

Attenuator/Switch Driver . . . . HP 11713A

1 dB Precision Step Attenuator. . . . . .HP 8494G, Option 001

10 dB Precision Step Attenuator. . . . . .HP 8496G, Option 001

Attenuator Interconnector Kit . . . . HP 11716A

Adapter

Type N (m) to BNC (f) (*4 required*) 1250-1476

Type N (f) to 2.4 mm (f) . . . . HP 11903B

(*for HP 8564E/EC and HP 8565E/EC*)

Cable

BNC, 122 cm (48 in.) *(3 required)* . . . . HP 10503A

Procedure

1. Connect the equipment as shown in Figure 2-8. The spectrum analyzer provides the frequency reference for the HP E4421B.

2. Set the HP E4421B controls as follows:

   Frequency . . . . 50 MHz

   Amplitude . . . . +10 dBm

   Amplitude increment . . . . 0.04 dB

   RF Output. . . . . On

3. On the spectrum analyzer, press **PRESET**, **CAL**, **REALIGN LO & IF**. Wait for the adjustments to finish. Set the controls as follows:

   Center frequency . . . . 50 MHz

   Span . . . . .0 Hz

   Resolution BW . . . . .300 Hz

   Video BW . . . . .100 Hz

   Sweep time . . . . 2 s

4. Set the step attenuators to 0 dB.
5. On the spectrum analyzer, press **MKR**.

10 dB/Div Log Scale, RES BW ≥ 300 Hz

6. On the HP E4421B, press **Amplitude** and use the increment ⇓ and ⇑ keys to adjust the amplitude until the spectrum analyzer marker reads exactly 0 dBm ±0.17 dB.
7. Enter the calibrated attenuation values as the actual attenuation in Table 2-18 using the appropriate step attenuator calibration data.

   For the 40 dB and 4 dB attenuator step, use the attenuator calibration data section 4 setting and data.
8. On the spectrum analyzer, press **SGL SWP, MKR, MKRNOISE ON**, and **MARKER DELTA**. Press **AMPLITUDE**, **MORE 1 OF 3, REF LVL OFFSET,** 22.8, **dB,** and **SGL SWP**. The reference level offset effectively removes the noise marker corrections for the envelope detector, log amplifiers, and noise bandwidth correction.
9. Increase the step attenuator setting by 6 dB to the next value listed in Table 2-18.
10. On the spectrum analyzer, press **SGL SWP** and wait for the completion of a new sweep. Subtract 0.02 dB from the ΔMKR amplitude reading and record the result as the actual ΔMKR reading in Table 2-18.

NOTE The noise marker subtracts 22.78 dB from the 32 data point average. The reference level offset can only correct for 22.8 dB of this difference due to its 0.1 dB resolution. Subtracting 0.02 dB from the ΔMKR reading corrects for the 0.02 dB residual error.

11. Repeat step 9 and step 10 for each step attenuator setting in Table 2-18.

12. Calculate the correct values for the corrected delta marker entries in Table 2-18 as follows:

   a. Calculate the attenuation error by subtracting the actual attenuation from the total step attenuator setting.
      Atten error = Total step attenuator setting – Actual attenuation

   b. Calculate the corrected delta marker by subtracting the attenuation error from the actual delta marker reading.

      Corrected Δ marker = Δ marker reading – Atten error

   c. Record this value as the corrected Δ marker value in Table 2-18

NOTE The log fidelity incremental error in the 10 dB/div scale is calculated only for readings from –12 dB to –90dB from the reference level.

---

13. Calculate the incremental error for a given dB from REF LVL as follows:

a. Set current actual ΔMKR equal to the actual ΔMKR reading for the current total step attenuator setting.
b. Set previous actual ΔMKR equal to the actual ΔMKR reading for the total step attenuator setting listed in parenthesis in the incremental error column for the current total step attenuator setting.
c. Calculate the incremental error as follows:

   Incremental error (dB/dB) = (current ΔMKR − previous ΔMKR + 12 dB) / 12
   For example, given:

   Actual ΔMKR reading at –18 dB from REF LVL = –17.83 dB
   Actual ΔMKR reading at –24 dB from REF LVL = –24.17 dB
   Actual ΔMKR reading at –30 dB from REF LVL = –30.33 dB
   The incremental error for the 30 dB total step attenuator setting (–30.33 dB) is calculated as follows:

   Incremental error = (–30.33 – (–17.83) + 12) / 12
   = –0.50 / 12
   = –0.042 dB/dB

d. Enter the result of the incremental error calculation in the **Incremental Error** column of Table 2-18

10 dB/Div Log Scale, RES BW ≤ 100 Hz

14. Set the spectrum analyzer controls as follows:

Trigger . . . . Continuous

Reference level offset . . . . 0 dB

Markers . . . . off

Span . . . . 100 Hz

Resolution BW. . . . . 10 Hz

Sweep time . . . . Automatic

15. Set the HP E4421B controls as follows:

Amplitude . . . . +10 dBm

Amplitude increment . . . . .0.04 dB

16. Set the step attenuators to 0 dB.
17. On the spectrum analyzer, press **PEAK SEARCH**.
18. On the HP E4421B, press **Amplitude** and use the increment ⇓ and ⇑ keys to adjust the amplitude until the spectrum analyzer marker reads exactly 0 dBm ±0.17 dB.
19. Enter the calibrated attenuation values as the actual attenuation in Table 2-19 using the appropriate step attenuator calibration data.

    For the 40 dB and 4 dB attenuator step, use the attenuator calibration data section 4 setting and data.
20. On the spectrum analyzer, press **SGL SWP**, **PEAK SEARCH**, and **MARKER DELTA**.
21. Increase the step attenuator setting by 6 dB to the next value listed in Table 2-19.

NOTE Increase the attenuator setting 4 dB for last two entries in Table 2-19

22. If the total step attenuator setting is ≥ 80 dB (40 dB, for example), press **SGL SWP** and wait until a new sweep is completed. Press **PEAK SEARCH** and record the ΔMKR amplitude as the actual ΔMKR reading in Table 2-19.
23. If the total step attenuator is ≥80 dB (+84 dB, for example), press **TRIG**, **CONT, BW**, **VID AVG ON**, **1**, **0**, **HZ**, and wait for `VAVG 10` to be displayed above the graticule. Press **SGL SWP** and wait until a new sweep is completed. Press **PEAK SEARCH** and record the ΔMKR as the actual ΔMKR reading in Table 2-19.
24. Repeat step 21, step 22, and step 23 for each (nominal) step attenuator setting in Table 2-19.

25. Calculate the correct values for the corrected delta marker entries in Table 2-19 as follows:

    a. Calculate the attenuation error by subtract the actual attenuation from the total step attenuator setting.
       Error = Total step attenuator setting – Actual attenuation

    b. Calculate the corrected delta marker by subtracting the attenuation error from the actual delta marker reading.

       Corrected Δ marker = Δ marker reading – Atten error

    c. Record this value as the corrected Δ marker value in Table 2-19

26. Calculate the incremental error for a given dB from REF LVL as follows:

    a. Set current actual ΔMKR equal to the actual ΔMKR reading for the current total step attenuator setting.

    b. Set previous ΔMKR equal to the ΔMKR reading for the total step attenuator setting listed in parenthesis as the incremental error column for the current total step attenuator setting.

    c. Calculate the incremental error as follows:

       Incremental error (dB/dB) = (current ΔMKR – previous ΔMKR + 12 dB) / 6

       For example, given:

       Actual ΔMKR reading at –18 dB from REF LVL = –17.83 dB
       Actual ΔMKR reading at –24 dB from REF LVL = –24.17 dB
       Actual ΔMKR reading at –30 dB from REF LVL = –30.33 dB
       The incremental error for the –30 dB from REF LVL setting is calculated as follows:

       Incremental error = (–30.33 – (–17.83) + 12) / 6
       = –0.50 / 6
       = –0.083 dB/2 dB

    d. Place the result of the incremental error calculation in the **Incremental Error** column of Table 2-19.

2 dB/Div Log Scale

27. Set the spectrum analyzer controls as follows:

    Trigger . . . . Continuous

    Markers . . . . off

    Log dB/division . . . . 2 dB

    Span . . . . 0 Hz

    Resolution BW. . . . . 1 kHz

    Video BW . . . . 300 Hz

    Sweep time . . . . .1 s

    Video average . . . . off

28. Set the HP E4421B controls as follows:

    Amplitude . . . . +10 dBm

    Amplitude increment . . . . .0.02 dB

29. Set the step attenuators to 0 dB.
30. On the spectrum analyzer, press **MKR**.
31. On the HP E4421B, press **Amplitude** and use the increment ⇓ and ⇑ keys to adjust the amplitude until the spectrum analyzer marker reads exactly 0 dBm ±0.03 dB.
32. Enter the calibrated attenuation values as the actual attenuation in Table 2-20 using the appropriate step attenuator calibration data.

    For the 4 dB attenuator step, use the attenuator calibration data section 4 setting and data.
33. On the spectrum analyzer, press **SGL SWP, MKR,** and **MARKER DELTA**.
34. Increase the step attenuator setting by 2 dB to the next value listed in Table 2-20.
35. On the spectrum analyzer, press **SGL SWP** and wait for the completion of a new sweep. Record the ΔMKR amplitude reading as the actual ΔMKR reading in Table 2-20.
36. Repeat step 34 and step 35 for each step attenuator setting in Table 2-20.

37. Calculate the correct values for the corrected delta marker entries in Table 2-20 as follows:

    a. Calculate the attenuation error by subtracting the actual attenuation from the total step attenuator setting.
       Atten error = Total step attenuator setting – Actual attenuation

    b. Calculate the corrected delta marker by subtracting the attenuation error from the actual delta marker reading.

       Corrected Δ marker = Δ marker reading – Atten error

    c. Record this value as the corrected Δ marker value in Table 2-20

38. From each ΔMKR reading in Table 2-20, subtract the previous ΔMKR reading. Add 2 dB to this number. Divide this result by 2 dB and record the result as the incremental error in Table 2-20.

    Incremental error = (current ΔMKR – previous ΔMKR + 2) / 2

Linear Scale

39.Set the spectrum analyzer controls as follows:

Trigger . . . . Continuous

Amplitude scale. . . . . linear

Amplitude units . . . . dBm

40.Set the HP E4421B controls as follows:

Amplitude . . . . +10 dBm

Amplitude increment . . . . .0.02 dB

41.Set the step attenuators to 0 dB.

42.On the spectrum analyzer, press **MKR,** and **MARKER NORMAL**.

43.On the HP E4421B, press **Amplitude** and use the increment ⇓ and ⇑ keys to adjust the amplitude until the spectrum analyzer marker reads exactly 0 dBm ± 0.02 dB.

44.Enter the calibrated attenuation values as the actual attenuation in Table 2-21 using the appropriate step attenuator calibration data.

For the 4 dB attenuator step, use the attenuator calibration data section 4 setting and data.

45.On the spectrum analyzer, press **SGL SWP**, **MKR,** and **MARKER DELTA**.

46.Increase the attenuation setting of the step attenuators 2 dB or to the next value listed in Table 2-21.

47.On the spectrum analyzer, press **SGL SWP** and wait for the completion of a new sweep. Record the ΔMKR amplitude as the actual ΔMKR amplitude reading in Table 2-21.

48.Repeat step 46 and step 47 for each step attenuator setting in Table 2-21.

49.Calculate the correct values for the corrected delta marker entries in Table 2-21 as follows:

a. Calculate the attenuation error by subtracting the actual attenuation from the total step attenuator setting.
   Atten error = Total step attenuator setting – Actual attenuation

b. Calculate the corrected delta marker by subtracting the attenuation error from the actual delta marker reading.

   Corrected Δ marker = Δ marker reading – Atten error

c. Record this value as the corrected Δ marker value in Table 2-21

Table 2-18 10 dB/Div Log Scale Fidelity (RES BW ≥300 Hz)

Step Attenuator Setting			Actual Attenuation	Δ MKR Reading		Incremental Error	Measurement Uncertainty
1 dB Step (dB)	10 dB Step (dB)	Total (dB)	(dB)	Actual (dB)	Corrected (dB)	(dB)	(dB)
0	0	0	0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)
6	0	6				N/A	±0.03
2	10	12				(0)	±0.04
8	10	18				(6)	±0.04
4[a]	20	24				(12)	±0.04
0	30	30				(18)	±0.04
6	30	36				(24)	±0.04
2	40[a]	42				(30)	±0.04
8	40[a]	48				(36)	±0.04
4	50	54				(42)	±0.04
0	60	60				(48)	±0.04
6	60	66				(54)	±0.04
2	70	72				(60)	±0.05
8	70	78				(66)	±0.05
4[a]	80	84				(72)	±0.05
0	90	90				(78)	±0.11

a. Use the attenuator calibration data section 4 setting and data.

Table 2-19 10 dB/Div Log Scale Fidelity (RES BW ≤100 Hz)

Step Attenuator Setting			Actual Attenuation	Δ MKR Reading		Incremental Error	Measurement Uncertainty
1 dB Step (dB)	10 dB Step (dB)	Total (dB)	(dB)	Actual (dB)	Corrected (dB)	(dB)	(dB)
0	0	0	0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)
6	0	6				N/A	±0.03
2	10	12				(0)	±0.04
8	10	18				(6)	±0.04
4[a]	20	24				(12)	±0.04
0	30	30				(18)	±0.04
6	30	36				(24)	±0.04
2	40[a]	42				(30)	±0.04
8	40[a]	48				(36)	±0.04
4	50	54				(42)	±0.04
0	60	60				(48)	±0.04
6	60	66				(54)	±0.04
2	70	72				(60)	±0.05
8	70	78				(66)	±0.05
4[a]	80	84				(72)	±0.05
0	90	90				(78)	±0.05
4[a]	90	94				N/A	±0.05
8	90	98				N/A	±0.05

a. Use the attenuator calibration data section 4 setting and data.

Table 2-20 2 dB/Div Log Scale Fidelity

Step Attenuator Setting			Actual Attenuation	Δ MKR Reading		Incremental Error	Measurement Uncertainty
1 dB Step (dB)	10 dB Step (dB)	Total (dB)	(dB)	Actual (dB)	Corrected (dB)	(dB)	(dB)
0	0	0	0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)
2	0	2				N/A	±0.03
4[a]	0	4					±0.03
6	0	6					±0.03
8	0	8					±0.03
0	10	10					±0.03
2	10	12					±0.03
4[a]	10	14					±0.03
6	10	16					±0.03
8	10	18					±0.03

a. Use the attenuator calibration data section 4 setting and data.

Table 2-21 Linear Scale Fidelity

Step Attenuator Setting			Actual Attenuation	Δ MKR Reading		Measurement Uncertainty
1 dB Step (dB)	10 dB Step (dB)	Total (dB)	(dB)	Actual (dB)	Corrected (dB)	(dB)
0	0	0	0 (Ref.)	0 (Ref.)	0 (Ref.)	0 (Ref.)
2	0	2				±0.03
4[a]	0	4				±0.03
6	0	6				±0.03
8	0	8				±0.03
0	10	10				±0.03
2	10	12				±0.04
4[a]	10	14				±0.04
6	10	16				±0.04
8	10	18				±0.04

a. Use the attenuator calibration data section 4 setting and data.

33a. Second Harmonic Distortion: HP 8560E/EC

Instrument Under Test

HP 8560E/EC

Related Specification

Second Harmonic Distortion

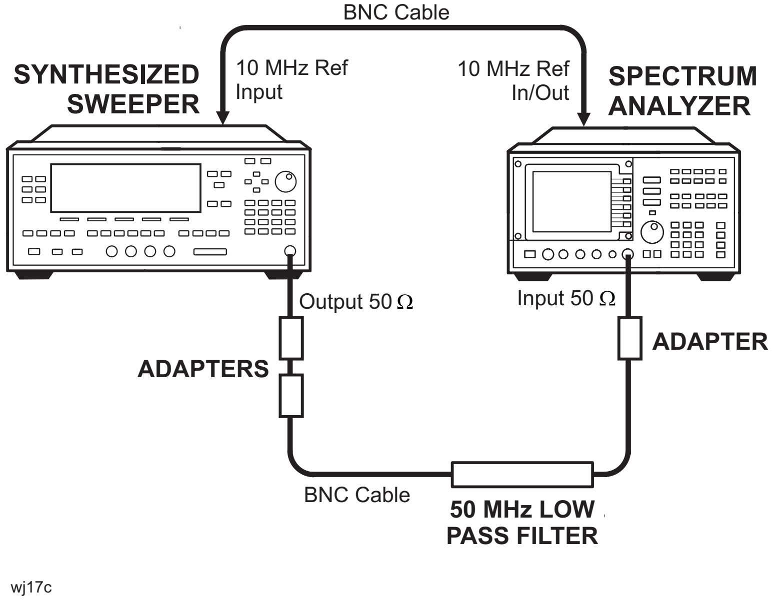
Related Adjustment

There is no related adjustment procedure for this performance test.

Description

A synthesized sweep generator and low-pass filter provide the signal for measuring second harmonic distortion. The low-pass filter eliminates any harmonic distortion originating at the signal source. The synthesized sweeper is phase-locked to the spectrum analyzer 10 MHz reference. This test is performed at an input frequency of 40 MHz.

Figure 2-9 Second Harmonic Distortion Test Setup



Equipment

Synthesized sweep generator . . . . HP 83640B

50 MHz low-pass filter 0955-0306

Adapter

Type N (m) to BNC (f)1250-1476

SMA (m) to BNC (f). 1250-1200

APC-3.5 (f) to 2.4 mm (f). . . . . HP 11901B

Cable

BNC, 122 cm (48 in) . . . . HP 10503A

Procedure

1. Connect the equipment as shown in Figure 2-9. The spectrum analyzer provides the frequency reference for the synthesized sweeper.
2. Set the HP 83640B controls as follows:

   Frequency . . . . 40 MHz
   Amplitude. . . . .–20 dBm
   Amplitude increment . . . . .0.04 dB
   RF Output. . . . . On

3. On the spectrum analyzer, press **PRESET**. Set the controls as follows:

   Center frequency . . . . 40 MHz
   Span . . . . 1 kHz
   Reference level . . . .–30 dBm

4. On the spectrum analyzer, press **PEAK SEARCH**.
5. On the HP 83640B, adjust the output power level for a spectrum analyzer marker amplitude reading of –30 dBm ±0.17 dB.
6. On the spectrum analyzer, press **SGL SWP**. Wait for the completion of the sweep, then press **PEAK SEARCH**, **MKR**→, and **MARKER** → **CF STEP**.
7. Press **MKR, MARKER DELTA**, **FREQUENCY,** ⇑, and **SGL SWP**.
8. After the spectrum analyzer completes a new sweep, press **PEAK SEARCH**. Record the Δ MKR amplitude reading as the Second Harmonic Distortion.

Second harmonic distortion: ___________________ dBc

(Measurement uncertainty: +1.87/–2.28 dB)

34a. Second Harmonic Distortion: HP 8561E/EC

Instrument Under Test

HP 8561E/EC

Related Specification

Second Harmonic Distortion

Related Adjustment

There is no related adjustment procedure for this performance test.

Description

A synthesized sweep generator and low-pass filter provide the signal for measuring second harmonic distortion. The low-pass filter eliminates any harmonic distortion originating at the signal source. The spectrum analyzer frequency response is calibrated out for the >1.45 GHz test. The synthesized sweeper is phase-locked to the spectrum analyzer 10 MHz reference.

Figure 2-10 Second Harmonic Distortion Test Setup, Band 0

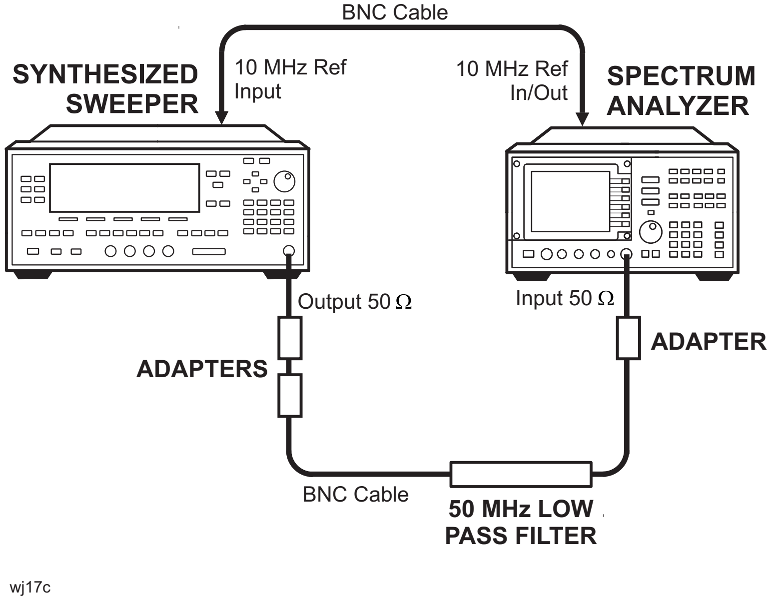
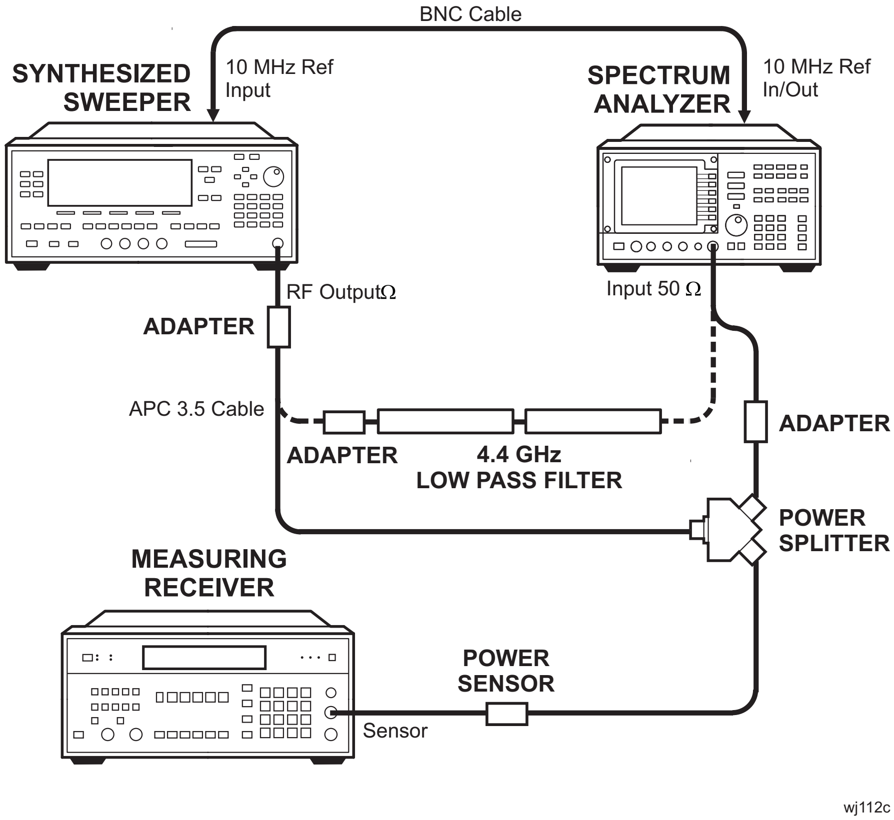


Figure 2-11 Second Harmonic Distortion Test Setup, Band 1



Equipment

Synthesized sweeper. . . . . HP 83640B
Measuring receiver . . . . HP 8902A
Power sensor . . . . HP 8485A
50 MHz low-pass filter 0955-0306
4.4 GHz low-pass filter *(2 required)*. . . . . HP 11689A
Power splitter . . . . HP 11667B

Adapters

Type N (m) to BNC (f). 1250-1476
APC-3.5 (m) to Type N (m). 1250-1743
APC-3.5 (f) to Type N (m). 1250-1744
APC-3.5 (m) to BNC (f). 1250-1200
APC-3.5 (f) to 2.4 mm (f). .HP 11901B

Cables

BNC, 122 cm (48 in.) *(2 required)*HP 10503A

APC 3.5, 91 cm (36 in.) 8120-4921

Procedure

Second Harmonic Distortion, <1.45 GHz

1. Connect the equipment as shown in Figure 2-10, using the 50 MHz low-pass filter. The spectrum analyzer provides the frequency reference for the synthesized sweeper.
2. Set the HP 83640B controls as follows:

   Frequency . . . . 40 MHz

   Amplitude . . . . –20 dBm

   Amplitude increment . . . . 0.04 dB

   RF Output . . . . On
3. On the spectrum analyzer, press **PRESET**. Set the controls as follows:

   Center frequency. . . . . 40 MHz

   Span . . . . 1 kHz

   Reference level . . . . –30 dBm
4. On the spectrum analyzer, press **PEAK SEARCH**.
5. On the HP 83640B, adjust the output power level for a spectrum analyzer marker amplitude reading of –30 dBm ±0.17 dB.
6. On the spectrum analyzer, press **SGL SWP**. Wait for the completion of the sweep, then press **PEAK SEARCH**, **MKR**→, and **MARKER** → **CF STEP**.
7. Press **MKR, MARKER DELTA, FREQUENCY,** ⇑, and **SGL SWP**.
8. After the spectrum analyzer completes a new sweep, press **PEAK SEARCH**. Record the Δ MKR amplitude reading as the second harmonic distortion (<1.45 GHz).

   Second harmonic distortion (<1.45 GHz): _____________ dBc

Second Harmonic Distortion, >1.45 GHz

9. Zero and calibrate the HP 8485A in LOG mode (readout in dBm). Enter the power sensor 3 GHz calibration factor into the HP 8902A.
10. Connect the equipment as shown in Figure 2-11, without the filters in place.
11. On the spectrum analyzer, set the controls as follows:

    Center frequency . . . . 2.95 GHz

    Center frequency step . . . . 2.95 GHz

    Reference level . . . . 0 dBm

    Span . . . . 10 kHz

    Resolution BW . . . . 300 Hz
12. On the HP 83640B, set the controls as follows:

    CW frequency . . . . 2.95 GHz

    Power level . . . . –10 dBm
13. On the spectrum analyzer press **TRIG**, **SWEEP CONT**, **MKR**, **MARKERS OFF**, and**PEAK SEARCH**.
14. Press **AMPLITUDE**, **MORE 1 OF 3**, **MORE 2 OF 3**, and **PRESEL AUTO PK**.

NOTE Wait for the PEAKING message to disappear before continuing to the next step.

15. On the HP 83640B, adjust the power level for a spectrum analyzer MKR reading of –5 dBm.
16. On the HP 8902A, press **RATIO**. Enter the power sensor 6 GHz calibration factor into the HP 8902A.
17. Set the HP 83640B frequency to 5.9 GHz.
18. On the spectrum analyzer press **FREQUENCY**, ⇑, and **PEAK SEARCH**.
19. Press **AMPLITUDE**, **MORE 1 OF 3**, **MORE 2 OF 3**, and **PRESEL AUTO PK** .

NOTE Wait for the PEAKING message to disappear before continuing to the next step.

20. On the HP 83640B, adjust the power level for a spectrum analyzer MKR reading of –5 dBm.
21. Record the HP 8902A reading here, as the frequency response error:

Frequency response error:_____________________ dB

22. Connect the equipment as shown in Figure 2-11, with the filter in place.
23. On the HP 83640B, set the controls as follows:

CW frequency . . . . 2.95 GHz

Power level . . . .–5 dBm

24. On the spectrum analyzer press **MKR**, **MARKERS OFF**, **FREQUENCY**, ⇓, and **PEAK SEARCH**.
25. On the HP 83640B, adjust the power level for a spectrum analyzer marker amplitude reading of 0 dBm.
26. On the spectrum analyzer press **SGL SWP**, **SGL SWP**, **PEAK SEARCH**, **MARKER DELTA**, **FREQUENCY**, and ⇑.
27. Press **AMPLITUDE**, 30, –**dBm**, and **SGL SWP** .

NOTE In order to obtain proper readings, wait for the completion of a new sweep.

28. Press **PEAK SEARCH**. Record the Δ MKR amplitude reading here:

Δ MKR amplitude reading:_____________________ dBc

29. Algebraically add the frequency response error recorded in step 21 to the Δ MKR amplitude reading in step 28. Record the result here, as the second harmonic distortion (>1.45 GHz).

Second harmonic
distortion (>1.45 GHz): _______________________ dBc

36a. Frequency Response: HP 8560E/EC

Instrument Under Test

HP 8560E/EC

Related Specification

Relative Frequency Response
Absolute Frequency Response

Related Adjustment

Frequency Response Adjustment
LO Distribution Amplifier Adjustment

Description

For frequencies of 250 kHz and greater the output of a source is fed through a power splitter. One output of the power splitter is fed to a power sensor and then to a measuring receiver. The other output of the power splitter is fed to the spectrum analyzer. The source power level is adjusted at 300 MHz to place the displayed signal at the spectrum analyzer center horizontal graticule line. The measuring receiver, used as a power meter, is placed in ratio mode. At each new source frequency and spectrum analyzer center frequency, the source power level is adjusted to place the signal at the center horizontal graticule line. The measuring receiver displays the inverse of the frequency response relative to the calibrator.

For frequencies below 250 kHz the output of a function generator is fed through a power splitter to an ac digital volt meter (ACDVM) and to the spectrum analyzer. At each function generator frequency setting and spectrum analyzer center frequency setting, the function generator power level is adjusted to place the displayed signal at the spectrum analyzer center horizontal graticule line. The ACDVM is used to measure the function generator output signal level in dBm.

Figure 2-12 Frequency Response Test Setup, 250 kHz to 2.9 GHz

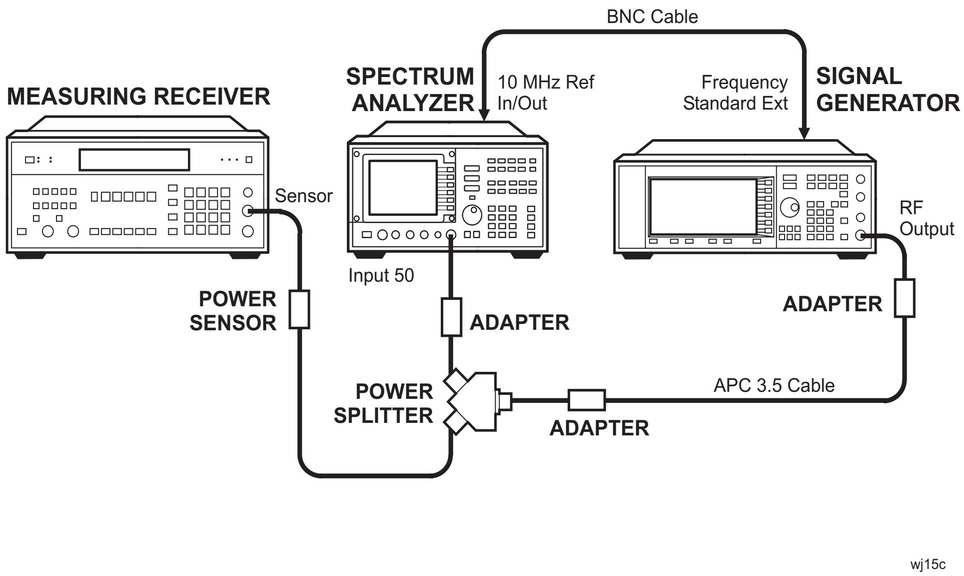
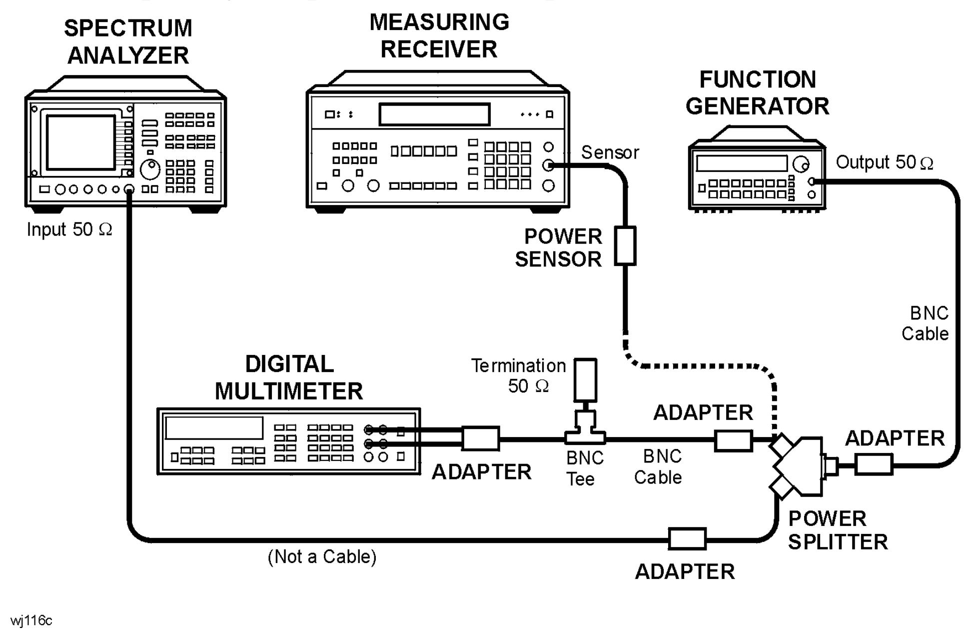


Figure 2-13 Frequency Response Test Setup, ≤250 kHz



Equipment

Measuring receiver . . . . HP 8902A

Function Generator. . . . . HP 3324A or HP 33127A

Signal generator . . . . HP E4421B

AC Digital Voltmeter . . . . HP 3458A

Power sensor . . . . HP 8482A

Power splitter . . . . HP 11667A

Coaxial 50 Ω termination . . . . HP 908A

Adapters

Type N (m) to type N (m) 1250-1475

Type N (m) to BNC (f) *(2 required)* 1250-1476

Type N (m) to APC 3.5 (f) *(2 required)*. 1250-1744

BNC (f) to Dual Banana Plug 1251-2816

BNC Tee. 1250-0781

Cables

BNC, 122 cm (48 in) *(2 required)* . . . . HP 10503A

APC-3.5, 91 cm (36 in) 8120-4921

DVM test leads . . . . HP 34118A

Procedure

1. Zero and calibrate the HP 8902A and the HP 8482A in log mode, as described in the HP 8902A Operation Manual. Enter the power sensor 300 MHz calibration factor into the HP 8902A.
2. Connect the equipment as shown in Figure 2-12.
3. On the HP E4421B, set the controls as follows:

   CW frequency . . . . 300 MHz

   Frequency increment . . . . 100 MHz

   Amplitude. . . . . –4 dBm
4. On the spectrum analyzer, press **PRESET**. Set the controls as follows:

   Center frequency . . . . 300 MHz

   Span . . . . 0 Hz

   Reference level . . . . –5 dBm dB/division . . . . 1 dB

Resolution BW. . . . . 30 kHz

5. On the spectrum analyzer, press **MKR**.
6. On the HP E4421B, adjust the power level for a MKR amplitude of –10 dBm ±0.05 dB.
7. Press **RATIO** on the HP 8902A.

DC Coupled Frequency Response (≥250 kHz)

8. On the spectrum analyzer, press **AMPLITUDE, MORE 1 OF 3**, and **COUPLING DC**.
9. Set the HP E4421B frequency to 250 kHz.
10. On the spectrum analyzer, press **FREQUENCY**, **CENTER FREQ**, 250, and **kHz**.
11. On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
12. Enter the 0.3 MHz power sensor calibration factor, indicated in Table 2-22, into the HP 8902A.
13. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-22. Record the power ratio here exactly as it is displayed on the HP 8902A:

HP 8902A reading at 250 kHz: _______________ dB

14. Set the HP E4421B to 1.0 MHz.
15. On the spectrum analyzer, press **FREQUENCY, CENTER FREQ**, 1.0, and **MHz**.
16. On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
17. Enter the 1 MHz power sensor calibration factor, indicated in Table 2-22, into the HP 8902A.
18. Record the negative of the power ratio displayed on the HP 8902A, as the HP 8902A reading in Table 2-22.
19. On the HP E4421B, set the frequency to the next value listed in Table 2-22.
20. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-22.
21. On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
22. Enter the power sensor calibration factor, indicated in Table 2-22, into the HP 8902A.
23. Record the negative of the power ratio displayed on the HP 8902A, as the HP 8902A reading in Table 2-22.

24. To step through the remaining frequencies listed in Table 2-22, repeat step 19 through step 23.

AC Coupled Frequency Response (≥250 kHz)

25. On the spectrum analyzer, press **AMPLITUDE, MORE 1 OF 3**, and **COUPLING AC**.
26. Set the HP E4421B to 250 kHz.
27. On the spectrum analyzer, press **FREQUENCY, CENTER FREQ**, 250, and **kHz**.
28. On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
29. Enter the 0.3 MHz power sensor calibration factor, indicated in Table 2-23, into the HP 8902A.
30. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-23. Record the power ratio here exactly as it is displayed on the HP 8902A:

HP 8902A reading at 250 kHz:__________________ dB

31. Set the HP E4421B to 1.0 MHz.
32. On the spectrum analyzer, press **FREQUENCY**, **CENTER FREQ**, 1.0, and **MHz**.
33. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
34. Enter the 0.1 MHz power sensor calibration factor, indicated in Table 2-23, into the HP 8902A.
35. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-23.
36. On the HP E4421B, set the frequency to the next value listed in Table 2-23.
37. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-23.
38. On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
39. Enter the power sensor calibration factor, indicated in Table 2-23, into the HP 8902A.
40. Record the negative of the power ratio displayed on the HP 8902A, as the HP 8902A reading in Table 2-23.
41. To step through the remaining frequencies listed in Table 2-23, repeat step 36 through step 40.

DC Coupled Frequency Response (≤250 kHz)

42. On the spectrum analyzer, press **AMPLITUDE**, **MORE 1 OF 3**, and **COUPLING DC**. Set the controls as follows:

    Center frequency . . . . 250 kHz
    Span . . . . 100 Hz
    Resolution BW . . . . 10 Hz
    Marker . . . . off
    Video BW . . . . 1 Hz

43. On the HP 3324A, set the controls as follows:

    Frequency . . . . 250 kHz
    Amplitude . . . .–4 dBm
    Output . . . . 50 Ω
    Amplitude increment . . . . .0.01 dB

44. On the HP 3458A, set the controls as follows:

    Function. . . . . Sync AC Volts
    Math. . . . . dBm
    RES Register . . . . 50 Ω
    Front/Rear Terminal. . . . . Front
    Resolution . . . . 7.5 digits

45. Connect the equipment as shown in Figure 2-13 with the HP 8482A power sensor and HP 8902A connected to the power splitter.
46. Enter the power sensor calibration factor for 0.1 MHz into the HP 8902A.
47. Zero and calibrate the sensor.
48. Adjust the HP 3324A amplitude until the HP 8902A display reads the same value as recorded in step 13.
49. Disconnect the HP 8482A and power sensor from the power splitter connect the HP 3458A.
50. Record the HP 3458A reading here and in Table 2-24:

HP 3458A reading at 250 kHz: _______________ dBm

51. On the spectrum analyzer, press **PEAK SEARCH** and **MARKER DELTA**.
52. Set the spectrum analyzer CENTER FREQ and the HP 3324A frequency to the next frequency listed in Table 2-24.

53. Press **PEAK SEARCH** on the spectrum analyzer.
54. Adjust the HP 3324A amplitude for a Δ MKR amplitude reading of 0.00 dBm ±0.05 dB.
55. Record the HP 3324A amplitude readings in Table 2-24 as the ACDMV amplitude.
56. To step though the remaining frequencies listed in Table 2-24, repeat step 52 through step 55.
57. For each of the frequencies listed in Table 2-24, subtract the ACDVM amplitude reading from the ACDVM reading at 250 kHz recorded in step 50. Record the results as the response relative to 250 kHz in Table 2-24.
58. Add to each of the response relative to 250 kHz entries in Table 2-24, the HP 8902A reading for 250 kHz listed in Table 2-22. Record the results as the response relative to 300 MHz in Table 2-24.

Test Results

59.Record dc coupled frequency response results below:

a. Enter the most positive number from Table 2-24, column 4.	_______________	dB
b. Enter the most positive number from Table 2-22, column 2.	_______________	dB
c. Of (a) and (b), enter whichever number is *more* positive.	_______________	dB
d. Enter the most negative number from Table 2-24, column 4.	_______________	dB
e. Enter the most negative number from Table 2-22, column 2.	_______________	dB
f. Of (d) and (e), enter whichever number is *more* negative.	_______________	dB
g. Subtract (f) from (c).	_______________	dB

60.Record ac coupled frequency response results below:

a. Enter the most positive number from Table 2-23, column 2.	_______________	dB
b. Enter the most negative number from Table 2-23, column 2.	_______________	dB
g. Subtract (b) from (a).	_______________	dB

61.This step applies only to spectrum analyzers with serial number prefixes 3632A and later. Record the dc coupled frequency response results over the 100 MHz to 2.9 GHz range:

a. Enter the most positive number from Table 2-22, column 2, for center frequencies between 100 MHz and 2.9 GHz.	_______________	dB
b. Enter the most negative number from Table 2-22, column 2, for center frequencies between 100 MHz and 2.9 GHz.	_______________	dB
c. Subtract (b) from (a).	_______________	dB

Table 2-22 DC Coupled Frequency Response (≥250 kHz)

Source Frequency (MHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (MHz)	Measurement Uncertainty (dB)
0.250		0.3	+0.32/–0.34
1		1	+0.32/–0.34
10		10	+0.32/–0.34
20		10	+0.32/–0.34
50		30	+0.32/–0.34
100		100	+0.32/–0.34
200		300	+0.32/–0.34
300		300	+0.32/–0.34
400		300	+0.32/–0.34
500		300	+0.32/–0.34
600		1000	+0.32/–0.34
700		1000	+0.32/–0.34
800		1000	+0.32/–0.34
900		1000	+0.32/–0.34
1000		1000	+0.32/–0.34
1100		1000	+0.32/–0.34
1200		1000	+0.32/–0.34
1300		1000	+0.32/–0.34
1400		1000	+0.32/–0.34
1500		1000	+0.32/–0.34
1600		2000	+0.32/–0.34
1700		2000	+0.32/–0.34
1800		2000	+0.32/–0.34
1900		2000	+0.32/–0.34
2000		2000	+0.32/–0.34
2100		2000	+0.32/–0.34
2200		2000	+0.32/–0.34
2300		2000	+0.32/–0.34
2400		2000	+0.32/–0.34
2500		2000	+0.32/–0.34
2600		3000	+0.32/–0.34
2700		3000	+0.32/–0.34
2800		3000	+0.32/–0.34
2900		3000	+0.32/–0.34

Table 2-23 AC Coupled Frequency Response (≥250 kHz)

Column 1 Frequency (MHz)	Column 2 HP 8902A Reading (dB)	Column 3 Cal Factor Frequency (MHz)	Column 4 Measurement Uncertainty (dB)
0.250		0.3	+0.32/–0.34
1		1	+0.32/–0.34
10		10	+0.32/–0.34
20		10	+0.32/–0.34
50		30	+0.32/–0.34
100		100	+0.32/–0.34
200		300	+0.32/–0.34
300		300	+0.32/–0.34
400		300	+0.32/–0.34
500		300	+0.32/–0.34
600		1000	+0.32/–0.34
700		1000	+0.32/–0.34
800		1000	+0.32/–0.34
900		1000	+0.32/–0.34
1000		1000	+0.32/–0.34
1100		1000	+0.32/–0.34
1200		1000	+0.32/–0.34
1300		1000	+0.32/–0.34
1400		1000	+0.32/–0.34
1500		1000	+0.32/–0.34
1600		2000	+0.32/–0.34
1700		2000	+0.32/–0.34
1800		2000	+0.32/–0.34
1900		2000	+0.32/–0.34
2000		2000	+0.32/–0.34
2100		2000	+0.32/–0.34
2200		2000	+0.32/–0.34
2300		2000	+0.32/–0.34
2400		2000	+0.32/–0.34
2500		2000	+0.32/–0.34
2600		3000	+0.32/–0.34
2700		3000	+0.32/–0.34
2800		3000	+0.32/–0.34
2900		3000	+0.32/–0.34

Table 2-24 DC Coupled Frequency Response (<250 kHz)

Function Generator Frequency	ACDVM Amplitude (dBm)	Response Relative to 250 kHz	Response Relative to 300 MHz	Measurement Uncertainty (dB)
250 kHz		0 (Ref)		+0.27/–0.28
100 kHz				±0.23
10 kHz				±0.23
1 kHz				±0.23
500 Hz				±0.23
200 Hz				±0.23

37a. Frequency Response: HP 8561E/EC

Instrument Under Test

HP 8561E/EC

Related Specification

Relative Frequency Response
Absolute Frequency Response
Band Switching Uncertainty

Related Adjustment

Frequency Response Adjustment
LO Distribution Amplifier Adjustment

Description

For frequencies of 250 kHz and greater the output of a source is fed through a power splitter. One output of the power splitter is fed to a power sensor and then to a measuring receiver. The other output of the power splitter is fed to the spectrum analyzer. The source power level is adjusted at 300 MHz to place the displayed signal at the spectrum analyzer center horizontal graticule line. The measuring receiver, used as a power meter, is placed in ratio mode. At each new source frequency and spectrum analyzer center frequency, the source power level is adjusted to place the signal at the center horizontal graticule line. The measuring receiver displays the inverse of the frequency response relative to the calibrator.

For frequencies below 250 kHz the output of a function generator is fed through a power splitter to an ac digital volt meter (ACDVM) and to the spectrum analyzer. At each function generator frequency setting and spectrum analyzer center frequency setting, the function generator power level is adjusted to place the displayed signal at the spectrum analyzer center horizontal graticule line. The ACDVM is used to measure the function generator output signal level in dBm.

Figure 2-14 Frequency Response Test Setup, 250 kHz to 2.9 GHz

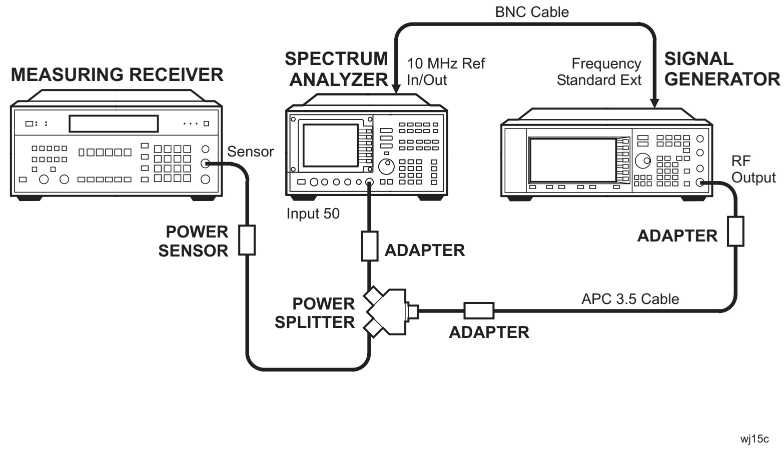


Figure 2-15 Frequency Response Test Setup, 2.9 MHz to 6.5 GHz

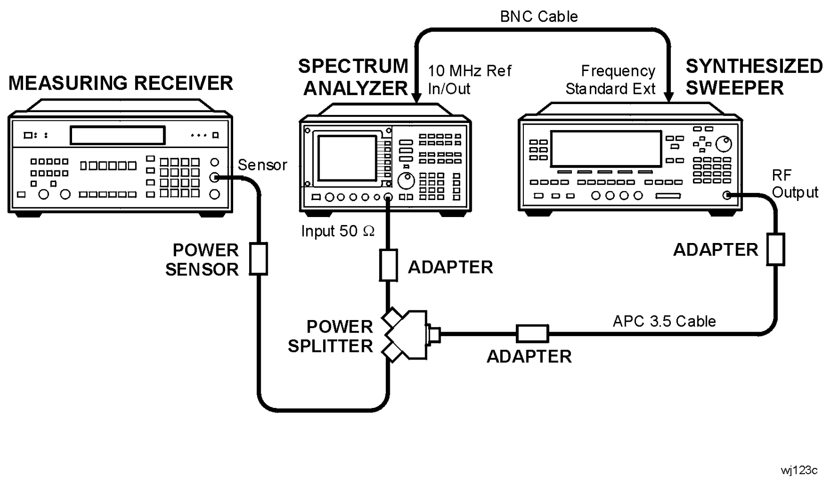
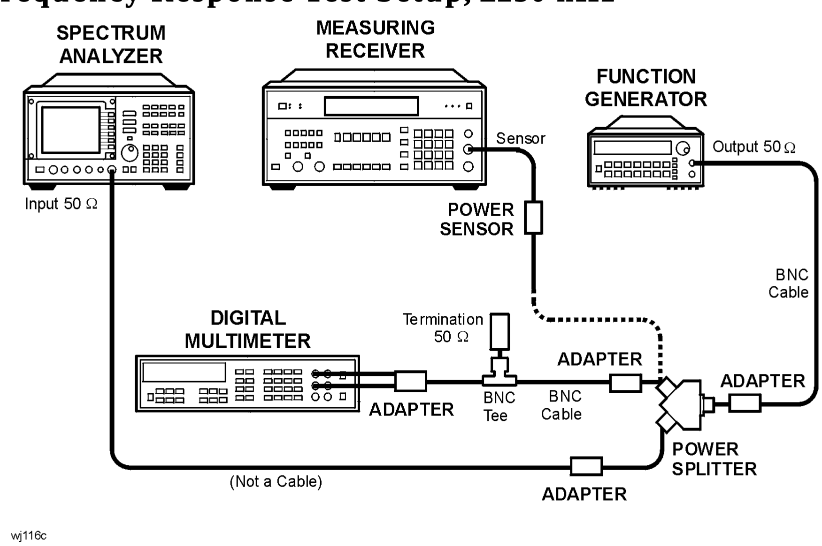


Figure 2-16 Frequency Response Test Setup, ≤250 kHz



Equipment

Measuring receiver . . . . HP 8902A
Synthesized sweeper . . . . HP 83640B
Function Generator . . . . HP 3324A or HP 33127A
Signal generator. . . . . .HP E4421B
AC Digital Voltmeter . . . . HP 3458A
Power sensor . . . . HP 8481A
Power sensor . . . . HP 8482A
Power splitter . . . . HP 11667A
Coaxial 50 Ω termination . . . . HP 908A

Adapters

APC-3.5 (f) to 2.4 mm (f) . . . . HP 11901B
Type N (m) to type N (m). 1250-1475
Type N (m) to BNC (f) *(2 required)* 1250-1476
Type N (m) to APC 3.5 (f) *(2 required)* 1250-1744
BNC (f) to Dual Banana Plug 1251-2816
BNC Tee 1250-0781

Cables

BNC, 122 cm (48 in) *(2 required)*. . . . . HP 10503A
APC-3.5, 91 cm (36 in) 8120-4921
DVM test leads. . . . . HP 34118A

Procedure

1. Zero and calibrate the HP 8902A and the HP 8482A in log mode, as described in the HP 8902A Operation Manual. Enter the power sensor 300 MHz calibration factor into the HP 8902A.
2. Connect the equipment as shown in Figure 2-14.
3. On the HP E4421B, press **INSTR PRESET**. Set the controls as follows:

   CW frequency . . . . 300 MHz
   Frequency increment . . . . 100 MHz
   Amplitude . . . .−4 dBm

4. On the spectrum analyzer, press **PRESET**. Set the controls as follows:

   Center frequency . . . . 300 MHz

   Center frequency step . . . . 100 MHz

   Span . . . . .0 Hz

   Reference level . . . . –5 dBm

   dB/division . . . . .1 dB

   Resolution BW . . . . .30 kHz

5. On the spectrum analyzer, press **MKR**.
6. On the HP E4421B, adjust the power level for a MKR amplitude of –10 dBm ±0.05 dB.
7. Press **RATIO** on the HP 8902A.

DC Coupled Frequency Response, Band 0 (250 kHz to 2.9 GHz)

8. On the spectrum analyzer, press **AMPLITUDE, MORE 1 OF 3**, and **COUPLING DC**.
9. Set the HP E4421B frequency to 250 kHz.
10. On the spectrum analyzer, press **FREQUENCY**, **CENTER FREQ**, 250, and **kHz**.
11. On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
12. Enter the 0.3 MHz power sensor calibration factor, indicated in Table 2-25, into the HP 8902A.
13. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-25. Record the power ratio here exactly as it is displayed on the HP 8902A:

HP 8902A reading at 250 kHz:_________________ dB

14. Set the HP E4421B to 1.0 MHz.
15. On the spectrum analyzer, press **FREQUENCY, CENTER FREQ**, 1.0, and **MHz**.
16. On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
17. Enter the 1 MHz power sensor calibration factor, indicated in Table 2-25, into the HP 8902A.
18. Record the negative of the power ratio displayed on the HP 8902A, as the HP 8902A reading in Table 2-25.

19. On the HP E4421B, set the frequency to the next value listed in Table 2-25.

20.On the spectrum analyzer, set the center frequency to the next value listed in Table 2-25.

21.On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.

22.Enter the power sensor calibration factor, indicated in Table 2-25, into the HP 8902A.

23.Record the negative of the power ratio displayed on the HP 8902A, as the HP 8902A reading in Table 2-25.

24.To step through the remaining frequencies listed in Table 2-25, repeat step 19 through step 23.

NOTE It will be necessary to enter the last source and spectrum analyzer frequency, 2.9 GHz, manually; the step functions will set the frequency to 2.95 GHz.

AC Coupled Frequency Response, Band 0 (250kHz to 2.9 GHz)

25.On the spectrum analyzer, press **AMPLITUDE, MORE 1 OF 3**, and **COUPLING AC**.

26.Set the HP E4421B to 250 kHz.

27.On the spectrum analyzer, press **FREQUENCY, CENTER FREQ**, 250, and **kHz**.

28.On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.

29.Enter the 0.3 MHz power sensor calibration factor, indicated in Table 2-26, into the HP 8902A.

30.Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-26. Record the power ratio here exactly as it is displayed on the HP 8902A:

HP 8902A reading at 250 kHz: _______________ dB

31.Set the HP E4421B to 1.0 MHz.

32.On the spectrum analyzer, press **FREQUENCY**, **CENTER FREQ**, 1.0, and **MHz**.

33.On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.

34.Enter the 1.0 MHz power sensor calibration factor, indicated in Table 2-26, into the HP 8902A.

35. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-26.
36. On the HP E4421B, set the frequency to the next value listed in Table 2-26.
37. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-26.
38. On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
39. Enter the power sensor calibration factor, indicated in Table 2-26, into the HP 8902A.
40. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-26.
41. To step through the remaining frequencies listed in Table 2-26, repeat step 36 through step 40.

NOTE It is necessary to enter the last source and spectrum analyzer frequency, (2.9 GHz) manually. The step functions will set the frequency to 2.95 GHz.

DC Coupled Frequency Response, Band 1 (2.9 GHz to 6.50 GHz)

42. Connect the equipment as shown in Figure 2-15.
43. Zero and calibrate the HP 8902A with the HP 8481A.
44. On the spectrum analyzer, press **FREQUENCY,** 2.95, and **GHz**.
45. Set the HP 83640B frequency to 2.95 GHz.
46. On the spectrum analyzer, press **AUX CTRL, INTERNAL MIXER**, and **PRESEL AUTO PK**. Wait for the PEAKING message to disappear.
47. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
48. Enter the 3.0 GHz power sensor calibration factor, indicated in Table 2-27, into the HP 8902A.
49. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-27.
50. On the HP 83640B, set the frequency to the next value listed in Table 2-27.
51. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-27.
52. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
53. Enter the power sensor calibration factor, indicated in Table 2-27, into the HP 8902A.

54.Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-27.

55.To step through the remaining frequencies listed in Table 2-27, repeat step 50 through step 54.

NOTE	It will be necessary to enter the last source and spectrum analyzer frequency, 6.5 GHz, manually; the step functions will set the frequency to 6.55 GHz.

AC Coupled Frequency Response, Band 1 (2.9 GHz to 6.50 GHz)

56.On the spectrum analyzer, press **FREQUENCY,** 2.95, and **GHz**.

57.Set the HP 83640B frequency to 2.95 GHz.

58.On the spectrum analyzer, press **AUX CTRL, INTERNAL MIXER**, and **PRESEL AUTO PK**. Wait for the PEAKING message to disappear.

59.On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.

60.Enter the 3.0 GHz power sensor calibration factor, indicated in Table 2-28, into the HP 8902A.

61.Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-28.

62.On the HP 83640B, set the frequency to the next value listed in Table 2-28.

63.On the spectrum analyzer, set the center frequency to the next value listed in Table 2-28.

64.On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.

65.Enter the power sensor calibration factor, indicated in Table 2-28, into the HP 8902A.

66.Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-28.

67.To step through the remaining frequencies listed in Table 2-28, repeat step 62 through step 66.

NOTE	It will be necessary to enter the last source and spectrum analyzer frequency, 6.5 GHz, manually; the step functions will set the frequency to 6.55 GHz.

DC Coupled Frequency Response (≤250 kHz)

68. On the spectrum analyzer, press **AMPLITUDE, MORE 1 OF 3**, and **COUPLING DC**. Set the controls as follows:

   Center frequency . . . . .250 kHz

   Span . . . . .100 Hz

   Resolution BW . . . . .10 Hz

   Marker . . . . off

   Video BW . . . . .1 Hz

69. On the HP 3324A, set the controls as follows:

   Frequency . . . . .250 kHz

   Amplitude. . . . . –4 dBm

   Amplitude increment . . . . 0.01 dB

70. On the HP 3458A, set the controls as follows:

   Function . . . . .Sync AC Volts

   Math . . . . .dBm

   RES Register . . . . .50 Ω

   Front/Rear Terminal . . . . .Front

   Resolution. . . . . .7.5 digits

71. Connect the equipment as shown in Figure 2-12 with the HP 8482A power sensor and HP 8902A connected to the power splitter.
72. Enter the power sensor calibration factor for 0.3 MHz into the HP 8902A.
73. Zero and calibrate the sensor.
74. Adjust the HP 3324A amplitude until the HP 8902A display reads the same value as recorded in step 13.
75. Disconnect the HP 8482A power sensor from the power splitter and connect the HP 3458A.
76. Record the HP 3458A reading here and in Table 2-29:

HP 3458A reading at 250 kHz:_______________ dBm

77. On the spectrum analyzer, press **PEAK SEARCH** and **MARKER DELTA**.
78. Set the spectrum analyzer CENTER FREQ and the HP 3324A frequency to the next frequency listed in Table 2-29.

79.Press **PEAK SEARCH** on the spectrum analyzer.

80.Adjust the HP 3324A amplitude for a Δ MKR amplitude reading of 0.00 dBm ±0.05 dB.

81.Record the HP 3458A amplitude readings in Table 2-29 as the ACDMV amplitude.

82.To step through the remaining frequencies listed in Table 2-29, repeat step 78 through step 81

83.For each of the frequencies listed in Table 2-29, subtract the ACDVM amplitude reading from the ACDVM reading at 250 kHz recorded in step 76. Record the results as the response relative to 250 kHz in Table 2-29.

84.Add to each of the response relative to 250 kHz entries in Table 2-29 the HP 8902A reading for 250 kHz listed in Table 2-25. Use the value from Table 2-29 for the ac coupled frequency. Record the results as the response relative to 300 MHz in Table 2-29.

Test Results

85.Enter the results of the dc coupled frequency response, Band 0, below:

86.a. Enter the most positive number from Table 2-29, column 4. ________________ dB

87.b. Enter the most positive number from Table 2-25, column 2. ________________ dB

c. Of (a) and (b), enter whichever number is *more* positive. ________________ dB

88.d. Enter the most negative number from Table 2-29, column 4. ________________ dB

89.e. Enter the most negative number from Table 2-25, column 2. ________________ dB

f. Of (c) and (d), enter whichever number is *more* negative. ________________ dB

g. Subtract (f) from (c). ________________ dB

90.Enter the results of the ac coupled frequency response, Band 0, below:

a. Enter the most positive number from Table 2-26, column 2. ________________ dB

b. Enter the most negative number from Table 2-26, column 2. ________________ dB

c. Subtract (b) from (a). ________________ dB

91. Enter the results of the dc coupled frequency response, Band 1, below:

a. Enter the most positive number from Table 2-27, column 2. _______________ dB

b. Enter the most negative number from Table 2-27, column 2. _______________ dB

c. Subtract (b) from (a). _______________ dB

92. Enter the results of the ac coupled frequency response, Band 1, below:

b. Enter the most positive number from Table 2-28, column 2. _______________ dB

c. Enter the most negative number from Table 2-28, column 2. _______________ dB

d. Subtract (b) from (a). _______________ dB

Band Switching Uncertainty

93.Band 0 to Band 1 results (dc coupled):

a. Enter the value recorded in step 85 (c): ______ dB

b. Enter the value recorded in step 91 (b): ______ dB

c. Compute the absolute value of the difference between these two entries. ______ dB

94.Band 1 to Band 0 results (dc coupled):

a. Enter the value recorded in step 85 66 (f): ______ dB

b. Enter the value recorded in step 91 67 (a): ______ dB

c. Compute the absolute value of the difference between these two entries. ______ dB

95.Band 0 to Band 1 results (ac coupled):

a. Enter the value recorded in step 90 (c): ______ dB

b. Enter the value recorded in step 92 (b): ______ dB

c. Compute the absolute value of the difference between these two entries. ______ dB

96.Band 1 to Band 0 results (ac coupled):

a. Enter the value recorded in step 90 (f): ______ dB

b. Enter the value recorded in step 92 (a): ______ dB

c. Compute the absolute value of the difference between these two entries. ______ dB

Table 2-25 DC Coupled Frequency Response (250 kHz to 2.9 GHz)

Source Frequency (MHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (MHz)	Measurement Uncertainty (dB)
0.250		0.3	+0.32/–0.34
1		1	+0.32/–0.34
10		10	+0.32/–0.34
20		10	+0.32/–0.34
50		30	+0.32/–0.34
100		100	+0.32/–0.34
200		300	+0.32/–0.34
300		300	+0.32/–0.34
400		300	+0.32/–0.34
500		300	+0.32/–0.34
600		1000	+0.32/–0.34
700		1000	+0.32/–0.34
800		1000	+0.32/–0.34
900		1000	+0.32/–0.34
1000		1000	+0.32/–0.34
1100		1000	+0.32/–0.34
1200		1000	+0.32/–0.34
1300		1000	+0.32/–0.34
1400		1000	+0.32/–0.34
1500		1000	+0.32/–0.34
1600		2000	+0.32/–0.34
1700		2000	+0.32/–0.34
1800		2000	+0.32/–0.34
1900		2000	+0.32/–0.34
2000		2000	+0.32/–0.34
2100		2000	+0.32/–0.34
2200		2000	+0.32/–0.34
2300		2000	+0.32/–0.34
2400		2000	+0.32/–0.34
2500		2000	+0.32/–0.34
2600		3000	+0.32/–0.34
2700		3000	+0.32/–0.34
2800		3000	+0.32/–0.34
2900		3000	+0.32/–0.34

Table 2-26 AC Coupled Frequency Response(250 kHz to 2.9 GHz)

Source Frequency (MHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (MHz)	Measurement Uncertainty (dB)
0.250		0.3	+0.32/–0.34
1		1	+0.32/–0.34
10		10	+0.32/–0.34
20		10	+0.32/–0.34
50		30	+0.32/–0.34
100		100	+0.32/–0.34
200		300	+0.32/–0.34
300		300	+0.32/–0.34
400		300	+0.32/–0.34
500		300	+0.32/–0.34
600		1000	+0.32/–0.34
700		1000	+0.32/–0.34
800		1000	+0.32/–0.34
900		1000	+0.32/–0.34
1000		1000	+0.32/–0.34
1100		1000	+0.32/–0.34
1200		1000	+0.32/–0.34
1300		1000	+0.32/–0.34
1400		1000	+0.32/–0.34
1500		1000	+0.32/–0.34
1600		2000	+0.32/–0.34
1700		2000	+0.32/–0.34
1800		2000	+0.32/–0.34
1900		2000	+0.32/–0.34
2000		2000	+0.32/–0.34
2100		2000	+0.32/–0.34
2200		2000	+0.32/–0.34
2300		2000	+0.32/–0.34
2400		2000	+0.32/–0.34
2500		2000	+0.32/–0.34
2600		3000	+0.32/–0.34
2700		3000	+0.32/–0.34
2800		3000	+0.32/–0.34
2900		3000	+0.32/–0.34

Table 2-27 DC Coupled Frequency Response (2.9 GHz to 6.5 GHz)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
2.95		3.0	+0.44/–0.49
3.05		3.0	+0.44/–0.49
3.15		3.0	+0.44/–0.49
3.25		3.0	+0.44/–0.49
3.35		3.0	+0.44/–0.49
3.45		3.0	+0.44/–0.49
3.55		4.0	+0.44/–0.49
3.65		4.0	+0.44/–0.49
3.75		4.0	+0.44/–0.49
3.85		4.0	+0.44/–0.49
3.95		4.0	+0.44/–0.49
4.05		4.0	+0.44/–0.49
4.15		4.0	+0.44/–0.49
4.25		4.0	+0.44/–0.49
4.35		4.0	+0.44/–0.49
4.45		4.0	+0.44/–0.49
4.55		5.0	+0.44/–0.49
4.65		5.0	+0.44/–0.49
4.75		5.0	+0.44/–0.49
4.85		5.0	+0.44/–0.49
4.95		5.0	+0.44/–0.49
5.05		5.0	+0.44/–0.49
5.15		5.0	+0.44/–0.49
5.25		5.0	+0.44/–0.49
5.35		5.0	+0.44/–0.49
5.45		5.0	+0.44/–0.49
5.55		6.0	+0.44/–0.49
5.65		6.0	+0.44/–0.49
5.75		6.0	+0.44/–0.49
5.85		6.0	+0.44/–0.49
5.95		6.0	+0.44/–0.49
6.05		6.0	+0.44/–0.49
6.15		6.0	+0.44/–0.49
6.25		6.0	+0.44/–0.49
6.35		6.0	+0.44/–0.49
6.45		6.0	+0.44/–0.49
6.50		6.0	+0.44/–0.49

Table 2-28 AC Coupled Frequency Response (2.9 GHz to 6.5 GHz)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
2.95		3.0	+0.44/–0.49
3.05		3.0	+0.44/–0.49
3.15		3.0	+0.44/–0.49
3.25		3.0	+0.44/–0.49
3.35		3.0	+0.44/–0.49
3.45		3.0	+0.44/–0.49
3.55		4.0	+0.44/–0.49
3.65		4.0	+0.44/–0.49
3.75		4.0	+0.44/–0.49
3.85		4.0	+0.44/–0.49
3.95		4.0	+0.44/–0.49
4.05		4.0	+0.44/–0.49
4.15		4.0	+0.44/–0.49
4.25		4.0	+0.44/–0.49
4.35		4.0	+0.44/–0.49
4.45		4.0	+0.44/–0.49
4.55		5.0	+0.44/–0.49
4.65		5.0	+0.44/–0.49
4.75		5.0	+0.44/–0.49
4.85		5.0	+0.44/–0.49
4.95		5.0	+0.44/–0.49
5.05		5.0	+0.44/–0.49
5.15		5.0	+0.44/–0.49
5.25		5.0	+0.44/–0.49
5.35		5.0	+0.44/–0.49
5.45		5.0	+0.44/–0.49
5.55		6.0	+0.44/–0.49
5.65		6.0	+0.44/–0.49
5.75		6.0	+0.44/–0.49
5.85		6.0	+0.44/–0.49
5.95		6.0	+0.44/–0.49
6.05		6.0	+0.44/–0.49
6.15		6.0	+0.44/–0.49
6.25		6.0	+0.44/–0.49
6.35		6.0	+0.44/–0.49
6.45		6.0	+0.44/–0.49
6.50		6.0	+0.44/–0.49

Table 2-29 DC Coupled Frequency Response (<250 kHz)

Function Generator Frequency	ACDVM Amplitude (dBm)	Response Relative to 250 kHz	Response Relative to 300 MHz	Measurement Uncertainty (dB)
250 kHz		0 (Ref)		±0.23
100 kHz				±0.23
10 kHz				±0.23
1 kHz				±0.23
500 Hz				±0.23
200 Hz				±0.23

38a. Frequency Response: HP 8562E/EC

Instrument Under Test

HP 8562E/EC

Related Specification

Relative Frequency Response
Absolute Frequency Response
Band Switching Uncertainty

Related Adjustment

Frequency Response Adjustment
LO Distribution Amplifier Adjustment

Description

For frequencies of 250 kHz and greater the output of a source is fed through a power splitter. One output of the power splitter is fed to a power sensor and then to a measuring receiver. The other output of the power splitter is fed to the spectrum analyzer. The source power level is adjusted at 300 MHz to place the displayed signal at the spectrum analyzer center horizontal graticule line. The measuring receiver, used as a power meter, is placed in ratio mode. At each new source frequency and spectrum analyzer center frequency, the source power level is adjusted to place the signal at the center horizontal graticule line. The measuring receiver displays the inverse of the frequency response relative to the calibrator.

For frequencies below 250 kHz the output of a function generator is fed through a power splitter to an ac digital volt meter (ACDVM) and to the spectrum analyzer. At each function generator frequency setting and spectrum analyzer center frequency setting, the function generator power level is adjusted to place the displayed signal at the spectrum analyzer center horizontal graticule line. The ACDVM is used to measure the function generator output signal level in dBm.

Figure 2-17 Frequency Response Test Setup, 250 kHz to 2.9 GHz

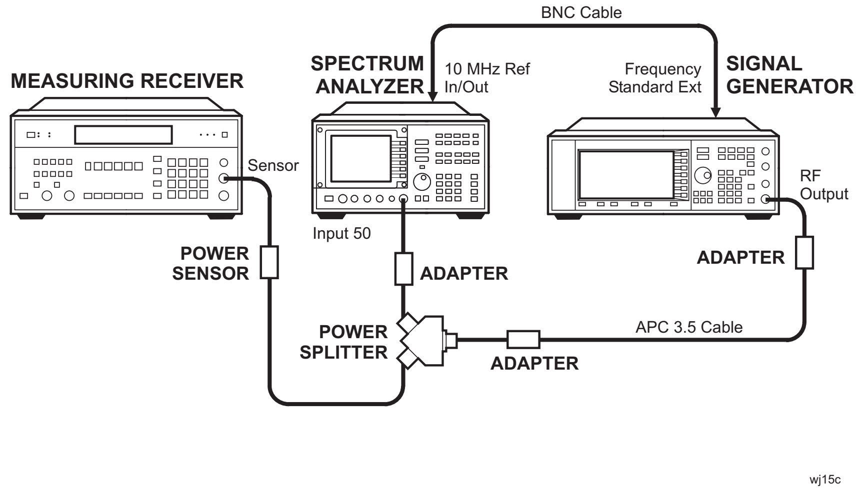


Figure 2-18 Frequency Response Test Setup, 2.9 MHz to 13.2 GHz

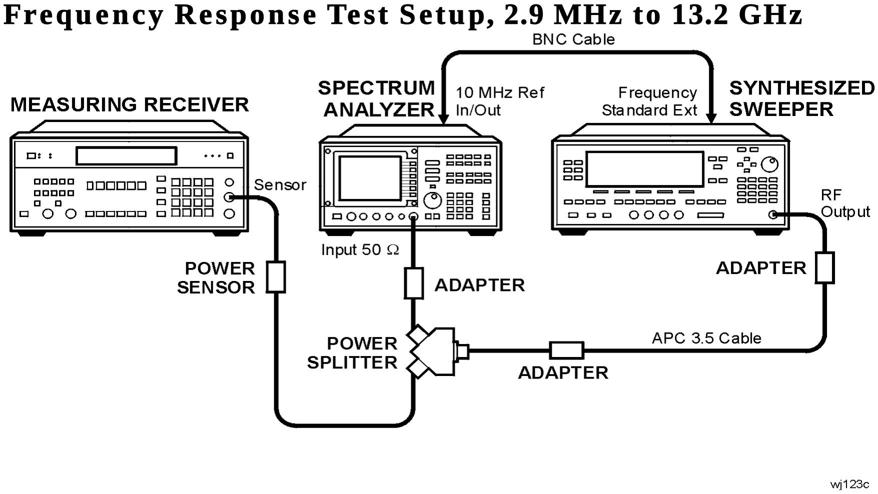
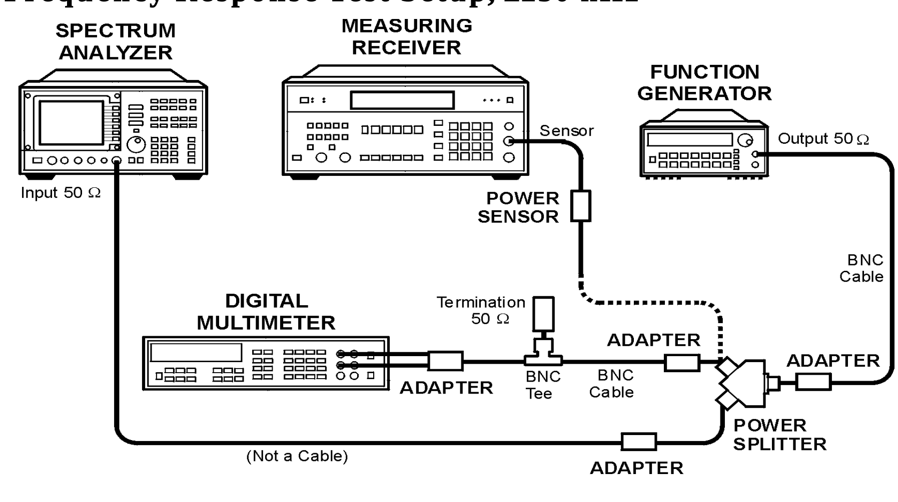


Figure 2-19 Frequency Response Test Setup, ≤250 kHz



Equipment

Measuring receiver . . . . HP 8902A
Synthesized sweeper . . . . HP 83640B
Function Generator . . . . HP 3324A or HP 33127A
Signal generator. . . . . .HP E4421B
AC Digital Voltmeter . . . . HP 3458A
Power sensor . . . . HP 8481A
Power sensor . . . . HP 8482A
Power splitter . . . . HP 11667A
Coaxial 50 Ω termination . . . . HP 908A

Adapters

APC-3.5 (f) to 2.4 mm (f) . . . . HP 11901B
Type N (m) to type N (m). 1250-1475
Type N (m) to BNC (f) *(2 required)* 1250-1476
Type N (m) to APC 3.5 (f) *(2 required)* 1250-1744
BNC (f) to Dual Banana Plug 1251-2816
BNC Tee 1250-0781

Cables

BNC, 122 cm (48 in) *(2 required)*. . . . . HP 10503A
APC-3.5, 91 cm (36 in) 8120-4921
DVM test leads. . . . . HP 34118A

Procedure

1. Zero and calibrate the HP 8902A and the HP 8482A in log mode, as described in the HP 8902A Operation Manual. Enter the power sensor 300 MHz calibration factor into the HP 8902A.
2. Connect the equipment as shown in Figure 2-17.
3. On the HP E4421B, press **INSTR PRESET**. Set the controls as follows:

   CW frequency . . . . 300 MHz
   Frequency increment . . . . 100 MHz
   Amplitude . . . .–4 dBm
4. On the spectrum analyzer, press **PRESET**. Set the controls as follows:

Center frequency . . . . 300 MHz
Center frequency step . . . . 100 MHz
Span . . . . .0 Hz
Reference level . . . . –5 dBm
dB/division . . . . .1 dB
Resolution BW . . . . .30 kHz

5. On the spectrum analyzer, press **MKR**.
6. On the HP E4421B, adjust the power level for a MKR amplitude of –10 dBm ±0.05 dB.
7. Press **RATIO** on the HP 8902A.

DC Coupled Frequency Response, Band 0 (250 kHz to 2.9 GHz)

8. On the spectrum analyzer, press **AMPLITUDE, MORE 1 OF 3**, and **COUPLING DC**.
9. Set the HP E4421B frequency to 250 kHz.
10. On the spectrum analyzer, press **FREQUENCY**, **CENTER FREQ**, 250, and **kHz**.
11. On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
12. Enter the 0.3 MHz power sensor calibration factor, indicated in Table 2-30, into the HP 8902A.
13. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-30. Record the power ratio here exactly as it is displayed on the HP 8902A:

HP 8902A reading at 250 kHz (dc coupled): ___________ dB

14. Set the HP E4421B to 1.0 MHz.
15. On the spectrum analyzer, press **FREQUENCY, CENTER FREQ**, 1.0, and **MHz**.
16. On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
17. Enter the 1 MHz power sensor calibration factor, indicated in Table 2-30, into the HP 8902A.

18. Record the negative of the power ratio displayed on the HP 8902A, as the HP 8902A reading in Table 2-30.

19. On the HP E4421B, set the frequency to the next value listed in Table 2-30.
20. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-30.
21. On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
22. Enter the power sensor calibration factor, indicated in Table 2-30, into the HP 8902A.
23. Record the negative of the power ratio displayed on the HP 8902A, as the HP 8902A reading in Table 2-30.
24. To step through the remaining frequencies listed in Table 2-30, repeat step 19 through step 23.

NOTE It will be necessary to enter the last source and spectrum analyzer frequency, 2.9 GHz, manually; the step functions will set the frequency to 2.95 GHz.

AC Coupled Frequency Response, Band 0 (250kHz to 2.9 GHz)

25. On the spectrum analyzer, press **AMPLITUDE, MORE 1 OF 3**, and **COUPLING AC**.
26. Set the HP E4421B to 300 MHz.
27. On the spectrum analyzer, press **FREQUENCY, CENTER FREQ**, 300, and **MHz**.
28. On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
29. Enter the 300 MHz power sensor calibration factor, indicated in Table 2-31, into the HP 8902A.
30. On the HP 8902A, press **RATIO**.
31. Set the HP E4421B to 250 kHz.
32. Enter the 0.3 MHz power sensor calibration factor, indicated in Table 2-31, into the HP 8902A.
33. On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
34. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-31. Record the power ratio here exactly as it is displayed on the HP 8902A:

HP 8902A reading at 250 kHz (ac coupled):___________ dB

35. Set the HP E4421B to 1.0 MHz.
36. On the spectrum analyzer, press **FREQUENCY**, **CENTER FREQ**, 1.0, and **MHz**.
37. On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
38. Enter the 1 MHz power sensor calibration factor, indicated in Table 2-31, into the HP 8902A.
39. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-31.
40. On the HP E4421B, set the frequency to the next value listed in Table 2-31.
41. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-31.
42. On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
43. Enter the power sensor calibration factor, indicated in Table 2-31, into the HP 8902A.
44. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-31.
45. To step through the remaining frequencies listed in Table 2-31, repeat step 40 through step 44.

NOTE It is necessary to enter the last source and spectrum analyzer frequency, (2.9 GHz) manually. The step functions will set the frequency to 2.95 GHz.

DC Coupled Frequency Response, Band 1 (2.9 GHz to 6.5 GHz)

46. Connect the equipment as shown in Figure 2-18.
47. Zero and calibrate the HP 8902A with the HP 8481A.
48. On the spectrum analyzer, press **AMPLITUDE, MORE 1 OF 3**, and **COUPLING DC**.
49. On the spectrum analyzer, press **FREQUENCY,** 2.95, and **GHz**.
50. Set the HP 83640B frequency to 2.95 GHz.
51. On the spectrum analyzer, press **AUX CTRL, INTERNAL MIXER**, and **PRESEL AUTO PK**. Wait for the PEAKING message to disappear.
52. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
53. Enter the 3.0 GHz power sensor calibration factor, indicated in Table 2-32, into the HP 8902A.
54. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-32.

55.On the HP 83640B, set the frequency to the next value listed in Table 2-32.

56.On the spectrum analyzer, set the center frequency to the next value listed in Table 2-32.

57.On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.

58.Enter the power sensor calibration factor, indicated in Table 2-32, into the HP 8902A.

59.Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-32.

60.To step through the remaining frequencies listed in Table 2-32, repeat step 55 through step 59.

NOTE It will be necessary to enter the last source and spectrum analyzer frequency, 6.5 GHz, manually; the step functions will set the frequency to 6.55 GHz.

DC Coupled Frequency Response, Band 2 (6.5 GHz to 13.2 GHz)

61.On the spectrum analyzer, press **FREQUENCY,** 6.5, **GHz**, **CF STEP**, 200, and **MHz**.

62.Set the HP 83640B frequency to 6.5 GHz and the FREQ STEP to 200 MHZ.

63.On the spectrum analyzer, press **AUX CTRL, INTERNAL MIXER**, and **PRESEL AUTO PK**. Wait for the PEAKING message to disappear.

64.On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.

65.Enter the 3.0 GHz power sensor calibration factor, indicated in Table 2-33, into the HP 8902A.

66.Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-33.

67.On the HP 83640B, set the frequency to the next value listed in Table 2-33.

68.On the spectrum analyzer, set the center frequency to the next value listed in Table 2-33.

69.On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.

70.Enter the power sensor calibration factor, indicated in Table 2-33, into the HP 8902A.

71.Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-33.

72.To step through the remaining frequencies listed in Table 2-33, repeat step 67 through step 71.

AC Coupled Frequency Response, Band 1 (2.9 GHz to 6.5 GHz)

73. On the spectrum analyzer, press **AMPLITUDE, MORE 1 OF 3**, and **COUPLING AC**.
74. On the spectrum analyzer, press **FREQUENCY,** 2.95, **GHz**.
75. Set the HP 83640B frequency to 2.95 GHz and the frequency step to 100 MHz..
76. On the spectrum analyzer, press **AUX CTRL, INTERNAL MIXER**, and **PRESEL AUTO PK**. Wait for the PEAKING message to disappear.
77. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of −10 dBm ±0.05 dB.
78. Enter the 3.0 GHz power sensor calibration factor, indicated in Table 2-34, into the HP 8902A.
79. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-34.
80. On the HP 83640B, set the frequency to the next value listed in Table 2-34.
81. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-34.
82. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of −10 dBm ±0.05 dB.
83. Enter the power sensor calibration factor, indicated in Table 2-34, into the HP 8902A.
84. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-34.
85. To step through the remaining frequencies listed in Table 2-34, repeat step 80 through step 84.

NOTE It will be necessary to enter the last source and spectrum analyzer frequency, 6.5 GHz, manually; the step functions will set the frequency to 6.55 GHz.

AC Coupled Frequency Response, Band 2 (6.5 GHz to 13.2 GHz)

86. On the spectrum analyzer, press **FREQUENCY,** 6.5, **GHz**.

87. Set the HP 83640B frequency to 6.5 GHz and the FREQ STEP to 200 MHZ.

88. On the spectrum analyzer, press **AUX CTRL, INTERNAL MIXER**, and **PRESEL AUTO PK**. Wait for the PEAKING message to disappear.

89. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.

90. Enter the 6.0 GHz power sensor calibration factor, indicated in Table 2-35, into the HP 8902A.

91. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-35.

92. On the HP 83640B, set the frequency to the next value listed in Table 2-35.

93. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-35.

94. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.

95. Enter the power sensor calibration factor, indicated in Table 2-35, into the HP 8902A.

96. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-35.

97. To step through the remaining frequencies listed in Table 2-35, repeat step 92 through step 96.

NOTE It will be necessary to enter the last source and spectrum analyzer frequency, 6.5 GHz, manually; the step functions will set the frequency to 6.55 GHz.

DC Coupled Frequency Response (≤250 kHz)

98.On the spectrum analyzer, press **AMPLITUDE, MORE 1 OF 3**, **COUPLING DC**. Set the controls as follows:

Center frequency . . . . .250 kHz

Span . . . . .100 Hz

Resolution BW . . . . .10 Hz

Marker . . . . off

Video BW . . . . .1 Hz

99.On the HP 3324A, set the controls as follows:

Frequency . . . . .250 kHz

Amplitude. . . . . –4 dBm

100.On the HP 3458A, set the controls as follows:

Function . . . . .Sync AC Volts

Math . . . . .dBm

RES Register . . . . .50 Ω

Front/Rear Terminal . . . . Front

Resolution. . . . . .7.5 digits

101.Connect the equipment as shown in Figure 2-19 with the HP 8482A power sensor and HP 8902A connected to the power splitter.

102.Enter the power sensor calibration factor for 0.1 MHz into the HP 8902A.

103.Zero and calibrate the sensor.

104.Adjust the HP 3324A amplitude until the HP 8902A display reads the same value as recorded in step 13.

105.Disconnect the HP 8482A power sensor from the power splitter and connect the HP 3458A.

106.Record the HP 3458A reading here and in Table 2-36:

HP 3458A reading at 250 kHz:_______________ dBm

107.On the spectrum analyzer, press **PEAK SEARCH** and **MARKER DELTA**.

108.Set the spectrum analyzer CENTER FREQ and the HP 3324A frequency to the next frequency listed in Table 2-36.

109. Press **PEAK SEARCH** on the spectrum analyzer

110. Adjust the HP 3324A amplitude for a Δ MKR amplitude reading of 0.00 dBm ±0.05 dB.

111. Record the HP 3458A amplitude readings in Table 2-36 as the ACDMV amplitude.

112. To step through the remaining frequencies listed in Table 2-36, repeat step 108 through step 111.

113. For each of the frequencies listed in Table 2-36, subtract the ACDVM amplitude reading from the ACDVM amplitude reading at 250 kHz recorded in step 106. Record the results as the response relative to 250 kHz in Table 2-36.

114. Add to each of the response relative to 250 kHz entries in Table 2-36 the HP 8902A reading for 250 kHz listed in Table 2-30. Use the value from Table 2-36 for the ac coupled frequency. Record the results as the response relative to 300 MHz in Table 2-36.

Test Results

115.Enter the results of the dc coupled frequency response, Band 0, below:

a. Enter the most positive number from Table 2-36, column 4. _______________ dB

b. Enter the most positive number from Table 2-30, column 2. _______________ dB

c. Of (a) and (b), enter whichever number is *more* positive. _______________ dB

d. Enter the most negative number from Table 2-36, column 4. _______________ dB

e. Enter the most negative number from Table 2-30, column 2. _______________ dB

f. Of (c) and (d), enter whichever number is *more* negative. _______________ dB

g. Subtract (f) from (c). _______________ dB

116.Enter the results of the ac coupled frequency response, Band 0, below:

a. Enter the most positive number from Table 2-31, column 2. _______________ dB

b. Enter the most negative number from Table 2-31, column 2. _______________ dB

c. Subtract (a) from (b). _______________ dB

117.Enter the results of the dc coupled frequency response, Band 1, below:

a. Enter the most positive number from Table 2-32, column 2. _______________ dB

b. Enter the most negative number from Table 2-32, column 2. _______________ dB

c. Subtract (b) from (a). _______________ dB

118.Enter the results of the dc coupled frequency response, Band 2, below:

a. Enter the most positive number from Table 2-33, column 2. _______________ dB

b. Enter the most negative number from Table 2-33, column 2. _______________ dB

c. Subtract (b) from (a). _______________ dB

119. Enter the results of the ac coupled frequency response, Band 1, below:

b. Enter the most positive number from Table 2-34, column 2. ______________ dB

c. Enter the most negative number from Table 2-34, column 2. ______________ dB

d. Subtract (b) from (a). ______________ dB

120. Enter the results of the ac coupled frequency response, Band 2, below:

a. Enter the most positive number from Table 2-35, column 2. ______________ dB

b. Enter the most negative number from Table 2-35, column 2. ______________ dB

c. Subtract (b) from (a). ______________ dB

Frequency Response, Band 0, 100 MHz to 2.3 GHz

121. Enter the results of the dc coupled frequency response, Band 0, for the frequency range 100 MHz to 2.3 GHz:

122. a. Enter the most positive number from Table 2-30, column 2, for center frequencies between 100 MHz and 2.3 GHz. ______________ dB

123. b. Enter the most negative number from Table 2-30, column 2, for center frequencies between 100 MHz and 2.3 GHz. ______________ dB

c. Subtract (b) from (a). ______________ dB

Band Switching Uncertainty DC Coupled

124.In the top row of Table 2-37, enter the values recorded in the indicated steps. For example, if step 118 (a) has a value of 1.22 dB, enter “1.22 dB” in the top row of the Band 2 column.

125.In the left column of Table 2-37, enter the values recorded in the indicated steps. For example, if step 118 (b) has a value of –0.95 dB, enter “–0.95 dB” in the left column of the Band 2 row.

126.Compute the other entries in Table 2-37 by taking the absolute value of the difference between the values in the left column and the top row.

Band Switching Uncertainty AC Coupled

127.In the top row of Table 2-38, enter the values recorded in the indicated steps. For example, if step 120 (a) has a value of 1.22 dB, enter “1.22 dB” in the top row of the Band 2 column.

128.In the left column of Table 2-38, enter the values recorded in the indicated steps. For example, if step 120 (b) has a value of –0.95 dB, enter “–0.95 dB” in the left column of the Band 2 row.

129.Compute the other entries in Table 2-38 by taking the absolute value of the difference between the values in the left column and the top row.

Table 2-30 DC Coupled Frequency Response, Band 0 (250 kHz to 2.9 GHz)

Source Frequency (MHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (MHz)	Measurement Uncertainty (dB)
0.250		0.01	+0.32/–0.34
1		1	+0.32/–0.34
10		10	+0.32/–0.34
20		10	+0.32/–0.34
50		30	+0.32/–0.34
100		100	+0.32/–0.34
200		300	+0.32/–0.34
300		300	+0.32/–0.34
400		300	+0.32/–0.34
500		300	+0.32/–0.34
600		1000	+0.32/–0.34
700		1000	+0.32/–0.34
800		1000	+0.32/–0.34
900		1000	+0.32/–0.34
1000		1000	+0.32/–0.34
1100		1000	+0.32/–0.34
1200		1000	+0.32/–0.34
1300		1000	+0.32/–0.34
1400		1000	+0.32/–0.34
1500		1000	+0.32/–0.34
1600		2000	+0.32/–0.34
1700		2000	+0.32/–0.34
1800		2000	+0.32/–0.34
1900		2000	+0.32/–0.34
2000		2000	+0.32/–0.34
2100		2000	+0.32/–0.34
2200		2000	+0.32/–0.34
2300		2000	+0.32/–0.34
2400		2000	+0.32/–0.34
2500		2000	+0.32/–0.34
2600		3000	+0.32/–0.34
2700		3000	+0.32/–0.34
2800		3000	+0.32/–0.34
2900		3000	+0.32/–0.34

Table 2-31 AC Coupled Frequency Response, Band0 (250 kHz to 2.9 GHz)

Source Frequency (MHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (MHz)	Measurement Uncertainty (dB)
0.250		0.01	+0.32/–0.34
1		1	+0.32/–0.34
10		10	+0.32/–0.34
20		10	+0.32/–0.34
50		30	+0.32/–0.34
100		100	+0.32/–0.34
200		300	+0.32/–0.34
300		300	+0.32/–0.34
400		300	+0.32/–0.34
500		300	+0.32/–0.34
600		1000	+0.32/–0.34
700		1000	+0.32/–0.34
800		1000	+0.32/–0.34
900		1000	+0.32/–0.34
1000		1000	+0.32/–0.34
1100		1000	+0.32/–0.34
1200		1000	+0.32/–0.34
1300		1000	+0.32/–0.34
1400		1000	+0.32/–0.34
1500		1000	+0.32/–0.34
1600		2000	+0.32/–0.34
1700		2000	+0.32/–0.34
1800		2000	+0.32/–0.34
1900		2000	+0.32/–0.34
2000		2000	+0.32/–0.34
2100		2000	+0.32/–0.34
2200		2000	+0.32/–0.34
2300		2000	+0.32/–0.34
2400		2000	+0.32/–0.34
2500		2000	+0.32/–0.34
2600		3000	+0.32/–0.34
2700		3000	+0.32/–0.34
2800		3000	+0.32/–0.34
2900		3000	+0.32/–0.34

Table 2-32 DC Coupled Frequency Response, Band 1 (2.9 GHz to 6.5 GHz)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
2.95		3.0	+0.44/–0.49
3.05		3.0	+0.44/–0.49
3.15		3.0	+0.44/–0.49
3.25		3.0	+0.44/–0.49
3.35		3.0	+0.44/–0.49
3.45		3.0	+0.44/–0.49
3.55		4.0	+0.44/–0.49
3.65		4.0	+0.44/–0.49
3.75		4.0	+0.44/–0.49
3.85		4.0	+0.44/–0.49
3.95		4.0	+0.44/–0.49
4.05		4.0	+0.44/–0.49
4.15		4.0	+0.44/–0.49
4.25		4.0	+0.44/–0.49
4.35		4.0	+0.44/–0.49
4.45		4.0	+0.44/–0.49
4.55		5.0	+0.44/–0.49
4.65		5.0	+0.44/–0.49
4.75		5.0	+0.44/–0.49
4.85		5.0	+0.44/–0.49
4.95		5.0	+0.44/–0.49
5.05		5.0	+0.44/–0.49
5.15		5.0	+0.44/–0.49
5.25		5.0	+0.44/–0.49
5.35		5.0	+0.44/–0.49
5.45		5.0	+0.44/–0.49
5.55		6.0	+0.44/–0.49
5.65		6.0	+0.44/–0.49
5.75		6.0	+0.44/–0.49
5.85		6.0	+0.44/–0.49
5.95		6.0	+0.44/–0.49
6.05		6.0	+0.44/–0.49
6.15		6.0	+0.44/–0.49
6.25		6.0	+0.44/–0.49
6.35		6.0	+0.44/–0.49
6.45		6.0	+0.44/–0.49

Table 2-32 DC Coupled Frequency Response, Band 1 (2.9 GHz to 6.5 GHz)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
6.50		6.0	+0.44/–0.49

Table 2-33 DC Coupled Frequency Response, Band 2 (6.5 GHz to 13.2 GHz)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
6.5		6.0	+0.45/–0.50 dB
6.7		7.0	+0.45/–0.50 dB
6.9		7.0	+0.45/–0.50 dB
7.1		7.0	+0.45/–0.50 dB
7.3		7.0	+0.45/–0.50 dB
7.5		7.0	+0.45/–0.50 dB
7.7		8.0	+0.45/–0.50 dB
7.9		8.0	+0.45/–0.50 dB
8.1		8.0	+0.45/–0.50 dB
8.3		8.0	+0.45/–0.50 dB
8.5		8.0	+0.45/–0.50 dB
8.7		9.0	+0.45/–0.50 dB
8.9		9.0	+0.45/–0.50 dB
9.1		9.0	+0.45/–0.50 dB
9.3		9.0	+0.45/–0.50 dB
9.5		9.0	+0.45/–0.50 dB
9.7		10.0	+0.45/–0.50 dB
9.9		10.0	+0.45/–0.50 dB
10.1		10.0	+0.45/–0.50 dB
10.3		10.0	+0.45/–0.50 dB
10.5		10.0	+0.45/–0.50 dB
10.7		11.0	+0.45/–0.50 dB
10.9		11.0	+0.45/–0.50 dB
11.1		11.0	+0.45/–0.50 dB
11.3		11.0	+0.45/–0.50 dB
11.5		11.0	+0.45/–0.50 dB
11.7		12.0	+0.45/–0.50 dB
11.9		12.0	+0.45/–0.50 dB

Table 2-33 DC Coupled Frequency Response, Band 2 (6.5 GHz to 13.2 GHz) (Continued)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
12.1		12.0	+0.45/–0.50 dB
12.3		12.0	+0.45/–0.50 dB
12.5		12.0	+0.45/–0.50 dB
12.7		13.0	+0.45/–0.50 dB
12.9		13.0	+0.45/–0.50 dB
13.1		13.0	+0.45/–0.50 dB
13.2		13.0	+0.45/–0.50 dB

Table 2-34 AC Coupled Frequency Response, Band 1 (2.9 GHz to 6.5 GHz)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
2.95		3.0	+0.44/–0.49
3.05		3.0	+0.44/–0.49
3.15		3.0	+0.44/–0.49
3.25		3.0	+0.44/–0.49
3.35		3.0	+0.44/–0.49
3.45		3.0	+0.44/–0.49
3.55		4.0	+0.44/–0.49
3.65		4.0	+0.44/–0.49
3.75		4.0	+0.44/–0.49
3.85		4.0	+0.44/–0.49
3.95		4.0	+0.44/–0.49
4.05		4.0	+0.44/–0.49
4.15		4.0	+0.44/–0.49
4.25		4.0	+0.44/–0.49
4.35		4.0	+0.44/–0.49
4.45		4.0	+0.44/–0.49
4.55		5.0	+0.44/–0.49
4.65		5.0	+0.44/–0.49
4.75		5.0	+0.44/–0.49
4.85		5.0	+0.44/–0.49
4.95		5.0	+0.44/–0.49
5.05		5.0	+0.44/–0.49

Table 2-34 AC Coupled Frequency Response, Band 1 (2.9 GHz to 6.5 GHz) (Continued)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
5.15		5.0	+0.44/–0.49
5.25		5.0	+0.44/–0.49
5.35		5.0	+0.44/–0.49
5.45		5.0	+0.44/–0.49
5.55		6.0	+0.44/–0.49
5.65		6.0	+0.44/–0.49
5.75		6.0	+0.44/–0.49
5.85		6.0	+0.44/–0.49
5.95		6.0	+0.44/–0.49
6.05		6.0	+0.44/–0.49
6.15		6.0	+0.44/–0.49
6.25		6.0	+0.44/–0.49
6.35		6.0	+0.44/–0.49
6.45		6.0	+0.44/–0.49
6.50		6.0	+0.44/–0.49

Table 2-35 AC Coupled Frequency Response, Band 2 (6.5 GHz to 13.2 GHz)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
6.5		6.0	+0.45/–0.50
6.7		7.0	+0.45/–0.50
6.9		7.0	+0.45/–0.50
7.1		7.0	+0.45/–0.50
7.3		7.0	+0.45/–0.50
7.5		7.0	+0.45/–0.50
7.7		8.0	+0.45/–0.50
7.9		8.0	+0.45/–0.50
8.1		8.0	+0.45/–0.50
8.3		8.0	+0.45/–0.50
8.5		8.0	+0.45/–0.50
8.7		9.0	+0.45/–0.50
8.9		9.0	+0.45/–0.50
9.1		9.0	+0.45/–0.50

Table 2-35 AC Coupled Frequency Response, Band 2 (6.5 GHz to 13.2 GHz) (Continued)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
9.3		9.0	+0.45/–0.50
9.5		9.0	+0.45/–0.50
9.7		10.0	+0.45/–0.50
9.9		10.0	+0.45/–0.50
10.1		10.0	+0.45/–0.50
10.3		10.0	+0.45/–0.50
10.5		10.0	+0.45/–0.50
10.7		11.0	+0.45/–0.50
10.9		11.0	+0.45/–0.50
11.1		11.0	+0.45/–0.50
11.3		11.0	+0.45/–0.50
11.5		11.0	+0.45/–0.50
11.7		12.0	+0.45/–0.50
11.9		12.0	+0.45/–0.50
12.1		12.0	+0.45/–0.50
12.3		12.0	+0.45/–0.50
12.5		12.0	+0.45/–0.50
12.7		13.0	+0.45/–0.50
12.9		13.0	+0.45/–0.50
13.1		13.0	+0.45/–0.50
13.2		13.0	+0.45/–0.50

Table 2-36 DC Coupled Frequency Response (<250 kHz)

Function Generator Frequency	ACDVM Amplitude (dBm)	Response Relative to 250 kHz	Response Relative to 300 MHz	Measurement Uncertainty (dB)
250 kHz		0 (Ref)		±0.23
100 kHz				±0.23
10 kHz				±0.23
1 kHz				±0.23
500 Hz				±0.23
200 Hz				±0.23

Table 2-37 Band Switching Uncertainty DC Coupled

	Band 0 Step 115c ________	Band 1 Step 117a ________	Band 2 Step 118a ________
Band 0 Step 115f ________	N/A	________	________
Band 1 Step 117b ________	________	N/A	________
Band 2 Step 118b ________	________	________	N/A

Table 2-38 Band Switching Uncertainty AC Coupled

	Band 0 Step 116c ________	Band 1 Step 119a ________	Band 2 Step 119a ________
Band 0 Step 116f ________	N/A	________	________
Band 1 Step 119b ________	________	N/A	________
Band 2 Step 120b ________	________	________	N/A

39a. Frequency Response: HP 8563E/EC

Instrument Under Test

HP 8563E/EC

Related Specification

Relative Frequency Response
Absolute Frequency Response
Band Switching Uncertainty

Related Adjustment

RYTHM Adjustment
Frequency Response Adjustment
LO Distribution Amplifier Adjustment

Description

For frequencies of 250 kHz and greater the output of a source is fed through a power splitter. One output of the power splitter is fed to a power sensor and then to a measuring receiver. The other output of the power splitter is fed to the spectrum analyzer. The source power level is adjusted at 300 MHz to place the displayed signal at the spectrum analyzer center horizontal graticule line. The measuring receiver, used as a power meter, is placed in ratio mode. At each new source frequency and spectrum analyzer center frequency, the source power level is adjusted to place the signal at the center horizontal graticule line. The measuring receiver displays the inverse of the frequency response relative to the calibrator.

For frequencies below 250 kHz the output of a function generator is fed through a power splitter to an ac digital volt meter (ACDVM) and to the spectrum analyzer. At each function generator frequency setting and spectrum analyzer center frequency setting, the function generator power level is adjusted to place the displayed signal at the spectrum analyzer center horizontal graticule line. The ACDVM is used to measure the function generator output signal level in dBm.

Figure 2-20 Frequency Response Test Setup, 250 kHz to 2.9 GHz

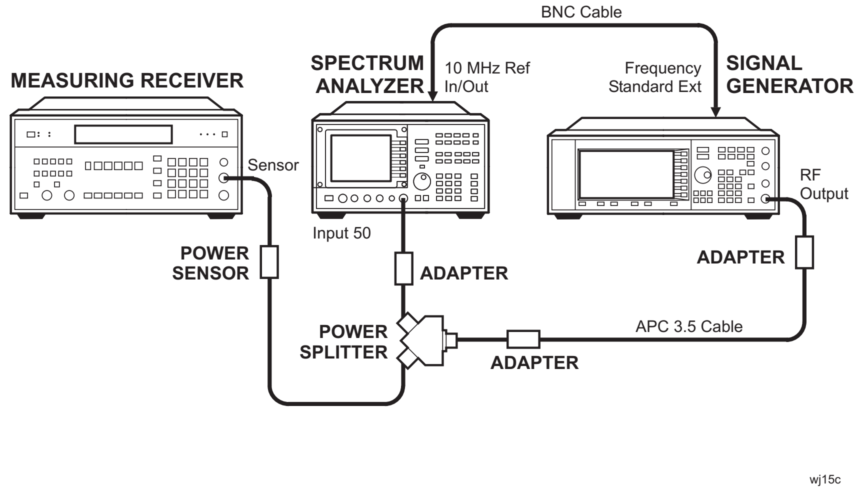


Figure 2-21 Frequency Response Test Setup, 2.9 MHz to 26.5 GHz

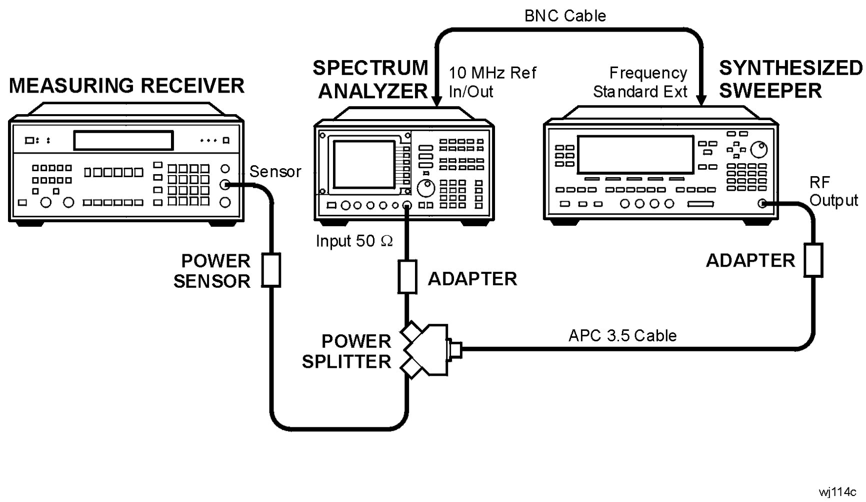
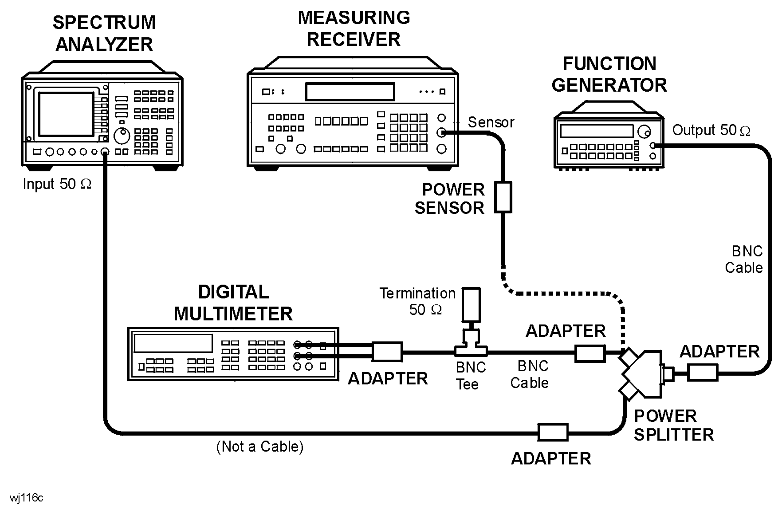


Figure 2-22 Frequency Response Test Setup, ≤250 kHz (Option 006, only)



Equipment

Measuring receiver . . . . HP 8902A

Synthesized sweeper . . . . HP 83640B

Function Generator . . . . HP 3324A or HP 33127A

Signal generator. . . . . HP E4421B

AC Digital Voltmeter . . . . HP 3458A

Power sensor . . . . HP 8482A

Power sensor . . . . HP 8485A

Power splitter . . . . HP 11667A

Power splitter . . . . HP 11667B

Coaxial 50 Ω termination . . . . HP 908A

Adapters

APC-3.5 (f) to 2.4 mm (f) . . . . HP 11901B

Type [N (m) to type N (m) 1250-1475

Type N (m) to BNC (f) *(2 required)* 1250-1476

Type N (m) to APC 3.5 (f) *(2 required)* 1250-1744

Type N (m) to APC 3.5 (m) 1250-1743

BNC (f) to Dual Banana Plug 1251-2816

BNC Tee 1250-0781

Cables

BNC, 122 cm (48 in) *(2 required)*. . . . . HP 10503A

APC-3.5, 91 cm (36 in) 8120-4921

DVM test leads. . . . . HP 34118A

Procedure

1. Zero and calibrate the HP 8902A and the HP 8482A in log mode, as described in the HP 8902A Operation Manual. Enter the power sensor 300 MHz calibration factor into the HP 8902A.
2. Connect the equipment as shown in Figure 2-20.

3. On the HP E4421B, press **INSTR PRESET**. Set the controls as follows:

   CW frequency . . . . 300 MHz

   Frequency increment . . . . 100 MHz

   Amplitude. . . . . –4 dBm

4. On the spectrum analyzer, press **PRESET**. Press **RECALL**, **MORE 1 OF 2,** and **FACTORY PRSEL PK**. Set the controls as follows:

   Center frequency . . . . 300 MHz

   Center frequency step . . . . 100 MHz

   Span . . . . .0 Hz

   Reference level . . . . –5 dBm

   dB/division . . . . .1 dB

   Resolution BW . . . . .30 kHz

5. On the spectrum analyzer, press **MKR**.
6. On the HP E4421B, adjust the power level for a MKR amplitude of –10 dBm ±0.05 dB.
7. Press **RATIO** on the HP 8902A.

Frequency Response, Band 0 (250 kHz to 2.9 GHz)

8. Set the HP E4421B frequency to 250 kHz.
9. On the spectrum analyzer, press **FREQUENCY**, **CENTER FREQ**, 250, and **kHz**.
10. On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
11. Enter the 0.3 MHz power sensor calibration factor, indicated in Table 2-39, into the HP 8902A.
12. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-39. Record the power ratio here exactly as it is displayed on the HP 8902A:

HP 8902A reading at 250 kHz:__________________ dB

13. Set the HP E4421B to 1.0 MHz.
14. On the spectrum analyzer, press **FREQUENCY, CENTER FREQ**, 1.0, and **MHz**.
15. On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.

16. Enter the 1.0 MHz power sensor calibration factor, indicated in Table 2-39, into the HP 8902A.
17. Record the negative of the power ratio displayed on the HP 8902A, as the HP 8902A reading in Table 2-39.
18. On the HP E4421B, set the frequency to the next value listed in Table 2-39.
19. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-39.
20. On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
21. Enter the 0.3 MHz power sensor calibration factor, indicated in Table 2-39, into the HP 8902A.
22. Record the negative of the power ratio displayed on the HP 8902A, as the HP 8902A reading in Table 2-39.
23. To step through the remaining frequencies listed in Table 2-39, repeat step 18 through step 22.

NOTE It will be necessary to enter the last source and spectrum analyzer frequency, 2.9 GHz, manually; the step functions will set the frequency to 2.95 GHz.

Frequency Response, Band 1 (2.9 GHz to 6.5 GHz)

24. Connect the equipment as shown in Figure 2-21.
25. Zero and calibrate the HP 8902A with the HP 8481A.
26. On the spectrum analyzer, press **FREQUENCY,** 2.95, and **GHz**.
27. Set the HP 83640B frequency to 2.95 GHz.
28. On the spectrum analyzer, press **AUX CTRL, INTERNAL MIXER**, and **PRESEL AUTO PK**. Wait for the PEAKING message to disappear.
29. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
30. Enter the 3.0 GHz power sensor calibration factor, indicated in Table 2-40, into the HP 8902A.
31. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-40.
32. On the HP 83640B, set the frequency to the next value listed in Table 2-40.
33. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-40.

34. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
35. Enter the power sensor calibration factor, indicated in Table 2-40, into the HP 8902A.
36. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-40.
37. To step through the remaining frequencies listed in Table 2-40, repeat step 32 through step 36.

Frequency Response, Band 2 (6.5 GHz to 13.2 GHz)

38. On the spectrum analyzer, press **FREQUENCY,** 6.5, **GHz**, **CF STEP**, 200, and **MHz**.
39. Set the HP 83640B frequency to 6.5 GHz and the FREQ STEP to 200 MHz.
40. On the spectrum analyzer, press **AUX CTRL, INTERNAL MIXER**, and **PRESEL AUTO PK**. Wait for the PEAKING message to disappear.
41. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
42. Enter the 6.0 GHz power sensor calibration factor, indicated in Table 2-41, into the HP 8902A.
43. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-41.
44. On the HP 83640B, set the frequency to the next value listed in Table 2-41.
45. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-41.
46. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
47. Enter the power sensor calibration factor, indicated in Table 2-41, into the HP 8902A.
48. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-41.
49. To step through the remaining frequencies listed in Table 2-41, repeat step 44 through step 48
50. On the spectrum analyzer, press **FREQUENCY,** 13.25, **GHz**

NOTE It will be necessary to enter the last source and spectrum analyzer frequency, 13.2 GHz, manually; the step functions will set the frequency to 13.3 GHz.

Frequency Response, Band 3 (13.2 GHz to 26.5 GHz)

51. Set the HP 83640B frequency to 13.25 GHz.
52. On the spectrum analyzer, press **AUX CTRL, INTERNAL MIXER**, and **PRESEL AUTO PK**. Wait for the PEAKING message to disappear.
53. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
54. Enter the 13.3 GHz power sensor calibration factor, indicated in Table 2-42, into the HP 8902A.
55. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-42.
56. On the HP 83640B, set the frequency to the next value listed in Table 2-42.
57. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-42.
58. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
59. Enter the power sensor calibration factor, indicated in Table 2-42, into the HP 8902A.
60. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-42.
61. To step through the remaining frequencies listed in Table 2-42, repeat step 56 through step 60.

Frequency Response (≤250 kHz) (Option 006 Only)

62. On the spectrum analyzer, set the controls as follows:

    Center frequency . . . . .250 kHz

    Span . . . . .100 Hz

    Resolution BW . . . . .10 Hz

    Marker . . . . off

63. On the HP 3324A, set the controls as follows:

    Frequency . . . . .250 kHz

    Amplitude. . . . . –4 dBm

64. On the HP 3458A, set the controls as follows:

    Function . . . . .Sync AC Volts

    Math . . . . .dBm

    RES Register . . . . .50 Ω

    Front/Rear Terminal . . . . .Front

    Resolution . . . . .7.5 digits

65. Connect the equipment as shown in Figure 2-22 with the HP 8482A power sensor and HP 8902A connected to the power splitter.
66. Enter the 0.3 MHz power sensor calibration factor, indicated in Table 2-43, into the HP 8902A.
67. Zero and calibrate the sensor.
68. Adjust the HP 3324A amplitude until the HP 8902A display reads the same value as recorded in step 12.
69. Disconnect the HP 8482A power sensor from the power splitter and connect the HP 3458A.
70. Record the HP 3458A reading here and in Table 2-43:

HP 3458A reading at 250 kHz:_______________ dBm

71. On the spectrum analyzer, press **PEAK SEARCH** and **MARKER DELTA**.
72. Set the spectrum analyzer CENTER FREQ and the HP 3324A frequency to the next frequency listed in Table 2-43.
73. Press **PEAK SEARCH** on the spectrum analyzer.

74. Adjust the HP 3324A amplitude for a Δ MKR amplitude reading of 0.00 dBm ±0.05 dB.
75. Record the HP 3458A amplitude readings in Table 2-43 as the ACDMV amplitude.
76. To step through the remaining frequencies listed in Table 2-36, repeat step 72 through step 75.
77. For each of the frequencies listed in Table 2-43, subtract the ACDVM amplitude reading from the ACDVM amplitude reading at 250 kHz recorded in step 70. Record the results as the response relative to 250 kHz in Table 2-43.
78. Add to each of the response relative to 250 kHz entries in Table 2-43 the HP 8902A reading for 250 kHz listed in Table 2-39. Record the results as the response relative to 300 MHz in Table 2-43.

Test Results

79. Enter the results of the frequency response, Band 0, 250 kHz to 2.9 GHz.

a. Enter the most positive number from Table 2-42, column 4. _______________ dB

b. Enter the most positive number from Table 2-39, column 2. _______________ dB

c. Of (a) and (b), enter whichever number is *more* positive. _______________ dB

d. Enter the most negative number from Table 2-42, column 4. _______________ dB

e. Enter the most negative number from Table 2-39, column 2. _______________ dB

f. Of (c) and (d), enter whichever number is *more* negative. _______________ dB

g. Subtract (f) from (c). _______________ dB

80.Enter the results of the frequency response, Band 1, 2.9 GHz to 6.5 GHz.

a. Enter the most positive number from Table 2-40, column 2. _______________ dB

b. Enter the most negative number from Table 2-40, column 2. _______________ dB

c. Subtract (b) from (a). _______________ dB

81.Enter the results of the frequency response, Band 2, 6.5 GHz to 13.2 GHz.

a. Enter the most positive number from Table 2-41, column 2. _______________ dB

b. Enter the most negative number from Table 2-41, column 2. _______________ dB

c. Subtract (b) from (a). _______________ dB

82.Frequency Response, Band 3, 13.2 GHz to 19.7 GHz

a. Enter the most positive number from Table 2-42, column 2 for center frequencies less than or equal to 22 GHz. _______________ dB

b. Enter the most negative number from Table 2-42, column 2 for center frequencies less than or equal to 22 GHz. _______________ dB

c. Subtract (b) from (a). _______________ dB

83.Frequency Response, Band 3, 19.9 GHz to 26.5 GHz

a. Enter the most positive number from Table 2-42, column 2 for center frequencies greater than 22 GHz. _______________ dB

b. Enter the most negative number from Table 2-42, column 2 for center frequencies greater than 22 GHz. _______________ dB

c. Subtract (b) from (a). _______________ dB

Frequency Response, Band 0, 100 MHz to 2.0 GHz

84. This step applies only to spectrum analyzers with serial number prefix 3645A or later. Enter the results of the frequency response, Band 0, for the frequency range 100 MHz to 2.0 GHz:

a. Enter the most positive number from Table 2-39, column 2, for center frequencies between 100 MHz and 2.0 GHz. _______________ dB

b. Enter the most negative number from Table 2-39, column 2, for center frequencies between 100 MHz and 2.0 GHz. _______________ dB

c. Subtract (b) from (a). _______________ dB

85. Frequency Response, Band 3, 13.2 GHz to 26.5 GHz

a. Enter the most positive number from 53 (a) and 54 (a). _______________ dB

b. Enter the most negative number from 53 (b) and 54 (b). _______________ dB

Band Switching Uncertainty

86. In the top row of Table 2-44, enter the values recorded in the indicated steps. For example, if step 82 (a) has a value of 1.22 dB, enter “1.22 dB” in the top row of the Band 3 column.

87. In the left column of Table 2-44, enter the values recorded in the indicated steps. For example, if step 81 (b) has a value of –0.95 dB, enter “–0.95 dB” in the left column of the Band 2 row.

88. Compute the other entries in Table 2-44 by taking the absolute value of the difference between the values in the left column and the top row.

Table 2-39 Frequency Response, Band 0 (250 kHz to 2.9 GHz)

Source Frequency (MHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (MHz)	Measurement Uncertainty (dB)
0.250		0.01	+0.32/–0.34
1		1	+0.32/–0.34
10		10	+0.32/–0.34
20		10	+0.32/–0.34
50		30	+0.32/–0.34
150		100	+0.32/–0.34
250		300	+0.32/–0.34
350		300	+0.32/–0.34
450		300	+0.32/–0.34
550		300	+0.32/–0.34
650		1000	+0.32/–0.34
750		1000	+0.32/–0.34
850		1000	+0.32/–0.34
950		1000	+0.32/–0.34
1050		1000	+0.32/–0.34
1150		1000	+0.32/–0.34
1250		1000	+0.32/–0.34
1350		1000	+0.32/–0.34
1450		1000	+0.32/–0.34
1550		2000	+0.32/–0.34
1650		2000	+0.32/–0.34
1750		2000	+0.32/–0.34
1850		2000	+0.32/–0.34
1950		2000	+0.32/–0.34
2050		2000	+0.32/–0.34
2150		2000	+0.32/–0.34
2250		2000	+0.32/–0.34
2350		2000	+0.32/–0.34
2450		2000	+0.32/–0.34
2550		3000	+0.32/–0.34
2650		3000	+0.32/–0.34
2750		3000	+0.32/–0.34
2850		3000	+0.32/–0.34
2900		3000	+0.32/–0.34

Table 2-40 Frequency Response, Band 1 (2.9 GHz to 6.5 GHz)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
2.95		3.0	+0.44/–0.49
3.05		3.0	+0.44/–0.49
3.15		3.0	+0.44/–0.49
3.25		3.0	+0.44/–0.49
3.35		3.0	+0.44/–0.49
3.45		3.0	+0.44/–0.49
3.55		4.0	+0.44/–0.49
3.65		4.0	+0.44/–0.49
3.75		4.0	+0.44/–0.49
3.85		4.0	+0.44/–0.49
3.95		4.0	+0.44/–0.49
4.05		4.0	+0.44/–0.49
4.15		4.0	+0.44/–0.49
4.25		4.0	+0.44/–0.49
4.35		4.0	+0.44/–0.49
4.45		4.0	+0.44/–0.49
4.55		5.0	+0.44/–0.49
4.65		5.0	+0.44/–0.49
4.75		5.0	+0.44/–0.49
4.85		5.0	+0.44/–0.49
4.95		5.0	+0.44/–0.49
5.05		5.0	+0.44/–0.49
5.15		5.0	+0.44/–0.49
5.25		5.0	+0.44/–0.49
5.35		5.0	+0.44/–0.49
5.45		5.0	+0.44/–0.49
5.55		6.0	+0.44/–0.49
5.65		6.0	+0.44/–0.49
5.75		6.0	+0.44/–0.49
5.85		6.0	+0.44/–0.49
5.95		6.0	+0.44/–0.49
6.05		6.0	+0.44/–0.49
6.15		6.0	+0.44/–0.49
6.25		6.0	+0.44/–0.49
6.35		6.0	+0.44/–0.49
6.45		6.0	+0.44/–0.49

Table 2-41 Frequency Response, Band 2 (6.5 GHz to 13.2 GHz)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
6.5		6.0	+0.45/–0.50 dB
6.7		7.0	+0.45/–0.50 dB
6.9		7.0	+0.45/–0.50 dB
7.1		7.0	+0.45/–0.50 dB
7.3		7.0	+0.45/–0.50 dB
7.5		7.0	+0.45/–0.50 dB
7.7		8.0	+0.45/–0.50 dB
7.9		8.0	+0.45/–0.50 dB
8.1		8.0	+0.45/–0.50 dB
8.3		8.0	+0.45/–0.50 dB
8.5		8.0	+0.45/–0.50 dB
8.7		9.0	+0.45/–0.50 dB
8.9		9.0	+0.45/–0.50 dB
9.1		9.0	+0.45/–0.50 dB
9.3		9.0	+0.45/–0.50 dB
9.5		9.0	+0.45/–0.50 dB
9.7		10.0	+0.45/–0.50 dB
9.9		10.0	+0.45/–0.50 dB
10.1		10.0	+0.45/–0.50 dB
10.3		10.0	+0.45/–0.50 dB
10.5		10.0	+0.45/–0.50 dB
10.7		11.0	+0.45/–0.50 dB
10.9		11.0	+0.45/–0.50 dB
11.1		11.0	+0.45/–0.50 dB
11.3		11.0	+0.45/–0.50 dB
11.5		11.0	+0.45/–0.50 dB
11.7		12.0	+0.45/–0.50 dB
11.9		12.0	+0.45/–0.50 dB
12.1		12.0	+0.45/–0.50 dB
12.3		12.0	+0.45/–0.50 dB
12.5		12.0	+0.45/–0.50 dB
12.7		13.0	+0.45/–0.50 dB
12.9		13.0	+0.45/–0.50 dB
13.1		13.0	+0.45/–0.50 dB
13.2		13.0	+0.45/–0.50 dB

Table 2-42 Frequency Response, Band 3 (13.2 GHz to 26.5 GHz)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
13.25		13.0	+0.46/–0.51 dB
13.3		13.0	+0.46/–0.51 dB
13.5		13.0	+0.46/–0.51 dB
13.7		14.0	+0.46/–0.51 dB
13.9		14.0	+0.46/–0.51 dB
14.1		14.0	+0.46/–0.51 dB
14.3		14.0	+0.46/–0.51 dB
14.5		14.0	+0.46/–0.51 dB
14.7		15.0	+0.46/–0.51 dB
14.9		15.0	+0.46/–0.51 dB
15.1		15.0	+0.46/–0.51 dB
15.3		15.0	+0.46/–0.51 dB
15.5		15.0	+0.46/–0.51 dB
15.7		16.0	+0.46/–0.51 dB
15.9		16.0	+0.46/–0.51 dB
16.1		16.0	+0.46/–0.51 dB
16.3		16.0	+0.46/–0.51 dB
16.5		16.0	+0.46/–0.51 dB
16.7		17.0	+0.46/–0.51 dB
16.9		17.0	+0.46/–0.51 dB
17.1		17.0	+0.46/–0.51 dB
17.3		17.0	+0.46/–0.51 dB
17.5		17.0	+0.46/–0.51 dB
17.7		18.0	+0.46/–0.51 dB
17.9		18.0	+0.46/–0.51 dB
18.1		18.0	+0.46/–0.51 dB
18.3		18.0	+0.46/–0.51 dB
18.5		18.0	+0.46/–0.51 dB
18.7		19.0	+0.46/–0.51 dB
18.9		19.0	+0.46/–0.51 dB
19.1		19.0	+0.46/–0.51 dB
19.3		19.0	+0.46/–0.51 dB
19.5		19.0	+0.46/–0.51 dB
19.7		20.0	+0.46/–0.51 dB

Table 2-42 Frequency Response, Band 3 (13.2 GHz to 26.5 GHz) (Continued)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
19.9		20.0	+0.51/–0.58
20.1		20.0	+0.51/–0.58
20.3		20.5	+0.51/–0.58
20.5		20.5	+0.51/–0.58
20.7		20.5	+0.51/–0.58
20.9		21.0	+0.51/–0.58
21.1		21.0	+0.51/–0.58
21.3		21.5	+0.51/–0.58
21.5		21.5	+0.51/–0.58
21.7		21.5	+0.51/–0.58
21.9		22.0	+0.51/–0.58
22.1		22.0	+0.51/–0.58
22.3		22.5	+0.51/–0.58
22.5		22.5	+0.51/–0.58
22.7		22.5	+0.51/–0.58
22.9		23.0	+0.51/–0.58
23.1		23.0	+0.51/–0.58
23.3		23.5	+0.51/–0.58
23.5		23.5	+0.51/–0.58
23.7		23.5	+0.51/–0.58
23.9		24.0	+0.51/–0.58
24.1		24.0	+0.51/–0.58
24.3		24.5	+0.51/–0.58
24.5		24.5	+0.51/–0.58
24.7		24.5	+0.51/–0.58
24.9		25.0	+0.51/–0.58
25.1		25.0	+0.51/–0.58
25.3		25.5	+0.51/–0.58
25.5		25.5	+0.51/–0.58
25.7		25.5	+0.51/–0.58
25.9		26.0	+0.51/–0.58
26.1		26.0	+0.51/–0.58
26.3		26.5	+0.51/–0.58
26.5		26.5	+0.51/–0.58

Table 2-43 Frequency Response (<250 kHz) (Option 006 Only)

Function Generator Frequency	ACDVM Amplitude (dBm)	Response Relative to 250 kHz	Response Relative to 300 MHz	Measurement Uncertainty (dB)
250 kHz		0 (Ref)		±0.23
100 kHz				±0.23
10 kHz				±0.23
1 kHz				±0.23
500 Hz				±0.23
200 Hz				±0.23

Table 2-44 Band Switching Uncertainty

	Band 0 Step 79c __________	Band 1 Step 80a __________	Band 2 Step 81a __________	Band 3 <19.8 GHz Step 82a __________	Band 3 >19.8 GHz Step 83a __________
Band 0 Step 79f __________	N/A	__________	__________	__________	__________
Band 1 Step 80b __________	__________	N/A	__________	__________	__________
Band 2 Step 81b __________	__________	__________	N/A	__________	__________
Band 3 <22 GHz Step 82b __________	__________	__________	__________	N/A	__________
Band 3 >22 GHz Step 83b __________	__________	__________	__________	__________	N/A

40a. Frequency Response: HP 8564E/EC

Instrument Under Test

HP 8564E/EC

Related Specification

Relative Frequency Response
Absolute Frequency Response
Band Switching Uncertainty

Related Adjustment

RYTHM Adjustment
Frequency Response Adjustment
LO Distribution Amplifier Adjustment
SBTX Adjustment

Description

For frequencies of 250 kHz and greater the output of a source is fed through a power splitter. One output of the power splitter is fed to a power sensor and then to a measuring receiver. The other output of the power splitter is fed to the spectrum analyzer. The source power level is adjusted at 300 MHz to place the displayed signal at the spectrum analyzer center horizontal graticule line. The measuring receiver, used as a power meter, is placed in ratio mode. At each new source frequency and spectrum analyzer center frequency, the source power level is adjusted to place the signal at the center horizontal graticule line. The measuring receiver displays the inverse of the frequency response relative to the calibrator.

For frequencies below 250 kHz the output of a function generator is fed through a power splitter to an ac digital volt meter (ACDVM) and to the spectrum analyzer. At each function generator frequency setting and spectrum analyzer center frequency setting, the function generator power level is adjusted to place the displayed signal at the spectrum analyzer center horizontal graticule line. The ACDVM is used to measure the function generator output signal level in dBm.

Figure 2-23 Frequency Response Test Setup, 250 kHz to 2.9 GHz

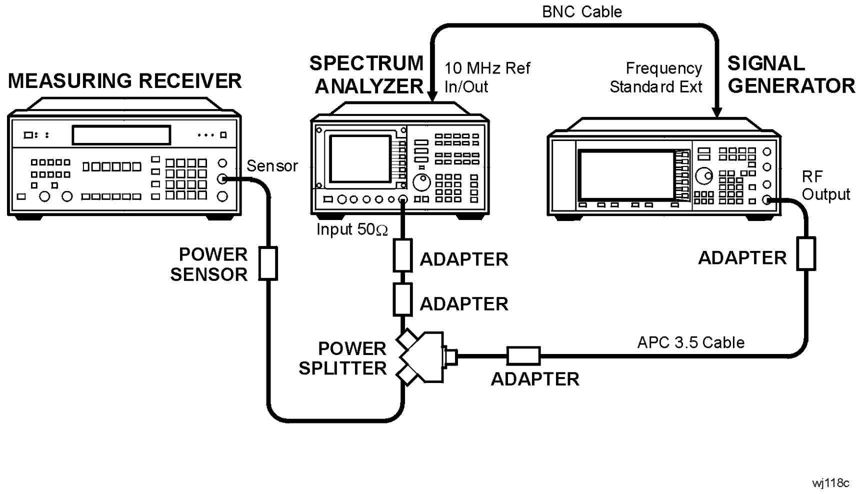


Figure 2-24 Frequency Response Test Setup, 2.9 MHz to 40 GHz

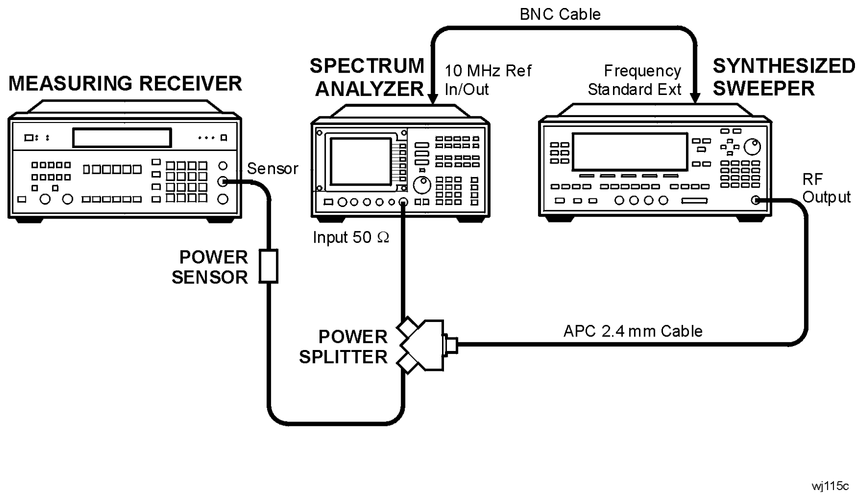
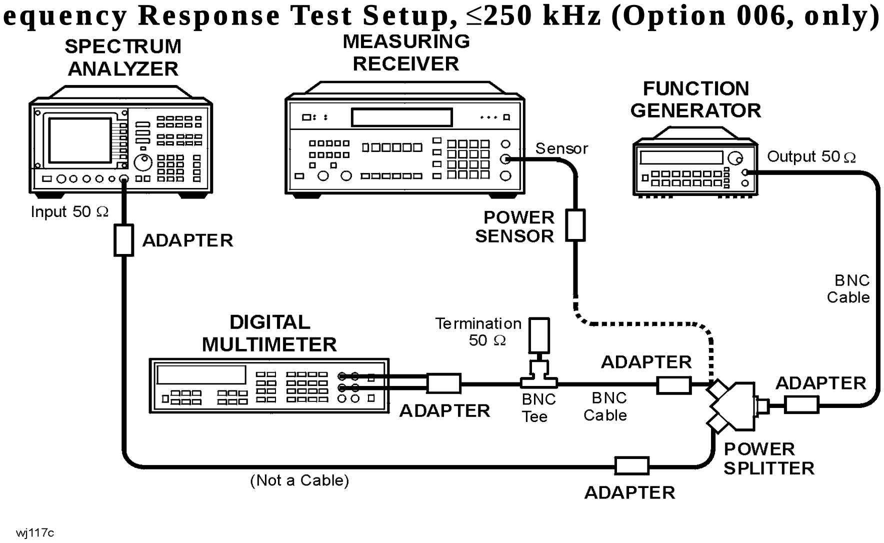


Figure 2-25 Frequency Response Test Setup, ≤250 kHz (Option 006, only)



Equipment

Measuring receiver . . . . HP 8902A
Synthesized sweeper . . . . HP 83640B
Function Generator . . . . HP 3324A or HP 33127A
Signal generator. . . . . HP E4421B
AC Digital Voltmeter . . . . HP 3458A
Power sensor . . . . HP 8482A
Power sensor . . . . HP 8487A
Power splitter . . . . HP 11667A
Power splitter . . . . HP 11667C
Coaxial 50 Ω termination . . . . HP 908A

Adapters

Type N (m) to type N (m). 1250-1475
Type N (m) to BNC (f) *(2 required)* 1250-1476
Type N (m) to APC 3.5 (f) *(2 required)* 1250-1744
Type N (f) to 2.4 mm (f) . . . . HP 11903B
BNC (f) to Dual Banana Plug 1251-2816
BNC Tee 1250-0781

Cables

BNC, 122 cm (48 in) *(2 required)*. . . . . HP 10503A
APC-3.5, 91 cm (36 in) 8120-4921
APC-2.4, 91 cm (36 in) 8120-6164
DVM test leads. . . . . HP 34118A

Procedure

1. Zero and calibrate the HP 8902A and the HP 8482A in log mode, as described in the HP 8902A Operation Manual. Enter the power sensor 300 MHz calibration factor into the HP 8902A.
2. Connect the equipment as shown in Figure 2-23, using the HP 11667A power splitter.
3. On the HP E4421B, press **INSTR PRESET**. Set the controls as follows:

   CW frequency . . . . 300 MHz

   Frequency increment . . . . 100 MHz

   Amplitude. . . . . –4 dBm
4. On the spectrum analyzer, press **PRESET**. Press **RECALL**, **MORE 1 OF 2,** and **FACTORY PRSEL PK**. Set the controls as follows:

   Center frequency . . . . 300 MHz

   Center frequency step . . . . 100 MHz

   Span . . . . .0 Hz

   Reference level . . . . –5 dBm

   dB/division . . . . .1 dB

   Resolution BW . . . . .30 kHz
5. On the spectrum analyzer, press **MKR**.
6. On the HP E4421B, adjust the power level for a MKR amplitude of –10 dBm ±0.05 dB.
7. Press **RATIO** on the HP 8902A.

Frequency Response, Band 0 (250 kHz to 2.9 GHz)

8. Set the HP E4421B frequency to 250 kHz.
9. On the spectrum analyzer, press **FREQUENCY**, **CENTER FREQ**, 250, and **kHz**.
10. On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
11. Enter the 0.3 MHz power sensor calibration factor, indicated in Table 2-45, into the HP 8902A.
12. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-45. Record the power ratio here exactly as it is displayed on the HP 8902A:

HP 8902A reading at 250 kHz:__________________ dB

13.Set the HP E4421B to 1.0 MHz.

14.On the spectrum analyzer, press **FREQUENCY, CENTER FREQ**, 1.0, and **MHz**.

15.On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.

16.Enter the 1.0 MHz power sensor calibration factor, indicated in Table 2-45, into the HP 8902A.

17.Record the negative of the power ratio displayed on the HP 8902A, as the HP 8902A reading in Table 2-45.

18.On the HP E4421B, set the frequency to the next value listed in Table 2-45.

19.On the spectrum analyzer, set the center frequency to the next value listed in Table 2-45.

20.On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.

21.Enter the power sensor calibration factor, indicated in Table 2-45, into the HP 8902A.

22.Record the negative of the power ratio displayed on the HP 8902A, as the HP 8902A reading in Table 2-45.

23.To step through the remaining frequencies listed in Table 2-45, repeat step 18 through step 22.

NOTE It will be necessary to enter the last source and spectrum analyzer frequency, 2.9 GHz, manually; the step functions will set the frequency to 2.95 GHz.

Frequency Response, Band 1 (2.9 GHz to 6.5 GHz)

24.Connect the equipment as shown in Figure 2-24, using the HP 11667C power splitter.

25.Zero and calibrate the HP 8902A with the HP 8487A. Enter the power sensor 0.3 MHz calibration factor into the HP 8902A.

26.On the spectrum analyzer, press **FREQUENCY,** 2.95, and **GHz**.

27.Set the HP 83640B frequency to 2.95 GHz.

28.On the spectrum analyzer, press **AUX CTRL, INTERNAL MIXER**, and **PRESEL AUTO PK**. Wait for the `PEAKING` message to disappear.

29.On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.

30.Enter the 3.0 GHz power sensor calibration factor, indicated in Table 2-46, into the HP 8902A.

31.Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-46.

32.On the HP 83640B, set the frequency to the next value listed in Table 2-46.

33. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-46.
34. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
35. Enter the power sensor calibration factor, indicated in Table 2-46, into the HP 8902A.
36. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-46.
37. To step through the remaining frequencies listed in Table 2-46, repeat step 32 through step 36.

Frequency Response, Band 2 (6.5 GHz to 13.2 GHz)

38. On the spectrum analyzer, press **FREQUENCY,** 6.5, **GHz**, **CF STEP**, 200, and **MHz**.
39. Set the HP 83640B frequency to 6.5 GHz and the FREQ STEP to 200 MHz.
40. On the spectrum analyzer, press **AUX CTRL, INTERNAL MIXER**, and **PRESEL AUTO PK**. Wait for the PEAKING message to disappear.
41. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
42. Enter the 6.0 GHz power sensor calibration factor, indicated in Table 2-47, into the HP 8902A.
43. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-47.
44. On the HP 83640B, set the frequency to the next value listed in Table 2-47.
45. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-47.
46. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
47. Enter the power sensor calibration factor, indicated in Table 2-47, into the HP 8902A.
48. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-47.

49. To step through the remaining frequencies listed in Table 2-47, repeat step 44 through step 48.

NOTE It will be necessary to enter the last source and spectrum analyzer frequency, 13.2 GHz, manually; the step functions will set the frequency to 13.3 GHz.

Frequency Response, Band 3 (13.2 GHz to 26.5 GHz)

50. On the spectrum analyzer, press **FREQUENCY,** 13.25, **GHz**.
51. Set the HP 83640B frequency to 13.25 GHz.
52. On the spectrum analyzer, press **AUX CTRL, INTERNAL MIXER**, and **PRESEL AUTO PK**. Wait for the PEAKING message to disappear.
53. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
54. Enter the 14.0 GHz power sensor calibration factor, indicated in Table 2-48, into the HP 8902A.
55. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-48.
56. On the HP 83640B, set the frequency to the next value listed in Table 2-48.
57. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-48.
58. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
59. Enter the power sensor calibration factor, indicated in Table 2-48, into the HP 8902A.
60. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-48.
61. To step through the remaining frequencies listed in Table 2-48, repeat step 56 through step 60.

Frequency Response, Band 4 (26.9 GHz to 31.1 GHz)

62. On the spectrum analyzer, press **FREQUENCY,** 26.9, **GHz**.
63. Set the HP 83640B frequency to 26.9 GHz.
64. On the spectrum analyzer, press **AUX CTRL, INTERNAL MIXER**, and **PRESEL AUTO PK**. Wait for the PEAKING message to disappear.
65. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
66. Enter the 27.0 GHz power sensor calibration factor, indicated in Table 2-49, into the HP 8902A.
67. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-49.
68. On the HP 83640B, set the frequency to the next value listed in Table 2-49.
69. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-49.
70. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
71. Enter the power sensor calibration factor, indicated in Table 2-49, into the HP 8902A.
72. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-49.
73. To step through the remaining frequencies listed in Table 2-49, repeat step 68 through step 72.

Frequency Response, Band 5 (31.2 GHz to 40.0 GHz)

74. On the spectrum analyzer, press **FREQUENCY,** 31.2, **GHz**.
75. Set the HP 83640B frequency to 31.2 GHz.
76. On the spectrum analyzer, press **AUX CTRL, INTERNAL MIXER**, and **PRESEL AUTO PK**. Wait for the PEAKING message to disappear.
77. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
78. Enter the 31.0 GHz power sensor calibration factor, indicated in Table 2-50, into the HP 8902A.
79. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-50.

80. On the HP 83640B, set the frequency to the next value listed in Table 2-50.
81. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-50.
82. On the HP 83640B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
83. Enter the power sensor calibration factor, indicated in Table 2-50, into the HP 8902A.
84. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-50.
85. To step through the remaining frequencies listed in Table 2-50, repeat step 80 through step 84.

Frequency Response (≤250 kHz) (Option 006 Only)

86. On the spectrum analyzer, set the controls as follows:

    Center frequency . . . . 250 kHz

    Span . . . . 100 Hz

    Resolution BW. . . . . 10 Hz

    Marker . . . . off

87. On the HP 3324A, set the controls as follows:

    Frequency . . . . 250 kHz

    Amplitude . . . . –4 dBm

    Amplitude increment . . . . .0.01 dB

88. On the HP 3458A, set the controls as follows:

    Function. . . . . Sync AC Volts

    Math. . . . . dBm

    RES Register . . . . 50 Ω

    Front/Rear Terminal. . . . . Front

    Resolution . . . . 7.5 digits

89.Connect the equipment as shown in Figure 2-25 with the HP 8482A power sensor and HP 8902A connected to the HP 11667A power splitter.

90.Enter the power sensor calibration factor for 0.1 MHz into the HP 8902A.

91.Zero and calibrate the sensor.

92.Adjust the HP 3324A amplitude until the HP 8902A display reads the same value as recorded in step 12.

93.Disconnect the HP 8482A power sensor from the power splitter and connect the HP 3458A.

94.Record the HP 3458A reading here and in Table 2-51:

HP 3458A reading at 250 kHz:_______________ dBm

95.On the spectrum analyzer, press **PEAK SEARCH** and **MARKER DELTA**.

96.Set the spectrum analyzer CENTER FREQ and the HP 3324A frequency to the next frequency listed in Table 2-51.

97.Press **PEAK SEARCH** on the spectrum analyzer.

98.Adjust the HP 3324A amplitude for a Δ MKR amplitude reading of 0.00 dBm ±0.05 dB.

99.Record the HP 3458A amplitude readings in Table 2-51 as the ACDMV amplitude.

100.To step through the remaining frequencies listed in Table 2-51, repeat step 96 through step 99.

101.For each of the frequencies listed in Table 2-51, subtract the “ACDVM amplitude” reading from the ACDVM reading at 250 kHz recorded in step 94. Record the results as the“ response relative to 250 kHz” in Table 2-51.

102.Add to each of the “response relative to 250 kHz” entries in Table 2-51 the “HP 8902A reading” for 250 kHz listed in Table 2-45. Record the results as the response relative to 300 MHz in Table 2-51.

Test Results

103. Frequency Response, Band 0 – 250 kHz to 2.9 GHz.

a. Enter the most positive number from Table 2-51, column 4. _______________ dB

b. Enter the most positive number from Table 2-45, column 2. _______________ dB

c. Of (a) and (b), enter whichever number is *more* positive. _______________ dB

d. Enter the most negative number from Table 2-51, column 4. _______________ dB

e. Enter the most negative number from Table 2-45, column 2. _______________ dB

f. Of (d) and (e), enter whichever number is *more* negative. _______________ dB

g. Subtract (f) from (c). _______________ dB

104. Frequency Response, Band 1 – 2.9 GHz to 6.5 GHz.

a. Enter the most positive number from Table 2-46, column 2. _______________ dB

b. Enter the most negative number from Table 2-46, column 2. _______________ dB

c. Subtract (b) from (a). _______________ dB

105. Frequency Response, Band 2 – 6.5 GHz to 13.2 GHz.

a. Enter the most positive number from Table 2-47, column 2. _______________ dB

b. Enter the most negative number from Table 2-47, column 2. _______________ dB

c. Subtract (b) from (a). _______________ dB

106.Frequency Response, Band 3 – 13.2 GHz to 20.2 GHz

a. Enter the most positive number from Table 2-48, column 2 for center frequencies less than or equal to 22 GHz. _______________ dB

b. Enter the most negative number from Table 2-48, column 2 for center frequencies less than or equal to 22 GHz. _______________ dB

c. Subtract (b) from (a). _______________ dB

107.Frequency Response, Band 3 – 22 GHz to 26.8 GHz

a. Enter the most positive number from Table 2-48, column 2 for center frequencies greater than 22 GHz. _______________ dB

b. Enter the most negative number from Table 2-48, column 2 for center frequencies greater than 22 GHz. _______________ dB

c. Subtract (b) from (a). _______________ dB

108.Frequency Response, Band 3 – 13.2 GHz to 26.8 GHz

109.a. Enter the most positive number from step 106 (a) and step 107 (a). _______________ dB

110.b. Enter the most negative number from step 106 (b) and step 107 (b). _______________ dB

111.Frequency Response, Band 4 – 26.9 GHz to 31.1 GHz.

a. Enter the most positive number from Table 2-49, column 2. _______________ dB

b. Enter the most negative number from Table 2-49, column 2. _______________ dB

c. Subtract (b) from (a). _______________ dB

112.Frequency Response, Band 5 – 31.2 GHz to 40 GHz.

a. Enter the most positive number from Table 2-50, column 2. _______________ dB

b. Enter the most negative number from Table 2-50, column 2. _______________ dB

c. Subtract (b) from (a). _______________ dB

Frequency Response, Band 0, 100 MHz to 2.0 GHz

113. This step applies only to spectrum analyzers with serial number prefix 3641A or later. Enter the results of the frequency response, Band 0, for the frequency range 100 MHz to 2.0 GHz:

a. Enter the most positive number from Table 2-45, column 2, for center frequencies between 100 MHz and 2.0 GHz. _______________ dB

b. Enter the most negative number from Table 2-45, column 2, for center frequencies between 100 MHz and 2.0 GHz. _______________ dB

c. Subtract (b) from (a). _______________ dB

Band Switching Uncertainty

114. In the top row of Table 2-52, enter the values recorded in the indicated steps. For example, if step 106 (a) has a value of 1.22 dB, enter “1.22 dB” in the top row of the Band 3 column.

115. In the left column of Table 2-52, enter the values recorded in the indicated steps. For example, if step 105 (b) has a value of –0.95 dB, enter “–0.95 dB” in the left column of the Band 2 row.

116. Compute the other entries in Table 2-52 by taking the absolute value of the difference between the values in the left column and the top row.

Table 2-45 Frequency Response, Band 0 (250 kHz to 2.9 GHz)

Source Frequency (MHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (MHz)	Measurement Uncertainty (dB)
0.250		0.01	+0.32/–0.34
1		1	+0.32/–0.34
10		10	+0.32/–0.34
20		10	+0.32/–0.34
50		30	+0.32/–0.34
150		100	+0.32/–0.34
250		300	+0.32/–0.34
350		300	+0.32/–0.34
450		300	+0.32/–0.34
550		300	+0.32/–0.34
650		1000	+0.32/–0.34
750		1000	+0.32/–0.34
850		1000	+0.32/–0.34
950		1000	+0.32/–0.34
1050		1000	+0.32/–0.34
1150		1000	+0.32/–0.34
1250		1000	+0.32/–0.34
1350		1000	+0.32/–0.34
1450		1000	+0.32/–0.34
1550		2000	+0.32/–0.34
1650		2000	+0.32/–0.34
1750		2000	+0.32/–0.34
1850		2000	+0.32/–0.34
1950		2000	+0.32/–0.34
2050		2000	+0.32/–0.34
2150		2000	+0.32/–0.34
2250		2000	+0.32/–0.34
2350		2000	+0.32/–0.34
2450		2000	+0.32/–0.34
2550		3000	+0.32/–0.34
2650		3000	+0.32/–0.34
2750		3000	+0.32/–0.34
2850		3000	+0.32/–0.34
2900		3000	+0.32/–0.34

Table 2-46 Frequency Response, Band 1 (2.9 GHz to 6.5 GHz)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
2.95		3.0	+0.44/–0.49
3.05		3.0	+0.44/–0.49
3.15		3.0	+0.44/–0.49
3.25		3.0	+0.44/–0.49
3.35		3.0	+0.44/–0.49
3.45		3.0	+0.44/–0.49
3.55		4.0	+0.44/–0.49
3.65		4.0	+0.44/–0.49
3.75		4.0	+0.44/–0.49
3.85		4.0	+0.44/–0.49
3.95		4.0	+0.44/–0.49
4.05		4.0	+0.44/–0.49
4.15		4.0	+0.44/–0.49
4.25		4.0	+0.44/–0.49
4.35		4.0	+0.44/–0.49
4.45		4.0	+0.44/–0.49
4.55		5.0	+0.44/–0.49
4.65		5.0	+0.44/–0.49
4.75		5.0	+0.44/–0.49
4.85		5.0	+0.44/–0.49
4.95		5.0	+0.44/–0.49
5.05		5.0	+0.44/–0.49
5.15		5.0	+0.44/–0.49
5.25		5.0	+0.44/–0.49
5.35		5.0	+0.44/–0.49
5.45		5.0	+0.44/–0.49
5.55		6.0	+0.44/–0.49
5.65		6.0	+0.44/–0.49
5.75		6.0	+0.44/–0.49
5.85		6.0	+0.44/–0.49
5.95		6.0	+0.44/–0.49
6.05		6.0	+0.44/–0.49
6.15		6.0	+0.44/–0.49
6.25		6.0	+0.44/–0.49
6.35		6.0	+0.44/–0.49
6.45		6.0	+0.44/–0.49

Table 2-47 Frequency Response, Band 2 (6.5 GHz to 13.2 GHz)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
6.5		6.0	+0.45/–0.50 dB
6.7		7.0	+0.45/–0.50 dB
6.9		7.0	+0.45/–0.50 dB
7.1		7.0	+0.45/–0.50 dB
7.3		7.0	+0.45/–0.50 dB
7.5		7.0	+0.45/–0.50 dB
7.7		8.0	+0.45/–0.50 dB
7.9		8.0	+0.45/–0.50 dB
8.1		8.0	+0.45/–0.50 dB
8.3		8.0	+0.45/–0.50 dB
8.5		8.0	+0.45/–0.50 dB
8.7		9.0	+0.45/–0.50 dB
8.9		9.0	+0.45/–0.50 dB
9.1		9.0	+0.45/–0.50 dB
9.3		9.0	+0.45/–0.50 dB
9.5		9.0	+0.45/–0.50 dB
9.7		10.0	+0.45/–0.50 dB
9.9		10.0	+0.45/–0.50 dB
10.1		10.0	+0.45/–0.50 dB
10.3		10.0	+0.45/–0.50 dB
10.5		10.0	+0.45/–0.50 dB
10.7		11.0	+0.45/–0.50 dB
10.9		11.0	+0.45/–0.50 dB
11.1		11.0	+0.45/–0.50 dB
11.3		11.0	+0.45/–0.50 dB
11.5		11.0	+0.45/–0.50 dB
11.7		12.0	+0.45/–0.50 dB
11.9		12.0	+0.45/–0.50 dB
12.1		12.0	+0.45/–0.50 dB
12.3		12.0	+0.45/–0.50 dB
12.5		12.0	+0.45/–0.50 dB
12.7		13.0	+0.45/–0.50 dB
12.9		13.0	+0.45/–0.50 dB
13.1		13.0	+0.45/–0.50 dB
13.2		13.0	+0.45/–0.50 dB

Table 2-48 Frequency Response, Band 3(13.2 GHz to 26.8 GHz)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
13.25		14.0	+0.53/–0.60
13.4		14.0	+0.53/–0.60
13.6		14.0	+0.53/–0.60
13.8		14.0	+0.53/–0.60
14.0		14.0	+0.53/–0.60
14.2		14.0	+0.53/–0.60
14.4		14.0	+0.53/–0.60
14.6		14.0	+0.53/–0.60
14.8		14.0	+0.53/–0.60
15.0		14.0	+0.53/–0.60
15.2		16.0	+0.53/–0.60
15.4		16.0	+0.53/–0.60
15.6		16.0	+0.53/–0.60
15.8		16.0	+0.53/–0.60
16.0		16.0	+0.53/–0.60
16.2		16.0	+0.53/–0.60
16.4		16.0	+0.53/–0.60
16.6		16.0	+0.53/–0.60
16.8		16.0	+0.53/–0.60
17.0		16.0	+0.53/–0.60
17.2		18.0	+0.53/–0.60
17.4		18.0	+0.53/–0.60
17.6		18.0	+0.53/–0.60
17.8		18.0	+0.53/–0.60
18.0		18.0	+0.53/–0.60
18.2		18.0	+0.53/–0.60
18.4		18.0	+0.53/–0.60
18.6		18.0	+0.53/–0.60
18.8		18.0	+0.53/–0.60
19.0		18.0	+0.53/–0.60
19.2		20.0	+0.53/–0.60
19.4		20.0	+0.53/–0.60
19.6		20.0	+0.53/–0.60
19.8		20.0	+0.53/–0.60
20.0		20.0	+0.53/–0.60

Table 2-48 Frequency Response, Band 3(13.2 GHz to 26.8 GHz) (Continued)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
20.2		20.0	+0.53/–0.60
20.4		20.0	+0.53/–0.60
20.6		20.0	+0.53/–0.60
20.8		20.0	+0.53/–0.60
21.0		20.0	+0.53/–0.60
21.2		21.0	+0.53/–0.60
21.4		21.0	+0.53/–0.60
21.6		21.0	+0.53/–0.60
21.8		21.0	+0.53/–0.60
22.0		22.0	+0.53/–0.60
22.2		22.0	+0.53/–0.60
22.4		22.0	+0.53/–0.60
22.6		22.0	+0.53/–0.60
22.8		22.0	+0.53/–0.60
23.0		22.0	+0.53/–0.60
23.2		24.0	+0.53/–0.60
23.4		24.0	+0.53/–0.60
23.6		24.0	+0.53/–0.60
23.8		24.0	+0.53/–0.60
24.0		24.0	+0.53/–0.60
24.2		24.0	+0.53/–0.60
24.4		24.0	+0.53/–0.60
24.6		24.0	+0.53/–0.60
24.8		24.0	+0.53/–0.60
25.0		24.0	+0.53/–0.60
25.2		26.0	+0.53/–0.60
25.4		26.0	+0.53/–0.60
25.6		26.0	+0.53/–0.60
25.8		26.0	+0.53/–0.60
26.0		26.0	+0.53/–0.60
26.2		26.0	+0.53/–0.60
26.4		26.5	+0.53/–0.60
26.6		26.5	+0.53/–0.60
26.8		27.0	+0.53/–0.60

Table 2-49 Frequency Response, Band 4 (26.9 GHz to 31.1 GHz)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
26.9		27.0	+0.74/–0.89
27.2		27.0	+0.74/–0.89
27.5		28.0	+0.74/–0.89
27.8		28.0	+0.74/–0.89
28.1		28.0	+0.74/–0.89
28.4		28.0	+0.74/–0.89
28.7		29.0	+0.74/–0.89
29.0		29.0	+0.74/–0.89
29.3		29.0	+0.74/–0.89
29.6		30.0	+0.74/–0.89
29.9		30.0	+0.74/–0.89
30.2		30.0	+0.74/–0.89
30.5		31.0	+0.74/–0.89
30.8		31.0	+0.74/–0.89
31.1		31.0	+0.74/–0.89

Table 2-50 Frequency Response, Band 5 (31.2 GHz to 40.0 GHz)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
31.2		31.0	+0.74/–0.89
31.6		32.0	+0.74/–0.89
32.0		32.0	+0.74/–0.89
32.4		32.0	+0.74/–0.89
32.8		33.0	+0.74/–0.89
33.2		33.0	+0.74/–0.89
33.6		34.0	+0.74/–0.89
34.0		34.0	+0.74/–0.89
34.4		34.0	+0.74/–0.89
34.8		35.0	+0.74/–0.89
35.2		35.0	+0.74/–0.89
35.6		36.0	+0.74/–0.89
36.0		36.0	+0.74/–0.89
36.4		36.0	+0.74/–0.89
36.8		37.0	+0.74/–0.89
37.2		37.0	+0.74/–0.89
37.6		38.0	+0.74/–0.89
38.0		38.0	+0.74/–0.89
38.4		38.0	+0.74/–0.89
38.8		39.0	+0.74/–0.89
39.2		39.0	+0.74/–0.89
39.6		40.0	+0.74/–0.89
40.0		40.0	+0.74/–0.89

Table 2-51 Frequency Response (<250 kHz) (Option 006 Only)

Function Generator Frequency	ACDVM Amplitude (dBm)	Response Relative to 250 kHz	Response Relative to 300 MHz	Measurement Uncertainty (dB)
250 kHz		0 (Ref)		±0.23
100 kHz				±0.23
10 kHz				±0.23
1 kHz				±0.23
500 Hz				±0.23
200 Hz				±0.23

Table 2-52 Band Switching Uncertainty

	Band 0 Step 103c ________	Band 1 Step 104a ________	Band 2 Step 105a ________	Band 3 <22 GHz Step 106a ________	Band 3 >22 GHz Step 107a ________	Band 4 Step 111a ________	Band 5 Step 112a ________
Band 0 Step 103f ________	N/A	________	________	________	________	________	________
Band 1 Step 104b ________	________	N/A	________	________	________	________	________
Band 2 Step 105b ________	________	________	N/A	________	________	________	________
Band 3 <22 GHz Step 106b ________	________	________	________	N/A	________	________	________
Band 3 >22 GHz Step 107b ________	________	________	________	________	N/A	________	________
Band 4 Step 111b ________	________	________	________	________	________	N/A	________
Band 5 Step 112b ________	________	________	________	________	________	________	N/A

41a. Frequency Response: HP 8565E/EC

Instrument Under Test

HP 8565E/EC

Related Specification

Relative Frequency Response
Absolute Frequency Response
Band Switching Uncertainty

Related Adjustment

RYTHM Adjustment
Frequency Response Adjustment
LO Distribution Amplifier Adjustment
SBTX Adjustment

Description

For frequencies of 250 kHz and greater the output of a source is fed through a power splitter. One output of the power splitter is fed to a power sensor and then to a measuring receiver. The other output of the power splitter is fed to the spectrum analyzer. The source power level is adjusted at 300 MHz to place the displayed signal at the spectrum analyzer center horizontal graticule line. The measuring receiver, used as a power meter, is placed in ratio mode. At each new source frequency and spectrum analyzer center frequency, the source power level is adjusted to place the signal at the center horizontal graticule line. The measuring receiver displays the inverse of the frequency response relative to the calibrator.

For frequencies below 250 kHz the output of a function generator is fed through a power splitter to an ac digital volt meter (ACDVM) and to the spectrum analyzer. At each function generator frequency setting and spectrum analyzer center frequency setting, the function generator power level is adjusted to place the displayed signal at the spectrum analyzer center horizontal graticule line. The ACDVM is used to measure the function generator output signal level in dBm.

Figure 2-26 Frequency Response Test Setup, 250 kHz to 2.9 GHz

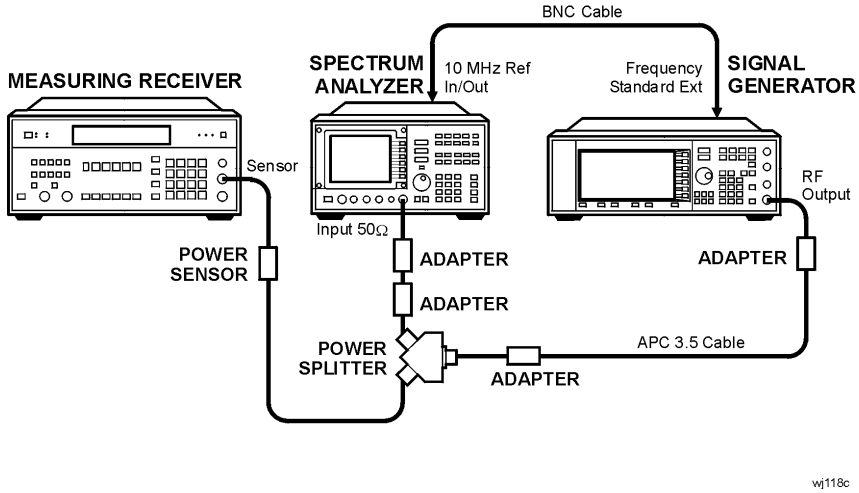


Figure 2-27 Frequency Response Test Setup, 2.9 MHz to 50 GHz

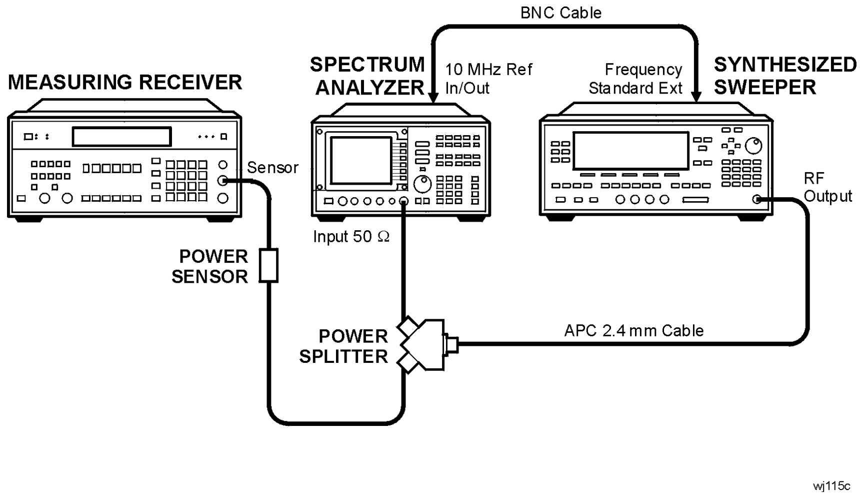
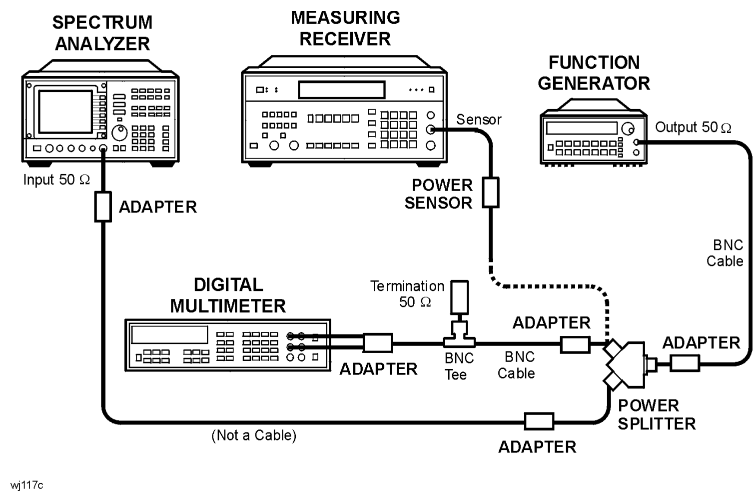


Figure 2-28 Frequency Response Test Setup, ≤250 kHz (Option 006, only)



Equipment

Measuring receiver . . . . HP 8902A
Synthesized sweeper . . . . HP 83650B
Function Generator . . . . HP 3324A or HP 33127A
Signal generator. . . . . .HP E4421B
AC Digital Voltmeter . . . . HP 3458A
Power sensor . . . . HP 8482A
Power sensor . . . . HP 8487A
Power splitter . . . . HP 11667A
Power splitter . . . . HP 11667C
Coaxial 50 Ω termination . . . . HP 908A

Adapters

Type N (m) to type N (m). 1250-1475
Type N (m) to BNC (f) *(2 required)* 1250-1476
Type N (m) to APC 3.5 (f) *(2 required)* 1250-1744
Type N (f) to 2.4 mm (f) . . . . HP 11903B
BNC (f) to Dual Banana Plug 1251-2816
BNC Tee 1250-0781

Cables

BNC, 122 cm (48 in) *(2 required)*. . . . . HP 10503A
APC-3.5, 91 cm (36 in) 8120-4921
2.4 mm, 91 cm (36 in) 8120-6164
DVM test leads. . . . . HP 34118A

Procedure

1. Zero and calibrate the HP 8902A and the HP 8482A in log mode, as described in the HP 8902A Operation Manual. Enter the power sensor 300 MHz calibration factor into the HP 8902A.
2. Connect the equipment as shown in Figure 2-26, using the HP 11667A power splitter.
3. On the HP E4421B, press **INSTR PRESET**. Set the controls as follows:

   CW frequency . . . . 300 MHz

   Frequency increment . . . . 100 MHz

   Amplitude. . . . . −4 dBm
4. On the spectrum analyzer, press **PRESET**. Press **RECALL**, **MORE 1 OF 2,** and **FACTORY PRSEL PK**. Set the controls as follows:

   Center frequency . . . . 300 MHz

   Center frequency step . . . . 100 MHz

   Span . . . . .0 Hz

   Reference level . . . . −5 dBm

   dB/division . . . . .1 dB

   Resolution BW . . . . .30 kHz
5. On the spectrum analyzer, press **MKR**.
6. On the HP E4421B, adjust the power level for a MKR amplitude of −10 dBm ±0.05 dB.
7. Press **RATIO** on the HP 8902A.

Frequency Response, Band 0 (250 kHz to 2.9 GHz)

8. Set the HP E4421B frequency to 250 kHz.
9. On the spectrum analyzer, press **FREQUENCY**, **CENTER FREQ**, 250, and **kHz**.
10. On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of −10 dBm ±0.05 dB.
11. Enter the 0.3 MHz power sensor calibration factor, indicated in Table 2-53, into the HP 8902A.
12. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-53. Record the power ratio here exactly as it is displayed on the HP 8902A:

HP 8902A reading at 250 kHz:__________________ dB

13.Set the HP E4421B to 1.0 MHz.

14.On the spectrum analyzer, press **FREQUENCY, CENTER FREQ**, 1.0, and **MHz**.

15.On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.

16.Enter the 1.0 MHz power sensor calibration factor, indicated in Table 2-53, into the HP 8902A.

17.Record the negative of the power ratio displayed on the HP 8902A, as the HP 8902A reading in Table 2-53.

18.On the HP E4421B, set the frequency to the next value listed in Table 2-53.

19.On the spectrum analyzer, set the center frequency to the next value listed in Table 2-53.

20.On the HP E4421B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.

21.Enter the power sensor calibration factor, indicated in Table 2-53, into the HP 8902A.

22.Record the negative of the power ratio displayed on the HP 8902A, as the HP 8902A reading in Table 2-53.

23.To step through the remaining frequencies listed in Table 2-53, repeat step 18 through step 22.

NOTE It will be necessary to enter the last source and spectrum analyzer frequency, 2.9 GHz, manually; the step functions will set the frequency to 2.95 GHz.

Frequency Response, Band 1 (2.9 GHz to 6.5 GHz)

24.Connect the equipment as shown in Figure 2-27, using the HP 11667C power splitter.

25.Zero and calibrate the HP 8902A with the HP 8487A.

26.On the spectrum analyzer, press **FREQUENCY,** 2.95, and **GHz**.

27.Set the HP 83650B frequency to 2.95 GHz.

28.On the spectrum analyzer, press **AUX CTRL, INTERNAL MIXER**, and **PRESEL AUTO PK**. Wait for the PEAKING message to disappear.

29.On the HP 83650B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.

30.Enter the 2.0 GHz power sensor calibration factor, indicated in Table 2-54, into the HP 8902A.

31.Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-54.

32. On the HP 83650B, set the frequency to the next value listed in Table 2-54.
33. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-54.
34. On the HP 83650B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
35. Enter the power sensor calibration factor, indicated in Table 2-54, into the HP 8902A.
36. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-54.
37. To step through the remaining frequencies listed in Table 2-54, repeat step 32 through step 36.

Frequency Response, Band 2 (6.5 GHz to 13.2 GHz)

38. On the spectrum analyzer, press **FREQUENCY,** 6.5, **GHz**, **CF STEP**, 200, and **MHz**.
39. Set the HP 83650B frequency to 6.5 GHz and the FREQ STEP to 200 MHz.
40. On the spectrum analyzer, press **AUX CTRL, INTERNAL MIXER**, and **PRESEL AUTO PK**. Wait for the `PEAKING` message to disappear.
41. On the HP 83650B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
42. Enter the 6.0 GHz power sensor calibration factor, indicated in Table 2-55, into the HP 8902A.
43. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-55.
44. On the HP 83650B, to set the frequency to the next value listed in Table 2-55.
45. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-55.
46. On the HP 83650B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
47. Enter the power sensor calibration factor, indicated in Table 2-55, into the HP 8902A.
48. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-55.
49. To step through the remaining frequencies listed in Table 2-55, repeat step 44 through step 48.

NOTE It will be necessary to enter the last source and spectrum analyzer frequency, 13.2 GHz, manually; the step functions will set the frequency to 13.3 GHz.

Frequency Response, Band 3 (13.2 GHz to 26.8 GHz)

50. On the spectrum analyzer, press **FREQUENCY,** 13.25, **GHz**.
51. Set the HP 83650B frequency to 13.25 GHz.
52. On the spectrum analyzer, press **AUX CTRL, INTERNAL MIXER**, and **PRESEL AUTO PK**. Wait for the PEAKING message to disappear.
53. On the HP 83650B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
54. Enter the 13.0 GHz power sensor calibration factor, indicated in Table 2-56, into the HP 8902A.
55. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-56.
56. On the HP 83650B, set the frequency to the next value listed in Table 2-56.
57. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-56.
58. On the HP 83650B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
59. Enter the power sensor calibration factor, indicated in Table 2-56, into the HP 8902A.
60. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-56.
61. To step through the remaining frequencies listed in Table 2-56, repeat step 56 through step 60.

Frequency Response, Band 4 (26.9 GHz to 31.1 GHz)

62. On the spectrum analyzer, press **FREQUENCY,** 26.9, **GHz**.
63. Set the HP 83650B frequency to 26.9 GHz.
64. On the spectrum analyzer, press **AUX CTRL, INTERNAL MIXER**, and **PRESEL AUTO PK**. Wait for the PEAKING message to disappear.
65. On the HP 83650B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
66. Enter the 27.0 GHz power sensor calibration factor, indicated in Table 2-57, into the HP 8902A.
67. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-57.
68. On the HP 83650B, set the frequency to the next value listed in Table 2-57.
69. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-57.
70. On the HP 83650B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
71. Enter the power sensor calibration factor, indicated in Table 2-57, into the HP 8902A.
72. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-57.
73. To step through the remaining frequencies listed in Table 2-57, repeat step 68 through step 72.

Frequency Response, Band 5 (31.2 GHz to 50.0 GHz)

74. On the spectrum analyzer, press **FREQUENCY,** 31.2, **GHz**.
75. Set the HP 83650B frequency to 31.2 GHz.
76. On the spectrum analyzer, press **AUX CTRL, INTERNAL MIXER**, and **PRESEL AUTO PK**. Wait for the PEAKING message to disappear.
77. On the HP 83650B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
78. Enter the 31.0 GHz power sensor calibration factor, indicated in Table 2-57, into the HP 8902A.
79. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-27.
80. On the HP 83650B, set the frequency to the next value listed in Table 2-23.

81. On the spectrum analyzer, set the center frequency to the next value listed in Table 2-23.
82. On the HP 83650B, adjust the power level for a spectrum analyzer MKR amplitude reading of –10 dBm ±0.05 dB.
83. Enter the power sensor calibration factor, indicated in Table 2-23, into the HP 8902A.
84. Record the negative of the power ratio displayed on the HP 8902A as the HP 8902A reading in Table 2-27.
85. To step through the remaining frequencies listed in Table 2-27, repeat step 80 through step 84.

Frequency Response (≤250 kHz) (Option 006 Only)

86. On the spectrum analyzer, set the controls as follows:

    Center frequency . . . . 250 kHz

    Span . . . . 100 Hz

    Resolution BW. . . . . 10 Hz

    Marker . . . . off

87. On the HP 3324A, set the controls as follows:

    Frequency . . . . 250 kHz

    Amplitude . . . .–4 dBm

    Amplitude increment . . . . .0.01 dB

88. On the HP 3458A, set the controls as follows:

    Function. . . . . Sync AC Volts

    Math. . . . . dBm

    RES Register . . . . 50 Ω

    Front/Rear Terminal. . . . . Front

    Resolution . . . . 7.5 digits

89. Connect the equipment as shown in Figure 2-28 with the HP 8482A power sensor and HP 8902A connected to the HP 11667A power splitter.
90. Enter the power sensor calibration factor for 0.1 MHz into the HP 8902A.
91. Zero and calibrate the sensor.
92. Adjust the HP 3324A amplitude until the HP 8902A display reads the same value as recorded in step 12.
93. Disconnect the HP 8482A power sensor from the power splitter and connect the HP 3458A.

94.Record the HP 3458A reading here and in Table 2-59:

HP 3458A reading at 250 kHz:_______________ dBm

95.On the spectrum analyzer, press **PEAK SEARCH** and **MARKER DELTA**.

96.Set the spectrum analyzer CENTER FREQ and the HP 3324A frequency to the next frequency listed in Table 2-59.

97.Press **PEAK SEARCH** on the spectrum analyzer.

98.Adjust the HP 3324A amplitude for a Δ MKR amplitude reading of 0.00 dBm ±0.05 dB.

99.Record the HP 3458A amplitude readings in Table 2-59 as the ACDMV amplitude.

100.To step through the remaining frequencies listed in Table 2-59, repeat step 96 through step 99.

101.For each of the frequencies listed in Table 2-59, subtract the ACDVM amplitude reading from the ACDVM amplitude reading at 250 kHz recorded in step 94. Record the results as the response relative to 250 kHz in Table 2-59.

102.Add to each of the response relative to 250 kHz entries in Table 2-59 the HP 8902A reading for 250 kHz listed in Table 2-53. Record the results as the response relative to 300 MHz in Table 2-59.

Test Results

103.Frequency Response, Band 0 – 250 kHz to 2.9 GHz.

a. Enter the most positive number from Table 2-59, column 4. _______________ dB

b. Enter the most positive number from Table 2-53, column 2. _______________ dB

c. Of (a) and (b), enter whichever number is *more* positive. _______________ dB

d. Enter the most negative number from Table 2-59, column 4. _______________ dB

e. Enter the most negative number from Table 2-53, column 2. _______________ dB

f. Of (d) and (e), enter whichever number is *more* negative. _______________ dB

g. Subtract (f) from (c). _______________ dB

104.Frequency Response, Band 1 – 2.9 GHz to 6.5 GHz.

a. Enter the most positive number from Table 2-54, column 2. _______________ dB

b. Enter the most negative number from Table 2-54, column 2. _______________ dB

c. Subtract (b) from (a). _______________ dB

105.Frequency Response, Band 2 – 6.5 GHz to 13.2 GHz.

a. Enter the most positive number from Table 2-55, column 2. _______________ dB

b. Enter the most negative number from Table 2-55, column 2. _______________ dB

c. Subtract (b) from (a). _______________ dB

106.Frequency Response, Band 3 – 13.2 GHz to 20.2 GHz.

a. Enter the most positive number from Table 2-56, column 2 for center frequencies less than or equal to 22 GHz. _______________ dB

b. Enter the most negative number from Table 2-56, column 2 for center frequencies less than or equal to 22 GHz. _______________ dB

c. Subtract (b) from (a). _______________ dB

107.Frequency Response, Band 3 – 20.4 GHz to 26.8 GHz.

a. Enter the most positive number from Table 2-56, column 2 for center frequencies greater than 22 GHz. _______________ dB

b. Enter the most negative number from Table 2-56, column 2 for center frequencies greater than 22 GHz. _______________ dB

c. Subtract (b) from (a). _______________ dB

108.Frequency Response, Band 3 – 13.2 GHz to 26.8 GHz.

109.a. Enter the most positive number from step 106 69 (a) and step 107 (a). _______________ dB

110.b. Enter the most negative number from step 106 (b) and step 107 (b). _______________ dB

111.Frequency Response, Band 4 – 26.9 GHz to 31.1 GHz.

a. Enter the most positive number from Table 2-57, column 2. _______________ dB

b. Enter the most negative number from Table 2-57, column 2. _______________ dB

c. Subtract (b) from (a). _______________ dB

112.Frequency Response, Band 5 – 31.2 GHz to 50.0 GHz.

a. Enter the most positive number from Table 2-58, column 2. ________________ dB

b. Enter the most negative number from Table 2-58, column 2. ________________ dB

c. Subtract (b) from (a). ________________ dB

Frequency Response, Band 0, 100 MHz to 2.0 GHz

113.This step applies only to spectrum analyzers with serial number prefix 3641A or later. Enter the results of the frequency response, Band 0, for the frequency range 100 MHz to 2.0 GHz:

a. Enter the most positive number from Table 2-53, column 2, for center frequencies between 100 MHz and 2.0 GHz. _______________ dB

b. Enter the most negative number from Table 2-53, column 2, for center frequencies between 100 MHz and 2.0 GHz. _______________ dB

c. Subtract (b) from (a). _______________ dB

Band Switching Uncertainty

114.In the top row of Table 2-60, enter the values recorded in the indicated steps. For example, if step 106 (a) has a value of 1.22 dB, enter “1.22 dB” in the top row of the Band 3 column.

115.In the left column of Table 2-60, enter the values recorded in the indicated steps. For example, if step 105 (b) has a value of –0.95 dB, enter “–0.95 dB” in the left column of the Band 2 row.

Compute the other entries in Table 2-60 by taking the absolute value of the difference between the values in the left column and the top row.

Table 2-53 Frequency Response, Band 0 (250 kHz to 2.9 GHz)

Source Frequency (MHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (MHz)	Measurement Uncertainty (dB)
0.250		0.01	+0.37/–0.41
1		1	+0.37/–0.41
10		10	+0.37/–0.41
20		10	+0.37/–0.41
50		30	+0.37/–0.41
150		100	+0.37/–0.41
250		300	+0.37/–0.41
350		300	+0.37/–0.41
450		300	+0.37/–0.41
550		300	+0.37/–0.41
650		1000	+0.37/–0.41
750		1000	+0.37/–0.41
850		1000	+0.37/–0.41
950		1000	+0.37/–0.41
1050		1000	+0.37/–0.41
1150		1000	+0.37/–0.41
1250		1000	+0.37/–0.41
1350		1000	+0.37/–0.41
1450		1000	+0.37/–0.41
1550		2000	+0.37/–0.41
1650		2000	+0.37/–0.41
1750		2000	+0.37/–0.41
1850		2000	+0.37/–0.41
1950		2000	+0.37/–0.41
2050		2000	+0.37/–0.41
2150		2000	+0.37/–0.41
2250		2000	+0.37/–0.41
2350		2000	+0.37/–0.41
2450		2000	+0.37/–0.41
2550		3000	+0.37/–0.41
2650		3000	+0.37/–0.41
2750		3000	+0.37/–0.41
2850		3000	+0.37/–0.41
2900		3000	+0.37/–0.41

Table 2-54 Frequency Response, Band 1 (2.9 GHz to 6.5 GHz)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
2.95		2.0	+0.49/–0.55
3.05		4.0	+0.49/–0.55
3.15		4.0	+0.49/–0.55
3.25		4.0	+0.49/–0.55
3.35		4.0	+0.49/–0.55
3.45		4.0	+0.49/–0.55
3.55		4.0	+0.49/–0.55
3.65		4.0	+0.49/–0.55
3.75		4.0	+0.49/–0.55
3.85		4.0	+0.49/–0.55
3.95		4.0	+0.49/–0.55
4.05		4.0	+0.49/–0.55
4.15		4.0	+0.49/–0.55
4.25		4.0	+0.49/–0.55
4.35		4.0	+0.49/–0.55
4.45		4.0	+0.49/–0.55
4.55		4.0	+0.49/–0.55
4.65		4.0	+0.49/–0.55
4.75		4.0	+0.49/–0.55
4.85		4.0	+0.49/–0.55
4.95		4.0	+0.49/–0.55
5.05		6.0	+0.49/–0.55
5.15		6.0	+0.49/–0.55
5.25		6.0	+0.49/–0.55
5.35		6.0	+0.49/–0.55
5.45		6.0	+0.49/–0.55
5.55		6.0	+0.49/–0.55
5.65		6.0	+0.49/–0.55
5.75		6.0	+0.49/–0.55
5.85		6.0	+0.49/–0.55
5.95		6.0	+0.49/–0.55
6.05		6.0	+0.49/–0.55
6.15		6.0	+0.49/–0.55
6.25		6.0	+0.49/–0.55
6.35		6.0	+0.49/–0.55
6.45		6.0	+0.49/–0.55

Table 2-55 Frequency Response, Band 2 (6.5 GHz to 13.2 GHz)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
6.5		6.0	+0.49/–0.56
6.7		6.0	+0.49/–0.56
6.9		6.0	+0.49/–0.56
7.1		8.0	+0.49/–0.56
7.3		8.0	+0.49/–0.56
7.5		8.0	+0.49/–0.56
7.7		8.0	+0.49/–0.56
7.9		8.0	+0.49/–0.56
8.1		8.0	+0.49/–0.56
8.3		8.0	+0.49/–0.56
8.5		8.0	+0.49/–0.56
8.7		8.0	+0.49/–0.56
8.9		8.0	+0.49/–0.56
9.1		10.0	+0.49/–0.56
9.3		10.0	+0.49/–0.56
9.5		10.0	+0.49/–0.56
9.7		10.0	+0.49/–0.56
9.9		10.0	+0.49/–0.56
10.1		10.0	+0.49/–0.56
10.3		10.0	+0.49/–0.56
10.5		10.0	+0.49/–0.56
10.7		10.0	+0.49/–0.56
10.9		10.0	+0.49/–0.56
11.1		12.0	+0.49/–0.56
11.3		12.0	+0.49/–0.56
11.5		12.0	+0.49/–0.56
11.7		12.0	+0.49/–0.56
11.9		12.0	+0.49/–0.56
12.1		12.0	+0.49/–0.56
12.3		12.0	+0.49/–0.56
12.5		12.0	+0.49/–0.56
12.7		12.0	+0.49/–0.56
12.9		12.0	+0.49/–0.56
13.1		14.0	+0.49/–0.56
13.2		14.0	+0.49/–0.56

Table 2-56 Frequency Response, Band 3 (13.2 GHz to 26.8 GHz)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
13.25		14.0	+0.53/–0.60
13.4		14.0	+0.53/–0.60
13.6		14.0	+0.53/–0.60
13.8		14.0	+0.53/–0.60
14.0		14.0	+0.53/–0.60
14.2		14.0	+0.53/–0.60
14.4		14.0	+0.53/–0.60
14.6		14.0	+0.53/–0.60
14.8		14.0	+0.53/–0.60
15.0		14.0	+0.53/–0.60
15.2		16.0	+0.53/–0.60
15.4		16.0	+0.53/–0.60
15.6		16.0	+0.53/–0.60
15.8		16.0	+0.53/–0.60
16.0		16.0	+0.53/–0.60
16.2		16.0	+0.53/–0.60
16.4		16.0	+0.53/–0.60
16.6		16.0	+0.53/–0.60
16.8		16.0	+0.53/–0.60
17.0		16.0	+0.53/–0.60
17.2		18.0	+0.53/–0.60
17.4		18.0	+0.53/–0.60
17.6		18.0	+0.53/–0.60
17.8		18.0	+0.53/–0.60
18.0		18.0	+0.53/–0.60
18.2		18.0	+0.53/–0.60
18.4		18.0	+0.53/–0.60
18.6		18.0	+0.53/–0.60
18.8		18.0	+0.53/–0.60
19.0		18.0	+0.53/–0.60
19.2		20.0	+0.53/–0.60
19.4		20.0	+0.53/–0.60
19.6		20.0	+0.53/–0.60
19.8		20.0	+0.53/–0.60
20.0		20.0	+0.53/–0.60

Table 2-56 Frequency Response, Band 3 (13.2 GHz to 26.8 GHz) (Continued)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
20.2		20.0	+0.53/–0.60
20.4		20.0	+0.53/–0.60
20.6		20.0	+0.53/–0.60
20.8		20.0	+0.53/–0.60
21.0		20.0	+0.53/–0.60
21.2		21.0	+0.53/–0.60
21.4		21.0	+0.53/–0.60
21.6		21.0	+0.53/–0.60
21.8		21.0	+0.53/–0.60
22.0		22.0	+0.53/–0.60
22.2		22.0	+0.53/–0.60
22.4		22.0	+0.53/–0.60
22.6		22.0	+0.53/–0.60
22.8		22.0	+0.53/–0.60
23.0		22.0	+0.53/–0.60
23.2		24.0	+0.53/–0.60
23.4		24.0	+0.53/–0.60
23.6		24.0	+0.53/–0.60
23.8		24.0	+0.53/–0.60
24.0		24.0	+0.53/–0.60
24.2		24.0	+0.53/–0.60
24.4		24.0	+0.53/–0.60
24.6		24.0	+0.53/–0.60
24.8		24.0	+0.53/–0.60
25.0		24.0	+0.53/–0.60
25.2		26.0	+0.53/–0.60
25.4		26.0	+0.53/–0.60
25.6		26.0	+0.53/–0.60
25.8		26.0	+0.53/–0.60
26.0		26.0	+0.53/–0.60
26.2		26.0	+0.53/–0.60
26.4		26.5	+0.53/–0.60
26.6		26.5	+0.53/–0.60
26.8		27.0	+0.53/–0.60

Table 2-57 Frequency Response, Band 4 (26.9 GHz to 31.1 GHz)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
26.9		27.0	+0.74/–0.89
27.2		27.0	+0.74/–0.89
27.5		28.0	+0.74/–0.89
27.8		28.0	+0.74/–0.89
28.1		28.0	+0.74/–0.89
28.4		28.0	+0.74/–0.89
28.7		29.0	+0.74/–0.89
29.0		29.0	+0.74/–0.89
29.3		29.0	+0.74/–0.89
29.6		30.0	+0.74/–0.89
29.9		30.0	+0.74/–0.89
30.2		30.0	+0.74/–0.89
30.5		31.0	+0.74/–0.89
30.8		31.0	+0.74/–0.89
31.1		31.0	+0.74/–0.89

Table 2-58 Frequency Response, Band 5 (31.2 GHz to 50.0 GHz)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
31.2		31.0	+0.74/–0.89
31.6		32.0	+0.74/–0.89
32.0		32.0	+0.74/–0.89
32.4		32.0	+0.74/–0.89
32.8		33.0	+0.74/–0.89
33.2		33.0	+0.74/–0.89
33.6		34.0	+0.74/–0.89
34.0		34.0	+0.74/–0.89
34.4		34.0	+0.74/–0.89
34.8		35.0	+0.74/–0.89
35.2		35.0	+0.74/–0.89
35.6		36.0	+0.74/–0.89
36.0		36.0	+0.74/–0.89
36.4		36.0	+0.74/–0.89
36.8		37.0	+0.74/–0.89
37.2		37.0	+0.74/–0.89
37.6		38.0	+0.74/–0.89
38.0		38.0	+0.74/–0.89
38.4		38.0	+0.74/–0.89
38.8		39.0	+0.74/–0.89
39.2		39.0	+0.74/–0.89
39.6		40.0	+0.74/–0.89
40.0		40.0	+0.74/–0.89
40.4		40.0	+0.74/–0.89
40.8		41.0	+0.74/–0.89
41.2		41.0	+0.74/–0.89
41.6		42.0	+0.74/–0.89
42.0		42.0	+0.74/–0.89
42.4		42.0	+0.74/–0.89
42.8		43.0	+0.74/–0.89
43.2		43.0	+0.74/–0.89
43.6		44.0	+0.74/–0.89
44.0		44.0	+0.74/–0.89
44.4		44.0	+0.74/–0.89

Table 2-58 Frequency Response, Band 5 (31.2 GHz to 50.0 GHz) (Continued) (Continued)

Source Frequency (GHz)	HP 8902A Reading (dB)	Pwr Sensor Cal Factor Frequency (GHz)	Measurement Uncertainty (dB)
44.8		45.0	+0.74/–0.89
45.2		45.0	+0.74/–0.89
45.6		46.0	+0.74/–0.89
46.0		46.0	+0.74/–0.89
46.4		46.0	+0.74/–0.89
46.8		47.0	+0.74/–0.89
47.2		47.0	+0.74/–0.89
47.6		48.0	+0.74/–0.89
48.0		48.0	+0.74/–0.89
48.4		48.0	+0.74/–0.89
48.8		49.0	+0.74/–0.89
49.2		49.0	+0.74/–0.89
49.6		50.0	+0.74/–0.89
50.0		50.0	+0.74/–0.89

Table 2-59 Frequency Response (<250 kHz) (Option 006 Only)

Function Generator Frequency	ACDVM Amplitude (dBm)	Response Relative to 250 kHz	Response Relative to 300 MHz	Measurement Uncertainty (dB)
250 kHz		0 (Ref)		±0.23
100 kHz				±0.23
10 kHz				±0.23
1 kHz				±0.23
500 Hz				±0.23
200 Hz				±0.23

Table 2-60 Band Switching Uncertainty

	Band 0 Step 103c ________	Band 1 Step 104a ________	Band 2 Step 105a ________	Band 3 <22 GHz Step 106a ________	Band 3 >22 GHz Step 107a ________	Band 4 Step 111a ________	Band 5 Step 112a ________
Band 0 Step 103f ________	N/A	________	________	________	________	________	________
Band 1 Step 104b ________	________	N/A	________	________	________	________	________
Band 2 Step 105b ________	________	________	N/A	________	________	________	________
Band 3 <22 GHz Step 106b ________	________	________	________	N/A	________	________	________
Band 3 >22 GHz Step 107b ________	________	________	________	________	N/A	________	________
Band 4 Step 111b ________	________	________	________	________	________	N/A	________
Band 5 Step 112b ________	________	________	________	________	________	________	N/A

43a. Third Order Intermodulation Distortion: HP 8560E/EC

Instrument Under Test

HP 8560E/EC

Related Specification

Third Order Intermodulation Distortion

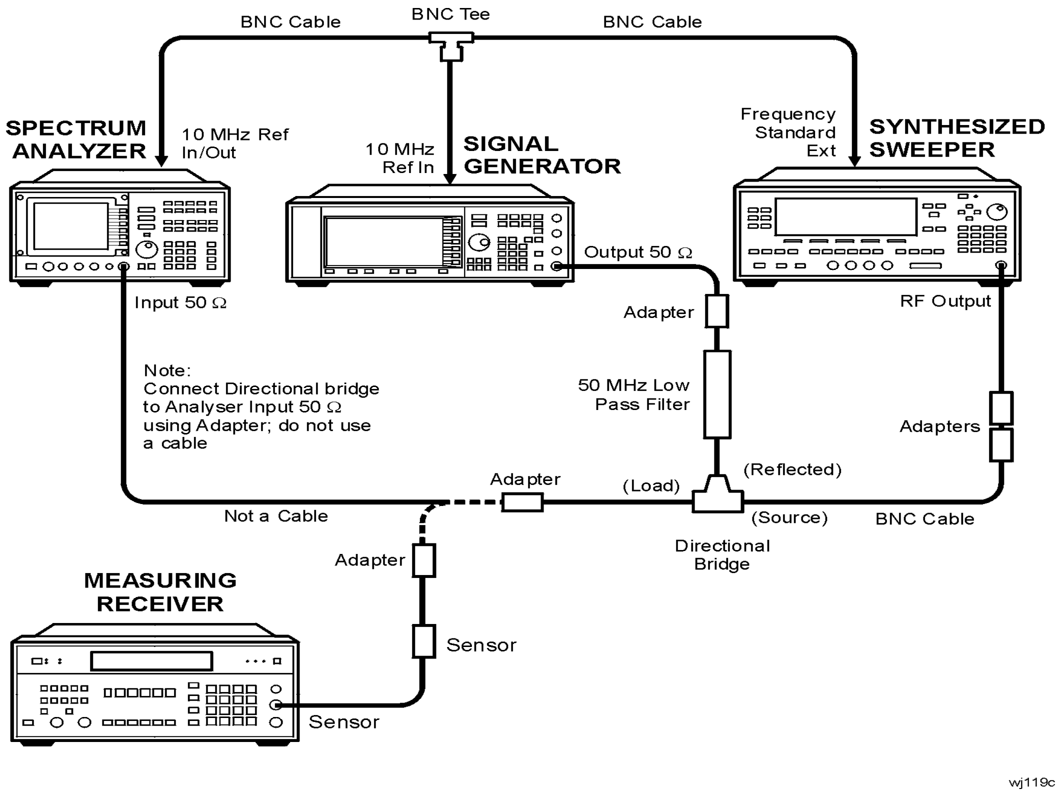
Related Adjustment

1st LO Distribution Amplifier Adjustment

Description

Two synthesized sources provide the signals required for measuring third order intermodulation distortion. A filter is used to attenuate the second harmonic of the signal closest to the distortion product being measured. The spectrum analyzer provides the 10 MHz reference for the synthesized sources.

Figure 2-29 Third Order Intermodulation Test Setup



Equipment

Signal generator . . . . HP E4421B

Synthesized sweeper. . . . . HP 83640B

Measuring receiver . . . . HP 8902A

Power sensor . . . . HP 8482A

Directional bridge . . . . HP 8721A

50 MHz low-pass filter 0955-0306

Adapters

Type N (f) to APC 2.4 (f) . . . . HP 11903B

Type N (m) to BNC (m). 1250-1473

Type N (m) to BNC (f). 1250-1476

Type N (f) to type N (f) 1250-1472

BNC tee (m) (f) (f) 1250-0781

Cable

BNC, 122 cm (48 in.) *(4 required)*HP 10503A

Procedure

1. Connect the equipment as shown in Figure 2-29, but do not connect the directional bridge to the spectrum analyzer.
2. Set the HP E4421B as follows:

   Frequency . . . . 45 MHz

   Amplitude. . . . . –14 dB

   Amplitude increment . . . . 0.04 dB

3. Press **PRESET** on the HP 83640B and set the controls as follows:

   CW frequency . . . . 45.05 MHz

   Power level. . . . . –110 dBm

   Modulation . . . . off

   RF power. . . . . off

   Frequency standard switch (rear panel). . . . . EXT

4. On the HP 8902A, set the controls as follows:

   FUNCTION . . . . RF POWER

   LOG/LIN. . . . . LOG

5. Press **PRESET** on the spectrum analyzer. Set the controls as follows:

Center frequency . . . . 45.0 MHz

Center frequency step . . . . 50 kHz

Span . . . . 1 kHz

Reference level . . . .–20 dBm

Resolution BW. . . . . 10 Hz

6. Zero the HP 8902A/HP 8482A combination and calibrate the HP 8482A at 50 MHz as described in the HP 8902A Operation Manual.
7. Connect the power sensor to the output of the directional bridge using an adapter; do not use a cable.
8. Press **Amplitude** on the HP E4421B and use the increment ⇓ and ⇑ keys to adjust the amplitude for a –20 dBm ±0.1 dB reading on the HP 8902A display.
9. Disconnect the power sensor from the directional bridge. Connect the directional bridge directly to the spectrum analyzer input using an adapter, not a cable
10. On the spectrum analyzer, press **PEAK SEARCH, MKR** →, and **MARKER** → **REF LVL**. Wait for completion of a new sweep. Press **MKR, MARKER DELTA**, **FREQUENCY**, and ⇑.
11. On the HP 83640B, press **RF, ON**, **POWER LEVEL,** –14, and **dBm**.
12. On the spectrum analyzer, press **PEAK SEARCH**.
13. On the HP 83640B, adjust the power level for a ΔMKR amplitude reading of 0 dB ±0.17 dB on the spectrum analyzer.
14. On the spectrum analyzer, press **MKR, MARKER NORMAL**, **PEAK SEARCH, MARKER DELTA**, **FREQUENCY,** ⇓, and ⇓. Wait for completion of a new sweep. Press **PEAK SEARCH**.
15. Record the spectrum analyzer ΔMKR amplitude reading below as the lower product suppression.

Lower product suppression ____________________ dBc

16. On the HP E4421B, press **FREQUENCY**, 45.05, and **MHz**.
17. On the HP 83640B, press **CW,** 45, and **MHz**.
18. On the spectrum analyzer, press **FREQUENCY,** ⇓, ⇓, and ⇓. Wait for completion of a new sweep. Press **PEAK SEARCH**.
19. Record the spectrum analyzer ΔMKR amplitude reading below as the upper product suppression.

Upper product suppression ____________________ dBc

20. Between the upper and lower product suppressions recorded in steps 15 and 19 above, record the more positive suppression as the third order intermodulation distortion.

Third order intermodulation distortion __________ dBc

44a. Third Order Intermodulation Distortion: HP 8561E/EC

Instrument Under Test

HP 8561E/EC

Related Specification

Third Order Intermodulation Distortion

Related Adjustment

1st LO Distribution Amplifier Adjustment

Description

Two synthesized sources provide the signals required for measuring third order intermodulation distortion. In the 30 Hz to 2.9 GHz band, a filter is used to attenuate the second harmonic of the signal closest to the distortion product being measured. A filter is not necessary in the preselected band. The spectrum analyzer provides the 10 MHz reference for the synthesized sources.

Figure 2-30 Third Order Intermodulation Test Setup (<2.9 GHz)

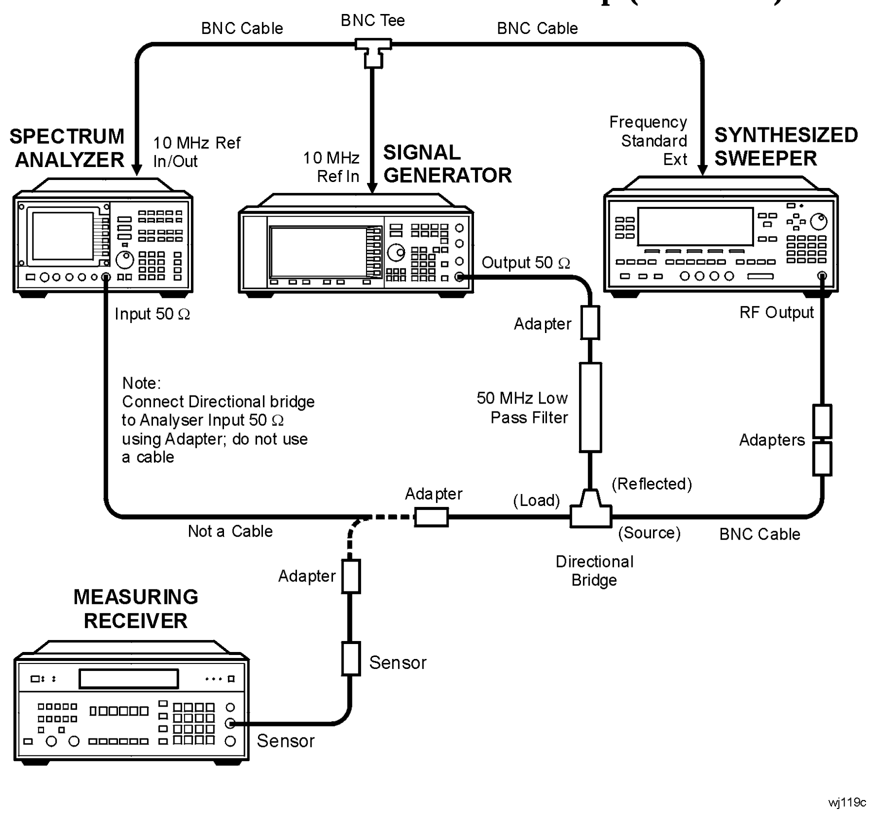
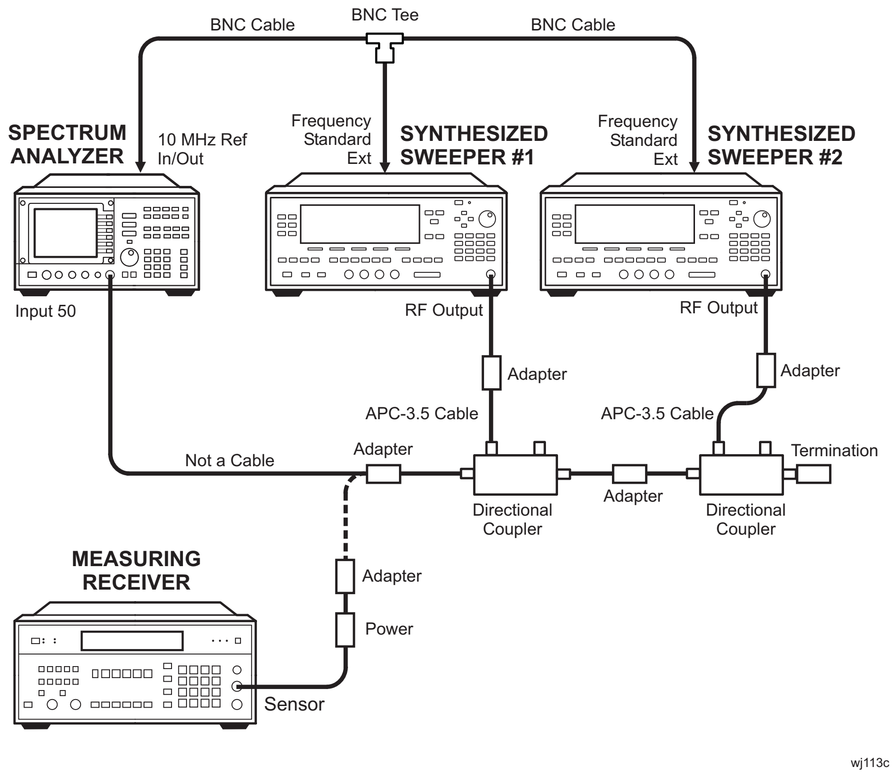


Figure 2-31 Third Order Intermodulation Test Setup (>2.9 GHz)



Equipment

Signal generator. . . . . .HP E4421B

Synthesized sweeper *(2 required)* . . . . HP 83640B

Measuring receiver . . . . HP 8902A

Power sensor . . . . HP 8481A

Directional bridge . . . . HP 8721A

Directional coupler *(2 required)* 0955-0098

50 MHz low-pass filter. 0955-0306

50 Ω SMA termination. 1810-0118

Adapters

Type N (f) to APC 2.4mm (f) . . . . .HP 11903B

Type N (m) to BNC (m) *(2 required)* 1250-1473

Type N (m) to BNC (f) 1250-1476

Type N (f) to type N (f). 1250-1472

Type N (m) to APC 3.5 (m) 1250-1743

APC 3.5 (f) to APC 2.4mm (f) *(2 required)* . . . . HP 11901B

SMA (m) to SMA (m). 1250-1159

BNC tee (m) (f) (f) 1250-0781

Cables

BNC, 122 cm (48 in.) *(4 required)*. . . . . HP 10503A

APC 3.5, 91 cm (36 in.) *(2 required)* 8120-4291

Procedure

Third Order Intermodulation (<2.9 GHz)

1. Connect the equipment as shown in Figure 2-30, but do not connect the directional bridge to the spectrum analyzer.

   Set the HP E4421B controls as follows:

   Frequency . . . . 45 MHz

   Amplitude . . . . –14 dB

   Amplitude increment . . . . .0.04 dB

2. Press **INSTR PRESET** on the HP 83640B and set the controls as follows:

   CW frequency . . . . 45.05 MHz

   Power level . . . . –110 dBm

   Modulation . . . . off

   RF power . . . . off

   Frequency standard switch (rear panel) . . . . EXT

3. On the HP 8902A, set the controls as follows:

   Function. . . . . RF power

   Log/linear. . . . . Log

4. Press **PRESET** on the spectrum analyzer. Set the controls as follows:

   Center frequency. . . . . 45.0 MHz

   Center frequency step. . . . . 50 kHz

   Span . . . . 1 kHz

   Reference level . . . .–20 dBm

   Resolution BW. . . . . 10 Hz

5. Zero the HP 8902A/HP 8482A combination and calibrate the HP 8482A at 50 MHz as described in the HP 8902A Operation Manual.
6. Connect the power sensor to the output of the directional bridge using an adapter; do not use a cable.
7. Press **Amplitude** on the HP E4421B and use the increment ⇓ and ⇑ keys to adjust the amplitude for a –20 dBm ±0.1 dB reading on the HP 8902A display.
8. Disconnect the power sensor from the directional bridge. Connect the directional bridge directly to the spectrum analyzer input using an adapter, not a cable.

9. On the spectrum analyzer, press **PEAK SEARCH, MKR** →, and **MARKER** → **REF LVL**. Wait for completion of a new sweep. Press **MKR, MARKER DELTA**, **FREQUENCY**, and ⇑.
10. On the HP 83640B, press **RF, ON**, **POWER LEVEL,** –14, and **dBm**.
11. On the spectrum analyzer, press **PEAK SEARCH**.
12. On the HP 83640B, adjust the power level for a ΔMKR amplitude reading of 0 dB ±0.17 dB on the spectrum analyzer.
13. On the spectrum analyzer, press **MKR, MARKER NORMAL**, **PEAK SEARCH, MARKER DELTA, FREQUENCY**, ⇓, and ⇓. Wait for completion of a new sweep. Press **PEAK SEARCH**.
14. Record the spectrum analyzer ΔMKR amplitude reading below as the lower product suppression.

Lower product suppression ____________________ dBc

15. On the HP E4421B, press **FREQUENCY,** 45.05, and **MHz**.
16. On the HP 83640B, press **CW,** 45, and **MHz**.
17. On the spectrum analyzer, press **FREQUENCY**, ⇑, ⇑, and ⇑. Wait for completion of a new sweep. Press **PEAK SEARCH**.
18. Record the spectrum analyzer ΔMKR amplitude reading below as the upper product suppression.

Upper product suppression ____________________ dBc

19. Between the upper and lower product suppressions recorded in steps 14 and 18 above, record the more positive suppression as the third order intermodulation distortion.

Third order
intermodulation distortion ____________________ dBc

Third Order Intermodulation (>2.9 GHz)

20. Connect the equipment as shown in Figure 2-31, but do not connect the directional coupler to the spectrum analyzer. The spectrum analyzer provides the 10 MHz reference to the synthesized sweepers.
21. On each HP 83640B, press **INSTR PRESET**. Set the controls as follows:

    Power level . . . . .0 dBm

    Modulation . . . . off

    RF power . . . . off

    Frequency standard switch (Rear Panel). . . . . EXT
22. On HP 83640B #1, press **CW,** 5, and **GHz**.
23. On HP 83640B #2, press, **CW,** 5.00005, and **GHz**.
24. Enter the power sensor 5 GHz calibration factor into the HP 8902A.
25. On the spectrum analyzer, press **PRESET, RECALL, MORE 1 OF 2**, and **FACTORY PRSEL PK**. Set the controls as follows:

    Center frequency. . . . . 5.0 GHz

    Reference level . . . .–15 dBm

    Span . . . . 10 kHz

    Center frequency step. . . . . 50 kHz

    Resolution BW. . . . . 300 Hz

    Video average . . . . off
26. Connect the power sensor to the directional coupler using an adapter; do not use a cable.
27. On HP 83640B #1, press **RF**, **ON**, and **POWER LEVEL**. Adjust the power level for a –15 dBm ±0.1 dB reading on the HP 8902A display.
28. Disconnect the power sensor from the directional coupler. Connect the directional coupler to the spectrum analyzer INPUT 50 Ω using an adapter. Do not use a cable.
29. On the spectrum analyzer, press **PEAK SEARCH**, **AMPLITUDE**, **MORE 1 OF 3, MORE 2 OF 3**, and **PRESEL AUTO PK**. Wait for the PEAKING message to disappear. Press **SPAN,** 1, **kHz**, **BW**, 10, and **Hz**.
30. On the spectrum analyzer, press **PEAK SEARCH**, **MKR** →, and **MARKER** → **REF LVL**. Wait for completion of a new sweep. Press **MKR, MARKER DELTA**, **FREQUENCY,** and ⇑.
31. On HP 83640B #2, press **RF, ON**, and **POWER LEVEL**.
32. On the spectrum analyzer, press **PEAK SEARCH**.

33. On HP 83640B #2, adjust the power level for a ΔMKR amplitude reading of 0.0 dB ±0.17 dB on the spectrum analyzer.
34. On the spectrum analyzer, press **MKR, MARKER NORMAL, PEAK SEARCH**, **MARKER DELTA, FREQUENCY,** and ⇑. Press **BW, VID AVG ON,** 5, **Hz**, **TRACE,** and **CLEAR WRITE A**. Wait until VAVG 5 is displayed above the graticule.
35. Press **SGL SWP** and wait for completion of a new sweep. Press **PEAK SEARCH**. Record the spectrum analyzer ΔMKR amplitude reading below as the upper product suppression.

Upper product suppression ____________________ dBc

36. On the spectrum analyzer, press **FREQUENCY,** ⇓, ⇓, and ⇓. Press **TRIG, SWEEP CONT, TRACE,** and **CLEAR WRITE A**. Wait until VAVG 5 is displayed above the graticule.
37. Press **SGL SWP** and wait for completion of a new sweep. Press **PEAK SEARCH**. Record the spectrum analyzer ΔMKR amplitude reading below as the lower product suppression.

Lower product suppression ____________________ dBc

38. Between the upper and lower product suppressions recorded in steps 35 and 37 above, record the more positive suppression as the uncorrected third order intermodulation distortion.

Uncorrected third order
intermodulation distortion ____________________ dBc

39. The uncorrected third order intermodulation distortion represents the distortion with –25 dBm at the input mixer. The distortion products with –30 dBm at the input mixer will be 10 dB lower than the distortion products measured. Subtract 10 dB from the uncorrected third order intermodulation distortion and record the result as the corrected third order intermodulation distortion.

Corrected third order
intermodulation distortion ____________________ dBc

45a. Third Order Intermodulation Distortion: HP 8562E/EC, 8563E/EC

Instrument Under Test

HP 8562E/EC
HP 8563E/EC

Related Specification

Third Order Intermodulation Distortion

Related Adjustment

1st LO Distribution Amplifier Adjustment

Description

Two synthesized sources provide the signals required for measuring third order intermodulation distortion. In the 30 Hz to 2.9 GHz band, a filter is used to attenuate the second harmonic of the signal closest to the distortion product being measured. A filter is not necessary in the preselected bands. The spectrum analyzer provides the 10 MHz reference for the synthesized sources.

Figure 2-32 Third Order Intermodulation Test Setup (50 Hz to 2.9 GHz)

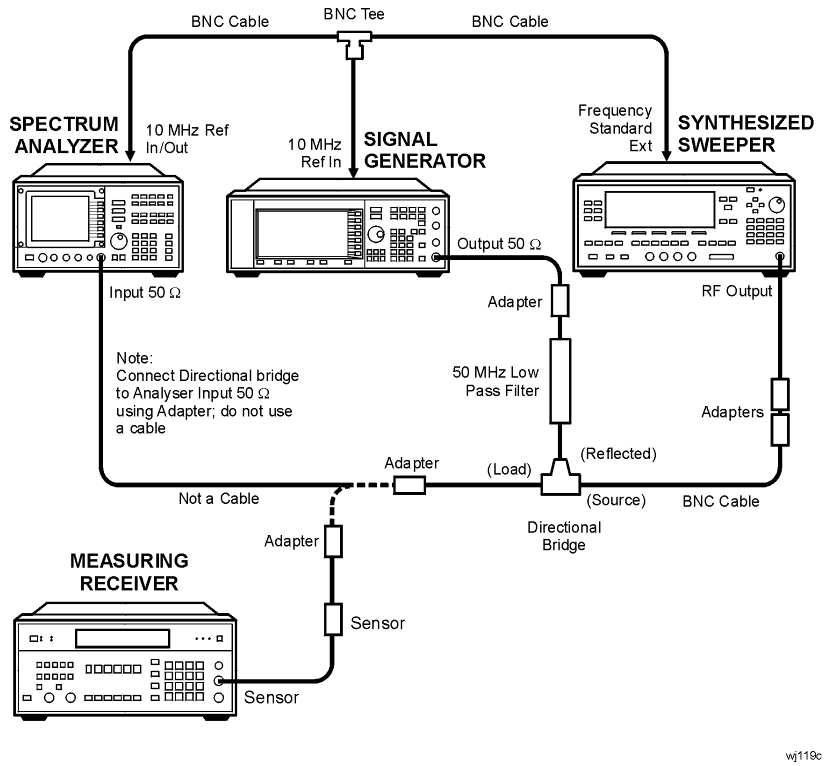
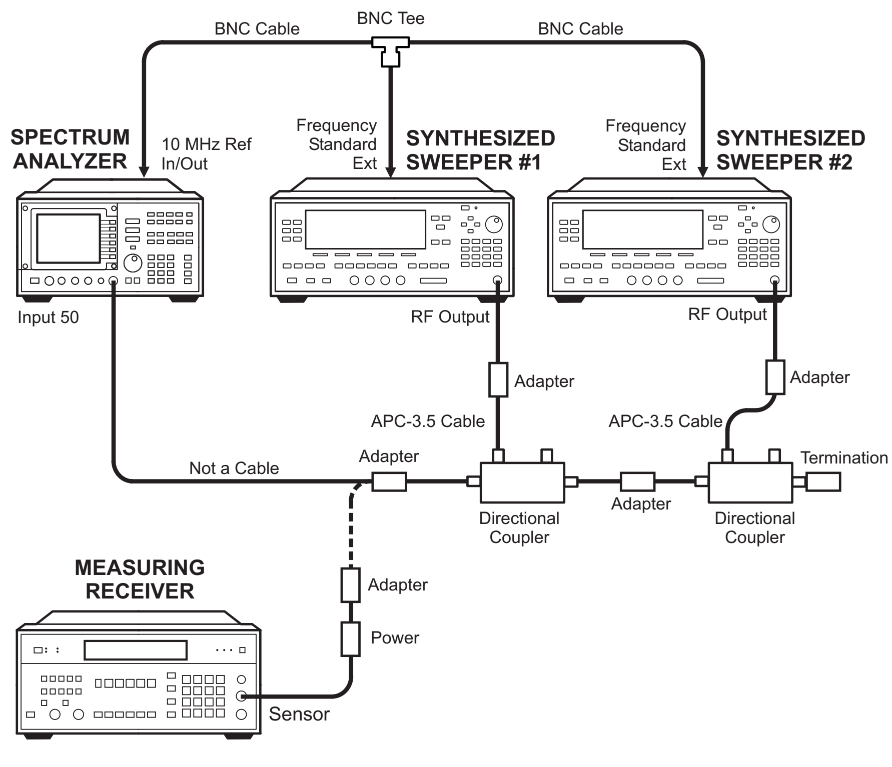


Figure 2-33 Third Order Intermodulation Test Setup (2.75 GHz to 6.5 GHz)



Equipment

Signal generator . . . . HP E4421B
Synthesized sweeper *(2 required)* . . . . HP 83640B
Measuring receiver . . . . HP 8902A
Power sensor . . . . HP 8481A
Directional bridge . . . . HP 8721A
Directional coupler *(2 required)* 0955-0098
50 MHz low-pass filter 0955-0306
50 Ω SMA termination 1810-0118

Adapters

Type N (f) to APC 2.4 (f) . . . . HP 11903B
Type N (m) to BNC (m) 1250-1473
Type N (f) to type N (f) 1250-1472
Type N (m) to BNC (f) 1250-1476
Type N (m) to APC 3.5 (m) 1250-1743
APC 3.5 (f) to APC 2.4 (f) *(2 required)* 5061-5311
SMA (m) to SMA (m) . . . . HP 11901B
BNC tee (m) (f) (f) 1250-0781

Cables

BNC, 122 cm (48 in.) *(4 required)* . . . . HP 10503A
APC 3.5, 91 cm (36 in.) *(2 required)* 8120-4291

Procedure

Third Order Intermodulation (< 2.9 GHz)

1. Connect the equipment as shown in Figure 2-32, but do not connect the directional bridge to the spectrum analyzer.
2. Set the HP E4421B controls as follows:

   Frequency . . . . 45 MHz

   Amplitude. . . . . –14 dBm

   Amplitude increment . . . . 0.04 dB
3. Press **INSTR PRESET** on the HP 83640B and set the controls as follows:

   CW frequency . . . . 45.05 MHz

   Power level. . . . . –110 dBm

   Modulation . . . . off

   RF power. . . . . off

   Frequency standard switch (rear panel). . . . . EXT
4. On the HP 8902A, set the controls as follows:

   Function . . . . RF power

   Log/linear . . . . Log
5. Press **PRESET** on the spectrum analyzer. Set the controls as follows:

   Center frequency . . . . 45.0 MHz

   Center frequency step . . . . .50 kHz

   Span . . . . .1 kHz

   Reference level . . . . –20 dBm

   Resolution BW . . . . .10 Hz
6. Zero the HP 8902A/HP 8481A combination and calibrate the HP 8481A at 50 MHz as described in the HP 8902A Operation Manual.
7. Connect the power sensor to the output of the directional bridge using an adapter; do not use a cable.
8. Press **Amplitude** on the HP E4421B and use the increment ⇓ and ⇑ keys to adjust the amplitude for a –20 dBm ±0.1 dB reading on the HP 8902A display.
9. Disconnect the power sensor from the directional bridge. Connect the directional bridge directly to the spectrum analyzer input using an adapter, not a cable.

10. On the spectrum analyzer, press **PEAK SEARCH, MKR** →, and **MARKER** → **REF LVL**. Wait for completion of a new sweep. Press **MKR, MARKER DELTA**, **FREQUENCY**, and ⇑.
11. On the HP 83640B, press **RF**, **ON**, **POWER LEVEL,** −14, and **dBm**.
12. On the spectrum analyzer, press **PEAK SEARCH**.
13. On the HP 83640B, adjust the power level for a ΔMKR amplitude reading of 0 dB ±0.17 dB on the spectrum analyzer.
14. On the spectrum analyzer, press **MKR, MARKER NORMAL**, **PEAK SEARCH, MARKER DELTA, FREQUENCY**, ⇓, and ⇓. Wait for completion of a new sweep. Press **PEAK SEARCH**.
15. Record the spectrum analyzer ΔMKR amplitude reading below as the lower product suppression.

Lower product suppression____________________ dBc

16. On the HP E4421B, press **FREQUENCY,** 45.05, and **MHz**.
17. On the HP 83640B, press **CW,** 45, **MHz**.
18. On the spectrum analyzer, press **FREQUENCY,** ⇑, ⇑, and ⇑. Wait for completion of a new sweep. Press **PEAK SEARCH**.
19. Record the spectrum analyzer ΔMKR amplitude reading below as the upper product suppression.

Upper product suppression____________________ dBc

20. Between the upper and lower product suppressions recorded in steps 15 and 19 above, record the more positive suppression as the third order intermodulation distortion at 45 MHz.

Third order
intermodulation distortion, 45 MHz____________ dBc

Third Order Intermodulation (2.9 GHz to 6.46 GHz)

21. Connect the equipment as shown in Figure 2-33, but do not connect the directional coupler to the spectrum analyzer. The spectrum analyzer provides the 10 MHz reference to the synthesized sweepers.
22. On each HP 83640B, press **INSTR PRESET**. Set the controls as follows:

Power level . . . . .0 dBm
Modulation . . . . off
RF power . . . . off
Frequency standard switch (Rear Panel). . . . . EXT

23. On HP 83640B #1, press **CW,** 5, and **GHz**.

24. On HP 83640B #2, press **CW,** 5.00005, and **GHz**.

25. Enter the power sensor 5 GHz calibration factor into the HP 8902A.

26. On the spectrum analyzer, press **PRESET**, **RECALL, MORE 1 OF 2**, and **FACTORY PRSEL PK**. Set the controls as follows:

    Center frequency . . . . .5.0 GHz

    Reference level . . . . –15 dBm

    Span . . . . .10 kHz

    Center frequency step . . . . .50 kHz

    Resolution BW . . . . .300 Hz

    Video average . . . . off

27. Connect the power sensor to the directional coupler using an adapter; do not use a cable.

28. On HP 83640B #1, press **RF**, **ON**, and **POWER LEVEL**. Adjust the power level for a –15 dBm ±0.1 dB reading on the HP 8902A display.

29. Disconnect the power sensor from the directional coupler. Connect the directional coupler to the spectrum analyzer INPUT 50 Ω using an adapter. Do not use a cable.

30. On the spectrum analyzer, press **PEAK SEARCH, AMPLITUDE**, **MORE 1 OF 3**, **MORE 2 OF 3,** and **PRESEL AUTO PK**. Wait for the PEAKING message to disappear. Press **SPAN,** 1, **kHz**, **BW**, 10, and **Hz**.

31. On the spectrum analyzer, press **PEAK SEARCH, MKR** →, and **MARKER** → **REF LVL**. Wait for completion of a new sweep. Press **MKR, MARKER DELTA, FREQUENCY**, and ⇑.

32. On HP 83640B #2, press **RF, ON**, and **POWER LEVEL**.

33. On the spectrum analyzer, press **PEAK SEARCH**.

34. On HP 83640B #2, adjust the power level for a ΔMKR amplitude reading of 0.0 dB ±0.17 dB on the spectrum analyzer.

35. On the spectrum analyzer, press **MKR**, **MARKER NORMAL**, **PEAK SEARCH**, **MARKER DELTA, FREQUENCY,** and ⇑. Press **BW**, **VID AVG ON**, 5, **Hz**, **TRACE**, and **CLEAR WRITE A**. Wait until VAVG 5 is displayed above the graticule.

36. Press **SGL SWP** and wait for completion of a new sweep. Press **PEAK SEARCH**. Record the spectrum analyzer ΔMKR amplitude reading below as the upper product suppression.

Upper product suppression ____________________ dBc

37. On the spectrum analyzer, press **FREQUENCY,** ⇓, ⇓, and ⇓. Press **TRIG, SWEEP CONT**, **TRACE**, and **CLEAR WRITE A**. Wait until VAVG 5 is displayed above the graticule.

38. Press **SGL SWP** and wait for completion of a new sweep. Press **PEAK SEARCH**. Record the spectrum analyzer ΔMKR amplitude reading below as the lower product suppression.

Lower product suppression_____________________ dBc

39. Between the upper and lower product suppressions recorded in steps 36 and 38 above, record the more positive suppression as the uncorrected third order intermodulation distortion.

Uncorrected third order
intermodulation distortion _____________________ dBc

40. The uncorrected third order intermodulation distortion represents the distortion with –25 dBm at the input mixer. The distortion products with –30 dBm at the input mixer will be 10 dB lower than the distortion products measured. Subtract 10 dB from the uncorrected third order intermodulation distortion and record the result as the third order intermodulation distortion at 5 GHz.

Third order
intermodulation distortion, 5 GHz ______________ dBc

Third Order Intermodulation (>6.46 GHz)

41. On HP 83640B #1, press **CW,** 8, **GHz**, **POWER LEVEL,** 0, **dBm, RF,** and **OFF**.
42. On HP 83640B #2, press **CW,** 8.00005, **GHz**, **POWER LEVEL,** 0, **dBm**, **RF,** and **OFF**.
43. Enter the power sensor 8 GHz calibration factor into the HP 8902A.
44. On the spectrum analyzer, press **PRESET, RECALL, MORE 1 OF 2**, and **FACTORY PRSEL PK**. Set the controls as follows:

    Center frequency . . . . .8.0 GHz

    Reference level . . . . –15 dBm

    Span . . . . .10 kHz

    Center frequency step . . . . .50 kHz

    Resolution BW . . . . .300 Hz

    Video average . . . . off

45. Disconnect the directional coupler from the spectrum analyzer. Connect the power sensor to the directional coupler using an adapter; do not use a cable.
46. On HP 83640B #1, press **RF, ON**, and **POWER LEVEL**. Adjust the power level for a –15 dBm ±0.1 dB reading on the HP 8902A display.
47. Disconnect the power sensor from the directional coupler. Connect the directional coupler to the spectrum analyzer INPUT 50 Ω using an adapter. Do not use a cable.
48. On the spectrum analyzer, press **PEAK SEARCH**, **AMPLITUDE**, **MORE 1 OF 3, MORE 2 OF 3,** and **PRESEL AUTO PK**. Wait for the PEAKING message to disappear. Press **SPAN,** 1, **kHz BW,** 10, and **Hz**.
49. On the spectrum analyzer, press **PEAK SEARCH, MKR** →, and **MARKER** → **REF LVL**. Wait for completion of a new sweep. Press **MKR, MARKER DELTA, FREQUENCY**, and ⇑.
50. On HP 83640B #2, press **RF, ON**, and **POWER LEVEL**.
51. On the spectrum analyzer, press **PEAK SEARCH**.
52. On HP 83640B #2, adjust the power level for a ΔMKR amplitude reading of 0.0 dB ±0.17 dB on the spectrum analyzer.
53. On the spectrum analyzer, press **MKR**, **MARKER NORMAL**, **PEAK SEARCH, MARKER DELTA**, **FREQUENCY**, and ⇑. Press **BW**, **VID AVG ON,** 5, **Hz**, **TRACE,** and **CLEAR WRITE A**. Wait until VAVG 5 is displayed above the graticule.
54. Press **SGL SWP** and wait for completion of a new sweep. Press **PEAK SEARCH**. Record the spectrum analyzer ΔMKR amplitude reading below as the upper product suppression.

Upper product suppression ____________________ dBc

55. On the spectrum analyzer, press **FREQUENCY,** ⇓, ⇓, and ⇓. Press **TRIG**, **SWEEP CONT, TRACE**, and **CLEAR WRITE A**. Wait until VAVG 5 is displayed above the graticule.

56. Press **SGL SWP** and wait for completion of a new sweep. Press **PEAK SEARCH**. Record the spectrum analyzer ΔMKR amplitude reading below as the lower product suppression.

Lower product suppression_____________________ dBc

57. Between the upper and lower product suppressions recorded in steps 54 and 56 above, record the more positive suppression as the uncorrected third order intermodulation distortion.

Uncorrected third order
intermodulation distortion _____________________ dBc

58. Subtract 10 dB from the uncorrected third order intermodulation distortion and record the result as the third order intermodulation distortion at 8 GHz.

Third order
intermodulation distortion, 8 GHz ______________ dBc

46a. Third Order Intermodulation Distortion: HP 8564E/EC, 8565E/EC

Instrument Under Test

HP 8564E/EC
HP 8565E/EC

Related Specification

Third Order Intermodulation Distortion

Related Adjustment

1st LO Distribution Amplifier Adjustment

Description

Two synthesized sources provide the signals required for measuring third order intermodulation distortion. In the 30 Hz to 2.9 GHz band, a filter is used to attenuate the second harmonic of the signal closest to the distortion product being measured. A filter is not necessary in the preselected bands. The spectrum analyzer provides the 10 MHz reference for the synthesized sources.

Figure 2-34 Third Order Intermodulation Test Setup (50 Hz to 2.9 GHz)

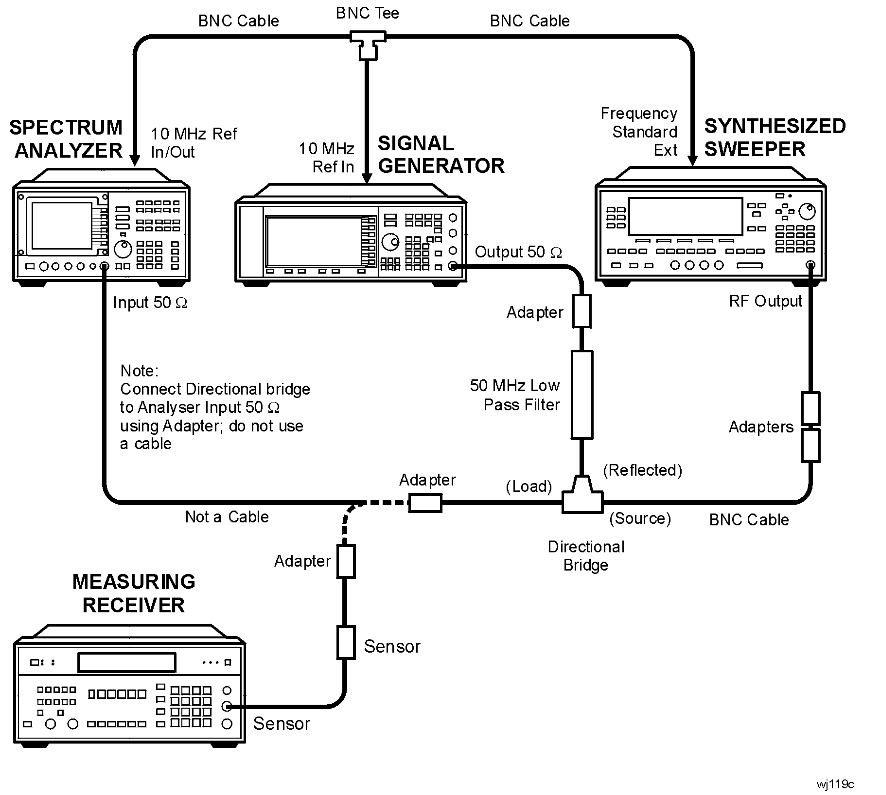
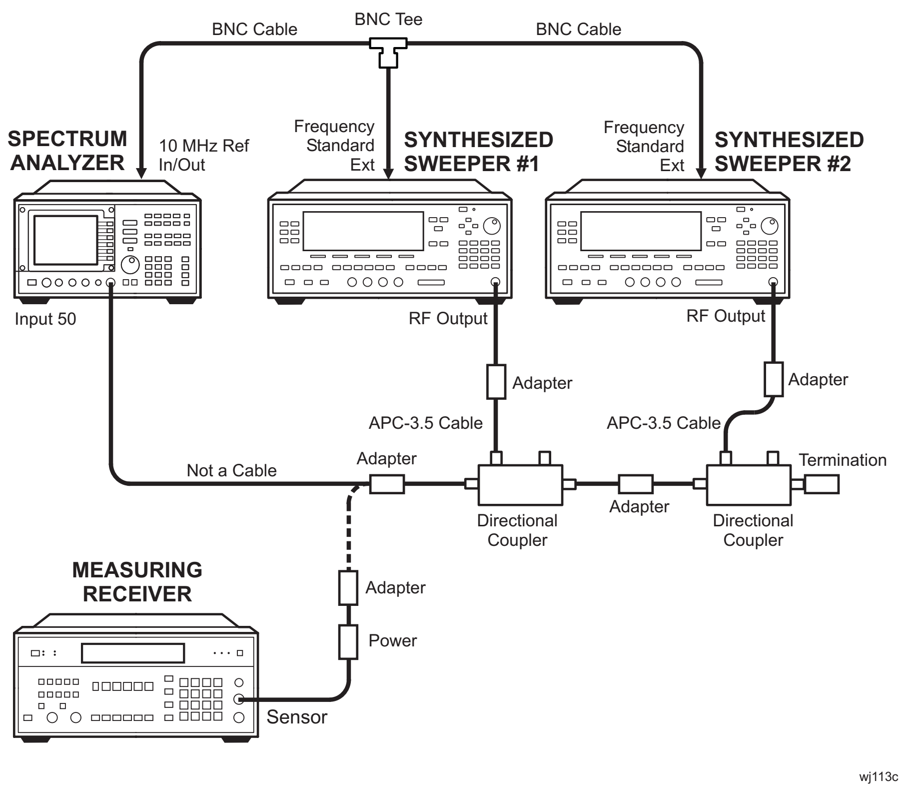


Figure 2-35 Third Order Intermodulation Test Setup (2.75 GHz to 6.5 GHz)



Equipment

Signal generator . . . . HP E4421B
Synthesized sweeper #1 . . . . HP 83640B
Synthesized sweeper #2 . . . . HP 83650A
Measuring receiver . . . . HP 8902A
Power sensor . . . . HP 8481A
Directional bridge . . . . HP 8721A
Directional coupler *(2 required)* 0955-0098
50 MHz low-pass filter 0955-0306
50 Ω SMA termination 1810-0118

Adapters

Type N (f) to APC 2.4mm (f). . . . . HP 11903B
Type N (m) to BNC (m) *(2 required)* 1250-1473
Type N (m) to BNC (f) 1250-1476
Type N (f) to type N (f) 1250-1472
Type N (m) to APC 3.5 (m) 1250-1743
SMA (m) to SMA (m). 1250-1159
BNC tee (m) (f) (f) 1250-0781
APC 3.5 (f) to 2.4 mm (f) *(2 required)*. . . . . HP 11901B

Cables

BNC, 122 cm (48 in.) *(4 required)*. . . . . HP 10503A
APC 3.5, 91 cm (36 in.) *(2 required)*. 8120-4291

Procedure

Third Order Intermodulation (< 2.9 GHz)

1. Connect the equipment as shown in Figure 2-34, but do not connect the directional bridge to the spectrum analyzer.
2. Set the HP E4421B controls as follows:

   Frequency . . . . 45 MHz

   Amplitude . . . .–14 dBm

   Amplitude increment . . . . .0.04 dB

   Output . . . . 50 Ω
3. Press **INSTR PRESET** on the HP 83640B and set the controls as follows:

   CW frequency . . . . .45.05 MHz

   Power level . . . . –110 dBm

   Modulation . . . . off

   RF power . . . . off

   Frequency standard switch (rear panel) . . . . EXT
4. On the HP 8902A, set the controls as follows:

   Function. . . . . RF power

   Log/linear. . . . . Log
5. Press **PRESET** on the spectrum analyzer. Set the controls as follows:

   Center frequency. . . . . 45.0 MHz

   Center frequency step . . . . 50 kHz

   Span . . . . 1 kHz

   Reference level . . . .–20 dBm

   Resolution BW. . . . . 10 Hz
6. Zero the HP 8902A/HP 8485A combination and calibrate the HP 8481A at 50 MHz as described in the HP 8902A Operation Manual.
7. Connect the power sensor to the output of the directional bridge using an adapter; do not use a cable.
8. Press **Amplitude** on the HP E4421B and use the increment ⇓ and ⇑ keys to adjust the amplitude for a –20 dBm ±0.1 dB reading on the HP 8902A display.
9. Disconnect the power sensor from the directional bridge. Connect the directional bridge directly to the spectrum analyzer input using an adapter, not a cable.

10. On the spectrum analyzer, press **PEAK SEARCH**, **MKR** →, and **MARKER** → **REF LVL**. Wait for completion of a new sweep. Press **MKR, MARKER DELTA**, **FREQUENCY**, and ⇑.

11. On the HP 83640B, press **RF**, **ON**, **POWER LEVEL**, −14, and **dBm**.

12. On the spectrum analyzer, press **PEAK SEARCH**.

13. On the HP 83640B, adjust the power level for a ΔMKR amplitude reading of 0 dB ±0.17 dB on the spectrum analyzer.

14. On the spectrum analyzer, press **MKR**, **MARKER NORMAL**, **PEAK SEARCH, MARKER DELTA**, **FREQUENCY**, ⇓, and ⇓. Wait for completion of a new sweep. Press **PEAK SEARCH**.

15. Record the spectrum analyzer ΔMKR amplitude reading below as the lower product suppression.

Lower product suppression ____________________ dBc

16. On the HP E4421B, press **FREQUENCY,** 45.05, and **MHz**.

17. On the HP 83640B, press **CW,** 45, and **MHz**.

18. On the spectrum analyzer, press **FREQUENCY**, ⇑, ⇑, and ⇑. Wait for completion of a new sweep. Press **PEAK SEARCH**.

19. Record the spectrum analyzer ΔMKR amplitude reading below as the upper product suppression.

Upper product suppression ____________________ dBc

20. Between the upper and lower product suppressions recorded in steps 15 and 19 above, record the more positive suppression as the third order intermodulation distortion at 45 MHz.

Third order
intermodulation distortion, 45 MHz ____________ dBc

Third Order Intermodulation (2.9 GHz to 6.46 GHz)

21. Connect the equipment as shown in Figure 2-35, but do not connect the directional coupler to the spectrum analyzer. The spectrum analyzer provides the 10 MHz reference to the synthesized sweepers.

22. On the HP 83640B, press **INSTR PRESET**. Set the controls as follows:

    Power level . . . . .0 dBm

    Modulation . . . . off

    RF power . . . . off

    Frequency standard switch (Rear Panel). . . . . EXT

23. On the HP 83650A, press **PRESET**. Set the controls as follows:

    Power level . . . . .0 dBm

    Modulation . . . . off

    RF power . . . . off

24. On the HP 83640B, press **CW**, 5, and **GHz**.

25. On the HP 83650A, press **CW**, 5.00005, and **GHz**.

26. Enter the power sensor 5 GHz calibration factor into the HP 8902A.

27. On the spectrum analyzer, press **PRESET, RECALL**, **MORE 1 OF 2**, and **FACTORY PRSEL PK**. Set the controls as follows:

    Center frequency. . . . . 5.0 GHz

    Reference level . . . .–15 dBm

    Span . . . . 10 kHz

    Center frequency step . . . . 50 kHz

    Resolution BW. . . . . 300 Hz

    Video average . . . . off

28. Connect the power sensor to the directional coupler using an adapter; do not use a cable.

29. On the HP 83640B, press **RF, ON**, and **POWER LEVEL**. Adjust the power level for a –15 dBm ±0.1 dB reading on the HP 8902A display.

30. Disconnect the power sensor from the directional coupler. Connect the directional coupler to the spectrum analyzer INPUT 50 Ω using an adapter. Do not use a cable.

31. On the spectrum analyzer, press **PEAK SEARCH**, **AMPLITUDE**, **MORE 1 OF 3**, **MORE 2 OF 3**, and **PRESEL AUTO PK**. Wait for the `PEAKING` message to disappear. Press **SPAN,** 1, **kHz**, **BW**, 10, and **Hz**.

32.On the spectrum analyzer, press **PEAK SEARCH**, **MKR** →, and **MARKER** → **REF LVL**. Wait for completion of a new sweep. Press **MKR, MARKER DELTA**, **FREQUENCY,** and ⇑.

33.On the HP 83650A, press **RF, ON**, and **POWER LEVEL**.

34.On the spectrum analyzer, press **PEAK SEARCH**.

35.On the HP 83650A, adjust the power level for a ΔMKR amplitude reading of 0.0 dB ±0.17 dB on the spectrum analyzer.

36.On the spectrum analyzer, press **MKR, MARKER NORMAL**, **PEAK SEARCH, MARKER DELTA, FREQUENCY,** and ⇑. Press **BW**, **VID AVG ON**, 5, **Hz**, **TRACE,** and **CLEAR WRITE A**. Wait until VAVG 5 is displayed above the graticule.

37.Press **SGL SWP** and wait for completion of a new sweep. Press **PEAK SEARCH**. Record the spectrum analyzer ΔMKR amplitude reading below as the upper product suppression.

Upper product suppression ____________________ dBc

38.On the spectrum analyzer, press **FREQUENCY,** ⇑, ⇑, and ⇑. Press **TRIG**, **SWEEP CONT, TRACE**, and **CLEAR WRITE A**. Wait until VAVG 5 is displayed above the graticule.

39.Press **SGL SWP** and wait for completion of a new sweep. Press **PEAK SEARCH**. Record the spectrum analyzer ΔMKR amplitude reading below as the lower product suppression.

Lower product suppression ____________________ dBc

40.Between the upper and lower product suppressions recorded in steps 37 and 39 above, record the more positive suppression as the uncorrected third order intermodulation distortion.

Uncorrected third order
intermodulation distortion ____________________ dBc

41.The uncorrected third order intermodulation distortion represents the distortion with –25 dBm at the input mixer. The distortion products with –30 dBm at the input mixer will be 10 dB lower than the distortion products measured. Subtract 10 dB from the uncorrected third order intermodulation distortion and record the result as the third order intermodulation distortion at 5 GHz.

Third order
intermodulation distortion, 5 GHz _____________ dBc

Third Order Intermodulation (>6.46 GHz)

42. On the HP 83640B, press **CW**, 8, **GHz**, **POWER LEVEL**, 0, **dBm**, **RF,** and **OFF**.
43. On the HP 83650A, press **CW,** 8.00005, **GHz**, **POWER LEVEL**, 0, **dBm**, **RF,** and **OFF**.
44. Enter the power sensor 8 GHz calibration factor into the HP 8902A.
45. On the spectrum analyzer, press **PRESET, RECALL**, **MORE 1 OF 2**, and **FACTORY PRSEL PK**. Set the controls as follows:

    Center frequency . . . . 8.0 GHz

    Reference level . . . . –15 dBm

    Span . . . . 10 kHz

    Center frequency step . . . . 50 kHz

    Resolution BW. . . . . 300 Hz

    Video average . . . . off
46. Disconnect the directional coupler from the spectrum analyzer. Connect the power sensor to the directional coupler using an adapter; do not use a cable.
47. On the HP 83640B, press **RF, ON**, and **POWER LEVEL**. Adjust the power level for a –15 dBm ±0.1 dB reading on the HP 8902A display.
48. Disconnect the power sensor from the directional coupler. Connect the directional coupler to the spectrum analyzer INPUT 50 Ω using an adapter. Do not use a cable.
49. On the spectrum analyzer, press **PEAK SEARCH, AMPLITUDE**, **MORE 1 OF 3, MORE 2 OF 3,** and **PRESEL AUTO PK**. Wait for the PEAKING message to disappear. Press **SPAN,** 1, **kHz**, **BW**, 10, and **Hz**.
50. On the spectrum analyzer, press **PEAK SEARCH, MKR** →, and **MARKER** → **REF LVL**. Wait for completion of a new sweep. Press **MKR, MARKER DELTA**, **FREQUENCY,** and ⇑.
51. On the HP 83650A, press **RF, ON**, and **POWER LEVEL**.
52. On the spectrum analyzer, press **PEAK SEARCH**.
53. On the HP 83650A, adjust the power level for a ΔMKR amplitude reading of 0.0 dB ±0.17 dB on the spectrum analyzer.
54. On the spectrum analyzer, press **MKR**, **MARKER NORMAL**, **PEAK SEARCH**, **MARKER DELTA**, **FREQUENCY**, and ⇑. Press **BW**, **VID AVG ON,** 5, **Hz**, **TRACE,** and **CLEAR WRITE A**. Wait until VAVG 5 is displayed above the graticule.
55. Press **SGL SWP** and wait for completion of a new sweep. Press **PEAK SEARCH**. Record the spectrum analyzer ΔMKR amplitude reading below as the upper product suppression.

Upper product suppression____________________ dBc

56. On the spectrum analyzer, press **FREQUENCY,** ⇓, ⇓, and ⇓. Press **TRIG**, **SWEEP CONT, TRACE,** and **CLEAR WRITE A**. Wait until VAVG 5 is displayed above the graticule.

57. Press **SGL SWP** and wait for completion of a new sweep. Press **PEAK SEARCH**. Record the spectrum analyzer ΔMKR amplitude reading below as the lower product suppression.

Lower product suppression ____________________ dBc

58. Between the upper and lower product suppressions recorded in steps 55 and 57 above, record the more positive suppression as the uncorrected third order intermodulation distortion.

Uncorrected third order
intermodulation distortion ____________________ dBc

59. Subtract 10 dB from the uncorrected third order intermodulation distortion and record the result as the third order intermodulation distortion at 8 GHz.

Third order
intermodulation distortion, 8 GHz _____________ dBc

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