Calibration Guide

HP ESA Spectrum Analyzers

This manual provides documentation for the following instruments:

HP ESA-E Series
HP E4401B
HP E4402B
HP E4404B
HP E4405B
HP E4407B

and

HP ESA-L Series
HP E4403B
HP E4408B
HP E4411B

HEWLETT® PACKARD

Manufacturing Part Number: E4401-90132
Printed in USA
September 1999

Supersedes E4401-90108

The following safety symbols are used throughout this manual. Familiarize yourself with the symbols and their meaning before operating this instrument.

WARNING

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

WARNING

This is a Safety Class 1 Product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protected earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.

WARNING

If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for protection are intact) only.

CAUTION

Caution denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in damage to or destruction of the instrument. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.

WARNING **This is a Safety Class 1 Product (provided with a protective earthing ground incorporated in the power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.**

WARNING **If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for protection are intact) only.**

CAUTION Always use the three-prong ac power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord may cause product damage.

CAUTION This instrument has autoranging line voltage input, be sure the supply voltage is within the specified range.

Warranty

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by Hewlett-Packard. Buyer shall prepay shipping charges to Hewlett-Packard and Hewlett-Packard shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to Hewlett-Packard from another country.

Hewlett-Packard warrants that its software and firmware designated by Hewlett-Packard for use with an instrument will execute its programming instructions when properly installed on that instrument. Hewlett-Packard does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error-free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HEWLETT-PACKARD SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HEWLETT-PACKARD SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

Where to Find the Latest Information

Documentation is updated periodically. For the latest information about HP ESA Spectrum Analyzers, including firmware upgrades and application information, please visit the following Internet URL: http//www.hp.com/go/esa.

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1 Calibrating

Calibration

This chapter identifies the performance test procedures which test the electrical performance of the analyzer.

Allow the analyzer to warm up in accordance with the temperature stability specifications before performing the tests in this chapter.

None of the test procedures involve removing the cover of the analyzer.

Calibration verifies that the analyzer performance is within all specifications. It is time consuming and requires extensive test equipment. Calibration consists of *all* the performance tests. For a complete listing of the performance tests, see the performance verification tests table for your specific analyzer.

Calibration Cycle

The performance tests in chapter 2 should be used to check the analyzer against its specifications once every year. Specifications are listed in this calibration guide.

Performance Verification Test Tables

The tables on the following pages list the performance tests in Chapter 2, “Performance Verification Tests”, required for each model number. Perform all the tests marked with a dot in the “Std” (standard) column. If any options are installed in the analyzer, also perform all tests marked with a dot in the appropriate option column.

Table 1-1 HP E4401B Performance Verification Tests

Performance Test Name		Calibration for Instrument Option:						
		Std[a]	1DN	1DQ	1DS	AYX	1D5	1D6
1.	10 MHz Reference Output Accuracy[b]	•						
2.	10 MHz Precision Frequency Reference Output Accuracy						•	
3.	Frequency Readout and Marker Frequency Count Accuracy	•						
5.	Frequency Span Readout Accuracy	•						
7.	Noise Sidebands	•						
8.	System Related Sidebands	•						
9.	Residual FM	•						
10.	Sweep Time Accuracy	•						
11.	Display Scale Fidelity	•						
12.	Input Attenuation Switching Uncertainty	•						
13.	Reference Level Accuracy	•						
15.	Resolution Bandwidth Switching Uncertainty	•						
16.	Absolute Amplitude Accuracy (Reference Settings)	•						
18.	Overall Absolute Amplitude Accuracy	•						
20.	Resolution Bandwidth Accuracy	•						
21.	Frequency Response	•						
24.	Frequency Response (Preamp On)				•			
27.	Other Input Related Spurious Responses	•						
29.	Spurious Responses	•						
32.	Gain Compression	•						
34.	Displayed Average Noise Level	•						
38.	Residual Responses	•						
39.	Fast Time Domain Amplitude Accuracy					•		
40.	Tracking Generator Absolute Amplitude and Vernier Accuracy		•	•				
42.	Tracking Generator Level Flatness		•	•				
44.	Tracking Generator Harmonic Spurious Outputs		•	•				
46.	Tracking Generator Non-Harmonic Spurious Outputs		•	•				
49.	Gate Delay Accuracy and Gate Length Accuracy							•
50.	Gate Mode Amplitude Error							•

a. Perform these tests for all HP E4401B analyzers.
b. Perform this test only on analyzers not equipped with Option 1D5.

Table 1-2 HP E4402B Performance Verification Tests

Performance Test Name		Calibration for Instrument Option:					
		Std[a]	1DN	1DS	AYX	1D5	1D6
1.	10 MHz Reference Output Accuracy[b]	•					
2.	10 MHz Precision Frequency Reference Output Accuracy					•	
3.	Frequency Readout and Marker Frequency Count Accuracy	•					
6.	Frequency Span Readout Accuracy	•					
7.	Noise Sidebands	•					
8.	System Related Sidebands	•					
9.	Residual FM	•					
10.	Sweep Time Accuracy	•					
11.	Display Scale Fidelity	•					
12.	Input Attenuation Switching Uncertainty	•					
14.	Reference Level Accuracy	•					
15.	Resolution Bandwidth Switching Uncertainty	•					
17.	Absolute Amplitude Accuracy (Reference Settings)	•					
19.	Overall Absolute Amplitude Accuracy	•					
20.	Resolution Bandwidth Accuracy	•					
22.	Frequency Response	•					
25.	Frequency Response (Preamp On)			•			
28.	Other Input Related Spurious Responses	•					
30.	Spurious Responses	•					
32.	Gain Compression	•					
35.	Displayed Average Noise Level	•					
38.	Residual Responses	•					
39.	Fast Time Domain Amplitude Accuracy				•		
41.	Tracking Generator Absolute Amplitude and Vernier Accuracy		•				
43.	Tracking Generator Level Flatness		•				
45.	Tracking Generator Harmonic Spurious Outputs		•				
47.	Tracking Generator Non-Harmonic Spurious Outputs		•				
48.	Tracking Generator L.O. Feedthrough Amplitude		•				
49.	Gate Delay Accuracy and Gate Length Accuracy						•
50.	Gate Mode Amplitude Error						•

a. Perform these tests for all HP E4402B analyzers.
b. Perform this test only on analyzers not equipped with Option 1D5.

Table 1-3 HP E4403B Performance Verification Tests

Performance Test Name		Calibration for Instrument Option:	
		Std[a]	1DN
1.	10 MHz Reference Output Accuracy	•	
3.	Frequency Readout and Marker Frequency Count Accuracy	•	
6.	Frequency Span Readout Accuracy	•	
7.	Noise Sidebands	•	
8.	System Related Sidebands	•	
9.	Residual FM	•	
10.	Sweep Time Accuracy	•	
11.	Display Scale Fidelity	•	
12.	Input Attenuation Switching Uncertainty	•	
14.	Reference Level Accuracy	•	
15.	Resolution Bandwidth Switching Uncertainty	•	
17.	Absolute Amplitude Accuracy (Reference Settings)	•	
19.	Overall Absolute Amplitude Accuracy	•	
20.	Resolution Bandwidth Accuracy	•	
22.	Frequency Response	•	
28.	Other Input Related Spurious Responses	•	
30.	Spurious Responses	•	
32.	Gain Compression	•	
35.	Displayed Average Noise Level	•	
38.	Residual Responses	•	
41.	Tracking Generator Absolute Amplitude and Vernier Accuracy		•
43.	Tracking Generator Level Flatness		•
45.	Tracking Generator Harmonic Spurious Outputs		•
47.	Tracking Generator Non-Harmonic Spurious Outputs		•
48.	Tracking Generator L.O. Feedthrough Amplitude		•

a. Perform these tests on all E4403B analyzers.

Table 1-4 HP E4404B Performance Verification Tests

Performance Test Name	Calibration for Instrument Option:					
	Std[a]	1DN	1DS	AYX	1D5	1D6
1. 10 MHz Reference Output Accuracy[b]	•					
2. 10 MHz Precision Frequency Reference Output Accuracy					•	
4. Frequency Readout and Marker Frequency Count Accuracy	•					
6. Frequency Span Readout Accuracy	•					
7. Noise Sidebands	•					
8. System Related Sidebands	•					
9. Residual FM	•					
10. Sweep Time Accuracy	•					
11. Display Scale Fidelity	•					
12. Input Attenuation Switching Uncertainty	•					
14. Reference Level Accuracy	•					
15. Resolution Bandwidth Switching Uncertainty	•					
17. Absolute Amplitude Accuracy (Reference Settings)	•					
19. Overall Absolute Amplitude Accuracy	•					
20. Resolution Bandwidth Accuracy	•					
23. Frequency Response	•					
26. Frequency Response (Preamp On)			•			
28. Other Input Related Spurious Responses	•					
31. Spurious Responses	•					
33. Gain Compression	•					
36. Displayed Average Noise Level	•					
38. Residual Responses	•					
39. Fast Time Domain Amplitude Accuracy				•		
41. Tracking Generator Absolute Amplitude and Vernier Accuracy		•				
43. Tracking Generator Level Flatness		•				
45. Tracking Generator Harmonic Spurious Outputs		•				
47. Tracking Generator Non-Harmonic Spurious Outputs		•				
48. Tracking Generator L.O. Feedthrough Amplitude		•				
49. Gate Delay Accuracy and Gate Length Accuracy						•
50. Gate Mode Amplitude Error						•

a. Perform these tests on all HP E4404B analyzers.
b. Perform this test only on analyzers not equipped with Option 1D5.

Table 1-5 HP E4405B Performance Verification Tests

	Performance Test Name	Calibration for Instrument Option:					
		Std[a]	1DN	1DS	AYX	1D5	1D6
1.	10 MHz Reference Output Accuracy[b]	•					
2.	10 MHz Precision Frequency Reference Output Accuracy					•	
4.	Frequency Readout and Marker Frequency Count Accuracy	•					
6.	Frequency Span Readout Accuracy	•					
7.	Noise Sidebands	•					
8.	System Related Sidebands	•					
9.	Residual FM	•					
10.	Sweep Time Accuracy	•					
11.	Display Scale Fidelity	•					
12.	Input Attenuation Switching Uncertainty	•					
14.	Reference Level Accuracy	•					
15.	Resolution Bandwidth Switching Uncertainty	•					
17.	Absolute Amplitude Accuracy (Reference Settings)	•					
19.	Overall Absolute Amplitude Accuracy	•					
20.	Resolution Bandwidth Accuracy	•					
23.	Frequency Response	•					
26.	Frequency Response (Preamp On)			•			
28.	Other Input Related Spurious Responses	•					
31.	Spurious Responses	•					
33.	Gain Compression	•					
36.	Displayed Average Noise Level	•					
38.	Residual Responses	•					
39.	Fast Time Domain Amplitude Accuracy				•		
41.	Tracking Generator Absolute Amplitude and Vernier Accuracy		•				
43.	Tracking Generator Level Flatness		•				
45.	Tracking Generator Harmonic Spurious Outputs		•				
47.	Tracking Generator Non-Harmonic Spurious Outputs		•				
48.	Tracking Generator L.O. Feedthrough Amplitude		•				
49.	Gate Delay Accuracy and Gate Length Accuracy						•
50.	Gate Mode Amplitude Error						•

a. Perform these tests on all HP E4405B analyzers.
b. Perform this test only if the analyzer is not equipped with Option 1D5.

Table 1-6 HP E4407B Performance Verification Tests

Performance Test Name		Calibration for Instrument Option:						
		Std[a]	1DN	1DS	AYX	1D5	1D6	AYZ
1.	10 MHz Reference Output Accuracy[b]	•						
2.	10 MHz Precision Frequency Reference Output Accuracy					•		
4.	Frequency Readout and Marker Frequency Count Accuracy	•						
6.	Frequency Span Readout Accuracy	•						
7.	Noise Sidebands	•						
8.	System Related Sidebands	•						
9.	Residual FM	•						
10.	Sweep Time Accuracy	•						
11.	Display Scale Fidelity	•						
12.	Input Attenuation Switching Uncertainty	•						
14.	Reference Level Accuracy	•						
15.	Resolution Bandwidth Switching Uncertainty	•						
17.	Absolute Amplitude Accuracy (Reference Settings)	•						
19.	Overall Absolute Amplitude Accuracy	•						
20.	Resolution Bandwidth Accuracy	•						
23.	Frequency Response	•						
26.	Frequency Response (Preamp On)			•				
28.	Other Input Related Spurious Responses	•						
31.	Spurious Responses	•						
33.	Gain Compression	•						
37.	Displayed Average Noise Level	•						
38.	Residual Responses	•						
39.	Fast Time Domain Amplitude Accuracy				•			
41.	Tracking Generator Absolute Amplitude and Vernier Accuracy		•					
43.	Tracking Generator Level Flatness		•					
45.	Tracking Generator Harmonic Spurious Outputs		•					
47.	Tracking Generator Non-Harmonic Spurious Outputs		•					
48.	Tracking Generator L.O. Feedthrough Amplitude		•					
49.	Gate Delay Accuracy and Gate Length Accuracy						•	
50.	Gate Mode Amplitude Error						•	
51.	First LO OUTPUT Amplitude Accuracy							•
52.	IF INPUT Accuracy							•

a. Perform these tests on all HP E4407B analyzers.
b. Perform this test only on analyzers not equipped with Option 1D5.

Table 1-7 HP E4408B Performance Verification Tests

Performance Test Name	Calibration for Instrument Option:	
	Std[a]	1DN
1. 10 MHz Reference Output Accuracy	•	
4. Frequency Readout and Marker Frequency Count Accuracy	•	
6. Frequency Span Readout Accuracy	•	
7. Noise Sidebands	•	
8. System Related Sidebands	•	
9. Residual FM	•	
10. Sweep Time Accuracy	•	
11. Display Scale Fidelity	•	
12. Input Attenuation Switching Uncertainty	•	
14. Reference Level Accuracy	•	
15. Resolution Bandwidth Switching Uncertainty	•	
17. Absolute Amplitude Accuracy (Reference Settings)	•	
19. Overall Absolute Amplitude Accuracy	•	
20. Resolution Bandwidth Accuracy	•	
23. Frequency Response	•	
28. Other Input Related Spurious Responses	•	
31. Spurious Responses	•	
33. Gain Compression	•	
37. Displayed Average Noise Level	•	
38. Residual Responses	•	
41. Tracking Generator Absolute Amplitude and Vernier Accuracy		•
43. Tracking Generator Level Flatness		•
45. Tracking Generator Harmonic Spurious Outputs		•
47. Tracking Generator Non-Harmonic Spurious Outputs		•
48. Tracking Generator L.O. Feedthrough Amplitude		•

a. Perform these tests on all HP E4408B analyzers.

Table 1-8 HP E4411B Performance Verification Tests

	Performance Test Name	Calibration for Instrument Option: Std[a]	1DN	1DQ
1.	10 MHz Reference Output Accuracy	•		
3.	Frequency Readout and Marker Frequency Count Accuracy	•		
5.	Frequency Span Readout Accuracy	•		
7.	Noise Sidebands	•		
8.	System Related Sidebands	•		
9.	Residual FM	•		
10.	Sweep Time Accuracy	•		
11.	Display Scale Fidelity	•		
12.	Input Attenuation Switching Uncertainty	•		
13.	Reference Level Accuracy	•		
15.	Resolution Bandwidth Switching Uncertainty	•		
16.	Absolute Amplitude Accuracy (Reference Settings)	•		
18.	Overall Absolute Amplitude Accuracy	•		
20.	Resolution Bandwidth Accuracy	•		
21.	Frequency Response	•		
27.	Other Input Related Spurious Responses	•		
29.	Spurious Responses	•		
32.	Gain Compression	•		
34.	Displayed Average Noise Level	•		
38.	Residual Responses	•		
40.	Tracking Generator Absolute Amplitude and Vernier Accuracy		•	•
42.	Tracking Generator Level Flatness		•	•
44.	Tracking Generator Harmonic Spurious Outputs		•	•
46.	Tracking Generator Non-Harmonic Spurious Outputs		•	•

a. Perform these tests on all HP E4411B analyzers.

Before You Start

There are four things you should do before starting the performance verification tests:

- Switch the analyzer on and let it warm up for five minutes.
- If the analyzer is an HP E4402B, E4403B, E4404B, E4405B, E4407B, or E4408B, connect a cable from AMPTD REF OUT to Input 50Ω.
- Press **System**, **Alignments**, **Align Now**, **All**, and wait for the auto alignments to finish.
- Read the rest of this section before you start any of the tests, and make a copy of the Performance Verification Test Record described below in "Recording the test results."

Recording the test results

Performance verification test records, for each spectrum analyzer, are provided in the chapter following the tests.

Each test result is identified as a *TR Entry* in the performance tests and on the performance verification test record. We recommend that you make a copy of the performance verification test record, record the test results on the copy, and keep the copy for your calibration test record. This record could prove valuable in tracking gradual changes in test results over long periods of time.

Self-Alignment

Perform a complete self-alignment at least once per day, or if the analyzer fails a verification test. To perform a self-alignment, press **System**, **Alignment**, **Align Now**, **All**. The instrument must be up to operating temperature in order for this test to be valid. If the analyzer continuously fails one or more specifications, complete any remaining tests and record all test results on a copy of the test record. Then refer to Chapter 12, "If You Have a Problem" for instructions on how to solve the problem.

Periodically verifying operation

The analyzer requires periodic verification of operation. Under most conditions of use, you should test the analyzer at least once a year with the complete set of performance verification tests.

Test equipment you will need

The following tables list the recommended test equipment for the performance tests. The tables also list recommended equipment for the analyzer adjustment procedures which are located in the *HP ESA Spectrum Analyzers Assembly-Level Repair Service Guide*. Any equipment that meets the critical specifications given in the table can be substituted for the recommended model.

Table 1-9 Recommended Test Equipment

Equipment	Critical Specifications for Equipment Substitution	Recommended Model	Use[a]
Digital Multimeter	Input Resistance ≥10 megohms Accuracy: 10 mV on 100 V range	HP 3458A	P,A,T
DVM Test Leads	For use with HP 3458A Digital Multimeter	HP 34118B	T
Universal Counter	Frequency Range: 10 MHz 100 Hz Time Interval Range: 25 ms to 100 ms Single Operation Range: +2.5 Vdc to –2.5 Vdc External Reference Input	HP 53132A	P,A,T
Frequency Standard	Frequency: 10 MHz Timebase Accuracy (Aging): $< 1 \times 10^{-9}$/day	HP 5071A	P,A
Oscilloscope	Bandwidth: dc to 100 MHz Vertical Scale Factor of 0.5 V to 5 V/Div Two channels Minimum Timebase Setting: < 100 ns Digitizing display with pulse width and time interval measurement functions Delta –T measurement accuracy in 200 ns / div: < 450 ps	HP 54820A	T

Table 1-9 Recommended Test Equipment

Equipment	Critical Specifications for Equipment Substitution	Recommended Model	Use [a]
Power Meter	Compatible with HP 8480 series power sensors. dB relative mode. Resolution: 0.01 dB Reference Accuracy: 1.2 %	HP E4419A	P,A,T
RF Power Sensor (2 required)	Frequency Range: 100 kHz to 3 GHz Maximum SWR: 1.60 (100 kHz to 300 kHz) 1.20 (300 kHz to 1 MHz) 1.1 (1 MHz to 2.0 GHz) 1.18 (2.0 GHz to 3.0 GHz) Amplitude range: –25 dBm to +10 dBm	HP 8482A	P,A,T
Microwave Power Sensor	Frequency Range: 50 MHz to 26.5 GHz Maximum SWR: 1.15 (50 MHz to 100 MHz) 1.10 (100 MHz to 2 GHz) 1.15 (2 GHz to 12.4 GHz) 1.20 (12.4 GHz to 18 GHz) 1.25 (18 GHz to 26.5 GHz) Amplitude range: –25 dBm to 0 dBm	HP 8485A	P,A,T
Power Sensor, 75 Ω (Option 1DP)	Frequency Range: 1 MHz to 1500 MHz Maximum SWR: 1.18 (600 kHz to 1500 MHz) Impedance: 75 Ω Amplitude Range: –30 dBm to +20 dBm	HP 8483A	P,A,T
Power Sensor, Low Power	Frequency Range: 50 MHz to 3.0 GHz Amplitude Range: –20 dBm to –70 dBm Maximum SWR: 1.4 (10 MHz to 30 MHz) 1.15 (30 MHz to 3.0 GHz)	HP 8481D	P,A,T
Synthesized Signal Generator	Frequency Range: 100 kHz to 1500 MHz Amplitude Range: –35 to +16 dBm SSB Noise: <–120 dBc/Hz at 20 kHz offset	HP 8663A	P,A

Table 1-9 Recommended Test Equipment

Equipment	Critical Specifications for Equipment Substitution	Recommended Model	Use [a]
Spectrum Analyzer, Microwave	Frequency Range: 100 kHz to 7 GHz Relative Amplitude Accuracy: 100 kHz to 1.5 GHz: < 1.8 dB Frequency Accuracy: < 10 kHz at 7 GHz	HP 8563E	P,T
Synthesized Sweeper (2 required)	Frequency Range: HP E4407B or E4408B: 10 MHz to 26.5 GHz All others: 10 MHz to 13.2 GHz Frequency Accuracy (CW): 0.02% Leveling Modes: Internal and External Modulation Modes: AM Power Level Range: –40 to +16 dBm	HP 83630/40/50B HP 83620/30/B 40/50B	P,A,T
Function Generator	Frequency Range: 0.1 Hz to 15 MHz Frequency Accuracy: 0.02% Waveform: Triangle, Square, Sine	HP 33120A or HP 3325B	P,A,T
Attenuator/Switch Driver	Compatible with HP 8494G and 8496G Programmable step attenuators	HP 11713A	P
Attenuator, 1 dB Step	Attenuation Range: 0 to 11 dB Frequency Range: 4 GHz Connectors: Type-N female Calibrated at 50 MHz with accuracy of 1 to 11 dB attenuation: 0.010 dB	HP 8494A/G	P
Attenuator, 10 dB Step	Attenuation Range: 0 to 110 dB Frequency Range: 4 GHz Connectors: Type-N female Calibrated at 50 MHz with accuracy of: 0 to 40 dB attenuation: 0.020 dB 50 to 100 dB attenuation: 0.065 dB 110 dB attenuation: 0.075 dB	HP 8496A/G	P
Attenuator, 10 dB Fixed	Nominal attenuation: 10 dB Frequency Range: dc to 3 GHz Connectors: Type-N(m) and Type-N(f)	HP 8491A Option 010	P

Table 1-9 Recommended Test Equipment

Equipment	Critical Specifications for Equipment Substitution	Recommended Model	Use [a]
Attenuator, 6 dB Fixed	Nominal attenuation: 6 dB Frequency Range: 50 MHz ±1 MHz VSWR: < 1.1: 1 at 50 MHz	HP 8491A Option 006	P
Attenuator, 20 dB Fixed	Nominal attenuation: 20 dB Frequency Range: 100 kHz to 3 GHz VSWR: < 1.2: 1 at ≤ 3 GHz	HP 8491A Option 020	P
Attenuator Interconnect Kit	Mechanically and electrically connects HP 8494A/G and HP 8496A/G	HP 11716 Series	

a. P = Performance Test, A = Adjustment, T = Troubleshooting

Table 1-10 Recommended Accessories

Equipment	Critical Specifications for Accessory Substitution	Recommended Model	Use [a]
Directional Bridge	Frequency Range: 5 MHz to 3 GHz Directivity: > 40 dB Coupling factor: 16 dB nominal Insertion Loss: 2 dB maximum	HP 86205A	P
Power Splitter (for HP E4401B/ 02B/03B/11B)	Frequency Range: 9 kHz to 13.2 GHz Insertion Loss: 6 dB nominal Output Tracking: < 0.25 dB Equivalent Output SWR: < 1.22:1	HP 11667A	P,A
Power Splitter (for HP E4404B/ 05B/07B/08B)	Frequency Range: 9 kHz to 26.5 GHz Insertion Loss: 6 dB nominal Output Tracking: < 0.25 dB Equivalent Output SWR: < 1.22:1	HP 11667B	
Directional Coupler (for HP E4404B/ 05B/07B/08B)	Frequency Range: 2 GHz to 15 GHz Directivity: > 16 dB Max.VSWR: 1.35:1 Transmission Arm Loss: < 1.5 dB (nominal) Coupled Arm Loss: ~ 10 dB (nominal)	HP 87300B	
Termination, 50 Ω (2 required for Option 1DN)	Impedance: 50 Ω nominal Connector: Type-N (m)	HP 909A	P,T
Termination, 50 Ω	Impedance: 50 Ω (nominal) Connector: BNC (m)	HP 11593A	P,A
Termination, 75 Ω (Option 1DQ, 1DP)	Impedance: 75 Ω (nominal) (2 required for Option 1DQ) (1 required for Option 1DP)	HP 909E Option 201	P,T

a. P = Performance Test, A = Adjustment, T = Troubleshooting

Table 1-11 Recommended Adapters

Critical Specifications for Adapter Substitution	Recommended Model	Use [a]
BNC (m) to BNC (m)	1250-0216	P,T
BNC tee (f,m,f)	1250-0781	A,T
Type-N (f) to APC 3.5 (f)	1250-1745	P,A,T
Type-N (f) to BNC (m)	1250-1477	P,T
Type-N (f) to BNC (m), 75 Ω (2 required for Option 1DQ) (1 required for Option 1DP)	1250-1534	P,A,T
Type-N (m) to BNC (f) (4 required)	1250-1476	P,A,T
Type-N (m) to BNC (m) (2 required)	1250-1473	P,T
Type-N (m) to BNC (m), 75 Ω (Option 1DP)	1250-1533	P,A,T
Type-N (m) to Type-N (m)	1250-1472	P,T
Type-N (m) to Type-N (m)	1250-1475	P,A,T
Type-N (f) to Type-N (f), 75 Ω (Option 1DP)	1250-1529	P,A,T
Type-N (f), 75 Ω, to Type-N (m), 50 Ω (Option 1DP)	1250-0597	P,A,T
Type-N (m) to SMA (m)	1250-1636	P
50 to 75 Ω Minimum Loss Frequency Range: dc to 1.5 GHz Insertion Loss: 5.7 dB, nominal (Option 1DP)	HP 11852B	P,A,T
Type N(f) to Type N(f)	1250-0777	
Type N(f) to BNC(f), 75 ohm (Option 1DP only)	1250-1535	
Type N (m) to APC 3.5 (f) (3 required)	1250-1744	
APC 3.5 (f) to APC 3.5 (f)	1250-1749	
Dual Banana to BNC (f)	1251-2277	P,A,T
Type N (m) to BNC (f) (2 required)	1250-0780	

a. P = Performance Test, A = Adjustment, T = Troubleshooting

Table 1-12 Recommended Cables

Critical Specifications for Cable Substitution	Recommended Model	Use [a]
Frequency Range: dc to 1 GHz Length: 122 cm (48 in) Connectors: BNC (m) both ends (4 required)	HP 10503A	P,A,T
Type-N, 62 cm (24 in)	HP 11500C	P,T
Type-N, 152 cm (60 in) (2 required)	HP 11500D	P,A,T
Frequency Range: dc to 310 MHz Length: 23 cm (9 in) Connectors: BNC (m) both ends	HP 10502A	P,T
BNC, 75 Ω, 30 cm (12 in) (option 1DP)	5062-6452	P,A,T
Cable, Test Length: 91 cm (36 in) Connectors: SMB (f) to BNC (m) (2 required)	85680-60093	T
APC 3.5 Cable Frequency: 9 kHz to 26.5 GHz Connectors: APC 3.5 (m) Length: >92 cm (36 in) (2 required)	8120-4921	P,A,T

a. P = Performance Test, A = Adjustment, T = Troubleshooting

2 Performance Verification Tests

These tests verify the electrical performance of the analyzer. Allow the analyzer to warm up in accordance with the temperature stability specifications before performing the tests.

Tests included in this section:

1. 10 MHz Reference Accuracy
2. 10 MHz Precision Frequency Reference Accuracy: HP E4401B, E4402B, E4404B, E4405B, and E4407B, Option 1D5
3. Frequency Readout and Marker Frequency Count Accuracy: HP E4401B, E4402B, E4403B, and E4411B
4. Frequency Readout and Marker Frequency Count Accuracy: HP E4404B, E4405B, E4407B, and E4408B
5. Frequency Span Readout Accuracy: HP E4401B and E4411B
6. Frequency Span Readout Accuracy: HP E4402B, E4403B, E4404B, E4405B, E4407B, and E4408B
7. Noise Sidebands
8. System Related Sidebands
9. Residual FM
10. Sweep Time Accuracy
11. Display Scale Fidelity
12. Input Attenuation Switching Uncertainty
13. Reference Level Accuracy: HP E4401B and E4411B
14. Reference Level Accuracy: HP E4402B, E4403B, E4404B, E4407B and E4408B.
15. Resolution Bandwidth Switching Uncertainty
16. Absolute Amplitude Accuracy (Reference Settings): HP E4401B and E4411B
17. Absolute Amplitude Accuracy (Reference Settings): HP E4402B, E4403B, E4404B, E4405B, E4407B, and E4408B
18. Overall Amplitude Accuracy: HP E4401B and E4411B
19. Overall Amplitude Accuracy: HP E4402B, E4403B, E4404B, E4405B, E4407B and E4408B
20. Resolution Bandwidth Accuracy
21. Frequency Response: HP E4401B and E4411B
22. Frequency Response, HP E4402B and E4403B
23. Frequency Response, HP E4404B, E4405B, E4407B and E4408B
24. Frequency Response (Preamp On): HP E4401B

25. Frequency Response (Preamp On): HP E4402B
26. Frequency Response (Preamp On): HP E4404B, E4405B, and E4407B
27. Other Input-Related Spurious Responses: HP E4401B and E4411B
28. Other Input-Related Spurious Responses: HP E4402B, E4403B, E4404B, E4405B, E4407B, E4408B
29. Spurious Responses: HP E4401B and E4411B
30. Spurious Responses: HP E4402B and E4403B
31. Spurious Responses: HP E4404B, E4405B, E4407B, and E4408B
32. Gain Compression: HP E4401B, E4402B, E4403B, and E4411B
33. Gain Compression: HP E4404B, E4405B, E4407B, and E4408B
34. Displayed Average Noise Level: HP E4401B and HP E4411B
35. Displayed Average Noise Level: HP E4402B and HP E4403B
36. Displayed Average Noise Level: HP E4404B and E4405B
37. Displayed Average Noise Level: HP E4407B and HP E4408B
38. Residual Responses
39. Fast Time Domain Amplitude Accuracy: HP E4401B, E4402B, E4404B, E4405B, and E4407B, Option AYX
40. Tracking Generator Absolute Amplitude and Vernier Accuracy: HP E4401B and E4411B, Option 1DN or 1DQ
41. Tracking Generator Absolute Amplitude and Vernier Accuracy: HP E4402B, E4403B, E4404B, E4405B, E4407B and E4408B, Option 1DN
42. Tracking Generator Level Flatness: HP E4401B and E4411B, Option 1DN or 1DQ
43. Tracking Generator Level Flatness: HP E4402B, E4403B, E4404B, E4405B, E4407B, E4408B, Option 1DN
44. Tracking Generator Harmonic Spurious Outputs: HP E4401B and E4411B, Option 1DN or 1DQ
45. Tracking Generator Harmonic Spurious Outputs: HP E4402B, E4403B, E4404B, E4405B, E4407B, and E4408B, Option 1DN
46. Tracking Generator Non-Harmonic Spurious Outputs: HP E4401B and E4411B, Option 1DN or 1DQ
47. Tracking Generator Non-harmonic Spurious Outputs: HP E4402B, E4403B, E4404B, E4405B, E4407B and E4408B, Option 1DN

48. Tracking Generator LO Feedthrough Amplitude: HP E4402B, E4403B, E4404B, E4405B, E4407B, and E4408B, Option 1DN
49. Gate Delay Accuracy and Gate Length Accuracy: HP E4401B, E4402B, E4404B, E4405B, and E4407B, Option 1D6
50. Gate Mode Additional Amplitude Error: HP E4401B, E4402B, E4404B, E4405B and E4407B, Option 1D6
51. First LO OUTPUT Amplitude Accuracy (Option AYZ only)
52. IF INPUT Accuracy (Option AYZ only)

Calibration

To perform calibration:

1. Run all performance verification tests listed in column 1 of Table 2-1.
2. If any of the performance verification tests fail, perform the appropriate calibration adjustments listed in column 2 of Table 2-1 which corresponds to the failure.
3. Repeat all of the performance verification tests listed in column 1 of Table 2-1 if any calibration adjustments were made in step 2. This will confirm that there is no interaction between adjustments which could negatively impact analyzer performance.

Table 2-1 lists the performance verification tests and adjustments needed for calibration. The performance tests are located in the following pages of this chapter. Adjustment information is located in the service guide.

Table 2-1 Calibration Requirements

Test #	Column 1 Performance Verification Tests	Column 2 Calibration Adjustments
1.	10 MHz Reference Output Accuracy	10 MHz Frequency Reference Adjustment
2.	10 MHz Precision Frequency Reference Output Accuracy	10 MHz Frequency Reference Adjustment
3.	Frequency Readout and Marker Frequency Accuracy	None
4.	Frequency Readout and Marker Frequency Accuracy	None
5.	Frequency Span Readout Accuracy	None
6.	Frequency Span Readout Accuracy	None
7.	Noise Sidebands	IF Amplitude
8.	System Related Sidebands	IF Amplitude

Table 2-1 Calibration Requirements

Test #	Column 1 Performance Verification Tests	Column 2 Calibration Adjustments
9.	Residual FM	None
10.	Sweep Time Accuracy	None
11.	Display Scale Fidelity	IF Amplitude
12.	Input Attenuation Switching Uncertainty	50 MHz Amplitude Reference
13.	Reference Level Accuracy	IF Amplitude
14.	Reference Level Accuracy	IF Amplitude
15.	Resolution BW Switching Uncertainty	IF Amplitude
16.	Absolute Amplitude Accuracy (Reference Settings)	None
17.	Absolute Amplitude Accuracy (Reference Settings)	None
18.	Overall Absolute Amplitude Accuracy	Frequency Response Adjustment
19.	Overall Absolute Amplitude Accuracy	None
20.	Resolution Bandwidth Accuracy	IF Amplitude
21.	Frequency Response	Frequency Response
22.	Frequency Response	Frequency Response
23.	Frequency Response	Frequency Response
24.	Frequency Response (Preamp On)	Frequency Response
25.	Frequency Response (Preamp On)	Frequency Response
26.	Frequency Response (Preamp On)	Frequency Response
27.	Other Input-Related Spurious Responses	None
28.	Other Input-Related Spurious Responses	None
29.	Spurious Responses	None
30.	Spurious Responses	None
31.	Spurious Responses	None
32.	Gain Compression	None
33.	Gain Compression	None

Table 2-1 Calibration Requirements

Test #	Column 1 Performance Verification Tests	Column 2 Calibration Adjustments
34.	Displayed Average Noise Level	Frequency Response
35.	Displayed Average Noise Level	Frequency Response
36.	Displayed Average Noise Level	Frequency Response
37.	Displayed Average Noise Level	Frequency Response
38.	Residual Responses	None
39.	Fast Time Domain Amplitude Accuracy	None
40.	Tracking Generator Absolute Amplitude and Vernier Accuracy	Tracking Generator ALC and Tracking Generator Frequency Slope
41.	Tracking Generator Absolute Amplitude and Vernier Accuracy	Tracking Generator ALC and Tracking Generator Frequency Slope
42.	Tracking Generator Level Flatness	Tracking Generator ALC and Tracking Generator Frequency Slope
43.	Tracking Generator Level Flatness	Tracking Generator ALC and Tracking Generator Frequency Slope
44.	Tracking Generator Harmonic Spurious Outputs	None
45.	Tracking Generator Harmonic Spurious Outputs	None
46.	Tracking Generator Non-Harmonic Spurious Outputs	None
47.	Tracking Generator Non-Harmonic Spurious Outputs	None
48.	Tracking Generator L.O. Feedthrough Amplitude	LO Power
49.	Gate Delay Accuracy and Gate Length Accuracy	None
50.	Gate Mode Amplitude Error	None
51.	First LO OUTPUT Amplitude Accuracy	LO Power
52.	IF INPUT Accuracy	IF INPUT Correction

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

1 dB Step Atten (dB)	Attenuator X				10 dB Step Atten (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

When using the programmable versions of the 1 dB and 10 dB step attenuator (HP 8494G and HP 8496G), the HP 11713A Attenuator/ Switch Driver must be used to control the attenuators. The HP 8494G 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 2-2 to determine which the settings of Attenuator X and Attenuator Y to set the step attenuators to the desired value. In the columns labelled Attenuator X and Attenuator Y, a “1” indicates that section is on (the LED in the button will be lit), while a “0” indicates that section is off. For example, if the 1 dB step attenuator should be set to 2 dB and the 10 dB step attenuator should be set to 60 dB, sections 2, 6, and 7 should be on (lit) and all other sections should be off.

1. 10 MHz Reference Accuracy

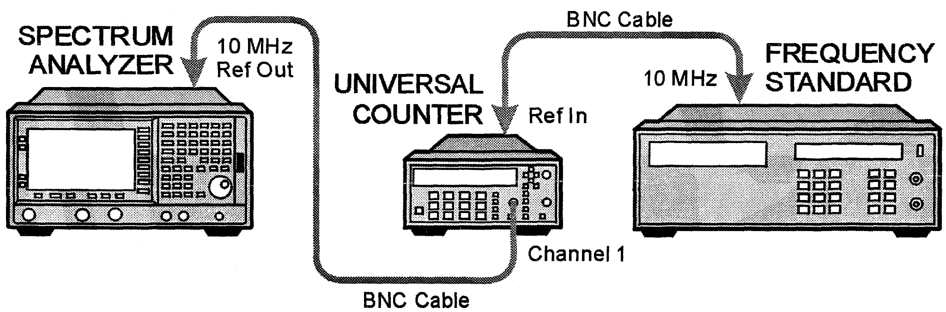
The settability is measured by changing the setting of the digital-to-analog converter (DAC) which controls the frequency of the timebase. The frequency difference per DAC step is calculated and compared to the specification.

The related adjustment for this performance verification test is the "10 MHz Reference Frequency Adjustment."

Equipment Required

Universal counter (Instructions are for HP 53132A. For HP 5316B, refer to its user documentation.)
Frequency standard
Cable, BNC, 122-cm (48-in) (*2 required*)

Figure 2-1 **10 MHz Reference Test Setup**



Procedure

1. Connect the equipment as shown in Figure 2-1. The frequency standard provides the reference for the universal counter.
2. Check that the analyzer is not in external reference mode. If `Ext Ref` appears on the screen, the analyzer is in external reference mode. If the analyzer is in external reference mode, disconnect the external reference.
3. Ensure that the analyzer has been on and in internal frequency mode for at least five minutes before proceeding.
4. Set the universal counter controls as follows:
   a. Press **Gate & ExtArm**
   b. Press any one of the arrow keys until `TIME` is displayed.

c. Press **Gate & ExtArm** again. Using the arrow keys, set the TIME to 10 s.

d. Press **Enter**

e. On Channel 1, press **50 Ω/1 MΩ** until LED is lit.

f. On Channel 1, press **x10 Attenuator** until LED is extinguished.

g. On Channel 1, press **AC/DC** until LED next to DC is extinguished.

h. On Channel 1, press **100 kHz Filter** until LED is extinguished.

i. On Channel 1, press **Trigger/Sensitivity** until `Auto Trig` is displayed.

j. Use the arrow keys to toggle to off.

k. Press **Freq & Ratio**.

5. Wait for the universal counter reading to stabilize. Record the universal counter reading in Table 2-3 as Counter Reading 1 with 0.1 Hz resolution.

6. Set the analyzer by pressing the following keys:

   System, Alignments, Timebase, Fine

7. Record the number in the active function block of the analyzer in Table 2-3 as Timebase Fine.

8. Press the ↑ (up arrow) key on the analyzer.

9. Wait for the frequency counter reading to stabilize. Record the frequency counter reading in Table 2-3 as Counter Reading 2 with 0.1 Hz resolution.

10. Press the ↓ (down arrow) key on the analyzer 2 times.

11. Wait for the frequency counter reading to stabilize. Record the frequency counter reading in Table 2-3 as Counter Reading 3 with 0.1 Hz resolution.

12. Press **Preset** on the analyzer to return the DAC settings to their initial values.

13. Subtract counter reading 1 from counter reading 2 and record the difference in Table 2-3 as the positive frequency change.

$$\text{Positive Frequency Change} = \text{Counter Reading 2} - \text{Counter Reading 1}$$

14. Subtract counter reading 3 from counter reading 1 and record the difference in Table 2-3 as the positive frequency change.

$$\text{Negative Frequency Change} = \text{Counter Reading 1} - \text{Counter Reading 3}$$

15.Of the positive frequency change and negative frequency change values recorded in Table 2-3, record the largest value in Table 2-3 as the maximum frequency change.

16.Divide the maximum frequency change by two and record the result as the settability.

Table 2-3 10 MHz Reference Accuracy Worksheet

Description	Measurement
Counter Reading 1	________ Hz
Timebase Fine DAC	________
Counter Reading 2	________ Hz
Counter Reading 3	________ Hz
Positive Frequency Change	________ Hz
Negative Frequency Change	________ Hz
Maximum Frequency Change	________ Hz
Settability	________ Hz

2. 10 MHz Precision Frequency Reference Accuracy: HP E4401B, E4402B, E4404B, E4405B, and E4407B, Option 1D5

This test applies only to analyzers equipped with the precision frequency reference, Option 1D5. If your analyzer does not have Option 1D5, perform "10 MHz Reference Output Accuracy" instead.

This test measures the warmup characteristics of the 10 MHz reference oscillator. The ability of the 10 MHz oscillator to meet its warmup characteristics gives a high level of confidence that it will also meet its yearly aging specification.

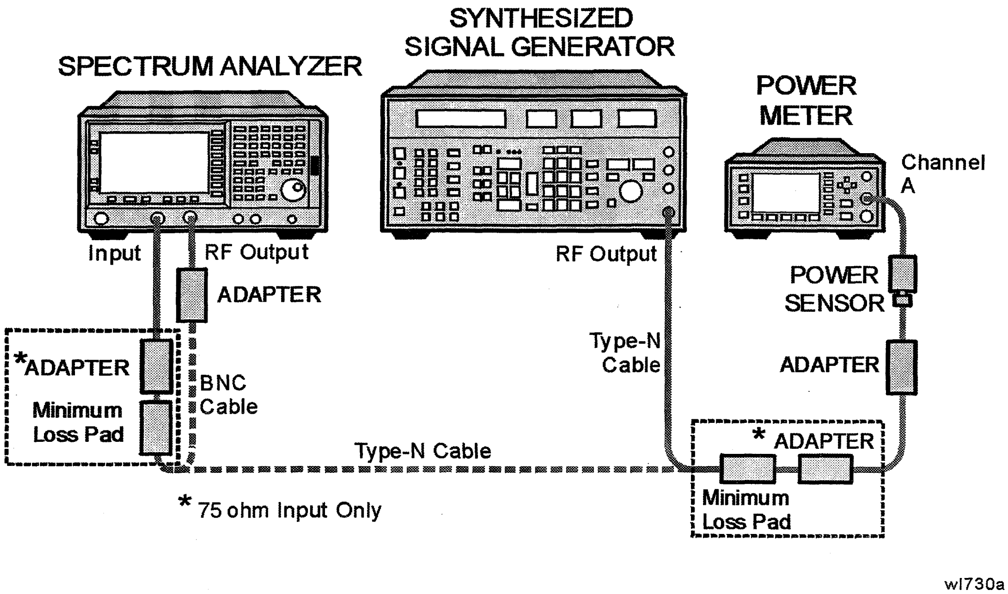
The universal counter is connected to the 10 MHz REF OUT. After the analyzer has been allowed to cool for at least 60 minutes, the analyzer is powered on. A frequency measurement is made five minutes after power is applied and the frequency is recorded. Another frequency measurement is made 10 minutes later (15 minutes after power is applied) and the frequency is recorded. A final frequency measurement is made 60 minutes after power is applied. The difference between each of the first two frequency measurements and the last frequency measurement is calculated and recorded.

The related adjustment for this performance verification test is the "10 MHz Precision Reference Frequency Adjustment."

Equipment Required

Universal counter (Instructions are for HP 53132A. For HP 5316B, refer to its user documentation.)
Frequency standard
Cable, BNC, 122-cm (48-in) (*2 required*)

Figure 2-2 **Frequency Reference Test Setup**



Procedure

The spectrum analyzer must have been allowed to sit with the power off for at least 60 minutes before performing this procedure. This adequately simulates a cold start.

1. Allow the analyzer to sit with the power off for at least 60 minutes before proceeding.
2. Switch the power to the analyzer on. Record the Power On Time below.

   Power On Time__________

3. Connect the equipment as shown in Figure 2-2. The frequency standard provides the reference for the universal counter. Disconnect any cable to the 10 MHz REF INPUT of the analyzer.
4. Check that the analyzer is not in external reference mode. `Ext Ref` will appear on the display if the analyzer is in external reference mode. If the analyzer is in external reference mode, disconnect the external reference.
5. Set the universal counter controls as follows:
   a. Press **Gate & ExtArm**
   b. Press any one of the arrow keys until `TIME` is displayed.
   c. Press **Gate & ExtArm** again. Using the arrow keys, set the `TIME` to 10s.
   d. Press **Enter**

e. On Channel 1, press **50 Ω/1 MΩ** to light LED next to 50 Ω.

f. On Channel 1, press **AC/DC** to extinguish LED next to DC.

g. On Channel 1, press **x10 Attenuator** to extinguish LED next to x10 Attenuator.

h. On Channel 1, press **100 kHz Filter** to extinguish LED next to 100 kHz Filter.

i. On Channel 1, press **Trigger/Sensitivity** until `Auto Trig` is displayed.

j. Use the arrows keys to toggle to off.

k. Press **Freq & Ratio**

6. Proceed with the next step 5 minutes after the Power On Time noted in step 2.

7. Wait for the universal counter reading to make at least two readings. Record the universal counter reading in Table 2-3 as Counter Reading 1 with 0.001 Hz resolution.

8. Proceed with next step 15 minutes after the Power On Time noted in step 2.

9. Wait for the universal counter reading to make at least two readings. Record the universal counter reading in Table 2-3 as Counter Reading 2 with 0.001 Hz resolution.

10. Proceed with next step 60 minutes after the Power On Time noted in step 2.

11. Wait for the universal counter reading to make at least two readings. Record the universal counter reading in Table 2-3 as Counter Reading 3 with 0.001 Hz resolution.

12. Calculate the 5 Minute Warm-up Error (in ppm) by subtracting Counter Reading 3 from Counter Reading 1 and dividing the result by 10.

$$\text{5 Minute Warm-up Error} = (\text{Counter Reading 1} - \text{Counter Reading 3})/10$$

NOTE Dividing the frequency by 10 is equivalent to dividing the difference first by 10 MHz (to normalize the difference to the reference frequency) and then multiplying by 1×10^6 to convert the result to parts-per-million (ppm).

13. Record the 5 Minute Warm-up Error (in ppm) in the performance verification test record as TR Entry 1.

14. Calculate the 15 Minute Warm-up Error (in ppm) by subtracting Counter Reading 3 from Counter Reading 2 and dividing the result by 10.

$$15 \text{ Minute Warm-up Error} = (\text{Counter Reading } 2 - \text{Counter Reading } 3)/$$

15. Record the 15 Minute Warm-up Error in the performance verification test record as TR Entry 2.

Table 2-4 10 MHz Reference Accuracy Worksheet

Description	Measurement
Counter Reading 1	________ Hz
Counter Reading 2	________ Hz
Counter Reading 3	________ Hz

3. Frequency Readout and Marker Frequency Count Accuracy: HP E4401B, E4402B, E4403B, and E4411B

The frequency readout accuracy of the spectrum analyzer is tested with an input signal of known frequency. By using the same frequency standard for the spectrum analyzer and the synthesized sweeper, the frequency reference error is eliminated.

There is no related adjustment for this performance test.

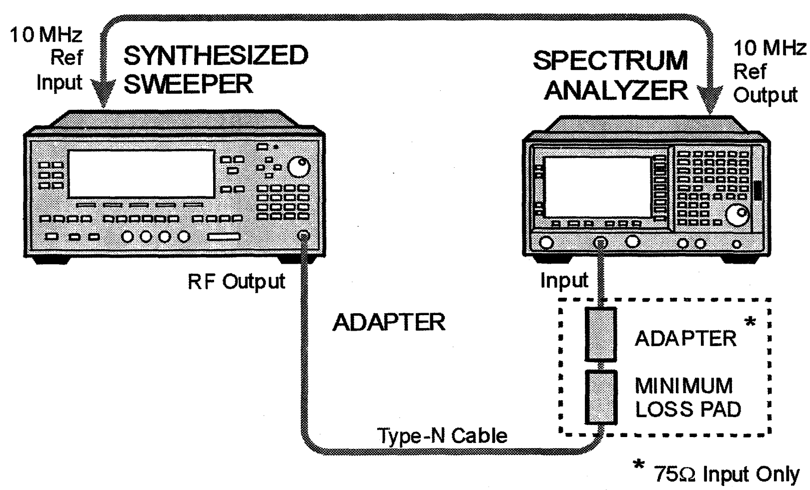
Equipment Required

Synthesized sweeper
Adapter, Type N (f) to APC 3.5 (m)
Cable, Type N, 183 cm (72 in)
Cable, BNC, 122 cm (48 in)

Additional Equipment for 75 Ω Input

Pad, minimum loss
Adapter, Type N (f) to BNC (m), 75 Ω

Figure 2-3 **Frequency Readout and Marker Frequency Accuracy Test Setup**



Procedure

This performance test consists of two parts:

"Part 1: Frequency Readout Accuracy"
"Part 2: Marker Count Accuracy"

Perform "Part 1: Frequency Readout Accuracy" before "Part 2: Marker Count Accuracy".

Part 1: Frequency Readout Accuracy

1. Connect the equipment as shown in Figure 2-3. Remember to connect the 10 MHz REF OUT of the analyzer to the 10 MHz REF INPUT of the synthesized sweeper.

CAUTION Use only 75 Ω cables, connectors, or adapters on instruments with 75 Ω inputs, or the input connector will be damaged.

2. Perform the following steps to set up the equipment:

   a. Press **INSTRUMENT PRESET** on the synthesized sweeper, then set the controls as follows:

      CW, 1.490 GHz (*HP E4401B and E4411B*)
      CW, 1.5 GHz (*HP E4402B and E4403B*)
      POWER LEVEL, –10 dBm

   b. Press **Preset** on the spectrum analyzer, then wait for the preset routine to finish. Set the analyzer by pressing the following keys:

      FREQUENCY, 1.490 GHz (*HP E4401B and E4411B*)
      CW, 1.5 GHz (*HP E4402B and E4403B*)
      SPAN, 20 MHz

3. Press **Peak Search (or Search)** on the analyzer to measure the frequency readout accuracy.

4. Record the marker frequency reading in the performance verification test record.

5. Repeat step 3 and step 4 above for the remaining spans listed in Table 2-5.

"Part 1: Frequency Readout Accuracy" is now complete. Continue with "Part 2: Marker Count Accuracy."

Table 2-5 Frequency Readout Accuracy

Spectrum Analyzer Span, MHz	TR Entry, Actual Marker Frequency
20	1
10	2
1	3

Part 2: Marker Count Accuracy

Perform "Part 1: Frequency Readout Accuracy" before performing this procedure.

1. Press **Preset** on the analyzer, then wait for the preset routine to finish. Set the analyzer to measure the marker count accuracy by pressing the following keys:

   FREQUENCY, 1.490 GHz (*HP E4401B and E4411B*)
   FREQUENCY, 1.5 GHz (*HP E4402B and E4403B*)
   SPAN, 10 MHz
   BW/Avg, Resolution BW, 100 kHz (Man)
   Freq Count, Marker Count (On)
   Resolution (Man) 1 Hz

2. Press **Peak Search (or Search)**, then wait for a count be taken (it may take several seconds).
3. Record the Cntr1 frequency reading as TR Entry 4 of the performance verification test record.
4. On the analyzer, press **SPAN, 1 MHz**.
5. Press **Peak Search (or Search)**, then wait for a count be taken (it may take several seconds).
6. Record the Cntr1 frequency reading as TR Entry 5 of the performance verification test record.

4. Frequency Readout and Marker Frequency Count Accuracy: HP E4404B, E4405B, E4407B, and E4408B

The frequency readout accuracy of the spectrum analyzer is tested with an input signal of known frequency. By using the same frequency standard for the spectrum analyzer and the synthesized sweeper, the frequency reference error is eliminated.

There is no related adjustment for this performance test.

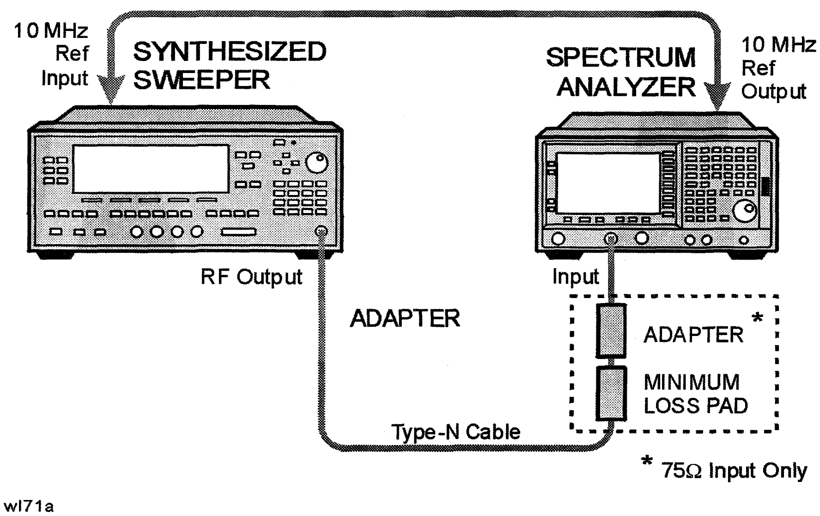
Equipment Required

Synthesized sweeper
Adapter, Type N (m) to APC 3.5 (f)
Adapter, APC 3.5 (f) to APC 3.5 (f)
Cable, APC 3.5, 91 cm (36 in)
Cable, BNC, 122 cm (48 in)

Additional Equipment for Option BAB

Adapter, APC 3.5 (f) to APC 3.5 (f)

Figure 2-4 **Frequency Readout and Marker Count Accuracy Test Setup**



Procedure

This performance verification test consists of two parts:

"Part 1: Frequency Readout Accuracy"
"Part 2: Marker Count Accuracy"

Perform “Part 1: Frequency Readout Accuracy” before “Part 2: Marker Count Accuracy”.

Part 1: Frequency Readout Accuracy

1. Connect the equipment as shown in Figure 2-4. Remember to connect the 10 MHz REF OUT of the analyzer to the 10 MHz REF INPUT of the synthesized sweeper.

   Option BAB only: Use the APC 3.5 adapter to connect the cable to the spectrum analyzer input.

2. Perform the following steps to set up the equipment:

   a. Press **INSTRUMENT PRESET** on the synthesized sweeper, then set the controls as follows:

      CW, 1.5 GHz
      POWER LEVEL, –10 dBm

   b. Press **Preset** on the spectrum analyzer, then wait for the preset routine to finish. Set the analyzer by pressing the following keys:

      FREQUENCY, 1.5 GHz
      SPAN, 20 MHz

3. Press **Peak Search (or Search)** on the analyzer to measure the frequency readout accuracy.
4. Record the Mkr1 frequency reading in the performance verification test record as indicated in Table 2-6.
5. Change to the next spectrum analyzer span setting listed in Table 2-6.
6. Repeat step 3 to step 5 for each spectrum analyzer frequency and span setting and synthesized sweeper CW frequency setting listed in Table 2-6 for the analyzer being tested.

"Part 1: Frequency Readout Accuracy" is now complete. Continue with "Part 2: Marker Count Accuracy."

Table 2-6 Frequency Readout Accuracy

Synthesized Sweeper CW Frequency, MHz	Spectrum Analyzer Span, MHz	Spectrum Analyzer Center Frequency, GHz	TR Entry Frequency, GHz
1500	20	1.5	1
1500	10	1.5	2
1500	1	1.5	3
4000	20	4.0	4

Table 2-6 **Frequency Readout Accuracy**

Synthesized Sweeper CW Frequency, MHz	Spectrum Analyzer Span, MHz	Spectrum Analyzer Center Frequency, GHz	TR Entry Frequency, GHz
4000	10	4.0	**5**
4000	1	4.0	**6**
Stop here for HP E4404B.			
9000	20	9.0	**7**
9000	10	9.0	**8**
9000	1	9.0	**9**
Stop here for HP E4405B.			
16000	20	16.0	**10**
16000	10	16.0	**11**
16000	1	16.0	**12**
21000	20	21.0	**13**
21000	10	21.0	**14**
21000	1	21.0	**15**

Part 2: Marker Count Accuracy

Perform "Part 1: Frequency Readout Accuracy" before performing this procedure.

1. Press **Preset** on the spectrum analyzer, then wait for the preset routine to finish.
2. Set the analyzer to measure the marker count accuracy by pressing the following keys:

   FREQUENCY, 1.5 GHz
   SPAN, 20 MHz
   BW/Avg, Resolution BW, 100 kHz (Man)
   Freq Count, Freq Count (On)
   Resolution Auto Man, 1 Hz (Man)

3. Press **Peak Search (or Search)**, then wait for a count be taken (it may take several seconds).

4. Record the Cntrl frequency reading in the performance verification test record as indicated in Table 2-7.

5. Repeat step 3 and step 4 for each analyzer center frequency and span setting and synthesized sweeper CW frequency setting listed in Table 2-7 for the analyzer being tested.

Performance verification test "Frequency Readout Accuracy and Marker Count Accuracy" is now complete.

Table 2-7 **Marker Count Accuracy**

Synthesized Sweeper CW Frequency	Spectrum Analyzer Center Frequency	Spectrum Analyzer Span	Cntr 1 Frequency
MHz	**GHz**	**MHz**	**TR Entry**
1500	1.5	20	**16**
1500	1.5	1	**17**
4000	4.0	20	**18**
4000	4.0	1	**19**
Stop here for HP E4404B.			
9000	9.0	20	**20**
9000	9.0	1	**21**
Stop here for HP E4405B.			
16000	16.0	20	**22**
16000	16.0	1	**23**
21000	21.0	20	**24**
21000	21.0	1	**25**

5. Frequency Span Readout Accuracy: HP E4401B and E4411B

For testing each frequency span, two synthesized sources are used to provide two precisely-spaced signals. The analyzer marker functions are used to measure this frequency difference.

There are no related adjustment procedures for this performance test.

Equipment Required

Synthesized sweeper
Synthesized signal generator
Power splitter
Adapter, Type-N (m) to Type-N (m)
Adapter, Type-N (f) to APC 3.5 (f)
Cable, Type-N, 152-cm (60-in) *(2 required)*
Cable, BNC, 122-cm (48-in)

Additional Equipment for 75 Ω Input

Pad, minimum loss
Adapter, Type-N (f), to BNC (m), 75 Ω

Procedure

Full Span Frequency Span Readout Accuracy

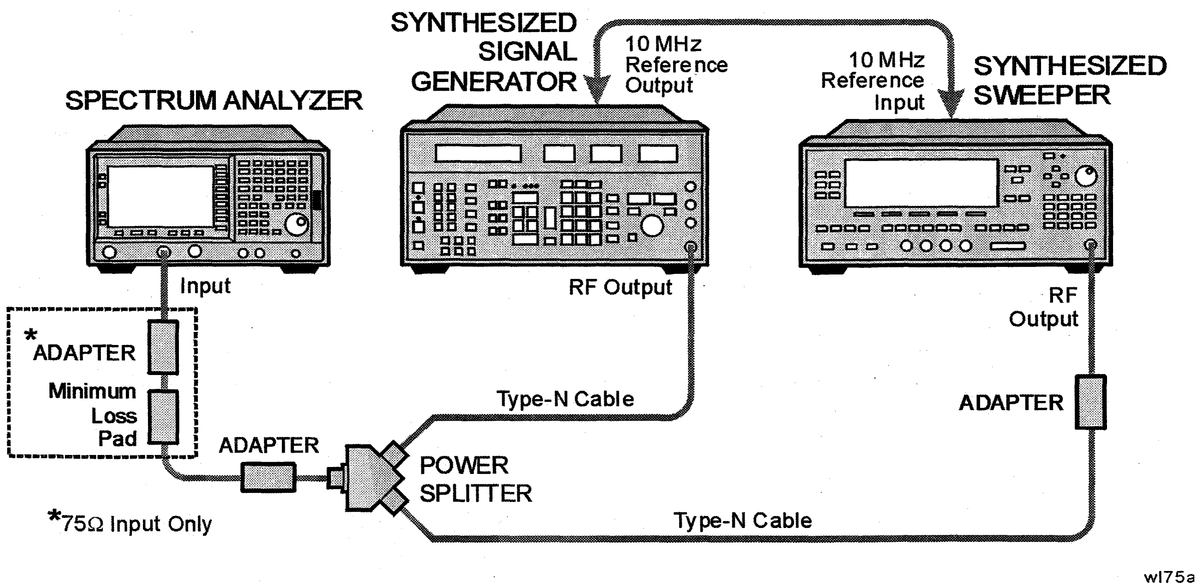
1. Connect the equipment as shown in Figure 2-5. Note that the power splitter is used as a combiner. The synthesized signal generator provides the frequency reference for the synthesized sweeper.
2. Press **Preset** on the analyzer, then wait for the preset routine to finish.
3. Press **PRESET** on the synthesized sweeper and set the controls as follows:

   CW, 1350 MHz
   POWER LEVEL, –5 dBm

4. On the synthesized signal generator, set the controls as follows:

   FREQUENCY, 150 MHz
   AMPLITUDE, 0 dBm

Figure 2-5 Frequency Span Readout Accuracy Test Setup



5. Adjust the analyzer center frequency, if necessary, to place the lower frequency on the second vertical graticule line (one division from the left-most graticule line).
6. On the analyzer, press **Single**. Wait for the completion of a new sweep, then press the following keys:

   Peak Search (or Search)
   Marker, Delta
   Next Peak

   The two markers should be on the signals near the second and tenth vertical graticule lines (the first graticule line is the left-most).
7. If necessary, continue pressing **Next Peak** until the active marker is on the right-most signal (1350 MHz).
8. Record the ΔMkr1 frequency reading as TR Entry 1 of the performance verification test record.

100 kHz and 100 MHz Frequency Span Readout Accuracy

9. Set the analyzer by pressing the following keys:

   FREQUENCY, Start Freq, 10 MHz
   Stop Freq, 110 MHz
   Sweep, Sweep (Cont)

10.On the synthesized sweeper set the controls as follows:

CW, 100 MHz
POWER LEVEL, –5 dBm

11.Set the synthesized signal generator controls as follows:

FREQUENCY, 20 MHz
AMPLITUDE, 0 dBm

12.Adjust the analyzer center frequency to center the two signals on the display.

13.On the analyzer, press **Single**. Wait for the completion of a new sweep, then press the following keys:

Peak Search (or Search)
Marker, Delta
Next Peak

The two markers should be on the signals near the second and tenth vertical graticule lines (the first graticule line is the left-most).

14.If necessary, continue pressing **Next Peak** until the active marker is on the right-most signal (100 MHz). Record the ΔMkr1 frequency reading in the performance test record as TR Entry 2.

15.Press **Marker, More, Marker All Off** on the analyzer.

16.Change to the next equipment settings listed in Table 2-8.

17.On the analyzer, press **Single**. Wait for the completion of a new sweep, then press the following keys:

Peak Search (or Search)
Marker, Delta
Next Peak

18.If necessary, continue pressing **Next Peak** until the marker delta is on the right-most signal. Record the ΔMkr1 frequency reading in the performance test record.

19.Repeat step 15 through step 18 for the remaining analyzer span settings listed in Table 2-8.

Table 2-8 Frequency Span Readout Accuracy

Analyzer Start Frequency, MHz	Analyzer Stop Frequency, MHz	Synthesized Signal Generator Frequency, MHz	Synthesized Sweeper Frequency, MHz	TR Entry	Analyzer Span, MHz
0	1500	150	1350	1	1500
10	110	20	100	2	100
10	10.1	10.01	10.09	3	0.1
800	900	810	890	4	100
800	800.1	800.01	800.09	5	0.1
1400	1500	1410	1490	6	100
1499	1499.1	1499.01	1499.09	7	0.1

6. Frequency Span Readout Accuracy: HP E4402B, E4403B, E4404B, E4405B, E4407B, and E4408B

For testing each frequency span, two synthesized sources are used to provide two precisely-spaced signals. The analyzer marker functions are used to measure this frequency difference.

There are no related adjustment procedures for this performance test.

Equipment Required

Synthesized sweeper
Synthesized signal generator
Power splitter
Adapter, Type-N (m) to Type-N (m)
Adapter, Type-N (f) to APC 3.5 (f)
Cable, Type-N, 152-cm (60-in) *(2 required)*
Cable, BNC, 122-cm (48-in)

Additional Equipment for Option BAB

Adapter, Type-N (m), to APC 3.5 (f)

Procedure

Full Span Frequency Span Readout Accuracy

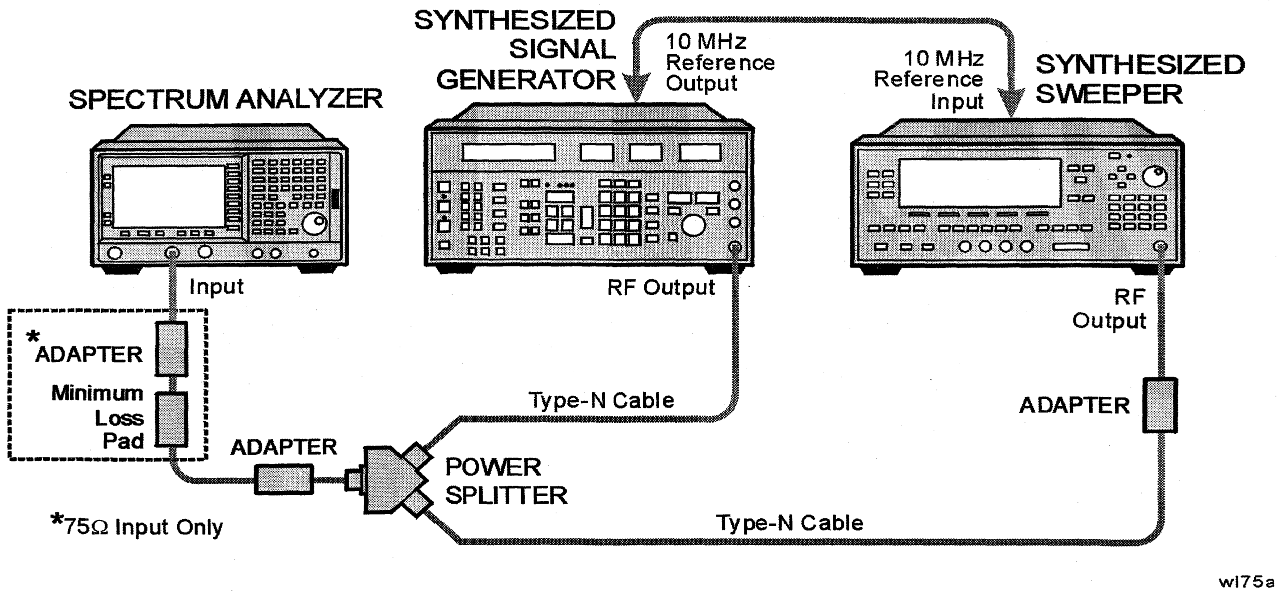
1. Connect the equipment as shown in Figure 2-5. Note that the power splitter is used as a combiner. The synthesized signal generator provides the frequency reference for the synthesized sweeper.
2. Press **Preset** on the analyzer, then wait for the preset routine to finish. Press **FREQUENCY**, **Stop Freq**, **3 GHz**
3. Press **PRESET** on the synthesized sweeper and set the controls as follows:

   CW, 2700 MHz
   POWER LEVEL, –5 dBm

4. On the synthesized signal generator, set the controls as follows:

   FREQUENCY, 300 MHz
   AMPLITUDE, 0 dBm

Figure 2-6 Frequency Span Readout Accuracy Test Setup



5. Adjust the analyzer center frequency, if necessary, to place the lower frequency on the second vertical graticule line (one division from the left-most graticule line).
6. On the analyzer, press **Single**. Wait for the completion of a new sweep, then press the following keys:

   Peak Search (or Search)
   Marker, Delta
   Next Peak

   The two markers should be on the signals near the second and tenth vertical graticule lines (the first graticule line is the left-most).
7. If necessary, continue pressing **Next Peak** until the active marker is on the right-most signal (2700 MHz).
8. Record the ΔMkr1 frequency reading as TR Entry 1 of the performance verification test record.

100 kHz and 100 MHz Frequency Span Readout Accuracy

9. Set the analyzer by pressing the following keys:

   FREQUENCY, Start Freq, 10 MHz
   Stop Freq, 110 MHz
   Sweep, Sweep (Cont)

10. On the synthesized sweeper set the controls as follows:

   CW, 100 MHz
   POWER LEVEL, –5 dBm

11.Set the synthesized signal generator controls as follows:

FREQUENCY, 20 MHz
AMPLITUDE, 0 dBm

12.Adjust the analyzer center frequency to center the two signals on the display.

13.On the analyzer, press **Single**. Wait for the completion of a new sweep, then press the following keys:

Peak Search (or Search)
Marker, Delta
Next Peak

The two markers should be on the signals near the second and tenth vertical graticule lines (the first graticule line is the left-most).

14.If necessary, continue pressing **Next Peak** until the active marker is on the right-most signal (100 MHz). Record the ΔMkr1 frequency reading in the performance test record as TR Entry 2.

15.Press **Marker, More, Marker Off** on the analyzer.

16.Change to the next equipment settings listed in Table 2-9.

17.On the analyzer, press **Single.** Wait for the completion of a new sweep, then press the following keys:

Peak Search (or Search)
Marker, Delta
Next Peak

18.If necessary, continue pressing **Next Peak** until the marker delta is on the right-most signal. Record the ΔMkr1 frequency reading in the performance test record.

19.Repeat step 15 through step 18 for the remaining analyzer span settings listed in Table 2-9.

Table 2-9 Frequency Span Readout Accuracy

Analyzer Start Frequency, MHz	Analyzer Stop Frequency, MHz	Synthesized Signal Generator Frequency, MHz	Synthesized Sweeper Frequency, MHz	TR Entry	Analyzer Span, MHz
0	3000	300	2700	1	3000
10	110	20	100	2	100
10	10.1	10.01	10.09	3	0.1
800	900	810	890	4	100
800	800.1	800.01	800.09	5	0.1
1400	1500	1410	1490	6	100
1499	1499.1	1499.01	1499.09	7	0.1

7. Noise Sidebands

A 1 GHz CW signal is applied to the input of the analyzer. The marker functions are used to measure the amplitude of the carrier and the noise level 10 kHz, 20 kHz, 30 kHz, and 100 kHz above and below the carrier.

There are no related adjustment procedures for this performance test.

Equipment Required

Synthesized signal generator
Cable, Type-N, 152-cm (60-in)

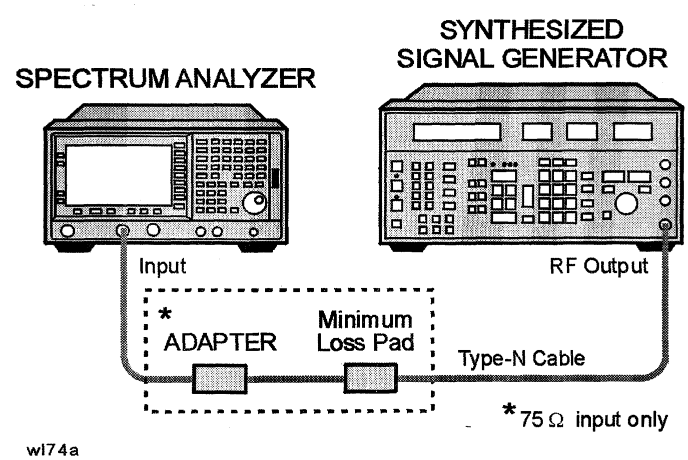
Additional Equipment for 75 Ω Input

Pad, minimum loss
Adapter, Type-N (f), to BNC (m), 75 Ω

Additional Equipment for Option BAB

Adapter, Type-N (f), to APC 3.5 (f)

Figure 2-7 **Noise Sidebands Test Setup**



CAUTION Use only 75 Ω cables, connectors, or adapters on instruments with 75 Ω connectors, or the connectors will be damaged.

Procedure

This performance test consists of four parts:

Part 1: Noise Sideband Suppression at 10 kHz
Part 2: Noise Sideband Suppression at 20 kHz
Part 3: Noise Sideband Suppression at 30 kHz
Part 4: Noise Sideband Suppression at 100 kHz

Perform part 1 before performing part 2 or part 3 of this procedure.

A worksheet is provided at the end of this procedure for calculating the noise sideband suppression.

Part 1: Noise Sideband Suppression at 10 kHz

1. Perform the following steps to set up the equipment:

   a. Set the synthesized signal generator controls as follows:

      FREQUENCY, 1000 MHz
      AMPLITUDE, 0 dBm (50 Ω Input only)
      AMPLITUDE, to +6 dBm (75 Ω Input only)
      AM OFF
      FM OFF

   b. Connect the equipment as shown in Figure 2-7.

   c. Press **Preset** on the analyzer, then wait for the preset routine to finish. Set the analyzer by pressing the following keys:

      FREQUENCY, 1 GHz
      SPAN, 10 MHz
      AMPLITUDE, Attenuation 10 dB (Man)
      AMPLITUDE, More, Y Axis Units (or Amptd Units), dBm

2. Press the following analyzer keys to measure the carrier amplitude.

   Peak Search (or Search)
   FREQUENCY, Signal Track (On)
   SPAN, 50 kHz
   BW/Avg, 1 kHz
   Video BW, 30 Hz (Man)
   FREQUENCY, Signal Track (Off)
   Sweep, Sweep Time, 5 sec
   Single

   Wait for the completion of a sweep, then press **Peak Search (or Search).**

3. Press the following analyzer keys to measure the noise sideband level at +10 kHz:

   Marker, Delta
   More, Function, Marker Noise (or Noise)
   AMPLITUDE, –10 dBm
   FREQUENCY, CF Step, 10 kHz
   Center Freq, ↑
   SPAN, Zero Span
   Single

   Record the marker delta amplitude reading in Table 2-10 as the Noise Sideband Level at +10 kHz.

4. Press the following analyzer keys to measure the noise sideband level at –10 kHz:

   FREQUENCY, ↓, ↓
   Single

   Record the marker amplitude reading in the Noise Sideband Worksheet as the Noise Sideband Level at –10 kHz.

5. Record the more positive value, either Noise Sideband Level at +10 kHz or Noise Sideband Level at –10 kHz from the Noise Sideband Worksheet as TR Entry 1 in the performance verification test record.

6. Press **FREQUENCY, ↑**

Part 2: Noise Sideband Suppression at 20 kHz

1. Press the following analyzer keys to measure the noise sideband level at +20 kHz:

   FREQUENCY, CF Step, 20 kHz
   Center Freq, ↑
   Single

   Record the marker amplitude reading in the Noise Sideband Worksheet as the Noise Sideband Level at +20 kHz.

2. Press the following analyzer keys to measure the noise sideband level at –20 kHz:

   FREQUENCY, ↓, ↓
   Single

   Record the marker amplitude reading in the Noise Sideband Worksheet as the Noise Sideband Level at –20 kHz.

3. Record the more positive value, either Noise Sideband Level at +20 kHz or Noise Sideband Level at –20 kHz from the Noise Sideband Worksheet as TR Entry 2 in the performance verification test record.

4. Press **FREQUENCY, ↑**

Part 3: Noise Sideband Suppression at 30 kHz

1. Press the following analyzer keys to measure the noise sideband level at +30 kHz:

   FREQUENCY, CF Step, 30 kHz
   Center Freq, ↑
   Single

   Record the marker amplitude reading in the Noise Sideband Worksheet as the Noise Sideband Level at +30 kHz.

2. Press the following analyzer keys to measure the noise sideband level at –30 kHz:

   FREQUENCY, ↓, ↓
   Single

   Record the marker amplitude reading in the Noise Sideband Worksheet as the Noise Sideband Level at –30 kHz.

3. Record the more positive value, either Noise Sideband Level at +30 kHz or Noise Sideband Level at –30 kHz from the Noise Sideband Worksheet as TR Entry 3 in the performance verification test record.

4. Press **FREQUENCY, ↑**

Part 4: Noise Sideband Suppression at 100 kHz

1. Press the following analyzer keys to measure the noise sideband level at +100 kHz:

   FREQUENCY, CF Step, 98 kHz
   Center Freq, ↑
   Single

   Record the marker amplitude reading in the Noise Sideband Worksheet as the Noise Sideband Level at +100 kHz.

2. Press the following analyzer keys to measure the noise sideband level at –100 kHz:

   FREQUENCY, ↓, ↓
   Single

NOTE A spur may exist at 100 kHz offset from the carrier. Measuring at ±98 kHz offset from the carrier will yield a noise sideband level worse than the reading at ±100 kHz offset.

   Record the marker amplitude reading in the Noise Sideband Worksheet as the Noise Sideband Level at –100 kHz.

3. Record the more positive value, either Noise Sideband Level at +100 kHz or Noise Sideband Level at –100 kHz from the Noise Sideband Worksheet as TR Entry 4 in the performance test verification record.

Table 2-10 **Noise Sideband Worksheet**

Description	Measurement
Noise Sideband Level at +10 kHz	dBc/Hz
Noise Sideband Level at –10 kHz	dBc/Hz
Noise Sideband Level at +20 kHz	dBc/Hz
Noise Sideband Level at –20 kHz	dBc/Hz
Noise Sideband Level at +30 kHz	dBc/Hz
Noise Sideband Level at –30 kHz	dBc/Hz
Noise Sideband Level at +100 kHz	dBc/Hz
Noise Sideband Level at –100 kHz	dBc/Hz

8. System Related Sidebands

A 500 MHz CW signal is applied to the input of the analyzer. The marker functions are used to measure the amplitude of the carrier and the amplitude of any system related sidebands more than 30 kHz away from the carrier. System related sidebands are any internally generated sidebands related to the line, power supply or local oscillator.

There are no related adjustment procedures for this performance test.

Equipment Required

Synthesized signal generator
Cable, Type-N, 152-cm (60-in)

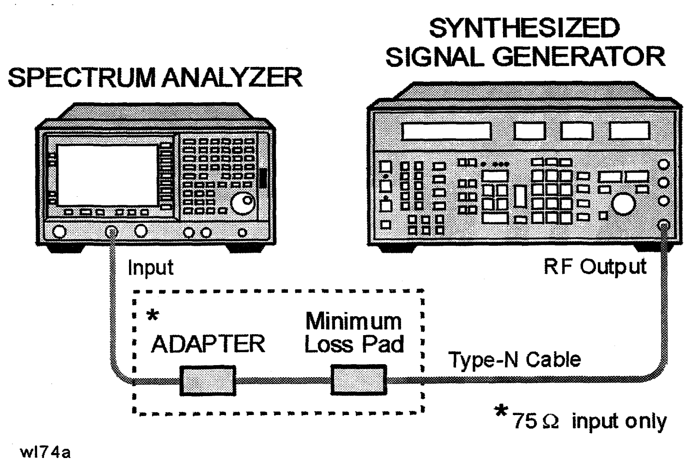
Additional Equipment for 75 Ω Input

Pad, minimum loss
Adapter, Type-N (f), to BNC (m), 75 Ω

Additional Equipment for Option BAB

Adapter, Type-N (f), to APC 3.5 (f)

Figure 2-8 **System Related Sidebands Test Setup**



CAUTION Use only 75 Ω cables, connectors, or adapters on instruments with 75 Ω connectors, or the connectors will be damaged.

Procedure

1. Perform the following steps to set up the equipment:
   a. Set the synthesized signal generator controls as follows:

      FREQUENCY, 500 MHz
      AMPLITUDE, 0 dBm *(50 Ω Input only)*
      AMPLITUDE, +6 dBm (75 Ω *Input only)*
      AM Off
      FM Off

   b. Connect the equipment as shown in Figure 2-8.
   c. Press **Preset** on the analyzer, then wait for the preset routine to finish. Set the analyzer by pressing the following keys:

      FREQUENCY, 500 MHz
      SPAN, 10 MHz

2. Set the analyzer to measure the system related sideband above the signal by performing the following steps:
   a. Press the following keys:

      Peak Search (or Search)
      FREQUENCY, Signal Track (On)
      SPAN, 200 kHz
      BW/Avg, 1 kHz
      Video BW, 30 Hz (Man)

      Allow the analyzer to take two complete sweeps. Then press the following keys:

      FREQUENCY, Signal Track (Off)
      CF Step, 130 kHz (Man)

   b. Press **Single** and wait for the completion of the sweep. Press **Peak Search (or Search)**, then **Marker, Delta**.
   c. Press the following analyzer keys:

      FREQUENCY
      ↑(step-up key)

3. Measure the system related sideband above the signal by pressing **Single** on the analyzer. Wait for the completion of a new sweep, then press **Peak Search (or Search)**.
4. Record the marker delta amplitude as TR Entry 1 of the performance verification test record.

5. Set the analyzer to measure the system related sideband below the signal by pressing the following analyzer keys:

   FREQUENCY
   ↓ (step-down key)
   ↓ (step-down key)

6. Measure the system related sideband below the signal by pressing **Single.** Wait for the completion of a new sweep, then press **Peak Search (or Search).**

   Record the marker delta amplitude as TR Entry 2 of the performance verification test record.

9. Residual FM

This test measures the inherent short-term instability of the analyzer LO system. With the analyzer in zero span, a stable signal is applied to the input and slope-detected on the linear portion of the IF bandwidth filter skirt. Any instability in the LO transfers to the IF signal in the mixing process. The test determines the slope of the IF filter in Hz/dB and then measures the signal amplitude variation caused by the residual FM. Multiplying these two values yields the residual FM in Hz.

Since the 10 Hz resolution bandwidth filter is digitally implemented, its slope is well known. The measured amplitude variation is simply multiplied by the known slope to yield the residual FM in a 10 Hz Res BW.

There are no related adjustment procedures for this performance test.

Equipment Required

Synthesized signal generator
Cable, Type-N, 152-cm (60-in)

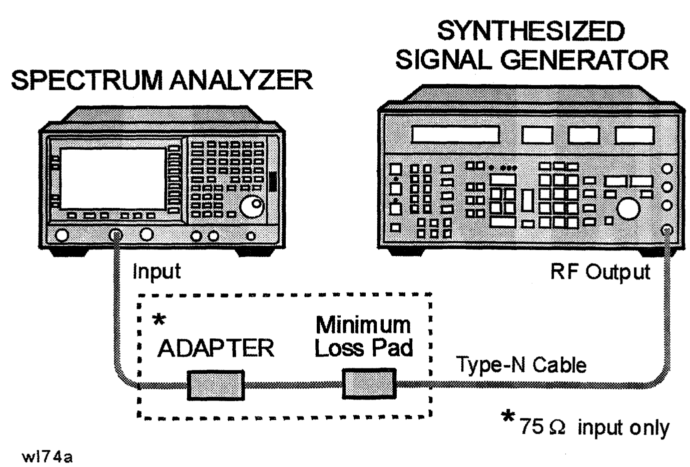
Additional Equipment for 75 Ω Input

Pad, minimum loss
Adapter, Type-N (f), to BNC (m), 75 Ω

Additional Equipment for Option BAB

Adapter, Type-N (f), to APC 3.5 (f)

Figure 2-9 **Residual FM Test Setup**



CAUTION Use only 75 Ω cables, connectors, or adapters on instruments with 75 Ω connectors, or the connectors will be damaged.

Procedure

This performance test consists of two parts:

"Part 1: Residual FM"
"Part 2: Residual FM for Option 1DR and 1D5"

Perform "Part 2: Residual FM for Option 1DR" in addition to Part 1 only if your analyzer is equipped with Option 1DR. Perform only Part 1 for analyzers that do not have Option 1DR.

Part 1: Residual FM

Determining the IF Filter Slope

1. Connect the equipment as shown in Figure 2-9.
2. Set the synthesized signal generator controls as follows:

   FREQUENCY, 1000 MHz
   AMPLITUDE, –10 dBm (50 Ω *Input only)*
   AMPLITUDE, –4 dBm (75 Ω *Input only)*
   AM OFF
   FM OFF

3. Press **Preset** on the analyzer, then wait for the preset routine to finish. Set the analyzer by pressing the following keys:

   FREQUENCY, Center Freq, 1 GHz
   SPAN, 1 MHz
   AMPLITUDE, Ref Level, –9 dBm (50 Ω *Input only)*
   AMPLITUDE, 39.8 dBmV (75 Ω *Input only)*
   Scale/Div, 2 dB
   BW/Avg, Resolution BW, 1 kHz

4. On the analyzer, press the following keys:

   Peak Search (or Search)
   SPAN, Span Zoom, 5 kHz

   Wait for the `Span 5kHz` message to appear, then press:

   Peak Search (or Search), More, Marker → Ref Lvl, Marker, Off

5. On the analyzer, press the following keys:

   Single (Wait for the sweep to finish.)
   Peak Search (or Search), Meas Tools
   Delta

6. On the analyzer, rotate RPG knob counterclockwise until the ΔMkr1 amplitude reads –8 dB ±0.3 dB.
7. Press **Delta**, then rotate the knob counterclockwise until the ΔMkr1 reads –4 dB ±0.3 dB.

   If you have difficulty achieving the ±0.3 dB setting, then make the following analyzer settings:

   Sweep, **Sweep** (Cont)
   SPAN, **2 kHz**
   BW/Avg, **Video BW**, **30 Hz** (Man)
   Repeat step 5 through step 7.

8. Divide the ΔMkr1 frequency in Hertz by the ΔMkr1 amplitude in dB to obtain the slope of the resolution bandwidth filter. For example, if the ΔMkr1 frequency is 275 Hz and the ΔMkr1 amplitude is 3.92 dB, the slope would be equal to 94.2 Hz/dB. Record the result below:

   Slope ___________ Hz/ dB

Measuring the Residual FM

9. On the analyzer, press:

   Marker, **Off**
   Peak Search (or Search)
   Meas Tools
   Delta

10. Rotate the RPG knob counterclockwise until the ΔMkr1 amplitude reads –10 dB ±0.3 dB.
11. On the analyzer, press the following keys:

    Marker, **Normal**
    Marker →, **Mkr → CF**
    Single
    BW/Avg, **Video BW** (Man), **1 kHz**
    SPAN, **Zero Span**
    Sweep, **Sweep Time**, **100 ms**
    Single

    The displayed trace should be about five divisions below the reference level. If it is not, press **Sweep**, **Sweep** (Cont), **FREQUENCY**, and use the RPG knob to place the displayed trace about five divisions below the reference level. Press **Single**.

12. On the analyzer, press **Peak Search (or Search)**, **Pk-Pk Search**. Read the ΔMkr1 amplitude, take its absolute value, and record the result as the Deviation.

    Deviation ___________ dB

13. Calculate the Residual FM by multiplying the Slope recorded in step 8 by the Deviation recorded in step 12.

    Record this value as TR Entry 1 (Residual FM (1 kHz Res BW) in the performance verification test record.

If you are testing an analyzer equipped with Option 1DR and 1D5, continue with "Part 2: Residual FM for Option 1DR and 1D5." Otherwise, the residual FM performance test is complete.

Part 2: Residual FM for Option 1DR and 1D5

Perform this additional procedure only if Option 1DR and Option 1D5 are present. Perform "Part 1: Residual FM" before performing this procedure.

1. Press **Preset** on the analyzer, then wait for the preset routine to finish. Set the analyzer by pressing the following keys:

   FREQUENCY, Center Freq, 1 GHz
   SPAN, 1 MHz
   AMPLITUDE, Ref Level, –9 dBm (50 Ω *Input only)*
   AMPLITUDE, Ref Level, 39.8 dBmV (75 Ω *Input only)*
   Scale/Div, 2 dB

2. On the analyzer press the following keys:

   Peak Search (or Search)
   SPAN, Span Zoom, 5 kHz

   Wait for the "`Span 5 kHz`" message to appear. Press the following analyzer keys:

   BW/Avg, Resolution BW, 10 Hz (Man)
   SPAN, 100 Hz

3. On the analyzer, press the following keys:

   Peak Search (or Search), More, Mkr → Ref Lvl
   Marker, Off

4. On the analyzer, press the following keys:

   Peak Search (or Search)
   Meas Tools
   Delta

5. On the analyzer, rotate the RPG knob counterclockwise until the ΔMkr1 amplitude reads –10 dB ±0.3 dB.

6. On the analyzer, press the following keys:

   Marker, Normal
   Marker →, Mkr → CF
   Single
   BW/Avg, Video BW, 10 Hz (Man)
   SPAN, Zero Span
   Sweep, Sweep Time, 20 ms
   Single

   The displayed trace should be about five divisions below the reference level. If it is not, press **Sweep**, **Sweep** (Cont), **FREQUENCY**, and use the RPG knob to place the displayed trace about five divisions below the reference level. Press **Single**.

7. On the analyzer, press **Peak Search (or Search), Pk-Pk Search**. Read the ΔMkr1 amplitude, take its absolute value, and record the result as the Deviation.

   Deviation ___________ dB

8. Calculate the Residual FM by multiplying the deviation recorded in step 7 by 0.426 Hz/dB. This is the slope of the 10 Hz Res BW filter at 10 dB below the peak of the filter.

   Record this value as TR Entry 2 (Residual FM (10 Hz RBW)) in the performance verification test record.

10. Sweep Time Accuracy

This test uses a function generator to amplitude modulate a 500 MHz CW signal from another signal generator. The analyzer demodulates this signal in zero span to display the response in the time domain. The marker Δ function on the analyzer is used to read out the sweep time accuracy.

If the analyzer is equipped with Option AYX, also perform "Fast Time Domain Amplitude Accuracy" in addition to this procedure.

There are no related adjustment procedures for this performance test.

Equipment Required

Function generator
Synthesized signal generator
Cable, Type-N, 152-cm (60-in)
Cable, BNC, 120-cm (48-in)

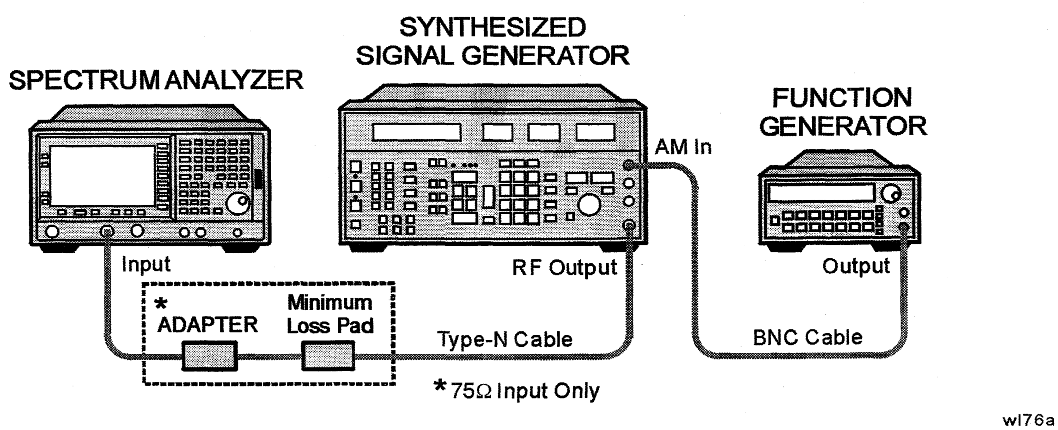
Additional Equipment for 75 Ω Input

Pad, minimum loss
Adapter, Type-N (f), to BNC (m), 75 Ω

Additional Equipment for Option BAB

Adapter, Type-N (f), to APC 3.5 (f)

Figure 2-10 **Sweep Time Accuracy Test Setup**



CAUTION Use only 75 Ω cables, connectors, or adapters on instruments with 75 Ω connectors, or the connectors will be damaged.

Procedure

1. Set the synthesized signal generator to output a 500 MHz, –10 dBm, CW signal. Set the AM and FM controls to off.

   75 Ω *Input only: Set output level to –4 dBm.*

2. Set the function generator to output a 2 kHz, 1.14 Vp-p triangle waveform signal.
3. Connect the equipment as shown in Figure 2-10.
4. Press **Preset** on the analyzer, then wait for the preset routine to finish. Set the analyzer by pressing the following keys:

   Center Frequency, 500 MHz
   SPAN, 10 MHz
   SPAN, Span Zoom, 50 kHz

5. Wait for the `Span 50 kHz` message to appear. Set Signal Track Off.
6. Set the span to 0 Hz and set the analyzer as follows:

   BW/Avg, Resolution BW, 3 MHz
   Sweep, Sweep Time, 5 ms
   AMPLITUDE, Scale Type (Lin)
   Peak Search (or Search), More, Search Parameters, Peak Excursion, 3 dB

7. Adjust the synthesized signal generator amplitude as necessary for a mid-screen display (marker amplitude should read approximately 110 mV).
8. Set the synthesized signal generator modulation source to EXT DC. Set AM ON at 90% modulation.
9. On the analyzer, press **Trig** then **Video**. Set the video trigger level to 110 mV (mid-screen).
10. On the analyzer, press **Single.** After the completion of the sweep, press **Peak Search (or Search), 0s, Meas Tools, Next Pk Right**. This is the marked signal.
11. Press **Marker, Delta**, then **Peak Search (or Search)** and press **Next Pk Right** 8 times so the delta marker is on the eighth signal peak from the marked signal.

12.Read the ΔMkr1 time. Calculate the sweeptime accuracy as follows:

$$\text{Sweep Time Accuracy} = 100 \times \frac{\Delta\text{Mkr1} - (0.8 \times \text{Sweep Time})}{\text{Sweep Time}}$$

NOTE The sweep time accuracy is defined as a percentage of the indicated sweep time, not of the indicated signal separation. Therefore, it is appropriate to divide the difference between the ΔMkr1 reading and the nominal signal separation by the sweep time, rather than dividing by the nominal signal separation.

13.Record the calculated sweeptime accuracy in Table 2-11.

14.If the analyzer is not equipped with Option AYX, fast time domain sweeps, repeat step 10 to step 13 only for sweeptime settings between 5 ms and 10 s as indicated in Table 2-11. For each sweeptime setting, set the function generator to the frequency indicated in Table 2-11.

15.If the analyzer is equipped with Option AYX, fast time domain sweeps, repeat step 10 to step 13 for all sweeptime settings as indicated in Table 2-11. For each sweeptime setting, set the function generator to the frequency indicated in Table 2-11.

Table 2-11 Sweep Time Accuracy

Spectrum Analyzer Sweep Time Setting	Synthesizer Function Generator Frequency	Δ Mkr 1 Reading	Sweep Time Accuracy, %	TR Entry
5 ms	2.0 kHz			1
20 ms	500.0 Hz			2
100 ms	100.0 Hz			3
1 s	10.0 Hz			4
10 s	1.0 Hz			5
The following entries only apply to analyzers equipped with Option AYX.				
1 ms	10.0 kHz			6
500 µs	20.0 kHz			7
100 µs	100.0 kHz			8

11. Display Scale Fidelity

A 50 MHz CW signal is applied to the input of the analyzer through two calibrated step attenuators. The attenuators are the amplitude reference standard. The source is adjusted for a response at the reference level. The attenuators are then set to achieve a nominal amplitude below the reference level. The analyzer amplitude marker is compared to the actual total attenuation to determine the scale fidelity error.

The test is performed in both log and linear amplitude scales.

The related adjustment for this performance test is "IF Amplitude."

Equipment Required

Synthesized signal generator
1 dB step attenuator
10 dB step attenuator
Attenuator switch driver (if programmable step attenuators are used)
Cable, Type-N 152-cm (60-in)
Cable, BNC 122-cm (48-in) (*2 required*)
Attenuator interconnect kit
Adapter, Type-N (m) to BNC (f) (*2 required*)

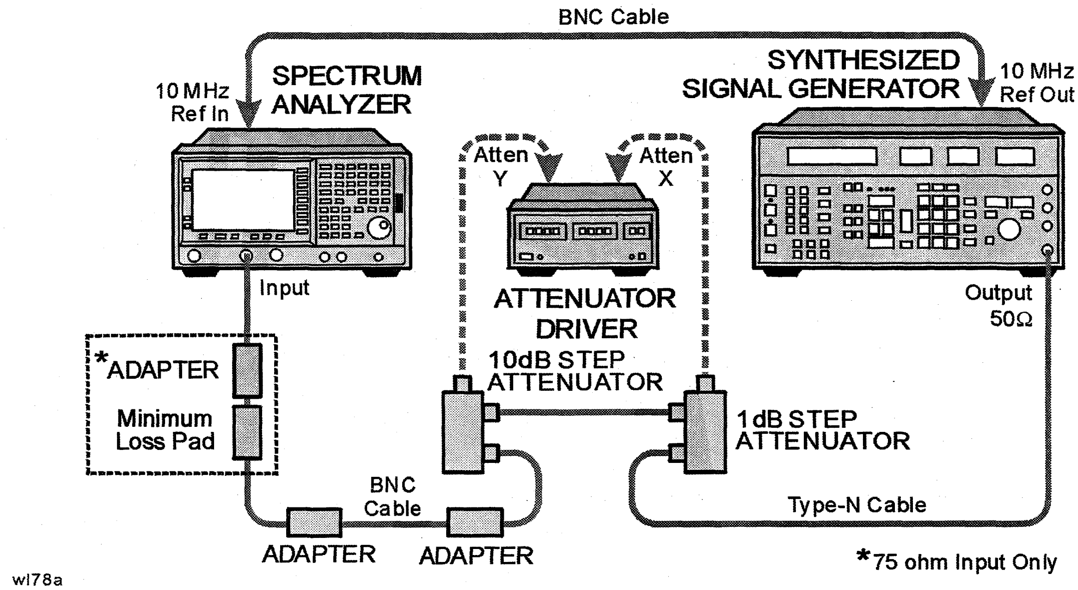
Additional Equipment for 75 Ω Input

50 Ω to 75 Ω minimum loss pad
Adapter, Type-N (f), to BNC (m), 75 Ω

Additional Equipment for Option BAB

Adapter, Type-N (f), to APC 3.5 (f)

Figure 2-11 **Scale Fidelity Test Setup**



CAUTION Use only 75 Ω cables, connectors, and adapters on instruments with 75 Ω connectors, or the connectors will be damaged.

Procedure

Calculate the Actual Attenuation Errors

1. From the calibration data supplied with the 10 dB step attenuator, enter into column 4 of Table 2-12 and Table 2-13 the actual attenuation for the corresponding nominal attenuation settings.

   If the calibration data does not indicate an actual attenuation value for the 0 dB setting, enter 0 dB.

NOTE The HP 8496G programmable attenuator has 4 attenuator sections consisting of 10 dB, 20 dB, 40 dB, and 40 dB attenuators. If using the HP 8496G programmable attenuator, enter the calibration data for the section three, 40 dB step, rather than the section four, 40 dB step.

2. From the calibration data supplied with the 1 dB step attenuator, enter into column 5 of Table 2-12 and Table 2-13 the actual attenuation for the corresponding nominal attenuation settings.

   If the calibration data does not indicate an actual attenuation value for the 0 dB setting, enter 0 dB.

NOTE The HP 8494G programmable attenuator has 4 attenuator sections consisting of 1 dB, 2 dB, 4 dB, and 4 dB attenuators. If using the HP 8494G programmable attenuator, enter the calibration data for the section three, 4 dB step, rather than the section four, 4 dB step.

3. For each row in Table 2-12 and Table 2-13, add the 10 dB and the 1 dB Step Attenuator Actual Attenuation values (columns 4 and 5) and place the results into the Total Actual Attenuation (column 6).

$$\text{Total Actual Attenuation} = \text{1 dB Step Attenuator Actual Attenuation} + \text{10 dB Step Attenuator Actual Attenuation}$$

Example for –36 dB from REF LVL setting:

$$\text{1 dB Step Attenuator Actual Attenuation (6 dB)} = 5.998 \text{ dB}$$

$$\text{10dB Step Attenuator Actual Attenuation (30 dB)} = 30.012 \text{ dB}$$

$$\text{Total Actual Attenuation} = 5.998\text{dB} + 30.012 \text{ dB} = 36.010 \text{ dB}$$

4. Enter the total actual attenuation (0 dB from the reference level) below:

   Total actual attenuation (0 dB from Ref Level) = _________ dB

Section 1: Log Display Scale Fidelity, Analog Bandwidths

Setup for Log Scale Measurement

5. Connect the equipment as indicated in Figure 2-11.
6. Press **Preset** on the analyzer and press the following keys:

   System, Alignments, Auto Align, Off
   FREQUENCY, 50 MHz
   SPAN, 45 kHz
   BW/Avg, 3 kHz
   BW/Avg, Video BW, 1 kHz

7. **Preset** the synthesized signal generator, then press **Blue Key, Special, 0.0**. Press the following keys:

   FREQUENCY, 50 MHz
   AMPLITUDE, –3 dBm (*50 Ω Input only*)
   AMPLITUDE, +4 dBm (*75 Ω Input only*)

8. Set the 1 dB step attenuator to 0 dB.
9. Set the 10 dB step attenuator to 0 dB.
10. Press **Peak Search (or Search)** on the analyzer.

11.Adjust the synthesized signal generator amplitude until the analyzer marker amplitude reads 0 dBm ±0.1 dB.

75 Ω Input: Adjust the synthesized signal generator amplitude until the analyzer marker reads 48.75 dBmV ±0.1 dB.

NOTE Do not adjust the synthesized signal generator amplitude after the reference is established.

12.On the analyzer, press **Marker, Delta**.

Measure the Cumulative Log Fidelity

13.Perform step 14 to step 16 for each measurement value in Table 2-12.

14.Set the 1 dB and 10 dB step attenuators as indicated in column 2 and column 3 of Table 2-12 for the various dB from REF LVL settings.

For settings of –64 dB and lower, press the following analyzer keys:

BW/Avg, Average (On)
5, Enter

15.Press **Peak Search (or Search)** on the analyzer and record the ΔMkr reading in column 7 of Table 2-12.

16.Calculate the Cumulative Log Fidelity Error (CLFE) as follows, and record the result in the performance verification test record as indicated in column 8 of Table 2-12:

$$\text{CLFE} = \text{Total Actual Attenuation} + \text{Mkr}\Delta\ \text{Reading} - \text{Total Actual Atten}\ (0\ \text{dB from Ref Level})$$

Table 2-12 Cumulative and Incremental Log Scale Fidelity Worksheet, Analog Resolution Bandwidths Measured at 3 kHz

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9
dB from REF LVL, dB	10 dB Step Atten Nominal Attenu-ation, dB	1 dB Step Atten Nominal Attenu-ation, dB	10 dB Step Atten Actual Attenu-ation, dB	1 dB Step Atten Actual Attenu-ation, dB	Total Actual Attenu-ation, dB	Mkr Δ Reading, dB	TR Entry – CLFE, dB	TR Entry – ILFE, dB
0 (Ref)	0	0				0 (Ref)	0 (Ref)	NA
–4	0	4					1)_____	22) _____
–8	0	8					2)_____	23) _____
–12	10	2					3)_____	24) _____
–16	10	6					4) _____	25) _____
–20	20	0					5) _____	26) _____
–24	20	4					6) _____	27) _____
–28	20	8					7) _____	28) _____
–32	30	2					8) _____	29) _____
–36	30	6					9) _____	30)_____
–40	40	0					10) _____	31) _____
–44	40	4					11) _____	32) _____
–48	40	8					12) _____	33) _____
–52	50	2					13) _____	34) _____
–56	50	6					14) _____	35) _____
–60	60	0					15) _____	36) _____
–64	60	4					16) _____	37) _____
–68	60	8					17) _____	38)_____
–72	70	2					18) _____	39) _____
–76	70	6					19) _____	40) _____
–80	80	0					20)_____	41)_____
–84	80	4					21) _____	NA

Calculate Incremental Log Fidelity

17.Calculate the Incremental Log Fidelity Error (ILFE) for dB from REF LVL settings of –4 dB to –80 dB using the current and previous Cumulative Log Fidelity Errors (CLFEs):

ILFE= CLFE(current) – CLFE(previous)

Example Calculation for ILFE at –20 dB from REFLVL setting:

Previous CLFE(–16 dB from REF LVL)= –0.07 dB

Current CLFE(–20 dB from REF LVL) = +0.02 dB

ILFE(–20 dB)= 0.02 dB–(–0.07 dB)= 0.09 dB

18.Record the result in the performance verification test record as indicated in column 9 of Table 2-12.

Section 2: Log Display Scale Fidelity, Digital Bandwidths

This section is for analyzers with Option 1DR (narrow resolution bandwidths) only.

Setup for Log Scale Measurement

19.Set the following parameters on the analyzer:

SPAN, 150 Hz
BW/Avg, 10 Hz
BW/Avg, Video BW, 3 Hz

20.Press **Peak Search (or Search)** on the analyzer.

21.Adjust the amplitude of the synthesized signal generator until the analyzer marker amplitude reads 0 dBm ±0.1 dB.

75 Ω Input only: Adjust the amplitude of the synthesized signal generator until the analyzer marker amplitude reads 48.75 dBmV ±0.1 dB.

22.Set the 1 dB and the 10 dB step attenuators to 0 dB.

NOTE Do not adjust the synthesized signal generator amplitude after the reference is established.

23.On the analyzer, press **Marker, Delta**.

Measure the Cumulative Log Fidelity

24. Perform step 25 to step 27 for each measurement value in Table 2-13.

25. Set the 1 dB and 10 dB step attenuators as indicated in Table 2-13 for the various dB from REF LVL settings.

    For settings of –84 dB and lower, press the following analyzer keys:

    BW/Avg, Average (On)
    5, Enter

26. Press **Peak Search (or Search)** on the analyzer and record the ΔMkr reading in column 7 of Table 2-13.

27. Calculate the Cumulative Log Fidelity Error (CLFE) as follows and record the result in the performance verification test record as indicated in column 8 of Table 2-13:

$$CLFE = \text{Total Actual Attenuation} + \text{Mkr}\nabla\text{Reading} - \text{Total Actual Atten}(0\text{ dB from Ref Level}$$

Table 2-13 Cumulative and Incremental Log Scale Fidelity Worksheet, Option 1DR Narrow Resolution Bandwidths Measured at 10 Hz

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9
dB from REF LVL, dB	10 dB Step Atten Nominal Attenu-ation, dB	1 dB Step Atten Nominal Attenu-ation, dB	10 dB Step Atten Actual Attenu-ation, dB	1 dB Step Atten Actual Attenu-ation, dB	Total Actual Attenu-ation, dB	Mkr Δ Reading, dB	TR Entry – CLFE, dB	TR Entry – ILFE, dB
0 (Ref)	0	0				0 (Ref)	0 (Ref)	NA
–4	0	4					43) ____	68) ____
–8	0	8					44) ____	69) ____
–12	10	2					45) ____	70)____
–16	10	6					46) ____	71) ____
–20	20	0					47) ____	72)____
–24	20	4					48) ____	73) ____
–28	20	8					49) ____	74) ____
–32	30	2					50) ____	75) ____
–36	30	6					51)____	76)____
–40	40	0					52) ____	77)____
–44	40	4					53) ____	78) ____

Table 2-13 Cumulative and Incremental Log Scale Fidelity Worksheet, Option 1DR Narrow Resolution Bandwidths Measured at 10 Hz

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9
dB from REF LVL, dB	10 dB Step Atten Nominal Attenu-ation, dB	1 dB Step Atten Nominal Attenu-ation, dB	10 dB Step Atten Actual Attenu-ation, dB	1 dB Step Atten Actual Attenu-ation, dB	Total Actual Attenu-ation, dB	Mkr Δ Reading, dB	TR Entry – CLFE, dB	TR Entry – ILFE, dB
–48	40	8					54) ____	79)____
–52	50	2					55) ____	80) ____
–56	50	6					56) ____	81) ____
–60	60	0					57) ____	82) ____
–64	60	4					58) ____	83)____
–68	60	8					59) ____	84) ____
–72	70	2					60) ____	85) ____
–76	70	6					61)____	86)____
–80	80	0					62)____	87) ____
–84	80	4					63) ____	NA
–88	80	8					64) ____	NA
–92	90	2					65) ____	NA
–96	90	4					66) ____	NA
–98	90	6					67) ____	NA

Calculate incremental log fidelity:

28. Calculate the Incremental Log Fidelity Error (ILFE) for dB from REF LVL settings of –4 dB to –80 dB using the current and previous Cumulative Log Fidelity Errors (CLFEs):

ILFE= CLFE(current) – CLFE(previous)

Record the result in the performance verification test record as indicated in column 9 of Table 2-13.

Section 3: Linear Display Scale Fidelity, Analog Bandwidths

Setup for linear scale measurement:

29.Press **Preset** on the analyzer and press the following keys:

System, Alignments, Auto Align, Off
FREQUENCY, 50 MHz
SPAN, 10 kHz
BW/Avg, 3 kHz
AMPLITUDE, Scale Type (Lin)
Input/Output (or Input), Input Z Corr (50) (*75 Ω Input only*)

30.Preset the synthesized signal generator, by pressing **Blue Key, Special, 0,0**. Press the following keys:

FREQUENCY, 50 MHz
AMPLITUDE, –3 dBm (*50 Ω Input only*)
AMPLITUDE, +4 dBm (*75 Ω Input only*)

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

32.Set the 10 dB step attenuator to 0 dB.

33.Press **Peak Search (or Search)** on the analyzer.

34.Adjust the synthesized signal generator amplitude until the analyzer marker amplitude reads 223.6 mV ±4 mV.

NOTE Do not adjust the amplitude of the synthesized signal generator after the reference is established.

Calculate ideal marker amplitude:

35.Considering Total Actual Attenuation at the 0 dB from REF LVL setting to be ATref, and the Total Actual Attenuation at any other dB from REF LVL setting to be ATmeas, calculate the Ideal Mkr Reading, in millivolts, as follows, and enter the result in column 7 of Table 2-14.

$$\text{Ideal Mkr Reading(mV)} = 1000\sqrt{0.05 \times 10^{(-\text{ATmeas} + \text{ATref})/10}}$$

For example, if ATref = 0.012 dB and ATmeas = 7.982, the Ideal Mkr Reading for the –8 dB from Ref Level setting would be:

$$\text{Ideal Mkr Reading(mV)} = 1000\sqrt{0.05 \times 10^{(-7.982 + 0.012)/10}} = 89.3\text{ mV}$$

Measure linear fidelity:

36.Perform step 37 to step 39 for each measurement value in Table 2-14.

37.Set the 1 dB and 10 dB step attenuators as indicated in column 2 and column 3 of Table 2-14 for the dB from REF LVL settings.

38.Press **Peak Search (or Search)** on the analyzer and record the Mkr Δ amplitude reading as the actual Mkr reading in column 8 of Table 2-14.

39.Calculate the Linear Fidelity Error (LFE) as a percentage of reference level (RL), and record the result in the performance verification test record as indicated in column 9 of Table 2-14.

$$\text{LFE}(\%\text{ of RL}) = 100 \times \frac{\text{Actual Mkr Reading} - \text{Ideal Mkr Reading}}{223.6\text{ mV}}$$

Example calculation for LFE(% of RL):

$$\text{Actual Mkr Reading} = 85.0\text{ mV}$$

$$\text{Ideal Mkr Reading} = 89.3\text{ mV}$$

$$\text{LFE}(\%\text{of RL}) = 100 \times \frac{85.0 - 89.3}{223.6}$$

$$\text{LFE}(\%\text{of RL}) = 1.92\%\text{ of RL}$$

Table 2-14 Linear Scale Fidelity Worksheet, Analog Resolution Bandwidths Measured at 3 kHz

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9
dB from REF LVL, dB	**10 dB Step Atten Nominal Attenu-ation dB**	**1 dB Step Atten Nominal Attenu-ation dB**	**10 dB Step Atten Actual Attenu-ation dB**	**1 dB Step Atten Actual Attenu-ation dB**	**Total Actual Attenu-ation (dB)**	**Ideal Mkr Reading (mV)**	**Actual Mkr Reading (mV)**	**TR Entry – LFE (% of RL)**
0 (Ref)	0	0				0 (Ref)	0 (Ref)	0 (Ref)
–4	0	4						89) _____
–8	0	8						90) _____
–12	10	2						91)_____
–16	10	6						92) _____
–20	20	0						93) _____

Section 4: Linear Display Scale Fidelity, Digital Bandwidths

This section is for analyzers with Option 1DR (narrow resolution bandwidths) only.

Setup for linear scale measurement:

40. Set the following parameters on the analyzer:

    SPAN, 100, Hz
    BW/Avg, 10 Hz
    Video BW, 1 Hz

41. Press **Peak Search (or Search)** on the analyzer.

42. Set the 1 dB and 10 dB step attenuators to 0 dB.

43. Adjust the synthesized signal generator amplitude until the analyzer marker amplitude reads 223.6 mV ±4mV.

NOTE Do not adjust the synthesized signal generator amplitude after the reference is established.

Calculate ideal marker amplitude:

44. Considering Total Actual Attenuation at the 0 dB from REF LVL setting to be ATref and the Total Actual Attenuation at any other dB from REF LVL setting to be ATmeas, calculate the Ideal Mkr Reading, in millivolts, as follows and enter the result in column 7 of Table 2-15.

$$\text{Ideal Mkr Reading(mV)} = 1000\sqrt{0.05 \times 10^{(-\text{ATmeas} + \text{ATref})/10}}$$

Measure linear fidelity:

45. Perform step 46 to step 48 for each measurement value in Table 2-15.

46. Set the 1 dB and 10 dB step attenuators as indicated in Table 2-15 for the dB from REF LVL settings.

47. Press **Peak Search (or Search)** on the analyzer and record the Mkr Δ amplitude reading as the actual Mkr reading in column 8 of Table 2-15.

48. Calculate the Linear Fidelity Error (LFE) as a percentage of reference level (RL), and record the result in the performance verification test record as indicated in column 9 of Table 2-15.

$$LFE(\%of\ RL) = 100 \times \frac{\text{Actual Mkr Reading} - \text{Ideal Mkr Reading}}{223.6\ \text{mV}}$$

Table 2-15 Linear Scale Fidelity Worksheet, Option 1DR Narrow Resolution Bandwidths Measured at 10 Hz

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9
dB from REF LVL (dB)	10 dB Step Atten Nominal Attenu-ation (dB)	1 dB Step Atten Nominal Attenu-ation (dB)	10 dB Step Atten Actual Attenu-ation (dB)	1 dB Step Atten Actual Attenu-ation (dB)	Total Actual Attenu-ation (dB)	Ideal Mkr Reading (mV)	Actual Mkr Reading (mV)	TR Entry – LFE (% of RL)
0 (Ref)	0	0				0 (Ref)	0 (Ref)	0 (Ref)
–4	0	4						94) _____
–8	0	8						95) _____
–12	10	2						96) _____
–16	10	6						97) _____
–20	20	0						98) _____

49. If the analyzer has a 75Ω Input press:

Input/Output (or Input)
Input Z Corr (75)

Zero Span Log Fidelity, Digital Bandwidths

This section is for analyzers with Option 1DR (narrow resolution bandwidths) only.

Setup for zero span measurements

50. Set the 1 dB step attenuator to 11 dB and the 10 dB step attenuator to 110 dB.

51. On the analyzer, press the following keys:

Preset
System, Alignments, Align Now, All *(wait for the alignment sequence to complete)*

52. Set the 1 dB and 10 dB step attenuators to 0 dB.

53. Set the following parameters on the analyzer:

FREQUENCY, 50 MHz
SPAN, 100 Hz
BW/Avg, 10 Hz

54. Press **Peak Search (or Search), Marker –>, and Marker –> CF** on the analyzer.

55. Press **SPAN, Zero Span** on the analyzer

56. Adjust the synthesized signal generator amplitude until the analyzer marker amplitude reads 0 dBm 0.1 dB

75 Ω Input: Adjust the synthesized signal generator amplitude until the analyzer marker amplitude reads 48.75 dBmV 0.1 dB

NOTE Do not adjust the synthesized signal generator amplitude after the reference is established.

57. On the analyzer press **Marker, Delta.**

Measure the Cumulative Log Fidelity

58. On the analyzer, press **Single, BW/Avg, Average, 5, Enter.**

59. Perform step 61 to step 64 for each measurement value in Table 2-16.

60. Set the 1 dB and 10 dB step attenuators as indicated in column 2 and column 3 of Table 2-16 for the various dB from REF LVL settings.

61. Press **Single** and wait for "VAvg 5" to be displayed to the right of the graticule area.

62. Record the ΔMkr1 amplitude reading in column 7 of Table 2-16.

63. Calculate the Cumulative Log Fidelity Error (CLFE) as follows, and record the result in the performance verification test record as indicated in column 8 of Table 2-16.

CLFE = Total Actual Attenuation + ΔMkr Reading – Total Actual Atten (0 dB from Ref Level)

Table 2-16 Zero Span Cumulative Log Fidelity Worksheet, Opt 1DR Narrow Resolution Bandwidths, (measured at 10 Hz)

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
dB from REF LVL (dB)	10 dB Step Atten Nominal Attenu-ation (dB)	1 dB Step Atten Nominal Attenu-ation (dB)	10 dB Step Atten Actual Attenu-ation (dB)	1 dB Step Atten Actual Attenu-ation (dB)	Total Actual Attenu-ation (dB)	ΔMkr Reading (dB)	TR Entry-CLFE (dB)
0 (Ref)	0	0				0 (Ref)	0 (Ref)
–4	0	4					97) _____
–8	0	8					98) _____
–12	10	2					99) _____
–16	10	6					100) _____
–20	20	0					101) _____
–24	20	4					102) _____
–28	20	8					103) _____
–32	30	2					104) _____
–36	30	6					105) _____
–40	40	0					106) _____
–44	40	4					107) _____
–48	40	8					108) _____
–52	50	2					109) _____
–56	50	6					110) _____
–60	60	0					111) _____
–64	60	4					112) _____
–68	60	8					113) _____
–70	70	0					114) _____

Post Test Instrument Restoration

64.On the analyzer, press the following keys:

Preset
System, Alignments, Auto Align, All

12. Input Attenuation Switching Uncertainty

A 50 MHz CW signal is applied to the input of the analyzer through two calibrated step attenuators. The attenuators are the amplitude reference standard. The source is adjusted for a response at the reference level. The internal attenuators are then varied between settings and the external attenuators are changed accordingly to maintain the same input level at the mixer. The spectrum analyzer marker functions are used to measure the amplitude differences. The actual attenuation values of the step attenuators are used to correct the marker amplitude readings yielding the input attenuation switching error.

The related adjustment for this performance test is “Frequency Response.”

Equipment Required

Synthesized signal generator
1 dB step attenuator
10 dB step attenuator
Attenuator switch driver (if programmable step attenuators are used)
10 dB fixed attenuator
Cable, Type-N 152-cm (60-in)
Cable, BNC 122-cm (48-in) (*2 required*)
Attenuator interconnect kit
Adapter, Type-N (m) to BNC (f) (*2 required*)

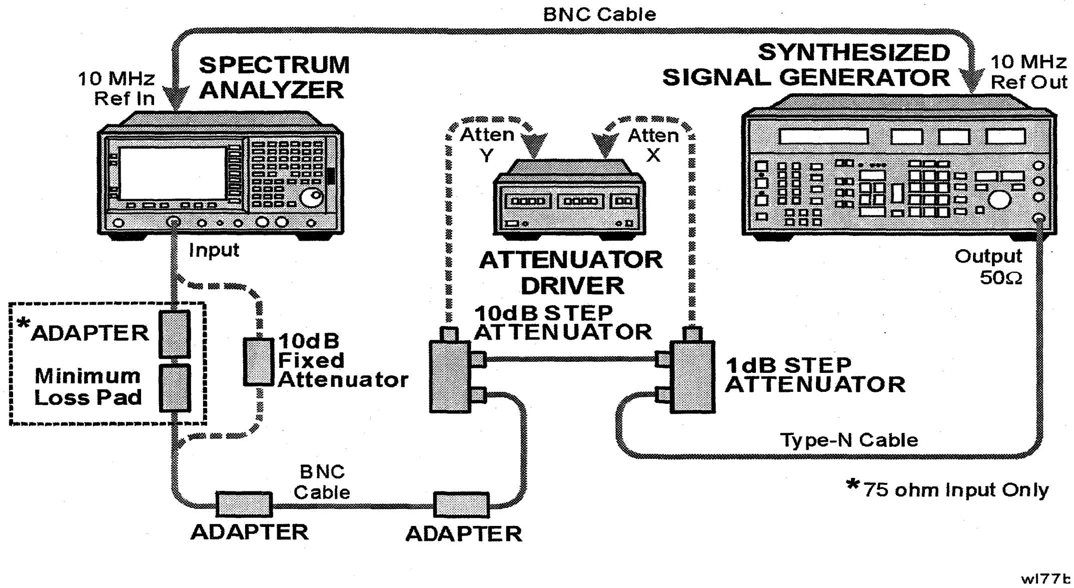
Additional Equipment for 75 Ω Input

50 Ω to 75 Ω minimum loss pad
Adapter, Type-N (f), to BNC (m), 75 Ω

Additional Equipment for Option BAB

Adapter, Type-N (f), to APC 3.5 (f)

Figure 2-12 Input Attenuator Switching Uncertainty Test Setup



CAUTION Use only 75 Ω cables, connectors, or adapters on instruments with 75 Ω connectors, or the connectors will be damaged.

Procedure

Calculate Actual Attenuation Values

1. From the calibration data supplied with the 1 dB step attenuator, enter into column 2 of Table 2-17 the actual attenuation for the corresponding nominal attenuation settings. If the calibration data does not indicate an actual attenuation value for the 0 dB setting, enter 0 dB.

NOTE The HP 8494G programmable attenuator has 4 attenuator sections consisting of 1 dB, 2 dB, 4 dB, and 4 dB attenuators. If using the HP 8494G programmable attenuator, enter the calibration data for the section three 4 dB step rather than the section four 4 dB step.

2. From the calibration data supplied with the 10 dB step attenuator, enter into column 4 of Table 2-17 the actual attenuation for the corresponding nominal attenuation settings. If the calibration data does not indicate an actual attenuation value for the 0 dB setting, enter 0 dB.

NOTE

The HP 8496G programmable attenuator has 4 attenuator sections consisting of 10 dB, 20 dB, 40 dB, and 40 dB attenuators. If using the HP 8496G programmable attenuator, enter the calibration data for the section three 40 dB step rather than the section four 40 dB step.

3. For each Total Nominal Attenuation setting indicated in Table 2-17, calculate the Total Actual Attenuation from the actual attenuation columns for the 1 dB and the 10 dB step attenuators and enter the result in Table 2-17.

   Total Actual Attenuation = 1 dB Step Attenuator Actual Attenuation + 10 dB Step Attenuator Actual Attenuation

   Example for 35 dB total nominal attenuation setting:

   1 dB Step Attenuator Actual Attenuation (5 dB) = 5.021 dB

   10 dB Step Attenuator Actual Attenuation (30 dB) = 29.981 dB

   Total Actual Attenuation = 5.998 dB + 30.012 dB = 35.002 dB

Table 2-17 Actual Attenuation Worksheet

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
1 dB step Attenuator Nominal Attenuation, dB	**1 dB step Attenuator Actual Attenuation, dB**	**10 dB step Attenuator Nominal Attenuation, dB**	**10 dB step Attenuator Actual Attenuation, dB**	**Total Nominal Atten-uation, dB**	**Total Actual Atten-uation, dB**
0		0		0	
5		0		5	
0		10		10	
5		10		15	
0		20		20	
5		20		25	
0		30		30	
5		30		35	
0		40		40	
5		40		45	
0		50		50	
5		50		55	
0		60		60	

Table 2-17 Actual Attenuation Worksheet

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
1 dB step Attenuator Nominal Attenuation, dB	1 dB step Attenuator Actual Attenuation, dB	10 dB step Attenuator Nominal Attenuation, dB	10 dB step Attenuator Actual Attenuation, dB	Total Nominal Atten-uation, dB	Total Actual Atten-uation, dB
5		60		65	

4. For each attenuation error value in column 4 of Table 2-18, calculate the attenuation errors by subtracting the difference between the Table 2-17 Total Actual Attenuation and Total Nominal Attenuation from the difference between the Total Actual Attenuation and Total Nominal Attenuation at 55 dB. Note that the total nominal attenuations listed in Table 2-18 are in a different order than those listed in Table 2-17.

AttenErr = (ActAtten(55 dB) - 55 dB) - (ActAtten(X dB) - NomAtten(X dB))

Where:

AttenErr = Attenuator Error between the X dB and 55 dB settings

ActAtten(55 dB) = Actual Attenuation of the 55 dB setting

ActAtten(X dB) = Actual Attenuation of the X dB setting

NomAtten(X dB) = Nominal Attenuation of the X dB setting

Example of attenuation error calculation for 35 dB nominal attenuation:

ActAtten (55 dB) = 55.15 dB
ActAtten (35 dB) = 35.002 dB
NomAtten (35 dB) = 35 dB

$$\text{AttenErr} = (55.15 - 55) - (35.002 - 35)$$
$$\text{AttenErr} = 0.15 - 0.002$$
$$\text{AttenErr} = 0.148 \text{ dB}$$

Setup for Switching Uncertainty Measurement

5. Connect the equipment as indicated in Figure 2-12. The 10 dB fixed attenuator (or minimum loss pad for 75 Ω input analyzers) should be connected directly to the input connector of the analyzer.

6. Press **Preset** on the analyzer. Press **System, Alignments, Auto Align, Off**. Set the controls as follows:

   FREQUENCY, 50 MHz
   SPAN, 100 kHz
   AMPLITUDE, –55 dBm *(50 Ω Input only)*
   AMPLITUDE, –6.2 dBmV *(75 Ω Input only)*
   AMPLITUDE, Attenuation, 10 dB
   AMPLITUDE, Scale/Div, 2 dB
   BW/Avg, 30 kHz
   BW/Avg, Video BW, 100 Hz

7. Preset the synthesized signal generator (**Blue Key, Special, 0,0**) and set the controls as follows:

   FREQUENCY, 50 MHz
   AMPLITUDE, +10 dBm *(50 Ω Input only)*
   AMPLITUDE, +6 dBm *(75 Ω Input only)*

8. Set the 1 dB step attenuator to 5 dB attenuation. Set the 10 dB step attenuator to 50 dB. Refer to the HP 11713A attenuator switch driver manual for information on manually controlling a programmable step attenuator.

9. Press **Peak Search (or Search)** on the analyzer.

10. Adjust the amplitude of the synthesized signal generator until the marker amplitude of the analyzer reads –57 dBm ± 0.1 dB.

    75 Ω *Input only: Adjust the amplitude of the synthesized signal generator until the marker of the analyzer reads –8.2 dBmV ± 0.1 dB.*

NOTE Do not adjust the amplitude of the synthesized signal generator after the reference is established.

11. On the analyzer, press **Peak Search (or Search), Marker, Delta.**

Table 2-18 Input Attenuation Switching Uncertainty Worksheet

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Spectrum Analyzer Internal Attenu-ation Setting	**Spectrum Analyzer Reference Level Setting 50Ω Input / 75 Ω Input**	**Total Nominal Attenu-ation Setting**	**Attenu-ation Error, dB**	**Ideal Marker Delta Reading**	**Marker Delta Reading, dB**	**TR Entry – Switching Error, dB**
10 dB	–55 dBm / –6.2 dBmV	55 dB	0	0 dB	0	Ref
0 dB	–65 dBm / –16.2 dBmV	65 dB		-10 dB		**1)**
5 dB	–60 dBm / –11.2 dBmV	60 dB		-5 dB		**2)**
15 dB	–50 dBm / –1.2 dBmV	50 dB		5 dB		**3)**
20 dB	–45 dBm / +3.8 dBmV	45 dB		10 dB		**4)**
25 dB	–40 dBm / +8.8 dBmV	40 dB		15 dB		**5)**
30 dB	–35 dBm / +13.8 dBmV	35 dB		20 dB		**6)**
35 dB	–30 dBm / +18.8 dBmV	30 dB		25 dB		**7)**
40 dB	–25 dBm / +23.8 dBmV	25 dB		30 dB		**8)**
45 dB	–20 dBm / +28.8 dBmV	20 dB		35 dB		**9)**
50 dB	–15 dBm / +33.8 dBmV	15 dB		40 dB		**10)**
55 dB	–10 dBm / +38.8 dBmV	10 dB		45 dB		**11)**
60 dB	–5 dBm / +43.8 dBmV	5 dB		50 dB		**12)**
65 dB[a]	0 dBm / +48.8 dBmV	0 dB		55 dB		**13)**

a. Does not apply to HP E4401B or HP E4411B.

Measure Switching Uncertainty

Perform step 12 to step 15 for each measurement value in Table 2-18.

12. Set the 1 dB and 10 dB step attenuators to the Total Nominal Attenuation setting value as indicated in column 3 of Table 2-18 for the various spectrum analyzer attenuation settings for each measurement. Table 2-17 may be used as a reference for setting the step attenuators to achieve the desired total nominal attenuation.
13. Similarly, set the corresponding spectrum analyzer attenuation and reference level settings as indicated in column 1 and column 2 of Table 2-18.
14. Press **Single**, then **Peak Search (or Search)** and record the marker amplitude reading as the Marker Delta Reading in column 6 of Table 2-18.
15. Calculate the Switching Error (Table 2-18, column 7) by subtracting the Ideal Marker Delta Reading and the Attenuation Error from the Marker Delta Reading. Record the result in the performance verification test record.

$$\text{Switching Error} = \text{Marker Delta Reading} - \text{Ideal Marker Delta Reading} - \text{Attenuattion Error}$$

Example for 25 dB spectrum analyzer internal attenuation setting:

$$\text{Marker Delta Reading} = 14.790\ \text{dB}$$

$$\text{Ideal Marker Delta Reading} = 15\ \text{dB}$$

$$\text{Attenuation Error} = -0.148\ \text{dB}$$

$$\text{Switching Error} = 14.790 - 15 - (-0.148) = -0.062\ \text{dB}$$

Post-test Instrument Restoration

16. On the analyzer, press **Preset, System, Alignments, Auto Align, All.**

13. Reference Level Accuracy: HP E4401B and E4411B

A 50 MHz CW signal is applied to the input 50 Ω of the analyzer through two step attenuators. The amplitude of the source is decreased in 10 dB steps and the analyzer marker functions are used to measure the amplitude difference between steps. The external attenuator is used as the reference standard. The test is performed in both log and linear amplitude scales.

It is only necessary to test reference levels as low as –90 dBm (with 10 dB internal attenuation) since lower reference levels are a function of the analyzer microprocessor manipulating the trace data. There is no error associated with the trace data manipulation.

The related adjustment for this performance test is "IF Amplitude."

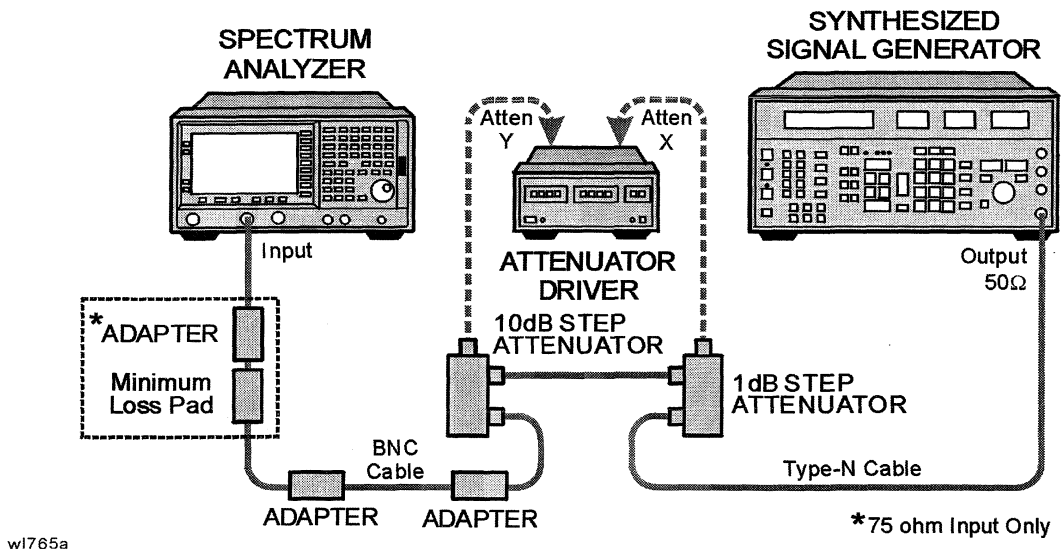
Equipment Required

Synthesized signal generator
1 dB step attenuator
10 dB step attenuator
Attenuator switch driver (if programmable step attenuators are used)
Cable, Type-N 152-cm (60-in)
Cable, BNC 122-cm (48-in) (*2 required*)
Attenuator interconnect kit
Adapter, Type-N (m) to BNC (f) (*2 required*)

Additional Equipment for 75 Ω Input

Pad, minimum loss
Adapter, Type-N (f), to BNC (m), 75 Ω

Figure 2-13 **Reference Level Accuracy Test Setup**



Procedure

Calculate the Actual Attenuation Errors

1. From the calibration data supplied with the 10 dB step attenuator, enter into column 2 of Table 2-19 and Table 2-20 the actual attenuation for the corresponding nominal attenuation settings. If no calibration data is supplied for 0 dB, enter zero.

NOTE The HP 8496G programmable attenuator has 4 attenuator sections consisting of 10 dB, 20 dB, 40 dB and 40 dB attenuators. If using the HP 8496G programmable attenuator, enter the calibration data for the section three 40 dB step rather than the section four 40 dB step.

2. Calculate the reference attenuation error by subtracting 20 dB from the actual attenuation for the 20 dB setting, and enter below.

$$\text{Reference Attenuator Error} = \text{Actual Attenuation}(20\ \text{dB}) - 20\ \text{dB}$$

Reference Attenuator Error ___________ dB

3. To calculate the Attenuation Error at other nominal attenuator settings, subtract the Attenuation Error at the other settings from the Reference Attenuator Error and enter the result in column 3 of Table 2-19 and Table 2-20.

$$\text{Attenuator Error }(X\ \text{dB}) = (\text{Actual Attenuation}(X\ \text{dB}) - \text{Nominal Attenuation }(X\ \text{dB})) - \text{Reference Attenuation Error}$$

Example for 50 dB attenuator setting:

$$\text{Actual Attenuation (50 dB)} = 50.08 \text{ dB}$$

$$\text{Actual Attenuation (20 dB)} = 19.85 \text{ dB}$$

$$\text{Reference Attenuation Error} = 19.85 \text{ dB} - 20 \text{ dB} = -0.15 \text{ dB}$$

$$\text{Attenuation Error (50 dB)} = (50.08 \text{ dB} - 50\text{dB}) - (-0.15) \text{ dB}$$

$$= +0.23 \text{ dB}$$

Log Scale, Analog Bandwidths

1. Set the synthesized signal generator controls as follows:

   FREQUENCY, 50 MHz
   AMPLITUDE, +2 dBm

2. Connect the equipment as shown in Figure 2-13. Set the 10 dB step attenuator to 20 dB attenuation and the 1 dB step attenuator to 5 dB attenuation.

3. Press **Preset** on the analyzer, then wait for the preset routine to finish. Press **System, Alignments, Auto Align, Off**. Set the analyzer by pressing the following keys:

   FREQUENCY, 50 MHz
   AMPLITUDE, –25 dBm *(50 Ω Input only)*
   AMPLITUDE, +26.75 dBmV *(75 Ω Input only)*
   Attenuation, 10 dB (Man)
   Scale/Div, 1 dB
   SPAN, 50 kHz
   BW/Avg, 3 kHz
   Video BW, 30 Hz

4. Set the 1 dB step attenuator to place the signal peak 1 to 3 dB (1 to 3 divisions) below the reference level.

5. On the analyzer, press the following keys:

   Single
   Peak Search (or Search)
   Marker, Delta

6. Set the 10 dB step attenuator and analyzer reference level according to column 1 and column 4 of Table 2-19. At each setting, do the following:

   a. Press **Single** on the analyzer.

   b. Press **Peak Search (or Search)**.

c. Record the marker delta amplitude reading in column 5 of Table 2-19.

d. Add the actual attenuation error to the analyzer marker delta amplitude and enter the result as the TR entry in the performance test record.

The following is an example for –35 dBm reference level:

Analyzer marker Δ amplitude = +0.17 dB

Attenuation Error (30 dB) = (–0.07) dB

Test Record Entry = 0.17 dB + (–0.07) dB = 0.10 dB

Table 2-19 Log Scale, Analog Bandwidths

Column 1	Column 2	Column 3	Column 4		Column 5	Column 6
10 dB Attenuator Nominal Attenuation, dB	10 dB Attenuator Actual Attenuation, dB	Attenuation Error, dB	Analyzer Reference Level[a], dBm	dBmV	Analyzer Marker Delta Amplitude, dB	TR Entry
20		0 (Ref)	–25	+23.75	0 (Ref)	(Ref)
10			–15	+33.75		1)
0			–5	+43.75		2)
30			–35	+13.75		3)
40			–45	+3.75		4)
50			–55	–6.25		5)
60			–65	–16.25		6)
70			–75	–26.25		7)

a. Use the dBm column values for analyzers with a 50 Ω input and the dBmV column for analyzers with a 75 Ω input.

Log Scale, Digital Bandwidths, Option 1DR

NOTE If the analyzer is not equipped with Option 1DR (narrow resolution bandwidths), skip to the next section (Linear Scale, Analog Bandwidths).

1. On the analyzer, press the following keys:

   SPAN, 150 Hz
   BW/Avg, 10 Hz
   Video BW, 1 Hz

2. Set the 1 dB step attenuator to place the signal peak 1 to 3 dB (1 to 3 divisions) below the reference level.
3. On the analyzer, press the following keys:

   Single
   Peak Search (or Search)
   Marker, Delta

4. Set the 10 dB step attenuator and analyzer reference level according to column 1 and column 4 of Table 2-20. At each setting, do the following:

   a. Press **Single** on the analyzer.

   b. Press **Peak Search (or Search)**.

   c. Record the Marker Delta Amplitude reading in column 5 of Table 2-20.

   d. Add the Actual Attenuation Error to the Analyzer Marker Delta Amplitude and enter the result as the TR Entry in the performance test record.

Table 2-20 Log Mode, Digital Bandwidths Worksheet, Option 1DR

Column 1	Column 2	Column 3	Column 4		Column 5	Column 6
10 dB Attenuator Nominal Attenuation, dB	10 dB Attenuator Actual Attenuation, dB	Attenuation Error, (dB)	Analyzer Reference Level[a], dBm	dBmV	Analyzer Marker Delta Amplitude, dB	TR Entry
20		0 (Ref)	–25	+23.75	0 (Ref)	(Ref)
10			–15	+33.75		**15)**
0			–5	+43.75		**16)**
30			–35	+13.75		**17)**
40			–45	+3.75		**18)**
50			–55	–6.25		**19)**
60			–65	–16.25		**20)**
70			–75	–26.25		**21)**

a. Use the dBm column values for analyzers with a 50 Ω input and the dBmV column for analyzers with a 75 Ω input.

Linear Scale, Analog Bandwidths

1. Set the 10 dB step attenuator to 20 dB attenuation.
2. Set the 1 dB step attenuator to 5 dB attenuation.
3. Set the analyzer by pressing the following keys:

   AMPLITUDE, –25 dBm (*50 Ω input only*)
   AMPLITUDE, +26.76 dBmV (*75 Ω input only*)
   AMPLITUDE, Scale Type (Lin)
   AMPLITUDE, More, Y Axis Units (or Amptd Units), dBm (*50 Ω input only*)
   AMPLITUDE, More, Y Axis Units (or Amptd Units), dBmV (*75 Ω input only*)
   SPAN, 50 kHz
   BW/Avg, 3 kHz
   Video BW, 30 Hz
   Sweep, Sweep Cont
   Marker, Off

4. Set the 1 dB step attenuator to place the signal peak one to three divisions below the reference level.

5. On the analyzer, press the following keys:

   Single
   Peak Search (or Search)
   Marker, Delta

6. Set the 10 dB step attenuator and analyzer reference level according to column 1 and column 4 of Table 2-21. At each setting, do the following:

   a. Press **Single** on the analyzer.

   b. Press **Peak Search (or Search).**

   c. Record the marker delta amplitude reading in column 5 of Table 2-21.

   d. Add the Attenuation Error to the Analyzer Marker Delta Amplitude and enter the result in the performance test record.

Table 2-21 Linear Mode, Analog Bandwidths Worksheet

Column 1	Column 2	Column 3	Column 4		Column 5	Column 6
10 dB Attenuator Nominal Attenuation, dB	10 dB Attenuator Actual Attenuation, dB	Attenuation Error, dB	Analyzer Reference Level[a], dBm	dBmV	Analyzer Marker Delta Amplitude, dB	TR Entry
20		0 (Ref)	–25	+23.75	0 (Ref)	(Ref)
10			–15	+33.75		**8)**
0			–5	+43.75		**9)**
30			–35	+13.75		**10)**
40			–45	+3.75		**11)**
50			–55	–6.25		**12)**
60			–65	–16.25		**13)**
70			–75	–26.25		**14)**

a. Use the dBm column values for analyzers with a 50 Ω input and the dBmV column for analyzers with a 75 Ω input.

Linear Scale, Digital Bandwidths, Option 1DR

NOTE If the analyzer is not equipped with Option 1DR (narrow resolution bandwidths), skip to the next section (Post-Test Instrument Restoration).

1. On the analyzer, press the following keys:

   SPAN, 150 Hz
   BW/Avg, 10 Hz
   Video BW, 1 Hz

2. Set the 1 dB step attenuator to place the signal peak 1 to 3 divisions below the reference level.

3. On the analyzer, press the following keys:

   Single
   Peak Search (or Search)
   Marker, Delta

4. Set the 10 dB step attenuator and analyzer reference level according to Table 2-22. At each setting, do the following:

   a. Press **Single** on the analyzer.

   b. Press **Peak Search (or Search).**

   c. Record the marker delta amplitude reading in column 5 of Table 2-22.

   d. Add the actual attenuation error to the Analyzer Marker Delta Amplitude and enter the result as the TR Entry in the performance test record.

Table 2-22 Linear Mode, Digital Bandwidths, Option 1DR

Column 1	Column 2	Column 3	Column 4		Column 5	Column 6
10 dB Attenuator Nominal Attenuation, dB	10 dB Attenuator Actual Attenuation, dB	Attenuation Error, dB	Analyzer Reference Level[a], dBm	dBmV	Analyzer Marker Delta Amplitude, dB	TR Entry
20		0 (Ref)	−25	+23.75	0 (Ref)	(Ref)
10			−15	+33.75		**22)**
0			−5	+43.75		**23)**
30			−35	+13.75		**24)**
40			−45	+3.75		**25)**
50			−55	−6.25		**26)**
60			−65	−16.25		**27)**
70			−75	−26.25		**28)**

a. Use the dBm column values for analyzers with a 50 Ω input and the dBmV column for analyzers with a 75 Ω input.

Post-test Instrument Restoration

To restore the default settings on the spectrum analyzer, press **Preset, System, Alignments, Auto Align, All.**

14. Reference Level Accuracy: HP E4402B, E4403B, E4404B, E4407B and E4408B.

A 50 MHz CW signal is applied to the Input 50 Ω of the analyzer through two step attenuators. The amplitude of the source is decreased in 10 dB steps and the analyzer marker functions are used to measure the amplitude difference between steps. The external attenuator is used as the reference standard. The test is performed in both log and linear amplitude scales.

It is only necessary to test reference levels as low as –90 dBm (with 10 dB internal attenuation) since lower reference levels are a function of the analyzer microprocessor manipulating the trace data. There is no error associated with the trace data manipulation.

The related adjustment for this performance test is “IF Amplitude.”

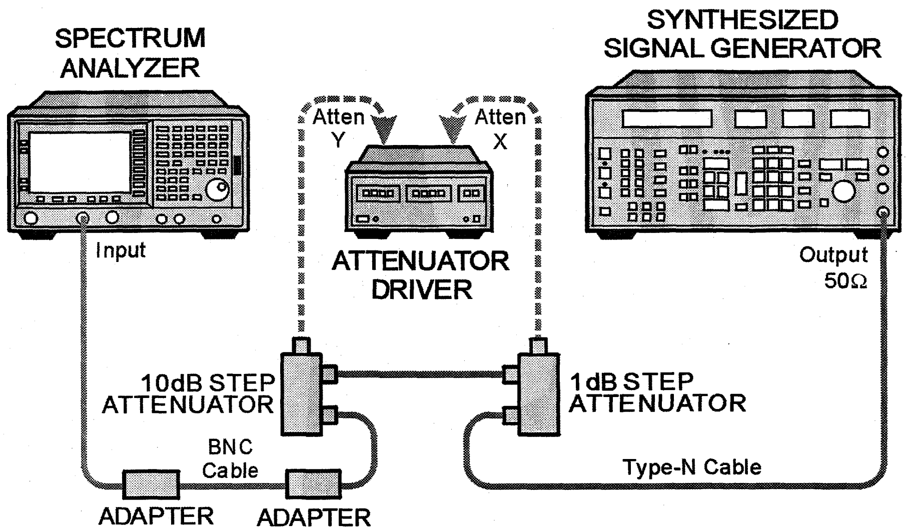
Equipment Required

Synthesized signal generator
1 dB step attenuator
10 dB step attenuator
Attenuator switch driver (if programmable step attenuators are used)
Cable, Type-N 152-cm (60-in)
Cable, BNC 122-cm (48-in) (*2 required*)
Attenuator interconnect kit
Adapter, Type-N (m) to BNC (f) (*2 required*)

Additional Equipment for Option BAB

Adapter, Type-N (f) to APC 3.5 (f)

Figure 2-14 **Reference Level Accuracy Test Setup**



wl764a

Procedure

Calculate the Actual Attenuation Errors

1. From the calibration data supplied with the 10 dB step attenuator, enter into column 2 of Table 2-23 and Table 2-24 the actual attenuation for the corresponding nominal attenuation settings. If no calibration data is supplied for 0 dB, enter zero.

NOTE The HP 8496G programmable attenuator has 4 attenuator sections consisting of 10 dB, 20 dB, 40 dB and 40 dB attenuators. If using the HP 8496G programmable attenuator, enter the calibration data for the section three 40 dB step rather than the section four 40 dB step.

2. Calculate the reference attenuation error by subtracting 20 dB from the actual attenuation for the 20 dB setting, and enter below.

   Reference Attenuator Error = Actual Attenuation(20 dB) – 20 dB

   Reference Attenuator Error __________ dB

3. To calculate the attenuation error at other nominal attenuator settings, subtract the attenuation error at the other settings from the reference attenuator error and enter the result in column 3 of Table 2-23 and Table 2-24.

Atten Error (X dB) = (Actual Attenuation(X dB) – Nominal Attenuation (X dB)) – Reference Attenuation Error

Example for 50 dB attenuator setting:

$$\text{Actual Attenuation (50 dB)} = 50.08\text{ dB}$$

$$\text{Actual Attenuation (20 dB)} = 19.85\text{ dB}$$

$$\text{Reference Attenuation Error} = 19.85\text{ dB} - 20\text{ dB} = -0.15\text{ dB}$$

$$\text{Attenuation Error (50 dB)} = (50.08\text{ dB} - 50\text{dB}) - (-0.15)\text{ dB}$$

$$= +0.23\text{ dB}$$

Log Scale, Analog Bandwidths

1. Set the synthesized signal generator controls as follows:

   FREQUENCY, 50 MHz
   AMPLITUDE, +2 dBm

2. Connect the equipment as shown in Figure 2-14. Set the 10 dB step attenuator to 20 dB attenuation and the 1 dB step attenuator to 5 dB attenuation.

3. Press **Preset** on the analyzer, then wait for the preset routine to finish. Press **System, Alignments, Auto Align, Off**. Set the analyzer by pressing the following keys:

   FREQUENCY, 50 MHz
   AMPLITUDE, –20 dBm
   Attenuation, 10 dB
   Scale/Div, 1 dB
   SPAN, 50 kHz
   BW/Avg, 3 kHz
   Video BW, 30 Hz

4. Set the 1 dB step attenuator to place the signal peak 1 to 3 divisions below the reference level.

5. On the analyzer, press the following keys:

   Single
   Peak Search (or Search)
   Marker, Delta

6. Set the 10 dB step attenuator and analyzer reference level according to Table 2-23. At each setting, do the following:

   a. Press **Single** on the analyzer.

   b. Press **Peak Search (or Search)**.

   c. Record the marker delta amplitude reading in column 5 of Table 2-23.

d. Add the actual attenuation error to the analyzer marker delta amplitude and enter the result as the TR Entry in the performance test record.

Example, for –35 dBm reference level:

$$\text{Analyzer marker } \Delta \text{ amplitude} = +0.17 \text{ dB}$$

$$\text{Attenuation Error (30 dB)} = (-0.07) \text{ dB}$$

$$\text{Test Record Entry} = 0.17 \text{ dB} + (-0.07) \text{ dB} = 0.10 \text{ dB}$$

Table 2-23 Log Mode, Analog Bandwidths Worksheet

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
10 dB Attenuator Nominal Attenuation, dB	**10 dB Attenuator Actual Attenuation, dB**	**Attenuation Error, dB**	**Analyzer Reference Level, dBm**	**Analyzer Marker Delta Amplitude, dB**	**TR Entry**
20		0 (Ref)	–20	0 (Ref)	(Ref)
10			–10		1)
0			0		2)
30			–30		3)
40			–40		4)
50			–50		5)
60			–60		6)
70			–70		7)
80			–80		8)

Log Scale, Digital Bandwidths, Option 1DR

NOTE If the analyzer is not equipped with Option 1DR (narrow resolution bandwidths), skip to the next section (Linear Scale, Analog Bandwidths).

7. On the analyzer, press the following keys:

   SPAN, 150 Hz
   BW/Avg, 10 Hz
   Video BW, 1 Hz

8. Set the 1 dB step attenuator to set the signal peak 1 to 3 divisions below the reference level.

9. On the analyzer, press the following keys:

   Single
   Peak Search (or Search)
   Marker, Delta

10. Set the 10 dB step attenuator and analyzer reference level according to Table 2-24. At each setting, do the following:

    a. Press **Single** on the analyzer.

    b. Press **Peak Search (or Search)**.

    c. Record the marker delta amplitude reading in column 5 of Table 2-24.

    d. Add the actual attenuation error to the analyzer marker Δ amplitude and enter the result as the TR Entry in the performance test record.

Table 2-24 Log Mode, Digital Bandwidths Worksheet, Option 1DR

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
10 dB Attenuator Nominal Attenuation, dB	10 dB Attenuator Actual Attenuation, dB	Attenuation Error, dB	Analyzer Reference Level, dBm	Analyzer Marker Delta Amplitude, dB	TR Entry
20		0 (Ref)	–20	0 (Ref)	(Ref)
10			–10		**17)**
0			0		**18)**
30			–30		**19)**
40			–40		**20)**
50			–50		**21)**
60			–60		**22)**
70			–70		**23)**
80			–80		**24)**

Linear Scale, Analog Bandwidths

1. Set the 10 dB step attenuator to 20 dB attenuation.
2. Set the 1 dB step attenuator to 5 dB attenuation.
3. Set the analyzer by pressing the following keys:

   AMPLITUDE, –20 dBm
   AMPLITUDE, Scale Type
   AMPLITUDE, More 1 of 2, Y Axis Units (or Amptd Units), dBm
   SPAN, 50 kHz
   BW/Avg, 3 kHz
   Video BW, 30 Hz
   Sweep, Sweep Cont
   Marker, Off

4. Set the 1 dB step attenuator to place the signal peak 1 to 3 divisions below the reference level.
5. On the analyzer, press the following keys:

   Single
   Peak Search (or Search)
   Marker, Delta

6. Set the 10 dB step attenuator and analyzer reference level according to Table 2-25, column 1 and column 4. At each setting, do the following:
   a. Press **Single** on the analyzer.
   b. Press **Peak Search (or Search).**
   c. Record the marker delta amplitude reading in column 5 of Table 2-25.
   d. Add the attenuation error to the Analyzer Marker Delta Amplitude and enter the result as the TR Entry in the performance test record.

Table 2-25 Linear Mode, Analog Bandwidths Worksheet

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
10 dB Attenuator Nominal Attenuation, dB	10 dB Attenuator Actual Attenuation, dB	Attenuation Error, dB	Analyzer Reference Level, dBm	Analyzer Marker Delta Amplitude, dB	TR Entry
20		0 (Ref)	–20	0 (Ref)	(Ref)
10			–10		**9)**
0			0		**10)**
30			–30		**11)**
40			–40		**12)**
50			–50		**13)**
60			–60		**14)**
70			–70		**15)**
80			–80		**16)**

Linear Scale, Digital Bandwidths, Option 1DR

NOTE If the analyzer is not equipped with Option 1DR (narrow resolution bandwidths), skip to the next section (Post-Test Instrument Restoration).

1. On the analyzer, press the following keys:

   SPAN, 150 Hz
   BW/Avg, 10 Hz
   Video BW, 1 Hz

2. Set the 1 dB step attenuator to place the signal peak 1 to 3 divisions below the reference level.
3. On the analyzer, press the following keys:

   Single
   Peak Search (or Search)
   Marker, Delta

4. Set the 10 dB step attenuator and analyzer reference level according to Table 2-26. At each setting, do the following:

   a. Press **Single** on the analyzer.

   b. Press **Peak Search (or Search)**.

c. Record the marker delta amplitude reading in column 5 of Table 2-26.

d. Add the actual attenuation error to the analyzer marker delta amplitude and enter the result as the TR Entry in the performance test record.

Table 2-26 Linear Mode, Digital Bandwidths Worksheet, Option 1DR

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
10 dB Attenuator Nominal Attenuation, dB	**10 dB Attenuator Actual Attenuation, dB**	**Attenuation Error, dB**	**Analyzer Reference Level, dBm**	**Analyzer Marker Delta Amplitude, dB**	**TR Entry**
20		0 (Ref)	–20	0 (Ref)	(Ref)
10			–10		**25)**
0			0		**26)**
30			–30		**27)**
40			–40		**28)**
50			–50		**29)**
60			–60		**30)**
70			–70		**31)**
80			–80		**32)**

Post-test Instrument Restoration

To restore the default settings on the spectrum analyzer, press **Preset, System, Alignments, Auto Align, All.**

15. Resolution Bandwidth Switching Uncertainty

To measure the resolution bandwidth switching uncertainty an amplitude reference is taken with the resolution bandwidth set to 3 kHz using the marker delta function. The resolution bandwidth is changed to settings between 5 MHz and 10 Hz and the amplitude variation is measured at each setting and compared to the specification. The span is changed as necessary to maintain approximately the same aspect ratio.

The related adjustment for this performance test is "IF Amplitude."

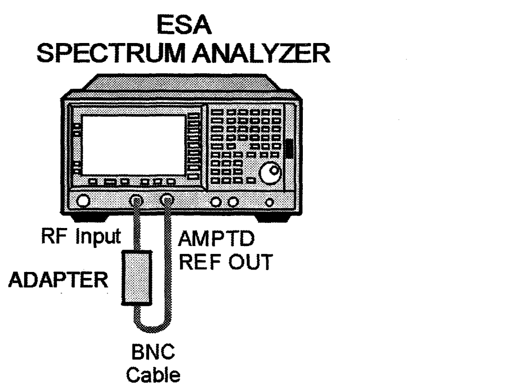
Equipment Required for HP E4402B, E4403B, E4404B, E4405B, E4407B and E4408

Adapter, Type-N (m) to BNC (f)
BNC Cable

Additional Equipment for Option BAB

Adapter, Type-N (f) to APC 3.5 (f)

Figure 2-15 Resolution Bandwidth Switching Test Setup



Procedure

1. On the HP E4402B, E4403B, E4404B, E4405B, E4407B, or E4408B connect a BNC cable from the AMPTD REF OUT to the INPUT 50 Ω using adapters as necessary. Refer to Figure 2-15.
2. Press **Preset** on the analyzer. Set the analyzer controls by pressing the following keys:

Input/Output (or Input), Amptd Ref (On) (*E4411B, E4401B*)
Input/Output (or Input), Amptd Ref Out (On) (*E4402B, E4403B, E4404B, E4405B, E4407, E4408B*)
FREQUENCY, 50 MHz
SPAN, 5 kHz
AMPLITUDE, More, Y Axis Units (or Amptd Units), dBm
AMPLITUDE, –25 dBm (*E4411B, E4401B*)
AMPLITUDE, –19 dBm (*E4402B/03B/04B/05B/07B/08B)*
AMPLITUDE, Scale/Div, 1 dB
BW/Avg, 1 kHz
BW/Avg, Video BW, 1 kHz

3. Press **AMPLITUDE** and use the RPG to adjust the reference level until the signal appears five divisions below the reference level, then press the following keys:

   Peak Search (or Search)
   Marker→, Mkr →CF
   Marker, Delta

4. Set the analyzer span and resolution bandwidth according to Table 2-27.
5. Press **Peak Search (or Search), Marker→, Mkr →CF, Peak Search (or Search)** then record the marker delta amplitude reading in the performance verification test record as indicated in Table 2-27.
6. Repeat step 4 and step 5 for each of the remaining resolution bandwidth and span settings listed in Table 2-27.

Table 2-27 Resolution Bandwidth Switching Uncertainty

Analyzer		Marker Delta Amplitude Reading
RES BW Setting	**SPAN Setting**	**TR Entry**
1 kHz	5 kHz	0 (Ref)
3 kHz	10 kHz	**1)**
9 kHz[a]	50 kHz	**2)**
10 kHz	50 kHz	**3)**
30 kHz	100 kHz	**4)**
100 kHz	500 kHz	**5)**
120 kHz[a]	500 kHz	**6)**
300 kHz	1 MHz	**7)**
1 MHz	5 MHz	**8)**

Table 2-27 **Resolution Bandwidth Switching Uncertainty**

Analyzer		Marker Delta Amplitude Reading
RES BW Setting	**SPAN Setting**	**TR Entry**
3 MHz	10 MHz	**9)**
5 MHz	25 MHz	**10)**

a. These Res BW Settings must be entered from the keypad; they can not be accessed from the step keys or RPG.

7. If you are testing an analyzer equipped with Option 1DR, continue with step 8. If the analyzer is not equipped with Option 1DR, stop here.
8. Set the resolution bandwidth and span according to Table 2-28.
9. Press **Peak Search (or Search), Marker→, Mkr →CF, Peak Search (or Search)** then record the Marker Delta Amplitude Reading in the performance verification test record as indicated in Table 2-28.
10. Repeat step 8 and step 9 for each of the remaining resolution bandwidth and span settings listed in Table 2-28.

Table 2-28 **Resolution Bandwidth Switching Uncertainty for Option 1DR**

Analyzer		Marker Delta Amplitude Reading
RES BW Setting	**SPAN Setting**	**TR Entry**
300 Hz	1 kHz	**11)**
200 Hz[a]	1 kHz	**12)**
100 Hz	500 Hz	**13)**
30 Hz	100 Hz	**14)**
10 Hz	50 Hz	**15)**

a. These Res BW Settings must be entered from the keypad; they can not be accessed from the step keys or RPG.

16. Absolute Amplitude Accuracy (Reference Settings): HP E4401B and E4411B

Absolute Amplitude Accuracy

The level of a 50 MHz signal is measured with a power meter. A complete auto alignment is performed. The 50 MHz signal is then measured with the spectrum analyzer. The difference between the power meter and spectrum analyzer readings is calculated.

Equipment Required

Synthesized signal generator
Measuring receiver
Power sensor, low power
Cable, Type-N, 152-cm (60-in)
Adapter, Type-N (f) to Type-N (f)

Additional Equipment for 75 Ω Input

Power sensor, 75 Ω
Adapter, mechanical, Type-N (f), 75 Ω to Type-N (m) 50 Ω
Pad, minimum loss
Adapter, Type-N (f), to BNC (m), 75 Ω

Procedure

This performance test consists of two parts:

Part 1. Absolute Amplitude Accuracy, Preamp Off

Part 2. Absolute Amplitude Accuracy, Preamp On (Option 1DS)

Part 1 should be performed on all ESA analyzers. Part 2 should be performed only on ESA-E Series analyzers equipped with Option 1DS, Preamplifier.

Part 1. Absolute Amplitude Accuracy, Preamp Off

1. On the synthesized signal generator set the controls as follows:

   FREQUENCY, 50 MHz
   AMPLITUDE, –27 dBm (50 Ω *Input only)*
   AMPLITUDE, –18 dBm (75 Ω *Input only*)
   RF ON
   AM OFF
   FM OFF

2. Calibrate the power meter and low-power power sensor.

   75 Ω *Input: Calibrate the power meter and 75 Ω* power sensor.

3. Connect the signal generator output to the low-power power sensor through the Type-N cable, using an adapter.

   75 Ω *Input: Connect the signal generator output to the 75 Ω power sensor through the Type-N cable using minimum loss pad and other adapters as necessary.*

4. Adjust the signal generator power level for a power meter reading of –25 dBm.

   75 Ω *Input: Adjust the power level of the signal generator for a power meter reading of –24 dBm. Allow the power sensor adequate time to settle; the 75 Ω power sensor is being used on its lowest range.*

   Record the power meter reading here.

   Power Meter Reading ___________ dBm

5. Press the following analyzer keys:

   Preset
   System, Alignments, Align Now, All (wait for alignment to finish)
   System, Alignments, Auto Align, (Off)
   FREQUENCY, Center Freq, 50 MHz
   SPAN, 2 kHz
   BW/Avg, Resolution BW (Man), 1 kHz
   Video BW (Man) 1 kHz

6. Press **AMPLITUDE –25 dBm, Attenuation (Man) 10 dB**, **Scale Type** (Log).

   75 Ω *Input: Set the reference level to +28.75 dBmV.*

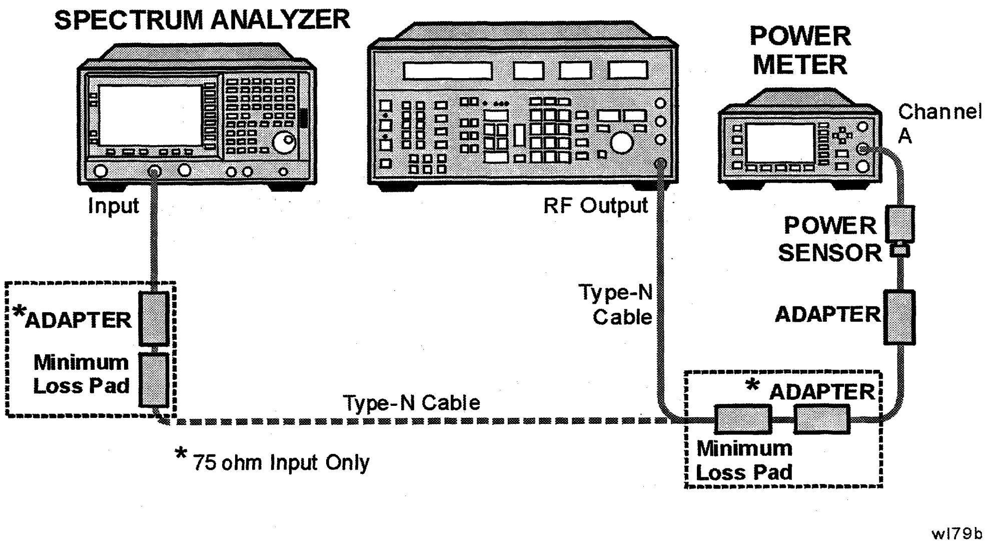
7. On the analyzer, press the following:

   AMPLITUDE, More, Y Axis Units (or Amptd Units), Volts
   Det/Demod, Detector, Sample, Return

8. Disconnect the power sensor from the Type-N cable. Connect the Type-N cable to the analyzer 50 Ω input.

   75 Ω *Input: Connect the Type-N cable to the analyzer 75 Ω input using a minimum loss adapter.*

Figure 2-16 Absolute Amplitude Accuracy Test Setup



9. Press **Peak Search (or Search).**

10. Convert the marker amplitude reading from volts to dBm using the following equation:

$$50\Omega \text{ Input Marker Amptd (dBm)} = 10 \times \log(\text{Mkr}(V^2/0.05))$$

$$75\Omega \text{ Input Marker Amptd (dBm)} = 10 \times \log(\text{Mkr}(V^2/0.075))$$

Marker Amptd (dBm) ___________ dBm

11. Subtract the power meter reading noted in step 4 from the Marker Amptd recorded in step 10. Record the difference as TR Entry 1 in the performance verification test record.

Absolute Amplitude Accuracy (Log) = Marker Amptd (dBm) – Power Meter Reading (dBm)

12. On the analyzer, press the following:

AMPLITUDE, Scale Type (Lin)
Peak Search (or Search)

13. Convert the marker amplitude reading from volts to dBm using the following equation:

$$50\Omega \text{ Input Marker Amptd (dBm)} = 10 \times \log(\text{Mkr}(V^2/0.05))$$

$$75\Omega \text{ Input Marker Amptd (dBm)} = 10 \times \log(\text{Mkr}(V^2/0.075))$$

Marker Amptd (dBm) ___________ dBm

14. Subtract the power meter reading noted in step 4 from the Marker Amptd recorded in step 13. Record the difference, Absolute Amplitude Accuracy (Lin), as TR Entry 2 in the performance verification test record.

Absolute Amplitude Accuracy (Lin) = Marker Amptd (dBm) – Power Meter Reading (dBm)

15. On the analyzer, press **Preset** and wait for the preset routine to finish. Then press: **System, Alignments, Auto Align, All.**

16. If the analyzer is equipped with Option 1DS, preamplifier, proceed to Part 2: Absolute Amplitude Accuracy, Preamp On.

Part 2. Absolute Amplitude Accuracy, Preamp On (Option 1DS)

1. On the synthesized signal generator set the controls as follows:

   FREQUENCY, 50 MHz
   AMPLITUDE, –30 dBm (50 Ω *Input only)*
   AMPLITUDE, –24 dBm (75 Ω *Input only*)
   RF ON
   AM OFF
   FM OFF

2. Calibrate the power meter and low-power power sensor.

   75 Ω *Input: Calibrate the measuring receiver and 75* Ω power sensor.

3. Connect the signal generator output to the power sensor through the Type-N cable, using an adapter.

   75 Ω *Input: Connect the signal generator output to the 75* Ω *power sensor through the Type-N cable using minimum loss pad and other adapters as necessary.*

4. Adjust the signal generator power level for a power meter reading of –30 dBm.

   75 Ω *Input: Adjust the power level of the signal generator for a power meter reading of –30 dBm. Allow the power sensor adequate time to settle; the 75* Ω *power sensor is being used on its lowest range.*

   Record the power meter reading here:

   Power Meter Reading ___________ dBm

5. Press the following analyzer keys:

   Preset, System, Alignments, Align Now, All (wait for alignment to finish), **Done, Auto Align, Off.**
   FREQUENCY, Center Freq, 50 MHz
   SPAN, 2 kHz
   BW/Avg, Resolution BW Auto Man, 1 kHz
   Video BW Auto Man 1 kHz

6. Press **AMPLITUDE –30 dBm, Atten** (Man) **0 dB, Scale Type** (Log).

   75 Ω *Input: Set the reference level to +18.75 dBmV.*

7. Press **AMPLITUDE, More, Int Preamp** (On).

8. Press **AMPLITUDE, More, Y Axis Units (or Amptd Units), Volts, Det/Demod, Detector, Sample, Return.**

9. Disconnect the power sensor from the Type-N cable. Connect the Type-N cable to the analyzer 50 Ω input.

   75 Ω *Input: Connect the Type-N cable to the analyzer 75 Ω input using a minimum loss adapter.*

10. Press **Peak Search (or Search).**

11. Convert the marker amplitude reading from volts to dBm using the following equation:

$$50\Omega \text{ Input Marker Amptd (dBm)} = 10 \times \log(\text{Mkr}(V^2/0.05))$$

$$75\Omega \text{ Input Marker Amptd (dBm)} = 10 \times \log(\text{Mkr}(V^2/0.075))$$

   Marker Amptd (dBm) ___________ dBm

12. Subtract the power meter reading noted in step 4 from the Marker Amptd recorded in step 11. Record the difference, Absolute Amplitude Accuracy (Log), as TR Entry 3 in the performance verification test record.

$$\text{Absolute Amplitude Accuracy (Log)} = \text{Marker Amptd (dBm)} - \text{Power Meter Reading (dBm)}$$

13. On the analyzer, press the following:

    AMPLITUDE, Scale Type (Lin)
    Peak Search (or Search)

14. Convert the marker amplitude reading from volts to dBm using the following equation:

$$50\Omega \text{ Input Marker Amptd (dBm)} = 10 \times \log(\text{Mkr}(V^2/0.05))$$

$$75\Omega \text{ Input Marker Amptd (dBm)} = 10 \times \log(\text{Mkr}(V^2/0.075))$$

    Marker Amptd (dBm) __________ dBm

15. Subtract the power meter reading noted in step 4 from the Marker Amptd recorded in step 14. Record the difference, Absolute Amplitude Accuracy (Lin), as TR Entry 4 in the performance verification test record.

$$\text{Absolute Amplitude Accuracy (Lin)} = \text{Marker Amptd (dBm)} - \text{Power Meter Reading (dBm)}$$

16. On the analyzer, press **Preset** and wait for the preset routine to finish. Then press: **System, Alignments, Auto Align, All.**

17. Absolute Amplitude Accuracy (Reference Settings): HP E4402B, E4403B, E4404B, E4405B, E4407B, and E4408B

Absolute Amplitude Accuracy

The level of a 50 MHz signal is measured with a power meter. A complete auto alignment is performed. The 50 MHz signal is then measured with the spectrum analyzer. The difference between the power meter and spectrum analyzer readings is calculated.

Equipment Required

Synthesized signal generator
Measuring receiver
RF power sensor
Low-power power sensor *(Option 1DS only)*
Cable, Type-N, 152-cm (60-in)
Adapter, Type-N (f) to Type-N (f)

Additional Equipment for Option BAB

Adapter, Type-N (f) to APC 3.5 (f)

Procedure

This performance test consists of two parts:

Part 1. Absolute Amplitude Accuracy, Preamp Off

Part 2. Absolute Amplitude Accuracy, Preamp On (Option 1DS)

Part 1 should be performed on all ESA analyzers. Part 2 should be performed only on ESA-E Series analyzers equipped with Option 1DS, Preamplifier.

Part 1. Absolute Amplitude Accuracy, Preamp Off

1. On the synthesized signal generator set the controls as follows:

   FREQUENCY, 50 MHz
   AMPLITUDE, –20 dBm
   RF ON
   AM OFF
   FM OFF

2. Calibrate the power meter and RF power sensor.

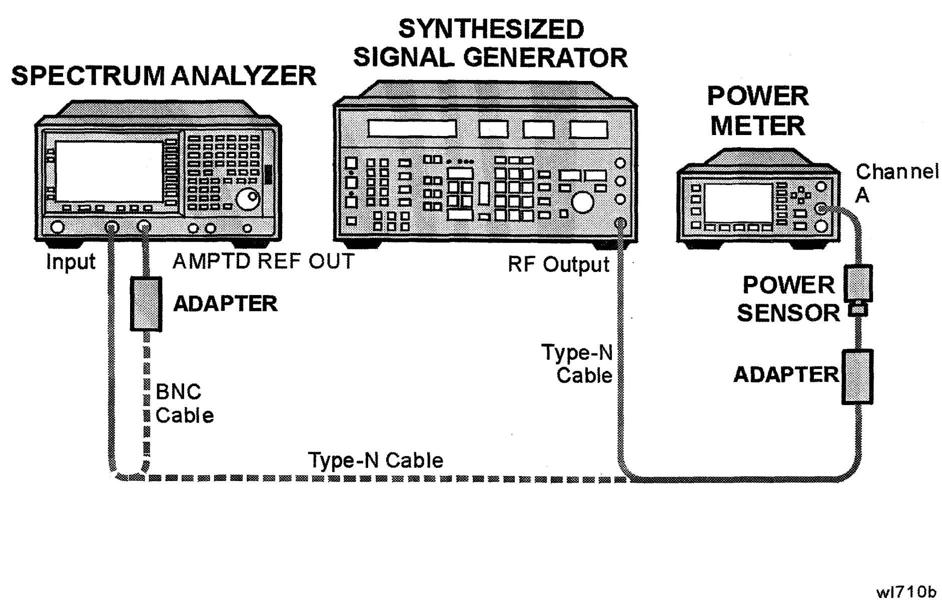
3. Connect the signal generator output to the power sensor through the Type-N cable, using an adapter.
4. Adjust the signal generator power level for a power meter reading of –20 dBm.

   Record the power meter reading here:

   Power Meter Reading __________ dBm
5. On the analyzer, connect the AMPTD REF OUT to the Input using a BNC Cable and adapter as shown in Figure 2-17.
6. Press the following analyzer keys:

   Preset, System, Alignments, Align Now, All (wait for alignment to finish), **Return, Auto Align, Off.**
   FREQUENCY, Center Freq, 50 MHz
   SPAN, 2 kHz
   BW/Avg, Resolution BW Auto Man, 1 kHz
   Video BW Auto Man 1 kHz
7. Press **AMPLITUDE –20 dBm, Atten Auto Man 10 dB, Scale Type** (Log).
8. Press **AMPLITUDE, More, Y Axis Units (or Amptd Units), Volts, Det/Demod, Detector, Sample, Return.**
9. Disconnect the power sensor from the Type-N cable. Connect the Type-N cable to the analyzer 50 Ω input.

Figure 2-17 Absolute Amplitude Accuracy Test Setup



10.Press **Peak Search (or Search).**

11. Convert the marker amplitude reading from volts to dBm using the following equation:

$$50\Omega \text{ Input Marker Amptd (dBm)} = 10 \times \log(\text{Mkr}(V^2/0.05))$$

Marker Amptd (dBm) __________ dBm

12. Subtract the power meter reading noted in step 4 from the Marker Amptd recorded in step 11. Record the difference, Absolute Amplitude Accuracy (Log), as TR Entry 1 in the performance verification test record.

Absolute Amplitude Accuracy (Log) = Marker Amptd (dBm) – Power Meter Reading (dBm)

13. On the analyzer, press the following:

AMPLITUDE, **Scale Type** (Lin)
Peak Search (or Search)

14. Convert the marker amplitude reading from volts to dBm using the following equation:

$$50\Omega \text{ Input Marker Amptd (dBm)} = 10 \times \log(\text{Mkr}(V^2/0.05))$$

Marker Amptd (dBm) __________ dBm

15. Subtract the power meter reading noted in step 4 from the Marker Amptd recorded in step 14. Record the difference, Absolute Amplitude Accuracy (Lin), as TR Entry 2 in the performance verification test record.

Absolute Amplitude Accuracy (Lin) = Marker Amptd (dBm) – Power Meter Reading (dBm)

16. On the analyzer, press **Preset** and wait for the preset routine to finish. Then press: **System**, **Alignments**, **Auto Align**, **All**.

17. If the analyzer is equipped with Option 1DS, preamplifier, proceed to Part 2: Absolute Amplitude Accuracy, Preamp On.

Part 2. Absolute Amplitude Accuracy, Preamp On (Option 1DS)

1. On the synthesized signal generator set the controls as follows:

FREQUENCY, 50 MHz
AMPLITUDE, –30 dBm
RF ON
AM OFF
FM OFF

2. Calibrate the power meter and low-power power sensor.

3. Connect the signal generator output to the power sensor through the Type-N cable, using an adapter.

4. Adjust the signal generator power level for a power meter reading of –30 dBm.

   Record the power meter reading here:

   Power Meter Reading ___________ dBm

5. On the analyzer, connect the AMPTD REF OUT to the INPUT using a BNC Cable and adapter as shown in Figure 2-17.

6. Press the following analyzer keys:

   Preset
   System, Alignments, Align Now, All (wait for alignment to finish)
   System, Alignments, Auto Align, (Off)
   FREQUENCY, Center Freq, 50 MHz
   SPAN, 2 kHz
   BW/Avg, Resolution BW (Man), **1 kHz**
   Video BW (Man) **1 kHz**

7. Press **AMPLITUDE –30 dBm, Attenuation** (Man) **0 dB, Scale Type** (Log).

8. Press **AMPLITUDE, More, Internal Preamp** (On).

9. On the analyzer, press the following:

   AMPLITUDE, More, Y Axis Units (or Amptd Units), Volts
   Det/Demod, Detector, Sample, Return

10. Disconnect the power sensor from the Type-N cable. Connect the Type-N cable to the analyzer 50 Ω input.

11. Press **Peak Search (or Search).**

12. Convert the marker amplitude reading from volts to dBm using the following equation:

$$50\Omega \text{ Input Marker Amptd (dBm)} = 10 \times \log(\text{Mkr}(V^2/0.05))$$

   Marker Amptd (dBm)___________ dBm

13. Subtract the power meter reading noted in step 4 from the Marker Amptd recorded in step 12. Record the difference, Absolute Amplitude Accuracy (Log), as TR Entry 3 in the performance verification test record.

Absolute Amplitude Accuracy (Log) = Marker Amptd (dBm) – Power Meter Reading (dBm)

14. On the analyzer, press the following:

   AMPLITUDE, Scale Type (Lin)
   Peak Search (or Search)

15. Convert the marker amplitude reading from volts to dBm using the following equation:

$$50\Omega \text{ Input Marker Amptd (dBm)} = 10 \times \log(\text{Mkr}(V^2/0.05))$$

Marker Amptd (dBm) ___________ dBm

16. Subtract the power meter reading noted in step 4 from the Marker Amptd recorded in step 15. Record the difference, Absolute Amplitude Accuracy (LIN), as TR Entry 1 in the performance verification test record.

$$\text{Absolute Amplitude Accuracy (Lin)} = \text{Marker Amptd (dBm)} - \text{Power Meter Reading (dBm)}$$

17. On the analyzer, press **Preset** and wait for the preset routine to finish. Then press: **System**, **Alignments**, **Auto Align**, **All**.

18. Overall Amplitude Accuracy: HP E4401B and E4411B

This test measures the absolute amplitude of the analyzer at 50 MHz. A synthesized signal generator and attenuators are used as the signal source to the analyzer. A power meter is used to measure this signal source with the attenuators set to 0 dB. The value measured is recorded as the source amplitude. The attenuators are used to adjust the signal levels applied to the analyzer between the initial signal amplitude (set with the power meter) and –50 dBm. The amplitude measured by the analyzer is compared to the actual signal level and the amplitude error is calculated.

There are no related adjustments for this performance test.

Equipment Required

Synthesized signal generator
10 dB step attenuator
1 dB step attenuator
Attenuator interconnection kit
Attenuator driver (if programmable step attenuators are used)
6 dB fixed attenuator
Power meter
Power sensor
Cable, Type-N, 62-cm (24 in.) (m) (2 *required*)
Cable, BNC
Adapter, Type-N (f) to Type-N (f)

Additional Equipment for 75 Ω Input

Power sensor, 75 Ω
Pad, minimum loss
Adapter, mechanical, Type-N (f), 75 Ω to Type-N (m) 50 Ω
Adapter, Type-N (f), to BNC (m), 75 Ω
Adapter, Type-N (f) to Type-N (f), 75 Ω

Procedure

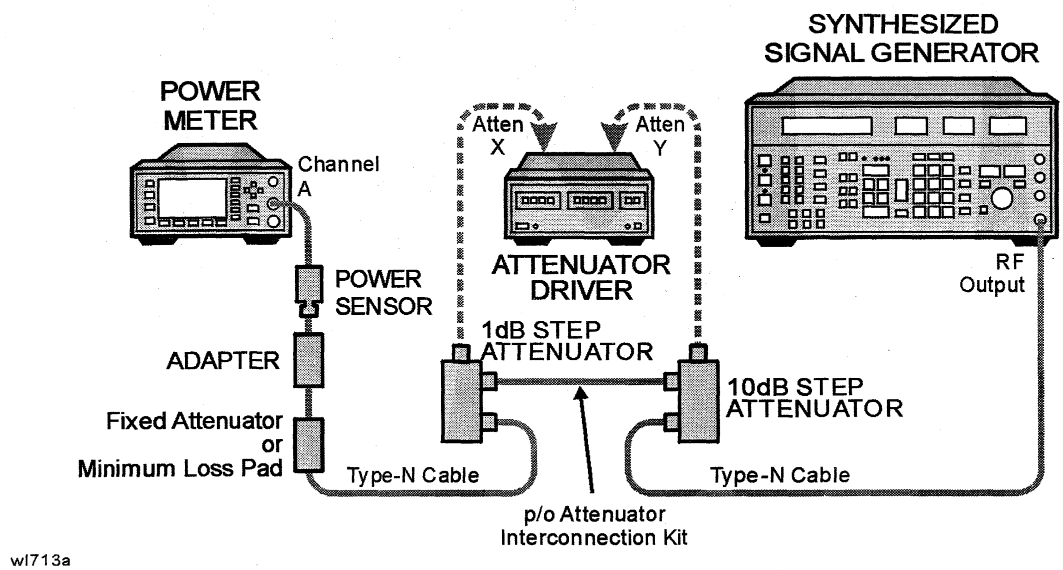
Measuring 0 dBm Reference Level

1. On the analyzer, press **Preset** and wait for the preset routine to finish.
2. Perform a complete self-alignment and set Auto Align Off. Press **System, Alignments, Align Now, All**, and wait for the alignment routine to finish. Then, press **Return, Auto Align, Off**.

3. Zero and calibrate the power meter and power sensor connected to Channel A of the power meter.

   75 Ω Inputs: Zero and calibrate the power meter and 75 Ω power sensor connected to Channel A of the power meter.

Figure 2-18 Measure Source Test Setup



4. Connect the equipment as shown in Figure 2-18. The power sensor should connect directly to the 6 dB fixed attenuator using an adapter.

   75 Ω Inputs: Use the minimum loss pad in place of the 6 dB fixed attenuator and a 75 Ω Type-N (f) to Type-N (f) adapter.

5. Preset the synthesized signal generator. Manually press **Blue Key, Special, 0, 0**. Set the signal generator as follows:

   FREQUENCY, 50 MHz
   AMPLITUDE, +6 dBm

6. Set the 10 dB and 1 dB step attenuators to 0 dB.

7. From the metrology data for the step attenuators at 50 MHz, obtain the actual attenuation for the 0 dB setting of each attenuator (in some cases, this might be zero by definition). Add the two actual attenuations to obtain the 0 dB reference attenuation.

$$RefAtten_{0\ dB} = 10\ dB\ Actual_{0\ dB} + 1\ dB\ Actual_{0\ dB}$$

   For example, if the actual attenuation for the 10 dB step attenuator is 0.03 dB, 10 dB $Actual_{0\ dB}$ is 0.03 dB. If the actual attenuation for the 1 dB step attenuator is 0.02 dB, 1 dB $Actual_{0\ dB}$ is 0.02 dB. In this case $RefAtten_{0dB}$ is 0.05 dB.

8. Retrieve metrology data for the step attenuators at 50 MHz. Enter the actual attenuation values for each attenuator setting as indicated in Table 2-29. If using a programmable attenuator, the section three 40 dB step should be used for the 40 dB setting on the 10 dB step attenuator. Similarly, the section three 4 dB step should be used for the 4 dB setting on the 1 dB step attenuator

Table 2-29 Amplitude Accuracy Worksheet, 0 dBm Reference Level

1 dB Step Attenuator		10 dB Step Attenuator		Total Attenuation		Nominal Amptd.	Meas. Amptd.	Amptd. Accuracy TR Entry
Setting	Actual	Setting	Actual	Setting	Actual			
0 dB		0 dB		0 dB		0 dBm		1
0 dB		10 dB		10 dB		–10 dBm		2
0 dB		20 dB		20 dB		–20 dBm		3
0 dB		30 dB		30 dB		–30 dBm		4
0 dB		40 dB		40 dB		–40 dBm		5
0 dB		50 dB		50 dB		–50 dBm		6

9. Calculate the actual total attenuation by adding the actual attenuation for the 1 dB step attenuator to the actual attenuation for the 10 dB step attenuator for each total attenuation setting listed in Table 2-29.

NOTE The external attenuators and cables are now part of the “source.”

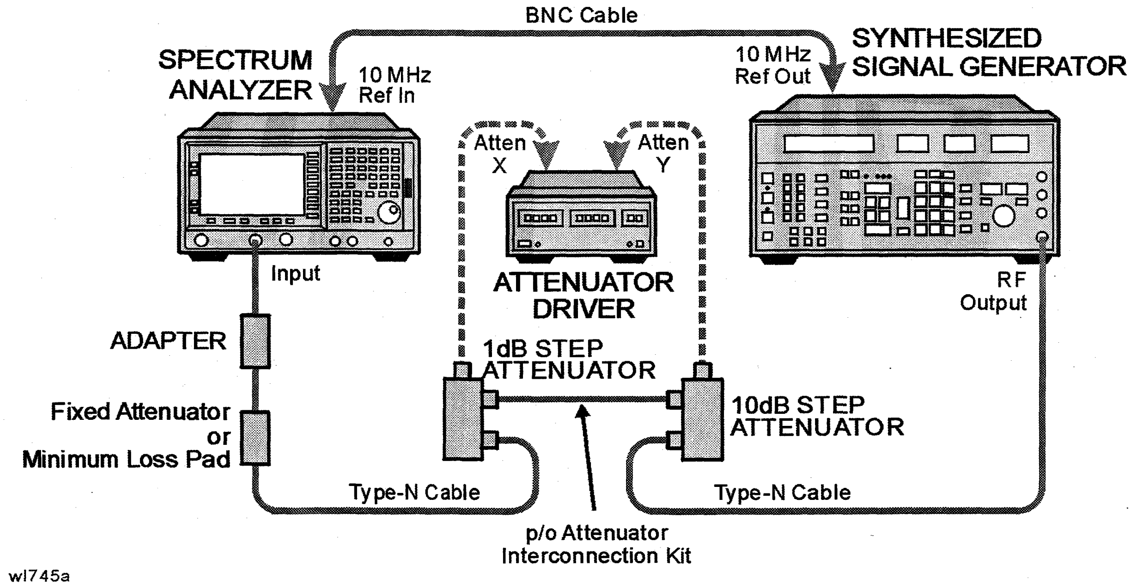
10. Adjust the signal generator amplitude for a power meter reading of 0 dBm ±0.2 dB. Record the power meter reading here:

$Amptd_{0dBm}$ = _______ dBm

11. Connect the equipment as indicated in Figure 2-19. The fixed attenuator must connect directly to the analyzer input.

75 Ω Inputs: The minimum loss pad should be connected to the analyzer input using a Type N (f) to BNC (m) 75 Ω adapter.

Figure 2-19 Amplitude Accuracy Test Setup



12.Set the analyzer as follows:

FREQUENCY, Center Freq, 50 MHz
SPAN, 6 kHz
BW/Avg, Resolution BW, 1 kHz
AMPLITUDE, More, Y Axis Units (or Amptd Units), dBm
AMPLITUDE, Ref Level, 0 dBm
Attenuation, 10 dB (Man)

13.Perform the following steps for each of the nominal amplitude values listed in Table 2-29:

a. Set the 1 dB step attenuator as indicated in Table 2-29.
b. Set the 10 dB step attenuator as indicated in Table 2-29.
c. Press **Single** and wait for the sweep to finish.
d. Press **Peak Search (or Search)**. Even though the signal may be slightly above the reference level for the first nominal amplitude setting, the marker can still make a valid measurement.
e. Record the Mkr 1 amplitude value as the measured amplitude in Table 2-29.
f. If the nominal amplitude is 0 dBm, calculate the amplitude accuracy as follows:

$$\text{Amplitude Accuracy} = \text{Measured Amplitude} - \text{Amptd0dBm}$$

g. If the amplitude is less than 0 dBm, calculate the amplitude accuracy as follows:

$$\text{Amplitude Accuracy} = \text{Measured Amplitude} - (\text{Amptd}_{0\ \text{dBm}} - \text{ActualTotalAtten} + \text{RefAtten}_{0\ \text{dB}})$$

h. Record the amplitude accuracy in the performance verification test record as indicated in Table 2-29.

Measuring –20 dBm Reference Level

1. Press **AMPLITUDE, Ref Level, –20 dBm**.
2. Copy the actual total attenuation values from Table 2-29 into the actual total attenuation column in Table 2-30. Not all values in Table 2-29 will be required in Table 2-30.

Table 2-30 Amplitude Accuracy Worksheet, –20 dBm Reference Level

1 dB Step Attenuator	10 dB Step Attenuator	Total Attenuation		Nominal Amplitude	Measured Amplitude	Amplitude Accuracy
Setting	Actual	Setting	Actual			(TR Entry)
0 dB	20 dB	20 dB		–20 dB		7
0 dB	30 dB	30 dB		–30 dB		8
0 dB	40 dB	40 dB		–40 dB		9
0 dB	50 dB	50 dB		–50 dB		10

3. Perform the following steps for each of the nominal amplitude values listed in Table 2-30:
   a. Set the 1 dB step attenuator as indicated in Table 2-30.
   b. Set the 10 dB step attenuator as indicated in Table 2-30.
   c. Press **Single** and wait for the sweep to finish.
   d. Press **Peak Search (or Search)**. Even though the signal may be slightly above the reference level for the first nominal amplitude setting, the marker can still make a valid measurement.
   e. Record the Mkr 1 amplitude value as the measured amplitude in Table 2-30.
   f. Calculate the amplitude accuracy as follows:

$$\text{Amplitude Accuracy} = \text{Measured Amplitude} - (\text{Amptd}_{0\ \text{dBm}} - \text{ActualTotalAtten} + \text{RefAtten}_{(}$$

   g. Record the amplitude accuracy in the performance verification test record as indicated in Table 2-30.

Measuring –40 dBm Reference Level

1. Press **AMPLITUDE, Ref Level, –40 dBm**.
2. Copy the actual total attenuation values from Table 2-30 into the actual total attenuation column in Table 2-31. Not all values in Table 2-30 will be required in Table 2-31.

Table 2-31 Amplitude Accuracy Worksheet, –40 dBm Reference Level

1 dB Step Attenuator	10 dB Step Attenuator	Total Attenuation		Nominal Amplitude	Measured Amplitude	Amplitude Accuracy
Setting	Actual	Setting	Actual			(TR Entry)
0 dB	40 dB	40 dB		–40 dB		10
0 dB	50 dB	50 dB		–50 dB		11

3. Perform the following steps for each of the nominal amplitude values listed in Table 2-31:

   a. Set the 1 dB step attenuator as indicated in Table 2-31.
   b. Set the 10 dB step attenuator as indicated in Table 2-31.
   c. Press **Single** and wait for the sweep to finish.
   d. Press **Peak Search (or Search)**. Even though the signal may be slightly above the reference level for the first nominal amplitude setting, the marker can still make a valid measurement.
   e. Record the Mkr 1 amplitude value as the measured amplitude in Table 2-31.
   f. Calculate the amplitude accuracy as follows:

$$\text{Amplitude Accuracy} = \text{Measured Amplitude} - (\text{Amptd}_{0\ \text{dBm}} - \text{ActualTotalAtten} + \text{RefAtten}_{0\ \text{dB}})$$

   g. Record the amplitude accuracy in the performance verification test record as indicated in Table 2-31.

Measuring –50 dBm Reference Level

1. Press **AMPLITUDE, Ref Level, –50 dBm.**

2. Copy the actual total attenuation values from Table 2-31 into the actual total attenuation column in Table 2-32. Not all values in Table 2-31 will be required in Table 2-32.

Table 2-32 **Amplitude Accuracy Worksheet, –50 dBm Reference Level**

1 dB Step Attenuator	10 dB Step Attenuator	Total Attenuation		Nominal Amplitude	Measured Amplitude	Amplitude Accuracy
Setting	Actual	Setting	Actual			(TR Entry)
0 dB	50 dB	50 dB		–50 dB		13

3. Perform the following steps for each of the nominal amplitude values listed in Table 2-32:

   a. Set the 1 dB step attenuator as indicated in Table 2-32.
   b. Set the 10 dB step attenuator as indicated in Table 2-32.
   c. Press **Single** and wait for the sweep to finish.
   d. Press **Peak Search (or Search)**. Even though the signal may be slightly above the reference level for the first nominal amplitude setting, the marker can still make a valid measurement.
   e. Record the Mkr 1 amplitude value as the measured amplitude in Table 2-32.
   f. Calculate the amplitude accuracy as follows:

$$\text{Amplitude Accuracy} = \text{Measured Amplitude} - (\text{Amptd}_{0\ \text{dBm}} - \text{ActualTotalAtten} + \text{RefAtten}$$

   g. Record the amplitude accuracy in the performance verification test record as indicated in Table 2-32.

19. Overall Amplitude Accuracy: HP E4402B, E4403B, E4404B, E4405B, E4407B and E4408B

This test measures the absolute amplitude of the analyzer at 50 MHz. A synthesized signal generator and attenuators are used as the signal source to the analyzer. A power meter is used to measure this signal source with the attenuators set to 0 dB. The value measured is recorded as the source amplitude. The attenuators are used to adjust the signal levels applied to the analyzer from the initial signal amplitude (set with the power meter) and –50 dBm. The amplitude measured by the analyzer is compared to the actual signal level and the amplitude error is calculated.

There are no related adjustments for this performance test.

Equipment Required

Synthesized signal generator
10 dB step attenuator
1 dB step attenuator
Attenuator interconnection kit
Attenuator driver (if programmable step attenuators are used)
6 dB fixed attenuator
Power meter
Power sensor
Cable, Type-N, 62 cm (24 in.) (m) (2 *required*)
Cable, BNC
Adapter, Type-N (f) to Type-N (f)

Additional Equipment for Option BAB

Adapter, Type N (f) to APC 3.5 (f)

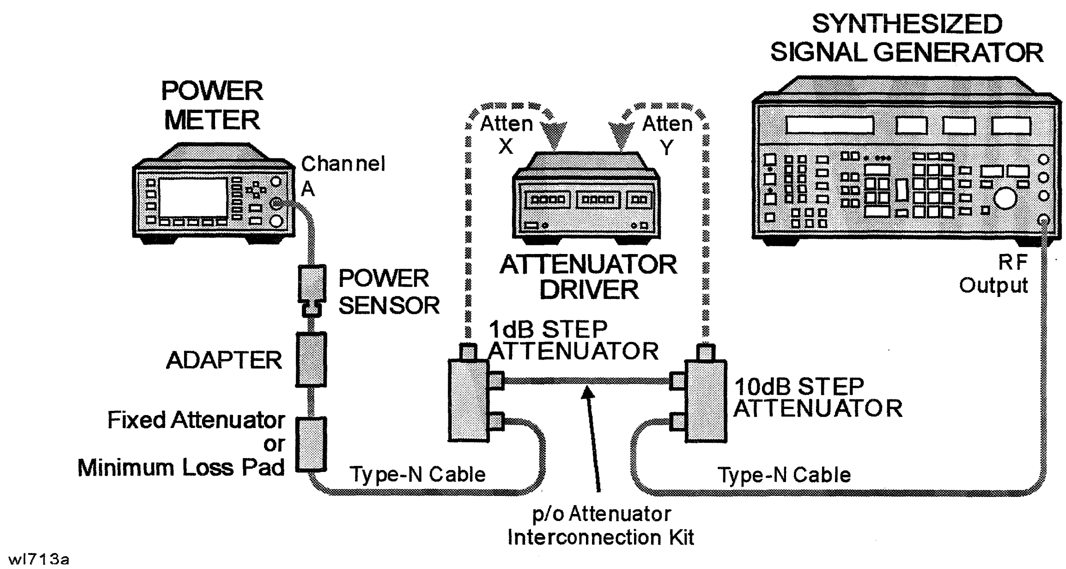
Procedure

Measuring 0 dBm Reference Level

1. On the analyzer, press **Preset** and wait for the preset routine to finish.
2. Connect a BNC cable from AMPTD REF OUT to the INPUT 50 Ω connector using a Type N (m) to BNC (f) adapter.
3. Perform a complete self-alignment and set Auto Align Off. Press **System, Alignments, Align Now, All**, and wait for the alignment routine to finish. Then, press **Return, Auto Align, Off**.
4. Zero and calibrate the power meter and power sensor connected to Channel A of the power meter.

5. Connect the equipment as shown in Figure 2-20. The power sensor should connect directly to the 6 dB fixed attenuator using an adapter.

Figure 2-20 Measure Source Test Setup



6. Preset the synthesized signal generator. Manually press **Blue Key, Special, 0, 0**. Set the signal generator as follows:

   FREQUENCY, 50 MHz
   AMPLITUDE, +6 dBm

7. Set the 10 dB and 1 dB step attenuators to 0 dB.

8. From the metrology data for the step attenuators at 50 MHz, obtain the actual attenuation for the 0 dB setting of each attenuator (in some cases, this might be zero by definition). Add the two actual attenuations to obtain the 0 dB reference attenuation.

$$\text{RefAtten}_{0dB} = 10\text{ dB Actual}_{0dB} + 1\text{ dB Actual}_{0dB}$$

   For example, if the actual attenuation for the 10 dB step attenuator is 0.03 dB, 10 dB Actual_{0dB} is 0.03 dB. If the actual attenuation for the 1 dB step attenuator is 0.02 dB, 1 dB Actual_{0dB} is 0.02 dB. In this case RefAtten_{0dB} is 0.05 dB.

9. Retrieve metrology data for the step attenuators at 50 MHz. Enter the actual attenuation values for each attenuator setting as indicated in Table 2-33. If using a programmable attenuator, the section three 40 dB step should be used for the 40 dB setting on the 10 dB step attenuator. Similarly, the section three 4 dB step should be used for the 4 dB setting on the 1 dB step attenuator.

Table 2-33 Amplitude Accuracy Worksheet, 0 dBm Reference Level

1 dB Step Attenuator		10 dB Step Attenuator		Total Attenuation		Nominal Amptd.	Meas. Amptd.	Amptd. Accuracy
Setting	Actual	Setting	Actual	Setting	Actual			(TR Entry)
0 dB		0 dB		0 dB		0 dBm		1
0 dB		10 dB		10 dB		–10 dBm		2
0 dB		20 dB		20 dB		–20 dBm		3
0 dB		30 dB		30 dB		–30 dBm		4
0 dB		40 dB		40 dB		–40 dBm		5
0 dB		50 dB		50 dB		–50 dBm		6

10. Calculate the actual total attenuation by adding the actual attenuation for the 1 dB step attenuator to the actual attenuation for the 10 dB step attenuator for each total attenuation setting listed in Table 2-33.

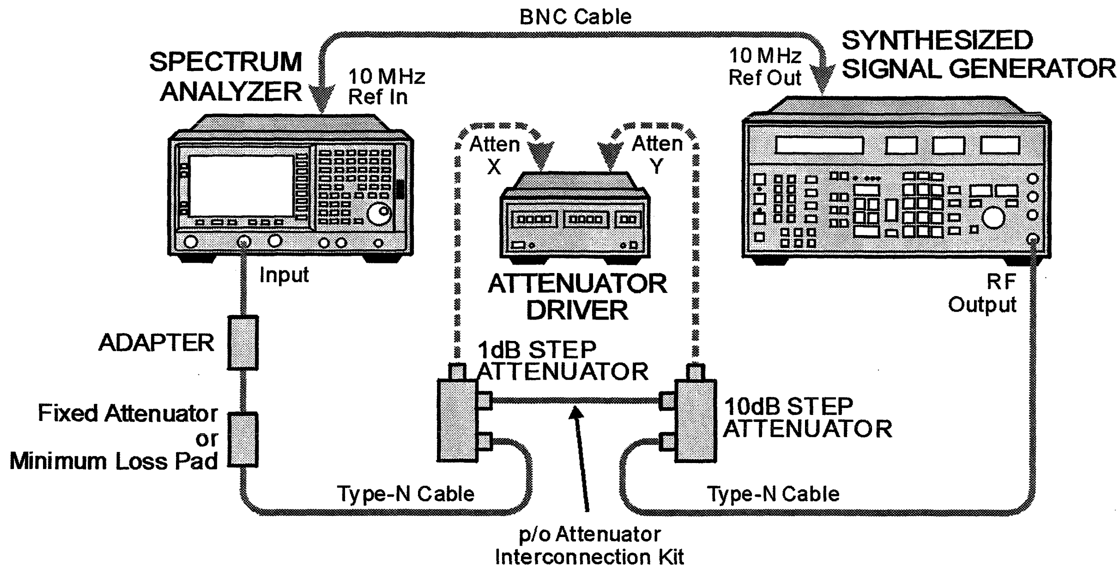
NOTE The external attenuators and cables are now part of the "source."

11. Adjust the signal generator amplitude for a power meter reading of 0 dBm ±0.2 dB. Record the power meter reading here:

$Amptd_{0dBm}$ = _______ dBm

12. Connect the equipment as indicated in Table 2-33. The fixed attenuator must connect directly to the analyzer input.

Figure 2-21 Amplitude Accuracy Test Setup



wl745a

13. Set the analyzer as follows:

FREQUENCY, Center Freq, 50 MHz
SPAN, 6 kHz
BW/Avg, Resolution BW, 1 kHz
AMPLITUDE, More, Y Axis Units (or Amptd Units), dBm
AMPLITUDE, Ref Level, 0 dBm
Attenuation, 10 dB (Man)

14. Perform the following steps for each of the nominal amplitude values listed in Table 2-33:

a. Set the 1 dB step attenuator as indicated in Table 2-33.
b. Set the 10 dB step attenuator as indicated in Table 2-33.
c. Press **Single** and wait for the sweep to finish.
d. Press **Peak Search (or Search)**. Even though the signal may be slightly above the reference level for the first nominal amplitude setting, the marker can still make a valid measurement.
e. Record the Mkr 1 amplitude value as the measured amplitude in Table 2-33.
f. If the nominal amplitude is 0 dBm, calculate the amplitude accuracy as follows:

$$\text{Amplitude Accuracy} = \text{Measured Amplitude} - \text{Amptd}_{0\text{dBm}}$$

g. If the amplitude is less than 0 dBm, calculate the amplitude accuracy as follows:

$$\text{Amplitude Accuracy} = \text{Measured Amplitude} - (\text{Amptd}_{0\text{dBm}} - \text{ActualTotalAtten} + \text{RefAtten}_{0}$$

h. Record the amplitude accuracy in the performance verification test record as indicated in Table 2-33.

Measuring –20 dBm Reference Level

1. Press **AMPLITUDE, Ref Level, –20 dBm**.
2. Copy the actual total attenuation values from Table 2-33 into the actual total attenuation column in Table 2-34. Not all values in Table 2-33 will be required in Table 2-34.

Table 2-34 Amplitude Accuracy Worksheet, –20 dBm Reference Level

1 dB Step Attenuator	10 dB Step Attenuator	Total Attenuation		Nominal Amplitude	Measured Amplitude	Amplitude Accuracy
Setting	Actual	Setting	Actual			(TR Entry)
0 dB	20 dB	20 dB		–20 dB		7
0 dB	30 dB	30 dB		–30 dB		8
0 dB	40 dB	40 dB		–40 dB		9
0 dB	50 dB	50 dB		–50 dB		10

3. Perform the following steps for each of the nominal amplitude values listed in Table 2-34:
   a. Set the 1 dB step attenuator as indicated in Table 2-34.
   b. Set the 10 dB step attenuator as indicated in Table 2-34.
   c. Press **Single** and wait for the sweep to finish.
   d. Press **Peak Search (or Search)**. Even though the signal may be slightly above the reference level for the first nominal amplitude setting, the marker can still make a valid measurement.
   e. Record the Mkr 1 amplitude value as the measured amplitude in Table 2-34.
   f. Calculate the amplitude accuracy as follows:

$$\text{Amplitude Accuracy} = \text{Measured Amplitude} - (\text{Amptd}_{0dBm} - \text{ActualTotalAtten} + \text{RefAtten}_{0dB})$$

   g. Record the amplitude accuracy in the performance verification test record as indicated in Table 2-34.

Measuring –40 dBm Reference Level

1. Press **AMPLITUDE, Ref Level, –40 dBm**.
2. Copy the actual total attenuation values from Table 2-34 into the actual total attenuation column in Table 2-35. Not all values in Table 2-34 will be required in Table 2-35.

Table 2-35 Amplitude Accuracy Worksheet, –40 dBm Reference Level

1 dB Step Attenuator	10 dB Step Attenuator	Total Attenuation		Nominal Amplitude	Measured Amplitude	Amplitude Accuracy
Setting	Actual	Setting	Actual			(TR Entry)
0 dB	40 dB	40 dB		–40 dB		10
0 dB	50 dB	50 dB		–50 dB		11

3. Perform the following steps for each of the nominal amplitude values listed in Table 2-35:

   a. Set the 1 dB step attenuator as indicated in Table 2-35.
   b. Set the 10 dB step attenuator as indicated in Table 2-35.
   c. Press **Single** and wait for the sweep to finish.
   d. Press **Peak Search (or Search)**. Even though the signal may be slightly above the reference level for the first nominal amplitude setting, the marker can still make a valid measurement.
   e. Record the Mkr 1 amplitude value as the measured amplitude in Table 2-35.
   f. Calculate the amplitude accuracy as follows:

$$\text{Amplitude Accuracy} = \text{Measured Amplitude} - (\text{Amptd}_{0dBm} - \text{ActualTotalAtten} + \text{RefAtten}_{0}$$

   g. Record the amplitude accuracy in the performance verification test record as indicated in Table 2-35.

Measuring –50 dBm Reference Level

1. Press **AMPLITUDE, Ref Level, –50 dBm**.
2. Copy the actual total attenuation values from Table 2-34 into the actual total attenuation column in Table 2-36. Not all values in Table 2-34 will be required in Table 2-36.

Table 2-36 Amplitude Accuracy Worksheet, –50 dBm Reference Level

1 dB Step Attenuator	10 dB Step Attenuator	Total Attenuation		Nominal Amplitude	Measured Amplitude	Amplitude Accuracy
Setting	Actual	Setting	Actual			(TR Entry)
0 dB	50 dB	50 dB		–50 dB		13

3. Perform the following steps for each of the nominal amplitude values listed in Table 2-36:

   a. Set the 1 dB step attenuator as indicated in Table 2-36.
   b. Set the 10 dB step attenuator as indicated in Table 2-36.
   c. Press **Single** and wait for the sweep to finish.
   d. Press **Peak Search (or Search)**. Even though the signal may be slightly above the reference level for the first nominal amplitude setting, the marker can still make a valid measurement.
   e. Record the Mkr 1 amplitude value as the measured amplitude in Table 2-36.
   f. Calculate the amplitude accuracy as follows:

$$\text{Amplitude Accuracy} = \text{Measured Amplitude} - (\text{Amptd0dBm} - \text{ActualTotalAtten} + \text{RefAtten0dB})$$

   g. Record the amplitude accuracy in the performance verification test record as indicated in Table 2-36.

20. Resolution Bandwidth Accuracy

The output of a synthesized signal generator is connected to the input of the analyzer, characterized through a 1 dB step attenuator set to 3 dB.

The amplitude of the synthesized signal generator is set to a reference amplitude 5 dB below top of screen. A marker reference is set and the attenuator is set to 0 dB.

The markers of the analyzer are then used to measure the 3 dB bandwidth. The first marker is set on the left filter skirt so that the marker delta amplitude is 1 dB plus the attenuator error for the 3 dB setting. The second marker is similarly set on the right filter skirt. The frequency difference between the two markers is the 3 dB bandwidth.

Resolution bandwidth settings ≤ 300 Hz (Option 1DR) are not measured. These bandwidths are digitally derived; therefore, their accuracy is verified by design.

The related adjustment for this performance test is "IF Amplitude."

Equipment Required

Synthesized signal generator
Cable, BNC, 122-cm (48-in)
Cable, Type-N, 152-cm (60-in) (*2 required*)
1 dB step attenuator
Attenuator/switch driver (if programmable step attenuators are used)

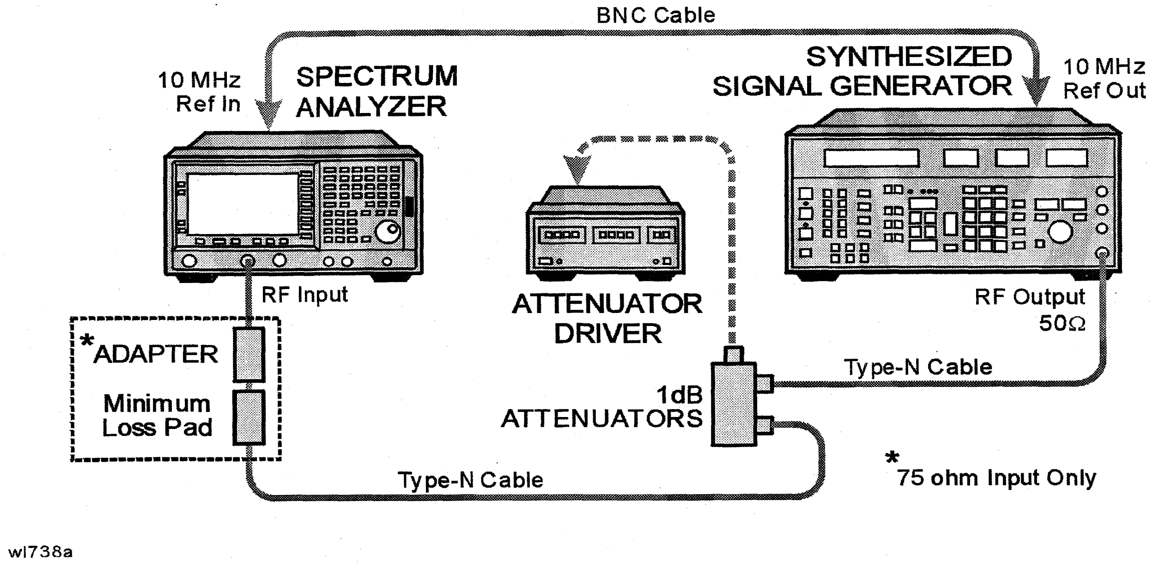
Additional Equipment for 75 Ω Input

Pad, minimum loss
Adapter, Type-N (f), to BNC (m), 75 Ω

Additional Equipment for Option BAB

Adapter, Type-N (f), to APC 3.5 (f)

Figure 2-22 **Resolution Bandwidth Accuracy Test Setup**



CAUTION Use only 75 Ω cables, connectors, or adapters on instruments with 75 Ω connectors, or the connectors will be damaged.

Procedure

1. Connect the equipment as shown in Figure 2-22.
2. On the synthesized signal generator, press **Blue Key, Special, 0, 0** and set the controls as follows:

   FREQUENCY, 50 MHz
   AMPLITUDE, 0 dBm (50 Ω *Input only)*
   AMPLITUDE, 6 dBm (75 Ω *Input only)*

3. On the analyzer, press **Preset**, then wait for the preset routine to finish. Press **System, Alignments, Auto Align, Off**. Set the analyzer by pressing the following keys:

   FREQUENCY, 50 MHz
   SPAN, 7.5 MHz
   AMPLITUDE, Scale/Div 1 dB
   AMPLITUDE, Y Axis Units (or Amptd Units), dBm
   BW/Avg, 5 MHz
   BW/Avg, Video BW, 30 Hz

4. Set the 1 dB step attenuator to 3 dB.

5. Note the error of the external 1 dB step attenuator at 3 dB and 6 dB below using its calibration records.

   Attenuator Error (3 dB) __________ dB

   Attenuator Error (6 dB) __________ dB

3 dB Resolution Bandwidth Accuracy

6. Press **Peak Search (or Search)**, **Meas Tools**, **Mkr→ CF** on the analyzer.
7. Adjust the amplitude of the synthesized signal generator for a marker amplitude reading of −5 dBm ± 0.2 dB.
8. Press **Peak Search (or Search)**, **Marker**, **Delta** on the analyzer.
9. Set the attenuator to 0 dB.
10. On the analyzer, press **Marker**. Lower the marker frequency by adjusting the knob until the marker delta amplitude is 0 dB plus the attenuator error (3 dB) noted in step 5 to a tolerance of ± 0.05 dB.
11. Record the marker frequency readout in column 3 of Table 2-37.
12. Using the analyzer knob, raise the marker frequency so that the marker delta amplitude is maximum. Continue increasing the marker frequency until the marker reads 0.0 dB plus the attenuator error (3 dB) noted in step 5 to a tolerance of ± 0.05 dB.
13. Record the marker frequency readout in column 4 of Table 2-37.
14. Set the attenuator to 3 dB.
15. Press **Marker**, **Normal** on the analyzer.
16. Repeat step 6 through step 15 for each of the Analyzer Res BW and Analyzer Span settings listed in Table 2-37.
17. Subtract the Lower Marker Frequency from the Upper Marker Frequency. Record the difference as the 3 dB Bandwidth, in the performance verification test record as indicated in Table 2-37.

    3db Bandwidth = Upper Marker Frequency - Lower Marker Frequency

Table 2-37 3 dB Resolution Bandwidth Accuracy

Column 1	Column 2	Column 3	Column 4	Column 5
Analyzer Res BW	Analyzer Span	Lower Marker Frequency	Upper Marker Frequency	TR Entry 3 dB Bandwidth
5 MHz	7.5 MHz			1)
3 MHz	4.5 MHz			2)
1 MHz	1.5 MHz			3)
300 kHz	450 kHz			4)
100 kHz	150 kHz			5)
30 kHz	45 kHz			6)
10 kHz	15 kHz			7)
3 kHz	4.5 kHz			8)
1 kHz	1.5 kHz			9)

6 dB Resolution Bandwidth Accuracy

18. Set the Analyzer Res BW to 120 kHz and the Analyzer Span to 180 kHz as shown in Table 2-38.
19. On the analyzer, press **Peak Search (or Search), Meas Tools, Mkr→ CF**.
20. Set the external 1 dB step attenuator to 6 dB and adjust the amplitude of the synthesized signal generator for a marker amplitude reading of −7 dBm ± 0.2 dB.
21. Press **Peak Search (or Search), Marker, Delta** on the analyzer.
22. Set the attenuator to 0 dB.
23. On the analyzer, press **Marker**. Lower the marker frequency by adjusting the knob until the marker delta amplitude is 0 dB plus the attenuator error (6 dB) noted in step 5 to tolerance of ± 0.05 dB.
24. Record the marker frequency readout in column 3 of Table 2-38.
25. Using the analyzer knob, raise the marker frequency so that the marker delta amplitude is maximum. Continue increasing the marker frequency until the marker reads 0.0 dB plus the attenuator error (6 dB) noted in step 5 to a tolerance of ± 0.05 dB.
26. Record the marker frequency readout in column 4 of Table 2-38.
27. Set the attenuator to 6 dB.
28. Press **Marker, Normal** on the analyzer.

29. Repeat step 19 to step 28 for each of the Analyzer Res BW and Analyzer Span settings listed in Table 2-38.

30. Subtract the Lower Marker Frequency from the Upper Marker Frequency. Record the difference as the 6 dB bandwidth, in the performance verification test record as indicated in Table 2-38.

6 dB Bandwidth = Upper Marker Frequency – Lower Marker Frequency

Table 2-38 6 dB Resolution Bandwidth Accuracy

Column 1	Column 2	Column 3	Column 4	Column 5
Analyzer Res BW	**Analyzer Span**	**Lower Marker Frequency**	**Upper Marker Frequency**	**TR Entry 3 dB Bandwidth**
120 kHz	180 kHz			**10)**
9 kHz	13.5 kHz			**11)**

Post-test Instrument Restoration

31. Press **Preset, System, Alignments, Auto Align, All.**

21. Frequency Response: HP E4401B and E4411B

This test measures the amplitude error of the analyzer as a function of frequency. To measure frequencies of 100 kHz and above, the output of a source is fed through a power splitter to a power sensor and the analyzer. The power level of the source is adjusted at 50 MHz to place the displayed signal at the center horizontal graticule line of the analyzer. The power meter is then set to measure dB relative to the power at 50 MHz. At each new source frequency and analyzer center frequency, the power level of the source is adjusted to place the signal at the center horizontal graticule line. The power meter displays the inverse of the frequency response relative to 50 MHz.

To measure frequencies below 100 kHz, a digital voltmeter (DVM) with a 50 Ω load replaces the power sensor and a function generator is used as the source.

For improved amplitude accuracy below 3 GHz, the power splitter is characterized using a specially-calibrated power sensor (the "reference" sensor) connected to one power splitter output port. The other power splitter output port connects to the "buried" sensor; it is not removed from the power splitter. Once the characterization is done, the reference sensor is removed and replaced by the analyzer.

This procedure does not test frequency response with the optional preamplifier (Option 1DS) turned on. If the analyzer is equipped with Option 1DS, also perform the "Frequency Response, Preamp On" procedure.

The related adjustment for this performance test is "Frequency Response."

Analyzers with 75 Ω inputs are tested only down to 1 MHz.

Equipment Required

Synthesized signal generator
Function generator
Power meter
RF power sensor, (*2 required*)
RF Power splitter
Digital multimeter
Adapter, APC 3.5 (f) to APC 3.5 (f)
Adapter, Type-N (m) to Type-N (m)
Adapter, Type-N (m) to BNC (f)
Dual banana plug to BNC (f)

BNC Tee (BNC f,m,f)
Cable, BNC, 120-cm (48-in) (*2 required*)
Cable, Type-N, 183-cm (72-in)
Cable, APC 3.5
Termination, 50 Ω, BNC (m)

Additional Equipment for 75 Ω Input

Power sensor, 75 Ω
Adapter, mechanical, Type-N (f) 75 Ω to Type-N (m) 50 Ω
Adapter, Type-N (m) to BNC (m), 75 Ω

CAUTION Use only 75 Ω cables, connectors, or adapters on instruments with 75 Ω connectors, or damage to the connectors will occur.

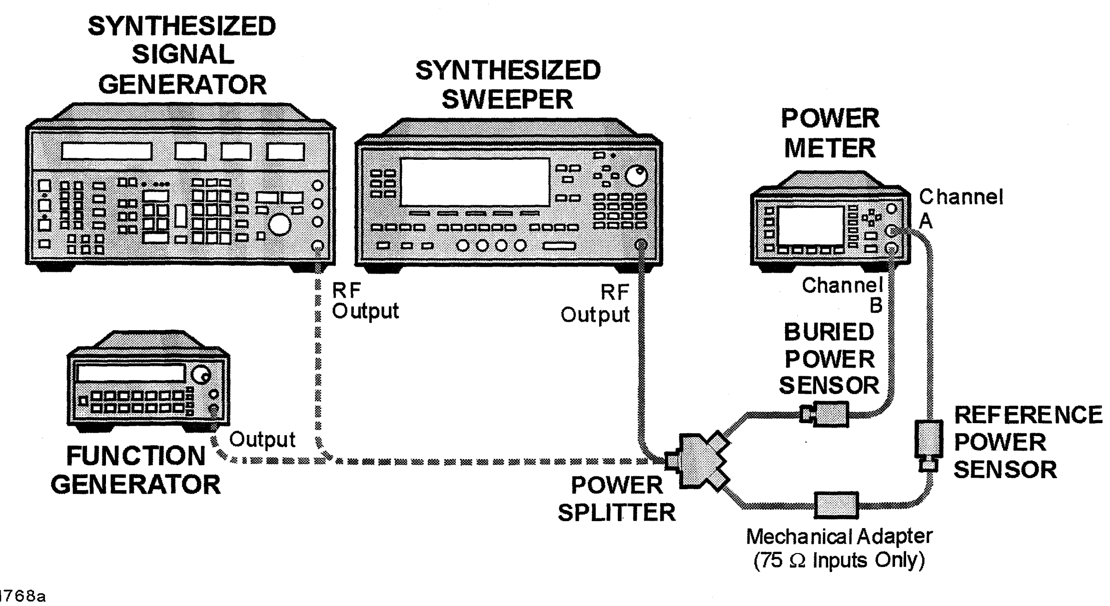
Procedure

Source/Splitter Characterization

1. Refer to Figure 2-23. Connect one of the HP 8482A power sensors to Channel A of the power meter. This will be the “reference” sensor. Connect the other HP 8482A power sensor to Channel B of the power meter. This will be the “buried” sensor.

   75Ω Inputs, Option 1DP: Connect the HP 8483A power sensor to Channel A of the power meter. This will be the “reference” sensor.

Figure 2-23 Source/Splitter Characterization Setup



2. Zero and calibrate both power sensors.
3. On the power meter, set the Channel A calibration factor to the calibration factor of the reference sensor for 100 kHz.

   75 Ω Inputs, Option 1DP: Use the calibration factor of the reference sensor for 1 MHz.
4. On the power meter, set the Channel B calibration factor to 100%. Do not change this calibration factor during this test.
5. Connect the equipment as shown in Figure 2-23. Use the synthesized signal generator as the source.

   75 Ω Inputs, Option 1DP: Connect the reference sensor to the power splitter using the mechanical adapter.
6. Set the source frequency to 100 kHz and amplitude to –4 dBm.

   75 Ω Inputs, Option 1DP: Set the source frequency to 1 MHz.
7. Adjust the source amplitude to obtain a Channel A power meter reading of –10 dBm ±0.01 dB.
8. Record the source amplitude setting, and both the Channel A and Channel B power meter readings in Table 2-39.
9. Tune the source to the next frequency in Table 2-39.
10. On the power meter, set the Channel A calibration factor to the calibration factor of the reference sensor for the current source frequency.
11. Adjust the source amplitude to obtain a Channel A power meter reading of –10 dBm ±0.01 dB.
12. Record the source amplitude setting, and both the Channel A and Channel B power meter readings in Table 2-39.
13. Repeat step 9 to step 12 for each frequency in Table 2-39.
14. For each entry in Table 2-39, calculate the Splitter Tracking Error as follows:

$$\text{Splitter Tracking Error} = \text{Channel A Power} - \text{Channel B Power}$$

   For example, if Channel A Power is –10.05 dBm and Channel B Power is –10.23 dBm, the Splitter Tracking Error is +0.18 dB.

Table 2-39 Source/splitter characterization

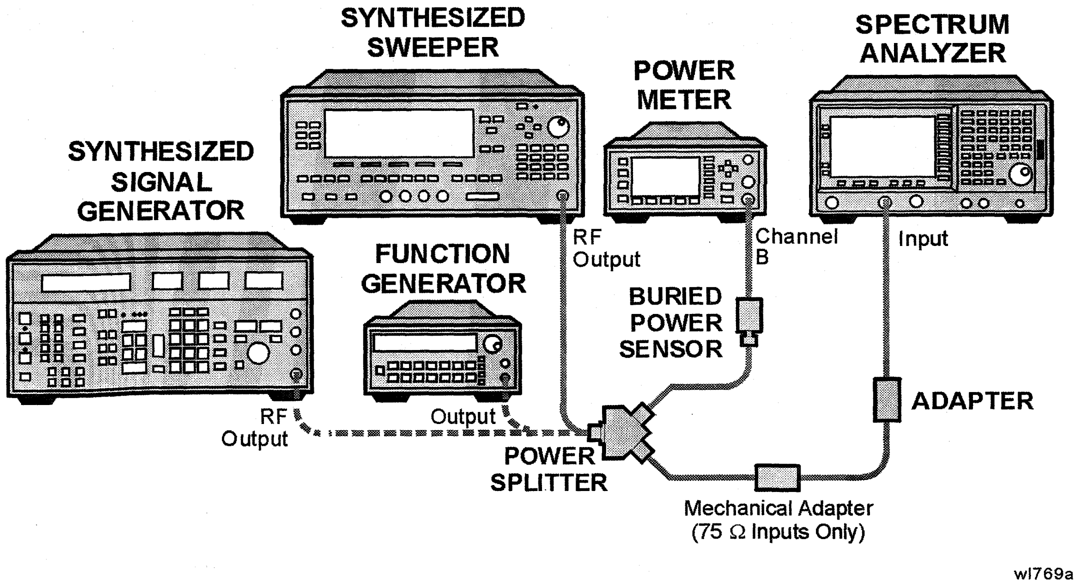
Frequency	Power Meter Reading		Splitter Tracking Error	Source Power Setting
	Channel A	Channel B		
100 kHz[a]				
500 kHz[a]				
1 MHz				
5 MHz				
10 MHz				
20 MHz				
50 MHz				
75 MHz				
175 MHz				
275 MHz				
375 MHz				
475 MHz				
575 MHz				
675 MHz				
775 MHz				
875 MHz				
975 MHz				
1075 MHz				
1175 MHz				
1275 MHz				
1375 MHz				
1500 MHz				

a. These values do not apply to analyzers with 75 Ω inputs (Option 1DP).

Measuring Frequency Response, 100 kHz to 1.5 GHz

1. Remove the reference sensor (Channel A sensor) from the power splitter. Connect the power splitter to the analyzer Input 50 Ω using an adapter. Do not use a cable. Refer to Figure 2-24.

Figure 2-24 Frequency Response Test Setup, 100 kHz to 1.5 GHz



75 Ω inputs, Option 1DP: Connect the power splitter to the analyzer Input 75 Ω using a mechanical adapter and a 75 Ω, Type-N(m) to BNC(m) adapter.

2. Set the source frequency to 100 kHz:

   75 Ω inputs, Option 1DP: Set the source frequency to 1 MHz.

3. Set the source AMPLITUDE to the value corresponding to the source power setting in Table 2-40 for the current source frequency (100 kHz or 1 MHz).

4. Preset the analyzer and wait for the preset routine to complete. Set the analyzer controls as follows:

   FREQUENCY, Center Freq, 100 kHz (*50 Ω Input*)
   FREQUENCY, Center Freq, 1 MHz (*75 Ω Input*)
   CF Step, 100 MHz
   SPAN, 20 kHz
   AMPLITUDE, More, Int Preamp (Off) (*Option 1DS only*)
   AMPLITUDE, More, Y Axis Units (or Amptd Units), dBm
   AMPLITUDE, Ref Level, –5 dBm
   Attenuation, 10 dB (Man)
   Scale/Div, 1 dB
   BW/Avg, Resolution BW, 3 kHz (Man)
   Video BW, 3 kHz (Man)

5. Adjust the source AMPLITUDE to obtain the Channel B power meter reading recorded in Table 2-39 ±0.1 dB.
6. Record the current Channel B power reading in Table 2-40 as the Current Channel B reading.
7. On the analyzer, press **Single** then **Peak Search (or Search)**.
8. Record the Mkr1 amplitude reading in Table 2-40.
9. Set the source to the next frequency listed in Table 2-40.
10. Set the analyzer center frequency to the next frequency listed in Table 2-40.
11. Adjust the source AMPLITUDE to obtain the Channel B power meter reading recorded in Table 2-39 ±0.1 dB for the current frequency.
12. Record the current Channel B power meter reading in Table 2-40 as the Current Channel B Reading.
13. On the analyzer, press **Single** then **Peak Search (or Search)**.
14. Record the Mkr1 amplitude reading in Table 2-40.
15. Repeat step 9 to step 14 for each frequency in Table 2-40.
16. Copy the splitter tracking errors from Table 2-39 into Table 2-40.
17. Calculate the Flatness Error for each frequency in Table 2-40 as follows:

$$\text{Flatness Error} = \text{Mkr1 Amptd} - \text{Current Channel B} - \text{Splitter Tracking Error}$$

For example, if Mkr1 Amptd is –10.32 dBm, Current Channel B is –10.2 and Splitter Tracking Error is 0.18 dB, Flatness Error would be –0.30 dB.

18. Record the Flatness Error for 50 MHz below as the 50 MHz Ref Amptd:

    50 MHz Ref Amptd ________

19. Calculate the Flatness Relative to 50 MHz for each frequency in Table 2-40 as follows:

$$\text{Flatness Relative to 50 MHz} = \text{Flatness Error} - \text{50 MHz Ref Amptd}$$

For example, if Flatness Error is –0.30 dB and 50 MHz Ref Amptd is +0.15 dB, Flatness Relative to 50 MHz would be –0.45 dB.

Table 2-40 Frequency response worksheet, 100 kHz to 1.5 GHz

Frequency	Current Channel B Reading	Mkr1 Amptd	Splitter Tracking Error	Flatness Error	Flatness Relative to 50 MHz
100 kHz[a]					
500 kHz[a]					
1 MHz					
5 MHz					
10 MHz					
20 MHz					
50 MHz					
75 MHz					
175 MHz					
275 MHz					
375 MHz					
475 MHz					
575 MHz					
675 MHz					
775 MHz					
875 MHz					
975 MHz					
1075 MHz					
1175 MHz					
1275 MHz					
1375 MHz					
1500 MHz					

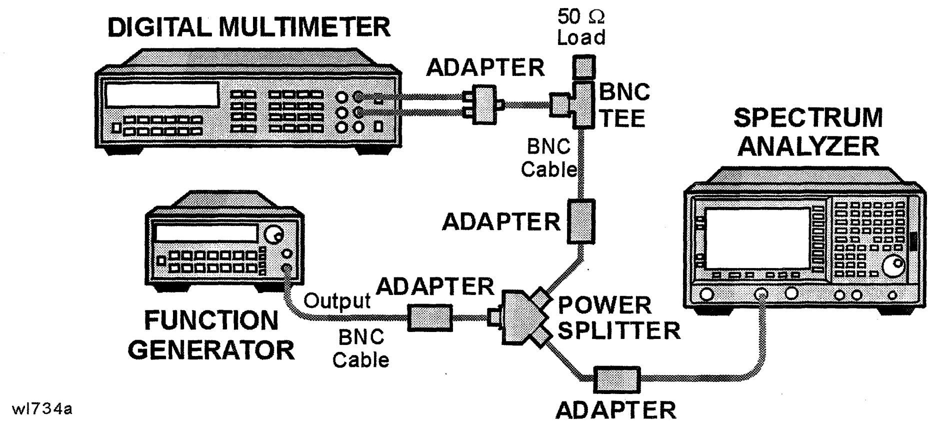
a. These values do not apply to analyzers with 75 Ω inputs (Option 1DP).

Measuring Frequency Response, ≤ 100 kHz

If the analyzer has Option 1DP, skip to the Test Results section.

1. Connect the equipment as shown in Figure 2-25.

Figure 2-25 Frequency Response Test Setup, ≤ 100 kHz



2. Set the function generator controls as follows:

   FREQUENCY, 100 kHz
   AMPLITUDE, –4 dBm

3. Set the DVM as follows:

Function	Synchronous AC Volts
Math	dBm
RES Register	50 Ω
Front/Rear Terminals	Front
Range	Auto

4. On the analyzer, press **FREQUENCY**, **100 kHz**.
5. Adjust the function generator amplitude until the DVM reading is –10 dBm ±0.1 dB.
6. Record the actual DVM reading in Table 2-41 as the DVM amplitude reading.
7. On the analyzer, press **Peak Search (or Search)**, **Marker, Delta**.
8. Set the analyzer center frequency to the next frequency listed in Table 2-41.

9. Set the function generator frequency to the next frequency listed in Table 2-41.
10. On the analyzer, press **Peak Search (or Search)**.
11. Adjust the function generator amplitude until the ΔMkr1 amplitude reads 0 dB ±0.05 dB.
12. Record the DVM reading in Table 2-41 as the DVM amplitude reading.
13. Repeat step 8 through step 12 for each frequency in Table 2-41.
14. For each of the frequencies in Table 2-41, subtract the DVM amplitude from the DVM Amplitude at 100 kHz recorded in step 6. Record the result as the Response Relative to 100 kHz in Table 2-41.
15. From Table 2-40, note the flatness relative to 50 MHz for the 100 kHz frequency. Record this below as the 100 kHz error relative to 50 MHz:

    100 kHz Error Relative to 50 MHz __________ dB

16. Add the 100 kHz error relative to 50 MHz that was recorded in step 15 above to each of the response relative to 100 kHz entries in Table 2-41. Record the results as the Response Relative to 50 MHz in Table 2-41.

Table 2-41 Frequency response worksheet, ≤ 100 kHz

Frequency	DVM Amplitude	Response Relative to 100 kHz	Response Relative to 50 MHz
100 kHz		0 dB (Ref)	
75 kHz			
50 kHz			
20 kHz			
9 kHz			

Test Results

1. Enter the most positive number from the Flatness Relative to 50 MHz column of Table 2-40:

   ___________ dB

2. Enter the most positive number from the Response Relative to 50 MHz column of Table 2-41:

   ___________ dB

   75 Ω inputs, Option 1DP: The frequency range below 100 kHz was not tested; no entry from Table 2-41 is necessary.

3. Record the more positive of numbers from step 1 and step 2 in Table 2-42 as the maximum response for band 0.
4. Enter the most negative number from the flatness relative to 50 MHz column of Table 2-40:

   ___________ dB

5. Enter the most negative number from the response relative to 50 MHz column of Table 2-41:

   ___________ dB

   75 Ω inputs, Option 1DP: The frequency range below 100 kHz was not tested; no entry from Table 2-41 is necessary.

6. Record the more negative of numbers from step 4 and step 5 in Table 2-42 as the minimum response for band 0.
7. Subtract the minimum response for band 0 from the maximum response for band 0 and record the result as the peak-to-peak response for band 0 in Table 2-42.

Table 2-42 Frequency Response Results

Band	Maximum Response		Minimum Response		Peak-to-peak Response	
	dBm	TR Entry	dBm	TR Entry	dBm	TR Entry
0		1		2		3

22. Frequency Response, HP E4402B and E4403B

This test measures the amplitude error of the analyzer as a function of frequency. To measure frequencies of 100 kHz and above, the output of a source is fed through a power splitter to a power sensor and the analyzer. The power level of the source is adjusted at 50 MHz to place the displayed signal at the center horizontal graticule line of the analyzer. The power meter is then set to measure dB relative to the power at 50 MHz. At each new source frequency and analyzer center frequency, the power level of the source is adjusted to place the signal at the center horizontal graticule line. The power meter displays the inverse of the frequency response relative to 50 MHz.

To measure frequencies below 100 kHz, a DVM with a 50Ω load replaces the power sensor and a function generator is used as the source.

For improved amplitude accuracy below 3 GHz, the power splitter is characterized using a specially-calibrated power sensor (the "reference" sensor) connected to one power splitter output port. The other power splitter output port connects to the "buried" sensor; it is not removed from the power splitter. Once the characterization is done, the reference sensor is removed and replaced by the analyzer.

This procedure does not test frequency response with the optional preamplifier (Option 1DS) turned on. If the analyzer is equipped with Option 1DS, also perform the "Frequency Response, Preamp On" procedure.

The related adjustment for this performance test is "Frequency Response."

Equipment Required

Synthesized sweeper
Function generator
Power meter
RF power sensor (*2 required*)
RF Power splitter
Digital multimeter
Adapter, APC 3.5 (f) to APC 3.5 (f)
Adapter, Type-N (m) to Type-N (m)
Adapter, Type-N (m) to BNC (f)
Dual banana plug to BNC (f)
BNC Tee (BNC f,m,f)

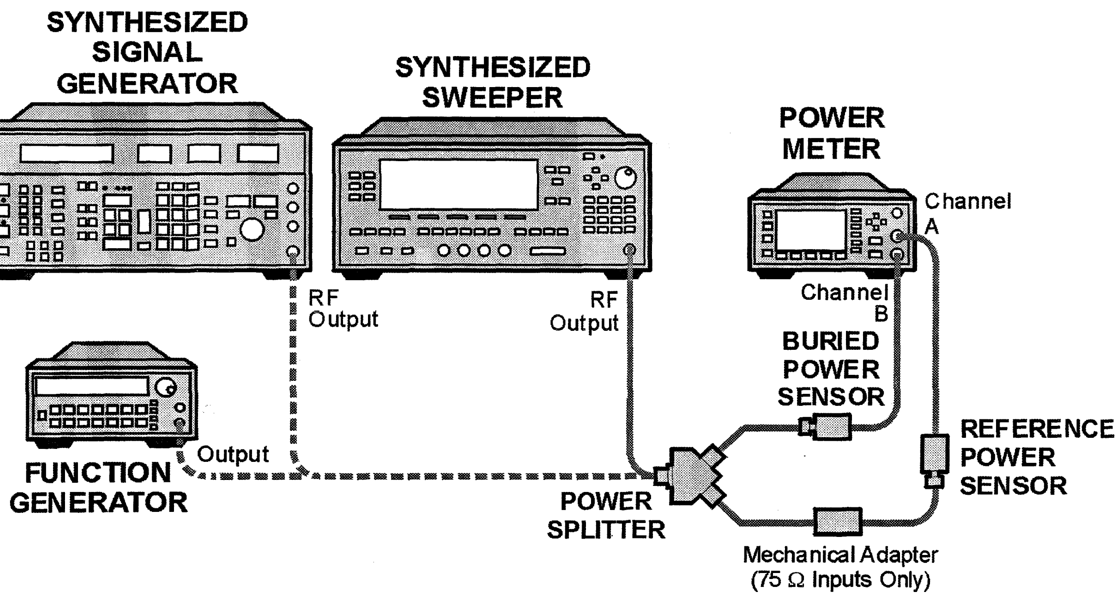
Cable, BNC, 122-cm (48-in) (*2 required*)
Cable, Type-N, 183-cm (72-in)
Cable, APC 3.5
Termination, 50 Ω, BNC (m)

Procedure

Source/Splitter Characterization

1. Connect one of the HP 8482A power sensors to Channel A of the power meter. This will be the "reference" sensor. Connect the other HP 8482A power sensor to Channel B of the power meter. This will be the "buried" sensor. Refer to Figure 2-26.

Figure 2-26 Source/Splitter Characterization Setup



wl768a

2. Zero and calibrate both power sensors.
3. On the power meter, set the Channel A calibration factor to the calibration factor of the reference sensor for 100 kHz.
4. On the power meter, set the Channel B calibration factor to 100%. Do not change this calibration factor during this test.
5. Connect the equipment as shown in Figure 2-26. Use the function generator as the source.
6. Set the function generator frequency to 100 kHz and amplitude to –4 dBm.

7. Adjust the function generator amplitude to obtain a Channel A power meter reading of –10 dBm ±0.01 dB.

8. Record the function generator amplitude setting, and both the Channel A and Channel B power meter readings in Table 2-43.

9. Tune the source to the next frequency in Table 2-43.

10. On the power meter, set the Channel A calibration factor to the calibration factor of the reference sensor for the current source frequency.

11. Adjust the source amplitude to obtain a Channel A power meter reading of –10 dBm ±0.01 dB.

12. Record the source amplitude setting, and both the Channel A and Channel B power meter readings in Table 2-43.

13. Repeat step 9 to step 12 for frequencies up to 10 MHz.

14. Replace the function generator with the synthesized sweeper.

15. Set the synthesized sweeper CW frequency to 10 MHz and the amplitude to –4 dBm.

16. Adjust the synthesized sweeper power level to obtain a Channel A power meter reading of –10 dBm ± 0.1 dB.

17. Record the synthesized sweeper power level and both the Channel A and Channel B power meter readings in Table 2-43.

18. Repeat step 9 to step 12 for each remaining frequency in Table 2-43.

19. For each entry in Table 2-43, calculate the Splitter Tracking Error as follows:

    Splitter Tracking Error = Channel A Power – Channel B Power

    For example, if Channel A Power is –10.05 dBm and Channel B Power is –10.23 dBm, the Splitter Tracking Error is +0.18 dB.

Table 2-43 Source/Splitter Characterization

Frequency	Power Meter Reading		Splitter Tracking Error	Source Power Setting
	Channel A	Channel B		
100 kHz				
500 kHz				
1 MHz				
5 MHz				
10 MHz[a]				

Table 2-43 **Source/Splitter Characterization**

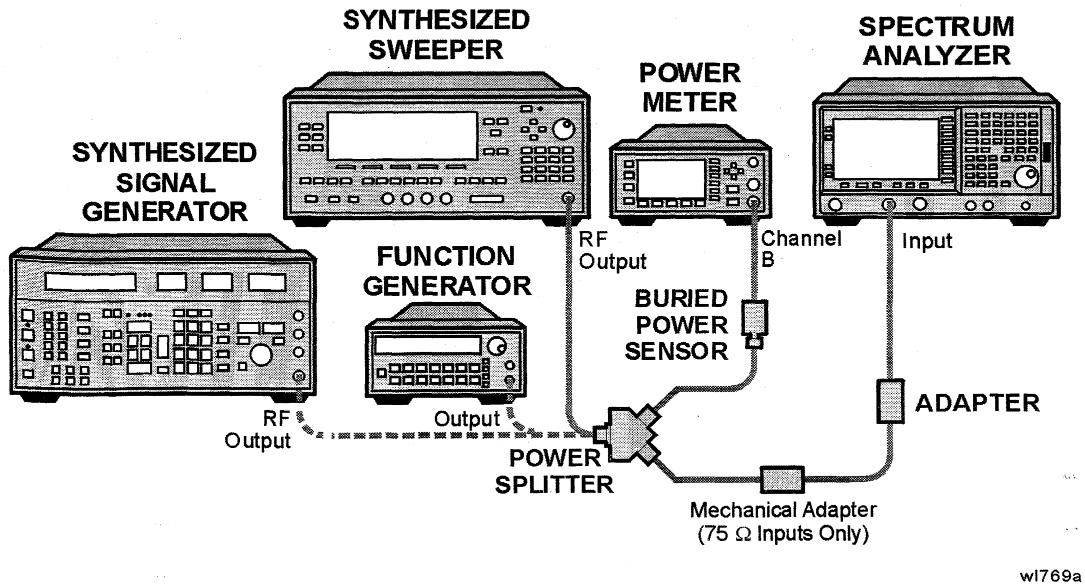
Frequency	Power Meter Reading		Splitter Tracking Error	Source Power Setting
	Channel A	Channel B		
10 MHz[b]				
20 MHz				0 dB (Ref)
50 MHz				
75 MHz				
175 MHz				
275 MHz				
375 MHz				
475 MHz				
575 MHz				
675 MHz				
775 MHz				
875 MHz				
975 MHz				
1075 MHz				
1175 MHz				
1275 MHz				
1375 MHz				
1500 MHz				
1525 MHz				
1725 MHz				
1925 MHz				
2125 MHz				
2325 MHz				
2525 MHz				
2725 MHz				
2925 MHz				
3000 MHz				

a. This entry is for data taken with function generator as source.
b. This entry is for data taken with synthesized sweeper as source.

Measuring Frequency Response, 100 kHz to 3.0 GHz

1. Remove the reference sensor (Channel A sensor) from the power splitter. Connect the power splitter to the INPUT 50Ω of the analyzer using an adapter. Do not use a cable. Refer to Figure 2-27.

Figure 2-27 Frequency Response Test Setup, 100 kHz to 3.0 GHz



2. Set the source frequency at 10 MHz.
3. Set the source POWER LEVEL to the value corresponding to the source power setting in Table 2-43 for the current source frequency (10 MHz).
4. Preset the analyzer and wait for the preset routine to complete. Set the analyzer controls as follows:

   FREQUENCY, Center Freq, 10 MHz
   CF Step, 100 MHz
   SPAN, 20 kHz
   AMPLITUDE, More, Int Preamp, Off (*Option 1DS only*)
   AMPLITUDE, More, Y Axis Units (or Amptd Units), dBm
   AMPLITUDE, Ref Level, –5 dBm
   Attenuation, 10 dB (Man)
   Scale/Div, 1 dB
   BW/Avg, Resolution BW, 3 kHz (Man)
   Video BW, 3 kHz (Man)

5. Adjust the source POWER LEVEL to obtain the Channel B power meter reading recorded in Table 1 ±0.1 dB.
6. Record the current Channel B power reading in Table 2-44 as the Current Channel B Reading.

7. On the analyzer, press **Single** then **Peak Search (or Search).**

8. Record the Mkr1 amplitude reading in Table 2-44.

9. Set the source to the next frequency listed in Table 2-44.

10. Set the analyzer center frequency to the next frequency listed in Table 2-44.

11. Adjust the source POWER LEVEL to obtain the Channel B power meter reading recorded in Table 2-44 ±0.1 dB for the current frequency.

12. Record the current Channel B power reading in Table 2-44 as the current Channel B reading.

13. On the analyzer, press **Single** then **Peak Search (or Search).**

14. Record the Mkr1 amplitude reading in Table 2-44.

15. Repeat step 9 to step 14 for frequencies up to 3.0 GHz in Table 2-44.

16. Replace the synthesized sweeper with a function generator.

17. Set the function generator amplitude to –4 dBm.

18. Set the function generator frequency to 100 kHz.

19. On the analyzer, press **FREQUENCY**, **Center Freq**, **100 kHz**.

20. Adjust the function generator amplitude to obtain the Channel B power meter reading recorded in Table 2-43 ± 0.1 dB for 100 kHz.

21. Record the current Channel B power reading in Table 2-44 as the current Channel B reading.

22. On the analyzer, press **Single** then **Peak Search (or Search).**

23. Record the analyzer Mkr1 Amplitude Reading in Table 2-44 as Mkr1 Amplitude.

24. Repeat step 18 to step 23 for frequencies between 100 kHz and 10 MHz.

25. Copy the Splitter Tracking Errors from Table 2-43 into Table 2-44.

26. Calculate the Flatness Error for each frequency in Table 2-44 as follows:

$$\text{Flatness Error} = \text{Mkr1 Amptd} - \text{Current Channel B} - \text{Splitter Tracking Error}$$

For example, if Mkr1 Amptd is –10.32 dBm, Current Channel B is –10.2 and Splitter Tracking Error is 0.18 dB, Flatness Error would be –0.30 dB.

27. Record the flatness error for 50 MHz below as the 50 MHz Ref Amptd:

    50 MHz Ref Amptd: __________

28. Calculate the setup change error (error due to changing the test setup from using a synthesized sweeper to using a function generator) as follows:

    a. Record the flatness error from Table 2-44 at 10 MHz using the function generator as $FlatError_{FG}$:

       $FlatError_{FG}$=__________ dB

    b. Record the flatness error from Table 2-44 at 10 MHz using the synthesized sweeper as $FlatError_{SS}$:

       $FlatError_{SS}$=__________ dB

    c. Subtract $FlatError_{FG}$ from $FlatError_{SS}$ and record the result as the Setup Change Error:

       $$\text{Setup Change Error} = \text{FlatError}_{FG} - \text{FlatError}_{SS}$$

       Setup Change Error =__________ dB

29. For frequencies less than 10 MHz calculate the Flatness Relative to 50 MHz for each frequency in Table 2-44 as follows:

$$\text{Flatness Relative to 50 MHz} = \text{Flatness Error} - \text{50 MHz Ref Amptd} - \text{Setup Change Error}$$

For example, if Flatness Error is –30.0 dB, 50 MHz Ref Amptd is +0.15 dB and Setup Change Error is –0.19 dB, Flatness Relative to 50 MHz would be –0.26 dB.

30. For frequencies 10 MHz and above, calculate the flatness relative to 50 MHz for each frequency in Table 2-44 as follows:

$$\text{Flatness Relative to 50 MHz} = \text{Flatness Error} - \text{50 MHz Ref Amptd}$$

For example, if Flatness Error is –0.30 dB and 50 MHz Ref Amptd is +0.15 dB, Flatness Relative to 50 MHz would be –0.45 dB.

Table 2-44 Frequency Response Worksheet, 100 kHz to 3.0 GHz

Frequency	Current Channel B Reading	Mkr1 Amptd	Splitter Tracking Error	Flatness Error	Flatness Relative to 50 MHz
100 kHz					
500 kHz					
1 MHz					
5 MHz					
10 MHz[a]					
10 MHz[b]					
20 MHz					
50 MHz					0 dB (Ref)
75 MHz					
175 MHz					
275 MHz					
375 MHz					
475 MHz					
575 MHz					
675 MHz					
775 MHz					
875 MHz					
975 MHz					
1075 MHz					
1175 MHz					
1275 MHz					
1375 MHz					
1525 MHz					
1525 MHz					
1725 MHz					
1925 MHz					
2125 MHz					

Table 2-44 Frequency Response Worksheet, 100 kHz to 3.0 GHz

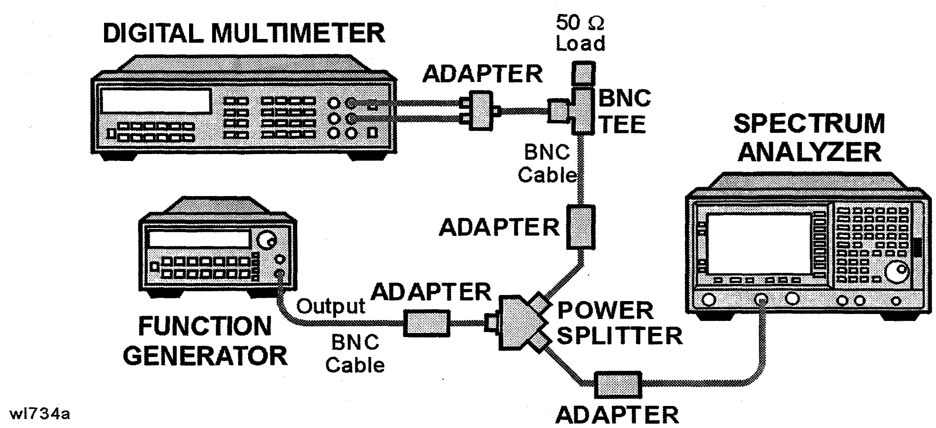
Frequency	Current Channel B Reading	Mkr1 Amptd	Splitter Tracking Error	Flatness Error	Flatness Relative to 50 MHz
2325 MHz					
2525 MHz					
2725 MHz					
2925 MHz					
3000 MHz					

a. This entry is for data taken with function generator as source.
b. This entry is for data taken with synthesized sweeper as source.

Measuring Frequency Response, ≤ 100 kHz

1. Connect the equipment as shown in Figure 2-28.

Figure 2-28 Frequency Response Test Setup, ≤ 100 kHz



2. Set the function generator controls as follows:

   FREQUENCY, 100 kHz
   AMPLITUDE, –4 dBm
   Amptd Increment, 0.05 dB

3. Set the DVM as follows:

Function	Synchronous AC Volts
Math	dBm
RES Register	50 Ω

Front/Rear Terminals	Front
Range	Auto

4. On the analyzer, press **FREQUENCY**, **100 kHz**.
5. Adjust the function generator amplitude until the DVM reading is –10 dBm ±0.1 dB.
6. Record the actual DVM reading in Table 2-45 as the DVM Amplitude reading.
7. On the analyzer, press **Peak Search (or Search), Marker, Delta.**
8. Set the analyzer center frequency to the next frequency listed in Table 2-45.
9. Set the function generator frequency to the next frequency listed in Table 2-45.
10. On the analyzer, press **Peak Search (or Search).**
11. Adjust the function generator amplitude until the ΔMkr1 amplitude reads 0 dB ±0.05 dB.
12. Record the DVM reading in Table 2-45 as the DVM Amplitude reading.
13. Repeat step 8 through step 12 for each frequency setting listed in Table 2-45.
14. For each of the frequencies in Table 2-45, subtract the DVM amplitude from the DVM amplitude at 100 kHz recorded in step 6. Record the result as the response relative to 100 kHz in Table 2-45.
15. From Table 2-44, note the flatness relative to 50 MHz for the 100 kHz frequency. Record this below as the 100 kHz Error Relative to 50 MHz:

    100 kHz Error Relative to 50 MHz =__________ dB
16. Add the 100 kHz error relative to 50 MHz that was recorded in step 15 above to each of the response relative to 100 kHz entries in Table 2-45. Record the results as the response relative to 50 MHz in Table 2-45.

Table 2-45 Frequency Response Worksheet, ≤ 100 kHz

Frequency	DVM Amplitude	Response Relative to 100 kHz	Response Relative to 50 MHz
100 kHz		0 dB (Ref)	
75 kHz			
50 kHz			

Table 2-45 Frequency Response Worksheet, ≤ 100 kHz

Frequency	DVM Amplitude	Response Relative to 100 kHz	Response Relative to 50 MHz
20 kHz			
9 kHz			

Test Results

Perform the following steps to verify the frequency response of the analyzer.

1. Enter the most positive number from the flatness relative to 50 MHz column of Table 2-44:

   ___________ dB

2. Enter the most positive number from the response relative to 50 MHz column of Table 2-45:

   ___________ dB

3. Record the more positive of numbers from step 1 and step 2 in Table 2-46 as the maximum response for band 0.
4. Enter the most negative number from the flatness relative to 50 MHz column of Table 2-44:

   ___________ dB

5. Enter the most negative number from the response relative to 50 MHz column of Table 2-45:

   ___________ dB

6. Record the most negative of numbers from step 4 and step 5 in Table 2-46 as the minimum response for band 0.
7. Subtract the minimum response for band 0 from the maximum response for band 0 and record the result as the peak-to-peak response for band 0 in Table 2-46.

Table 2-46 Frequency Response Results

Band	Maximum Response		Minimum Response		Peak-to-peak Response	
	dBm	TR Entry	dBm	TR Entry	dBm	TR Entry
0		1		2		3

23. Frequency Response, HP E4404B, E4405B, E4407B and E4408B

This test measures the amplitude error of the analyzer as a function of frequency. To measure frequencies of 100 kHz and above, the output of a source is fed through a power splitter to a power sensor and the analyzer. The power level of the source is adjusted at 50 MHz to place the displayed signal at the center horizontal graticule line of the analyzer. The power meter is then set to measure dB relative to the power at 50 MHz. At each new source frequency and spectrum analyzer center frequency, the power level of the source is adjusted to place the signal at the center horizontal graticule line. The power meter displays the inverse of the frequency response relative to 50 MHz.

To measure frequencies below 100 kHz, a DVM with a 50Ω load replaces the power sensor and a function generator is used as the source.

For improved amplitude accuracy below 3 GHz, the power splitter is characterized using a specially-calibrated power sensor (the "reference" sensor) connected to one power splitter output port. The other power splitter output port connects to the "buried" sensor; it is not removed from the power splitter. Once the characterization is done, the reference sensor is removed and replaced by the analyzer.

This procedure does not test frequency response with the optional preamplifier (Option 1DS) turned on. If the analyzer is equipped with Option 1DS, also perform the "Frequency Response, Preamp On" procedure.

The related adjustment for this performance test is "Frequency Response."

Equipment Required

Synthesized sweeper
Function generator
Power meter
RF Power sensor (*2 required*)
Microwave power sensor
Microwave power splitter
Digital multimeter
Adapter, APC 3.5 (f) to APC 3.5 (f)
Adapter, Type-N (m) to Type-N (m)
Adapter, Type-N (m) to BNC (f)
Dual banana plug to BNC (f)
BNC Tee (BNC f,m,f)
Cable, BNC, 122-cm (48-in) (*2 required*)
Cable, Type-N, 183-cm (72-in)

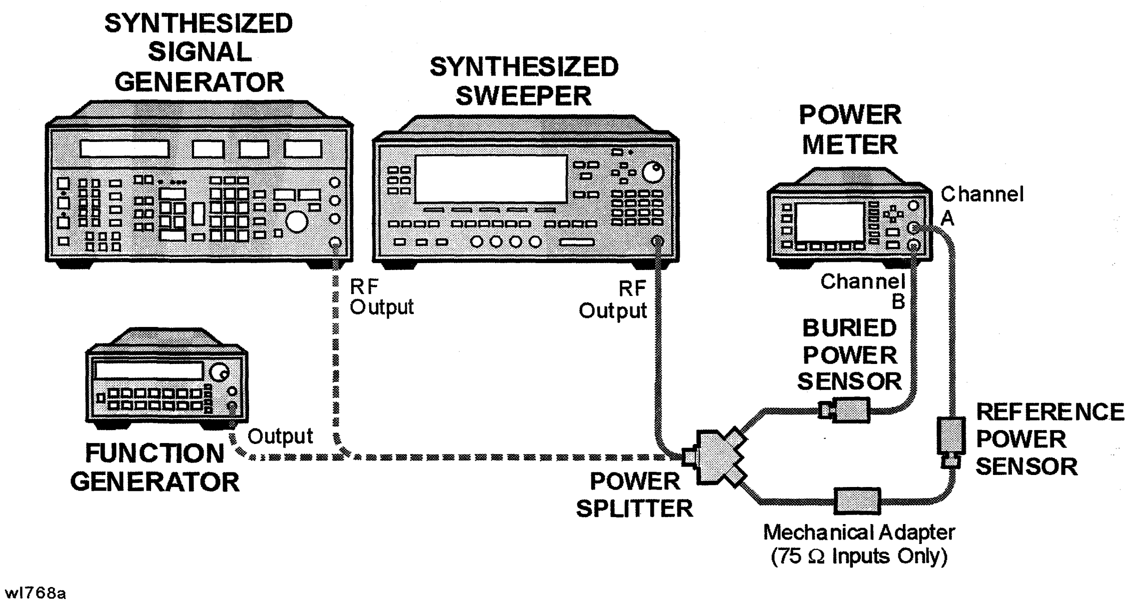
Cable, APC 3.5
Termination, 50 Ω, BNC (m)

Procedure

Part 1: Source/splitter characterization

1. Connect the HP 8482A to Channel A of the power meter. This will be the "reference" sensor. Connect the other HP 8482A to Channel B of the power meter. This will be the "buried" sensor. Refer to Figure 2-29.

Figure 2-29 Source/splitter characterization setup



2. Zero and calibrate both power sensors.
3. On the power meter, set the Channel A calibration factor to the calibration factor of the reference sensor for 100 kHz.
4. On the power meter, set the Channel B calibration factor to 100%. Do not change this calibration factor during this test.
5. Connect the equipment as shown in Figure 2-29. Use the function generator as the source.
6. Set the source frequency to 100 kHz and amplitude to –4 dBm.
7. Adjust the source amplitude to obtain a Channel A power meter reading of –10 dBm ±0.01 dB.
8. Record the source amplitude setting, and both the Channel A and Channel B power meter readings in Table 2-47.

9. Tune the source to the next frequency in Table 2-47.
10. On the power meter, set the Channel A calibration factor to the calibration factor of the reference sensor for the current source frequency.
11. Adjust the source amplitude to obtain a Channel A power meter reading of –10 dBm ±0.01 dB.
12. Record the source amplitude setting, and both the Channel A and Channel B power meter readings in Table 2-47.
13. Repeat step 9 to step 12 for frequencies up to 10 MHz.
14. Replace the function generator with the synthesized sweeper.
15. Set the synthesized sweeper CW frequency to 10 MHz and the amplitude to –4 dBm.
16. Adjust the synthesized sweeper power level to obtain a Channel A power meter reading of –10 dBm ± 0.1 dB.
17. Record the synthesized sweeper power level and both the Channel A and Channel B power meter readings in Table 2-47.
18. Repeat step 9 to step 12 for each remaining frequency in Table 2-47.
19. For each entry in Table 2-47, calculate the splitter tracking error as follows:

$$\text{Splitter Tracking Error} = \text{Channel A Power} - \text{Channel B Power}$$

For example, if Channel A Power is –10.05 dBm and Channel B Power is –10.23 dBm, the Splitter Tracking Error is +0.18 dB.

Table 2-47 Source/splitter characterization

Frequency	Power Meter Reading		Splitter Tracking Error	Source Power Setting
	Channel A	Channel B		
100 kHz				
500 kHz				
1 MHz				
5 MHz				
10 MHz[a]				
10 MHz[b]				
20 MHz				
50 MHz				

Table 2-47 Source/splitter characterization

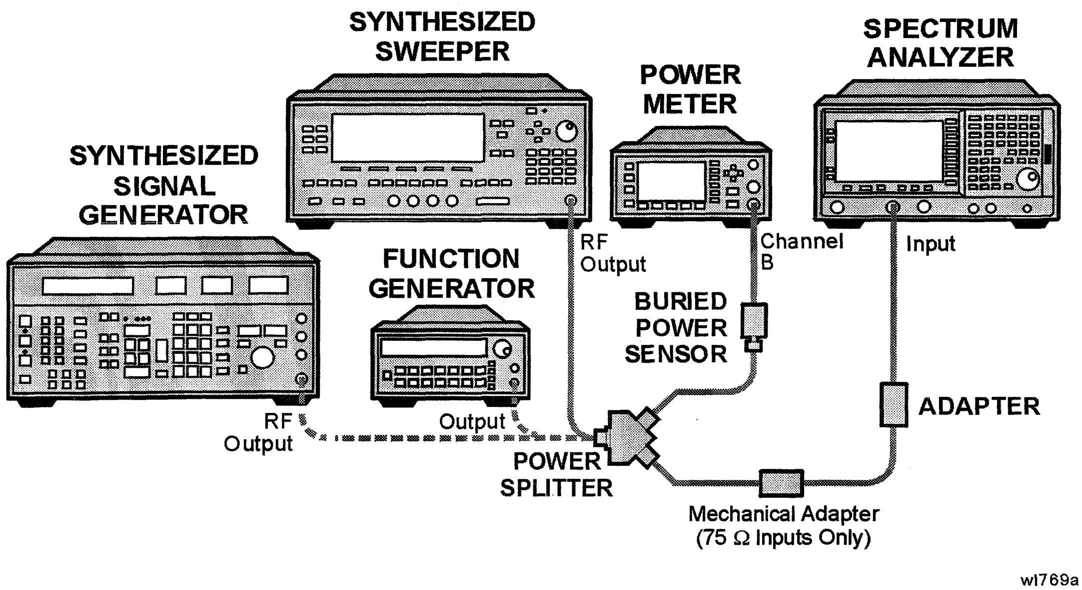
Frequency	Power Meter Reading		Splitter Tracking Error	Source Power Setting
	Channel A	Channel B		
75 MHz				
175 MHz				
275 MHz				
375 MHz				
475 MHz				
575 MHz				
675 MHz				
775 MHz				
875 MHz				
975 MHz				
1075 MHz				
1175 MHz				
1275 MHz				
1375 MHz				
1500 MHz				
1525 MHz				
1725 MHz				
1925 MHz				
2125 MHz				
2325 MHz				
2525 MHz				
2725 MHz				
2925 MHz				
3000 MHz				

a. This entry is for data taken with function generator as source.
b. This entry is for data taken with synthesized sweeper as source.

Measuring Frequency Response, 100 kHz to 3.0 GHz

1. Remove the reference sensor (Channel A sensor) from the power splitter. Connect the power splitter to the analyzer INPUT 50Ω using an adapter. Do not use a cable. Refer to Figure 2-30.

Figure 2-30 Frequency response test setup, 100 kHz to 3.0 GHz



2. Set the source frequency at 10 MHz.
3. Set the source POWER LEVEL to the value corresponding to the source power setting in Table 2-48 for the current source frequency (10 MHz).
4. Adjust the source POWER LEVEL to obtain the Channel B power meter reading recorded in Table 2-47 ±0.1 dB.
5. Adjust the synthesized signal generator amplitude for a marker amplitude reading of –14 dBm ±0.10 dB.
6. Preset the analyzer and wait for the preset routine to complete. Set the analyzer controls as follows:

   FREQUENCY, Center Freq, 10 MHz
   CF Step, 100 MHz
   SPAN, 20 kHz
   Input/Output (or Input), Coupling (DC) *(HP E4404B and E4405B)*
   AMPLITUDE, More, Int Preamp, (Off) *(Option 1DS only)*
   AMPLITUDE, Ref Level, –5 dBm
   Attenuation, 10 dB (Man)
   Scale/Div, 1 dB
   BW/Avg, Resolution BW, 3 kHz (Man)
   Video BW, 3 kHz (Man)

7. Record the current Channel B power reading in Table 2-48 as the current Channel B reading.
8. On the analyzer, press **Single**.
9. On the analyzer, press **Peak Search (or Search)**.
10. Record the Mkr1 amplitude reading in Table 2-48.
11. Set the source to the next frequency listed in Table 2-48.
12. Set the analyzer center frequency to the next frequency listed in Table 2-48.
13. Adjust the source POWER LEVEL to obtain the Channel B power meter reading recorded in Table 2-47 ±0.1 dB for the current frequency.
14. Record the current Channel B power reading in Table 2-48 as the current Channel B reading.
15. On the analyzer, press **Single** then **Peak Search (or Search)**.
16. Record the Mkr1 amplitude reading in Table 2-48.
17. Repeat step 9 to step 14 for each frequency in Table 2-48.
18. Replace the synthesized sweeper with a function generator.
19. Set the function generator amplitude to –4 dBm.
20. Set the function generator frequency to 100 kHz.
21. Set the analyzer center frequency to 100 kHz.
22. Adjust the function generator amplitude to obtain the Channel B power meter reading recorded in Table 2-47 ±0.1 dB for 100 kHz.
23. Record the current Channel B power reading in Table 2-48 as the current Channel B reading.
24. On the analyzer, press **Single** then **Peak Search (or Search)**.
25. Record the analyzer Mkr1 Amplitude Reading in Table 2-48 as Mkr1 amplitude.
26. Repeat step 18 to step 23 for frequencies between 100 kHz and 10 MHz.
27. Copy the splitter tracking errors from Table 2-47 into Table 2-48.
28. Calculate the flatness error for each frequency in Table 2-48 as follows:

$$\text{Flatness Error} = \text{Mkr1 Amptd} - \text{Current Channel B} - \text{Splitter Tracking Error}$$

For example, if Mkr1 Amptd is –10.32 dBm, Current Channel B is –10.2 and Splitter Tracking Error is 0.18 dB, Flatness Error would be –0.30 dB.

29.Record the flatness error for 50 MHz below as the 50 MHz Ref Amptd:

50 MHz Ref Amptd: _________

30.Calculate the setup change error (error due to changing the test setup from using a synthesized sweeper to using a function generator) as follows:

a. Record the flatness error from Table 2-48 at 10 MHz using the function generator as $FlatError_{FG}$:

$FlatError_{FG}$=_________ dB

b. Record the flatness error from Table 2-48 at 10 MHz using the synthesized sweeper as $FlatError_{SS}$:

$FlatError_{SS}$=_________ dB

c. Subtract $FlatError_{FG}$ from $FlatError_{SS}$ and record the result as the setup change error:

$$\text{Setup Change Error} = \text{FlatErrorFG} - \text{FlatErrorSS}$$

Setup Change Error =_________ dB

31.Calculate the flatness relative to 50 MHz for each frequency in Table 2-48 as follows:

$$\text{Flatness Relative to 50 MHz} = \text{Flatness Error} - \text{50 MHz Ref Amptd} - \text{Setup Change Error}$$

For example, if Flatness Error is –30.0 dB, 50 MHz Ref Amptd is +0.15 dB and Setup Change Error is –0.19 dB, Flatness Relative to 50 MHz would be –0.26 dB.

Table 2-48 Frequency response worksheet, 100 kHz to 3.0 GHz

Frequency	Current Channel B Reading	Mkr1 Amptd	Splitter Tracking Error	Flatness Error	Flatness Relative to 50 MHz
100 kHz					
500 kHz					
1 MHz					
5 MHz					
10 MHz[a]					
10 MHz[b]					
20 MHz					

Table 2-48 Frequency response worksheet, 100 kHz to 3.0 GHz

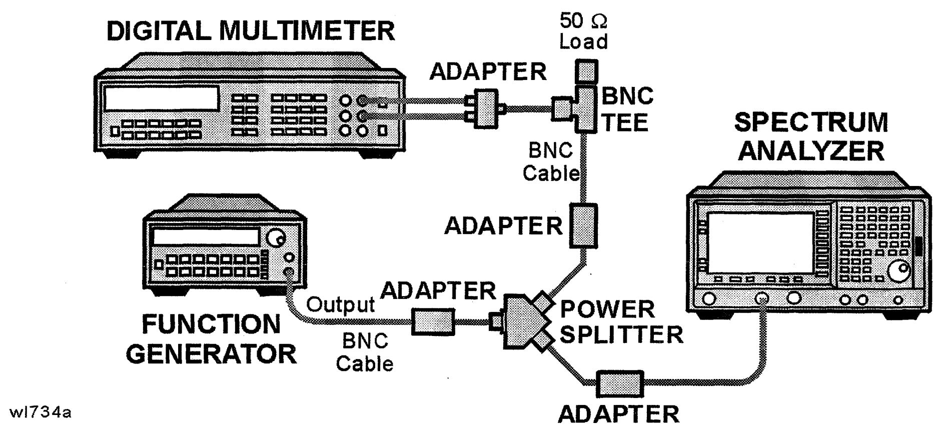
Frequency	Current Channel B Reading	Mkr1 Amptd	Splitter Tracking Error	Flatness Error	Flatness Relative to 50 MHz
50 MHz					0 dB (Ref)
75 MHz					
175 MHz					
275 MHz					
375 MHz					
475 MHz					
575 MHz					
675 MHz					
775 MHz					
875 MHz					
975 MHz					
1075 MHz					
1175 MHz					
1275 MHz					
1375 MHz					
1525 MHz					
1525 MHz					
1725 MHz					
1925 MHz					
2125 MHz					
2325 MHz					
2525 MHz					
2725 MHz					
2925 MHz					
3000 MHz					

a. This entry is for data taken with function generator as source.
b. This entry is for data taken with synthesized sweeper as source.

Measuring Frequency Response, ≤ 100 kHz

1. Connect the equipment as shown in Figure 2-31.

Figure 2-31 Frequency Response Test Setup, ≤ 100 kHz



2. Set the frequency synthesizer controls as follows:

   FREQUENCY, 100 kHz
   AMPLITUDE, –4 dBm
   Amptd Increment, 0.05 dB

3. Set the DVM as follows:

Function	Synchronous AC Volts
Math	dBm
RES Register	50 Ω
Front/Rear Terminals	Front
Range	Auto

4. On the analyzer, press the following keys:

   FREQUENCY, 100 kHz

5. Adjust the function generator amplitude until the DVM reading is –10 dBm ±0.1 dB.
6. Record the actual DVM reading in Table 2-49 as the DVM amplitude reading.
7. On the analyzer, press **Peak Search (or Search), Marker, Delta.**
8. Set the analyzer center frequency to the next frequency listed in Table 2-49.

9. Set the function generator frequency to the next frequency listed in Table 2-49.

10. On the analyzer, press **Peak Search (or Search).**

11. Adjust the function generator amplitude until the ΔMkr1 amplitude reads 0 dB ±0.05 dB.

12. Record the DVM reading in Table 2-49 as the DVM amplitude reading.

13. Repeat step 8 through step 12 for each frequency setting listed in Table 2-49.

14. For each of the frequencies in Table 2-49, subtract the DVM amplitude from the DVM amplitude at 100 kHz (recorded in step 6). Record the result as the response relative to 100 kHz in Table 2-49.

15. From Table 2-48, note the flatness relative to 50 MHz for the 100 kHz frequency. Record this below as the 100 kHz error relative to 50 MHz:

    100 kHz Error Relative to 50 MHz __________ dB

16. Add the 100 kHz error relative to 50 MHz that was recorded in step 15 above to each of the response relative to 100 kHz entries in Table 2-49. Record the results as the Response Relative to 50 MHz in Table 2-49.

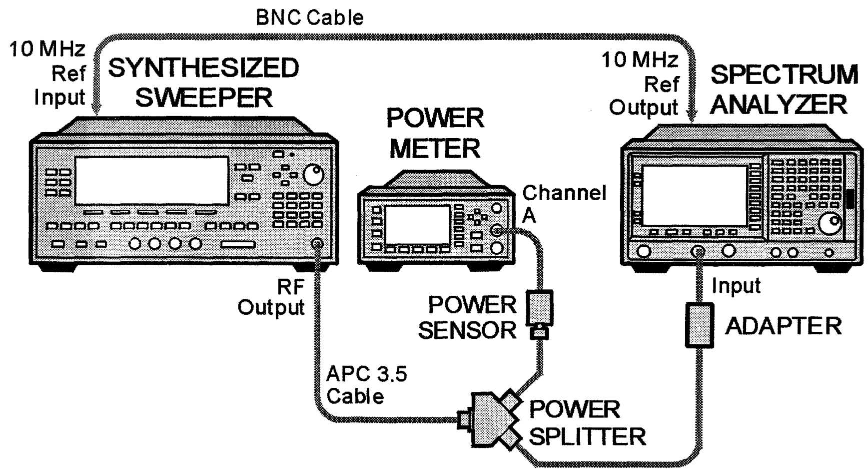
Table 2-49 **Frequency response worksheet, ≤ 100 kHz**

Frequency	DVM Amplitude	Response Relative to 100 kHz	Response Relative to 50 MHz
100 kHz		0 dB (Ref)	
75 kHz			
50 kHz			
20 kHz			
9 kHz			

Measuring Frequency Response, > 3 GHz

1. Replace the Channel B power sensor with the microwave power sensor. Zero and calibrate the power sensor and power meter in log mode. Enter the 50 MHz calibration factor of the power sensor into the power meter.
2. Connect the equipment as shown in Figure 2-32.

Figure 2-32 Frequency Response Test Setup, > 3 GHz



3. On the analyzer, press **FREQUENCY, 50 MHz, CF Step 200 MHz**.
4. Set the synthesized sweeper CW frequency to 50 MHz and FREQ STEP to 200 MHz.
5. Adjust the synthesized sweeper POWER LEVEL for a power meter reading of −10 dBm ±0.05 dB.
6. On the analyzer, press **Peak Search (or Search)**.
7. On the analyzer, press **Marker, Delta**.
8. Activate the dB relative mode on the power meter. Power meter readings will now read out relative to the power meter reading at 50 MHz.
9. Set the synthesized sweeper CW frequency to the next frequency listed in Table 2-50.
10. Enter the appropriate power sensor calibration factor into the power meter.
11. On the analyzer, press **Peak Search (or Search), Amplitude, Presel Center**.
12. Adjust the synthesized sweeper POWER LEVEL until the analyzer ΔMkr1 amplitude reading is 0 dB ±0.05 dB.

13.Record the negative of the power meter reading in Table 2-50 as the Flatness Relative to 50 MHz.

14.Repeat step 9 to step 13 for frequencies up to 6.7 GHz in Table 2-50. On the analyzer, pressing **FREQUENCY,** ↑ will allow you to step through most of the frequencies. Similarly, on the synthesized sweeper, pressing **CW,** ↑ will allow you to step through most of the frequencies.

If using the HP E4404B, proceed to "Test Results".

15.Set the analyzer center frequency by manually pressing **FREQUENCY, CF Step, 400 MHz.**

16.Set the synthesized sweeper FREQ STEP to 400 MHz.

17.Repeat step 9 to step 13 for frequencies up to 13.2 GHz in Table 2-50.

If using the HP E4404B or HP E4405B, proceed to "Test Results".

18.Repeat step 9 to step 13 for the remaining frequencies in Table 2-50.

Table 2-50 Frequency response worksheet, > 3 GHz

Frequency, GHz	Flatness Relative to 50 MHz, dB
3.05 GHz	
3.1 GHz	
3.3 GHz	
3.5 GHz	
3.7 GHz	
3.9 GHz	
4.1 GHz	
4.3 GHz	
4.5 GHz	
4.7 GHz	
4.9 GHz	
5.1 GHz	
5.3 GHz	
5.5 GHz	
5.7 GHz	
5.9 GHz	

Table 2-50 Frequency response worksheet, > 3 GHz

Frequency, GHz	Flatness Relative to 50 MHz, dB
6.1 GHz	
6.3 GHz	
6.5 GHz	
6.7 GHz	
End of procedure for E4404B	
6.8 GHz	
7.0 GHz	
7.4 GHz	
7.8 GHz	
8.2 GHz	
8.6 GHz	
9.0 GHz	
9.4 GHz	
9.8 GHz	
10.2 GHz	
10.6 GHz	
11.0 GHz	
11.4 GHz	
11.8 GHz	
12.2 GHz	
12.6 GHz	
12.8 GHz	
13.2 GHz	
End of procedure for E4405B	
13.3 GHz	
13.7 GHz	
14.1 GHz	
14.5 GHz	
14.9 GHz	

Table 2-50 Frequency response worksheet, > 3 GHz

Frequency, GHz	Flatness Relative to 50 MHz, dB
15.3 GHz	
15.7 GHz	
16.1 GHz	
16.5 GHz	
16.9 GHz	
17.3 GHz	
17.7 GHz	
18.1 GHz	
18.5 GHz	
18.9 GHz	
19.3 GHz	
19.7 GHz	
20.1 GHz	
20.5 GHz	
20.9 GHz	
21.3 GHz	
21.7 GHz	
22.1 GHz	
22.5 GHz	
22.9 GHz	
23.3 GHz	
23.7 GHz	
24.1 GHz	
24.5 GHz	
24.9 GHz	
25.1 GHz	

Table 2-50 Frequency response worksheet, > 3 GHz

Frequency, GHz	Flatness Relative to 50 MHz, dB
25.3 GHz	
25.7 GHz	
26.1 GHz	
26.5 GHz	

Test Results

Perform the following steps to verify the frequency response of the analyzer:

1. Enter the most positive number from the flatness relative to 50 MHz column of Table 2-48:

   ___________ dB

2. Enter the most positive number from the response relative to 50 MHz column of Table 2-49:

   ___________ dB

3. Record the more positive of numbers from step 1 and step 2 as the maximum response for band 0 in Table 2-51.
4. Enter the most negative number from the flatness relative to 50 MHz column of Table 2-48:

   ___________ dB

5. Enter the most negative number from the response relative to 50 MHz column of Table 2-49:

   ___________ dB

6. Record the more negative of numbers from step 4 and step 5 as the minimum response for band 0 in Table 2-51.
7. Subtract the minimum response for band 0 from the maximum response for band 0 and record the result as the peak-to-peak response to band 0 in Table 2-51.
8. Record the most positive number from the flatness relative to 50 MHz column of Table 2-50 for frequencies from 3.05 GHz to 6.7 GHz as the maximum response for band 1 in Table 2-51.
9. Record the most negative number from the flatness relative to 50 MHz column of Table 2-50 for frequencies from 3.05 GHz to 6.7 GHz as the maximum response for band 1 in Table 2-51.

10.Subtract the minimum response for band 1 from the maximum response for band 1 and record the result as the peak-to-peak response to band 1 in Table 2-51.

End of procedure for HP E4404B.

11.Record the most positive number from the flatness relative to 50 MHz column of Table 2-50 for frequencies from 6.8 GHz to 13.2 GHz as the maximum response for band 2 in Table 2-51.

12.Record the most negative number from the flatness relative to 50 MHz column of Table 2-50 for frequencies from 6.8 GHz to 13.2 GHz as the maximum response for band 2 in Table 2-51.

13.Subtract the minimum response for band 2 from the maximum response for band 2 and record the result as the peak-to-peak response to band 2 in Table 2-51.

End of procedure for HP E4405B.

14.Record the most positive number from the flatness relative to 50 MHz column of Table 2-50 for frequencies from 13.3 GHz to 24.9 GHz as the maximum response for band 3 in Table 2-51.

15.Record the most negative number from the flatness relative to 50 MHz column of Table 2-50 for frequencies from 13.3 GHz to 24.9 GHz as the maximum response for band 3 in Table 2-51.

16.Subtract the minimum response for band 3 from the maximum response for band 3 and record the result as the peak-to-peak response to band 3 in Table 2-51.

17.Record the most positive number from the flatness relative to 50 MHz column of Table 2-50 for frequencies from 25.1 GHz to 26.5 GHz as the maximum response for band 4 in Table 2-51.

18.Record the most negative number from the flatness relative to 50 MHz column of Table 2-50 for frequencies from 25.1 GHz to 26.5 GHz as the maximum response for band 4 in Table 2-51.

19.Subtract the minimum response for band 4 from the maximum response for band 4 and record the result as the peak-to-peak response to band 4 in Table 2-51.

Table 2-51 Frequency Response Results

Band	Maximum Response		Minimum Response		Peak-to-peak Response	
	dBm	TR Entry	dBm	TR Entry	dBm	TR Entry
0		1		2		3
1		4		5		6
2		7		8		9
3		10		11		12
4		13		14		15

24. Frequency Response (Preamp On): HP E4401B

This test measures the amplitude error of the spectrum analyzer as a function of frequency. The output of a source is fed through a power splitter to a power sensor and the spectrum analyzer. The power level of the source is adjusted at 50 MHz to place the displayed signal at approximately –32 dBm. At each new source frequency and spectrum analyzer center frequency, the power level of the source is adjusted to place the signal at approximately –32 dBm.

For improved amplitude accuracy the power splitter is characterized using a specially-calibrated power sensor (the “reference” sensor) connected to one power splitter output port. The other power splitter output port connects to the “buried” sensor; it is not removed from the power splitter. Once the characterization is done, the reference sensor is removed and replaced by the spectrum analyzer.

Spectrum analyzers with 75 Ω inputs are tested only down to 1 MHz.

This procedure only tests frequency response with the optional preamplifier (Option 1DS) turned on. Perform the “Frequency Response” procedure to test all other frequency response specifications.

The related adjustment for this performance test is “Frequency Response.”

Equipment Required

Synthesized signal generator
Power meter
RF power sensor (*2 required for 50 Ω inputs*)
20 dB fixed attenuator
Power splitter
Cable, Type-N (m), 183 cm
Cable, BNC, 120 cm
Adapter, Type-N (m) to Type-N (m)
Adapter, Type-N (m) to BNC (f)

Additional Equipment for 75 Ω Input

Power sensor, 75 Ω
Adapter, Type-N (m) 50 Ω to Type-N (f) 75 Ω, mechanical
Adapter, Type-N (m) to BNC (m), 75 Ω

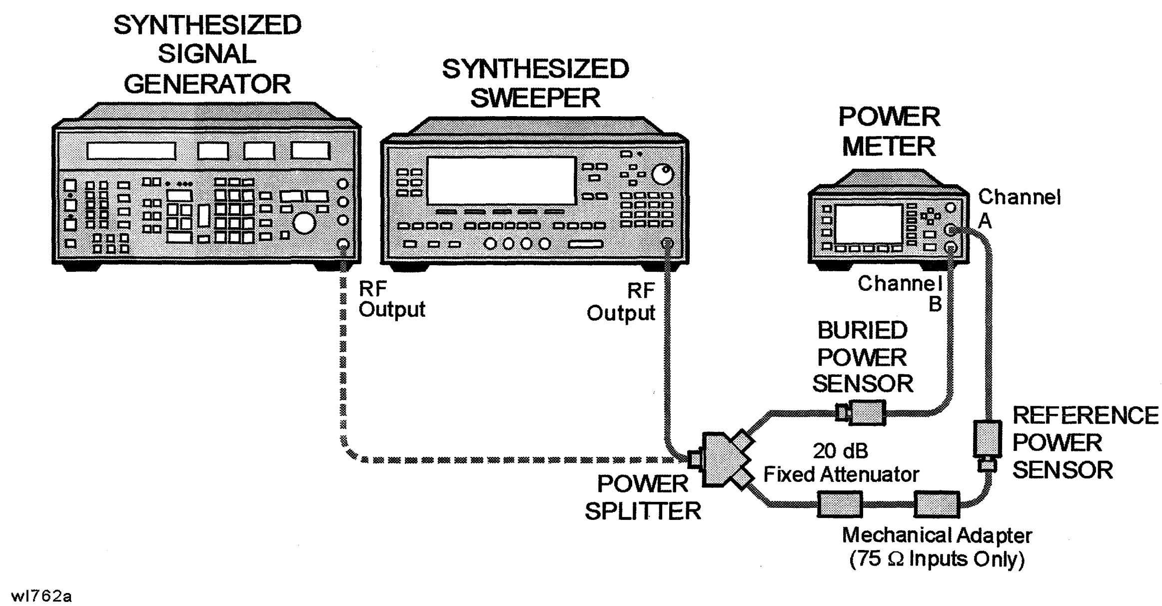
Procedure

Source/Splitter Characterization

1. Connect one RF power sensor to Channel A of the power meter. This will be the “reference” sensor. Connect the other RF power sensor to Channel B of the power meter. This will be the “buried” sensor. Refer to Figure 2-33.

   75 Ω inputs: Connect the 75 Ω power sensor to Channel A of the power meter. This will be the “reference” sensor.

Figure 2-33 Source/Splitter Characterization Setup



CAUTION Use only 75 Ω cables, connectors, or adapters on instruments with 75 Ω connectors, or damage to the connectors will occur.

2. Zero and calibrate both power sensors.
3. On the power meter, set the Channel A calibration factor to the calibration factor of the reference sensor at 100 kHz.

   75 Ω inputs: Set the Channel A calibration factor to the calibration factor of the reference sensor at 1 MHz.

4. On the power meter, seth the Channel B calibration factor to 100%. Do not change this calibration factor during this test.
5. Connect the equipment as shown in. Use the synthesized signal generator as the source. Note that the reference sensor connects to the 20 dB fixed attenuator.

75 Ω inputs: Connect the reference sensor to the power splitter using the mechanical adapter.

6. Set the source frequency to 100 kHz and amplitude to +6 dBm.

   75 Ω inputs: Set the source frequency to 1 MHz and amplitude to +6 dBm.

7. Adjust the source amplitude to obtain a Channel A power meter reading of –20 dBm ±0.1 dB.

8. Record the Channel A and Channel B power meter readings in Table 2-52.

9. Tune the source to the next frequency in Table 2-52.

10. On the power meter, set the Channel A calibration factor to the calibration factor of the reference sensor for the current source frequency.

11. Adjust the source amplitude to obtain a Channel A power meter reading of –20 dBm ±0.1 dB.

12. Record the Channel A and Channel B power meter readings in Table 2-52.

13. Repeat step 9 to step 12 for each frequency in Table 2-52.

14. For each entry in Table 2-52, calculate the Splitter Tracking Error as follows:

    $$\text{Splitter Tracking Error} = \text{Channel A Power} - \text{Channel B Power}$$

    For example, if Channel A Power is –20.3 dBm and Channel B power is –0.23 dBm, the splitter tracking error is –20.07 dB.

Table 2-52 Source/Splitter Characterization

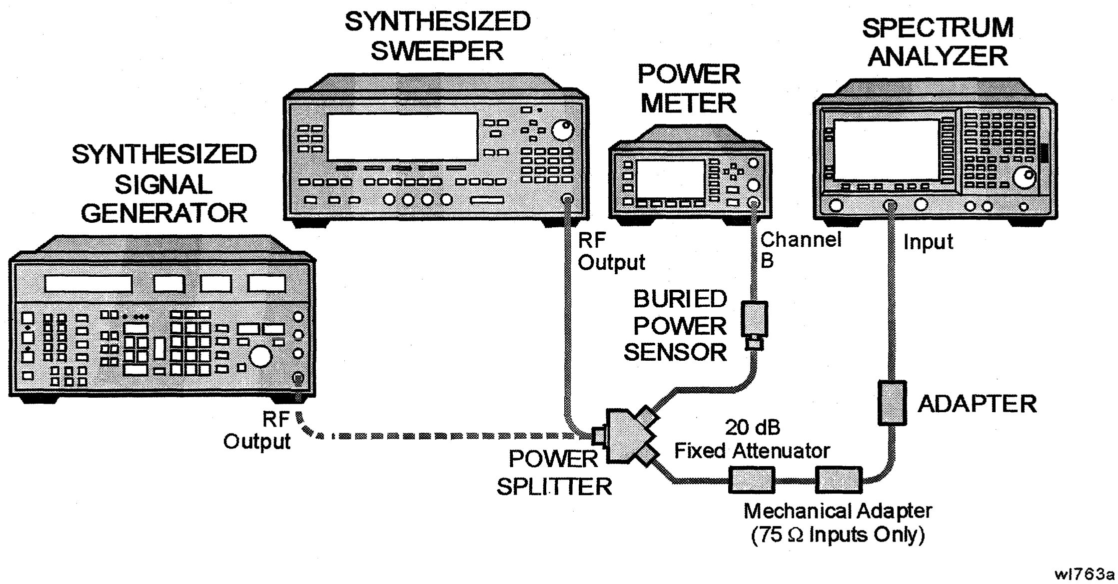
Frequency	Power Meter Reading		Splitter Tracking Error
	Channel A	Channel B	
100 kHz[a]			
500 kHz[a]			
1 MHz			
5 MHz			
10 MHz			
20 MHz			
50 MHz			
75 MHz			
175 MHz			
275 MHz			
375 MHz			
475 MHz			
575 MHz			
675 MHz			
775 MHz			
875 MHz			
975 MHz			
1075 MHz			
1175 MHz			
1275 MHz			
1375 MHz			
1500 MHz			

a. These values do not apply to analyzers with 75 Ω inputs (Option 1DP).

Measuring Frequency Response, Preamp On

1. Remove the reference sensor (Channel A sensor) from the 20 dB fixed attenuator. Connect the 20 dB fixed attenuator to the analyzer INPUT 50 Ω using an adapter. Do not use a cable. Refer to Figure 2-34.

Figure 2-34 Frequency Response Test Setup, Preamp On



75 Ω inputs: Connect the 20 dB fixed attenuator to the analyzer INPUT 75 Ω using a mechanical adapter and a 75 Ω, Type-N(m) to BNC(m) adapter.

2. Set the source frequency to 100 kHz:

   75 Ω inputs: Set the source frequency to 1 MHz.

3. Set the source AMPLITUDE to –6 dBm.
4. Preset the analyzer and wait for the preset routine to complete. Set the analyzer controls as follows:

   FREQUENCY, Center Freq, 100 kHz *(50 Ω Input)*
   FREQUENCY, Center Freq, 1 MHz *(75 Ω Input)*
   CF Step, 100 MHz
   SPAN, 20 kHz
   AMPLITUDE, More, Int Preamp (On)
   AMPLITUDE, More, Y Axis Units (or Amptd Units), dBm
   AMPLITUDE, Ref Level, –30 dBm
   Attenuation, 0 dB (Man)
   Scale/Div, 2 dB
   BW/Avg, Resolution BW, 3 kHz (Man)
   Video BW, 3 kHz (Man)

5. On the analyzer, press **Peak Search (or Search).**
6. Adjust the source AMPLITUDE to obtain a marker amplitude reading on the analyzer of –32.00 dBm ±0.2 dB.
7. Record the current Channel B power reading in Table 2-53 as the Current Channel B reading.
8. Record the Mkr1 amplitude reading in Table 2-53.
9. Set the source to the next frequency listed in Table 2-53.
10. Set the analyzer center frequency to the next frequency listed in Table 2-53.
11. On the analyzer, press **Peak Search (or Search).**
12. Adjust the source AMPLITUDE to obtain a marker amplitude reading on the analyzer of –32.00 dBm ±0.2 dB.
13. Record the current Channel B power reading in Table 2-53 as the Current Channel B reading.
14. Record the Mkr1 amplitude reading in Table 2-53 as Mkr1 Amptd.
15. Repeat step 9 to step 14 for each frequency in Table 2-53.
16. Copy the splitter tracking errors from Table 2-52 into Table 2-53.
17. Calculate the Flatness Error for each frequency in Table 2-53 as follows:

$$\text{Flatness Error} = \text{Mkr1 Amptd} - \text{Current Channel B} - \text{Splitter Tracking Error}$$

For example, if Mkr1 Amptd is –33.32 dBm, Current Channel B is –12.4 dBm, and Splitter Tracking Error is –20.07 dB, Flatness Error would be –0.85 dB.

18. Record the Flatness Error for 50 MHz below as the 50 MHz Ref Amptd:

    50 MHz Ref Amptd __________

19. Calculate the Flatness Relative to 50 MHz for each frequency in Table 2-53 as follows:

$$\text{Flatness Relative to 50 MHz} = \text{Flatness Error} - \text{50 MHz Ref Amptd}$$

For example, if Flatness Error is –0.30 dB and 50 MHz Ref Amptd is +0.15 dB, Flatness Relative to 50 MHz would be –0.45 dB.

Table 2-53 Frequency Response Worksheet, Preamp On

Frequency	Current Channel B Reading	Mkr1 Amptd	Splitter Tracking Error	Flatness Error	Flatness Relative to 50 MHz
100 kHz[a]					
500 kHz[a]					
1 MHz					
5 MHz					
10 MHz					
20 MHz					
50 MHz					0 dB (Ref)
75 MHz					
175 MHz					
275 MHz					
375 MHz					
475 MHz					
575 MHz					
675 MHz					
775 MHz					
875 MHz					
975 MHz					
1075 MHz					
1175 MHz					
1275 MHz					
1375 MHz					
1500 MHz					

a. These values do not apply to analyzers with 75 Ω inputs (Option 1DP).

Test Results

1. Record the most positive number from the Flatness Relative to 50 MHz column of Table 2-53 as the Maximum Response in Table 2-54 and as TR Entry 1 in the performance verification test record.
2. Record the most negative number from the Flatness Relative to 50 MHz column of Table 2-53 as the Minimum Response in Table 2-54 and as TR Entry 2 in the performance verification test record.
3. Subtract the Minimum Response value in Table 2-54 from the Maximum Response value in Table 2-54 and record the result as the Peak-to-Peak Response in Table 2-54 and as TR Entry 3 in the performance verification test record.

Table 2-54 Frequency Response Results

Maximum Response		Minimum Response		Peak-to-peak Response	
dBm	TR Entry	dBm	TR Entry	dBm	TR Entry
	1		2		3

25. Frequency Response (Preamp On): HP E4402B

This test measures the amplitude error of the spectrum analyzer as a function of frequency. The output of a source is fed through a power splitter to a power sensor and the spectrum analyzer. The power level of the source is adjusted at 50 MHz to place the displayed signal at approximately –32 dBm. At each new source frequency and spectrum analyzer center frequency, the power level of the source is adjusted to place the signal at approximately –32 dBm.

For improved amplitude accuracy the power splitter is characterized using a specially-calibrated power sensor (the “reference” sensor) connected to one power splitter output port. The other power splitter output port connects to the “buried” sensor; it is not removed from the power splitter. Once the characterization is done, the reference sensor is removed and replaced by the spectrum analyzer.

This procedure only tests frequency response with the optional preamplifier (Option 1DS) turned on. Perform the “Frequency Response” procedure to test all other frequency response specifications.

The related adjustment for this performance test is “Frequency Response.”

Equipment Required

Function generator
Synthesized sweeper
Power meter
RF power sensor (*2 required*)
20 dB fixed attenuator
Power splitter
Cable, Type-N (m), 183 cm
Cable, BNC, 120 cm
Adapter, Type-N (m) to Type-N (m)
Adapter, Type-N (m) to BNC (f)

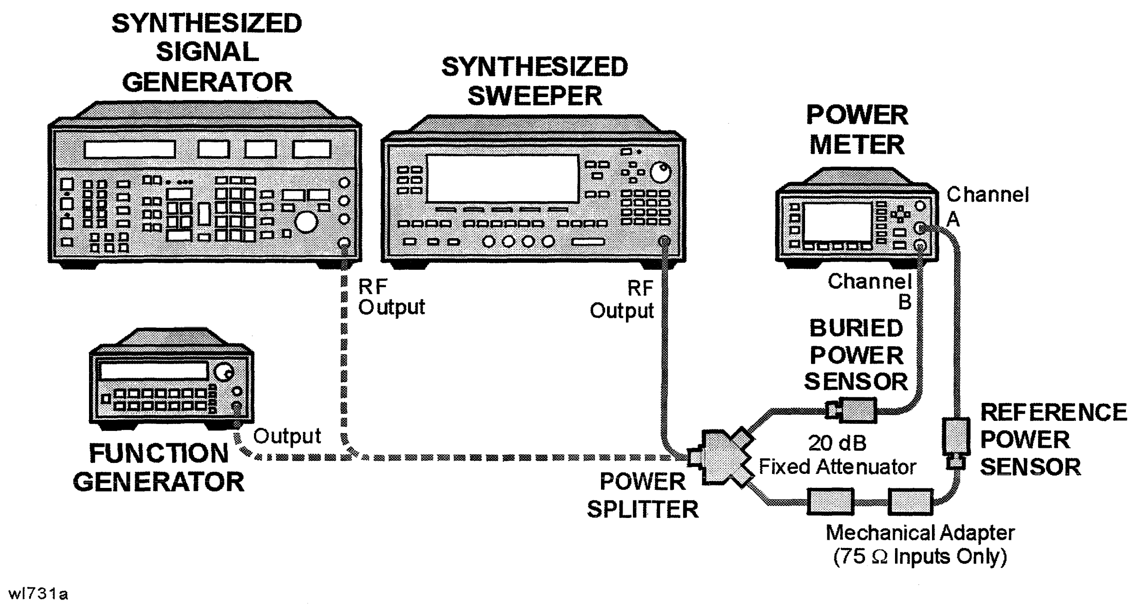
Procedure

Source/Splitter Characterization

1. Connect one RF power sensor to Channel A of the power meter. This will be the “reference” sensor. Connect the other RF power sensor to Channel B of the power meter. This will be the “buried” sensor.
2. Zero and calibrate both power sensors.

3. On the power meter, set the Channel A calibration factor to the calibration factor of the reference sensor at 1 MHz.
4. On the power meter, set the Channel B calibration factor to 100%. Do not change this calibration factor during this test.
5. Connect the equipment as shown in Figure 2-35. Use the function generator as the source. Note that the reference sensor connects to the 20 dB fixed attenuator.

Figure 2-35 Source/Splitter Characterization Setup



6. Set the function generator frequency to 1 MHz and amplitude to 450 mV rms (approximately +6 dBm).
7. Adjust the source amplitude to obtain a Channel A power meter reading of –20 dBm ±0.1 dB.
8. Record the Channel A and Channel B power meter readings in Table 2-55.
9. Tune the source to the next frequency in Table 2-55.
10. On the power meter, set the Channel A calibration factor to the calibration factor of the reference sensor for the current source frequency.
11. Adjust the source amplitude to obtain a Channel A power meter reading of –20 dBm ±0.1 dB.
12. Record the Channel A and Channel B power meter readings in Table 2-55.
13. Repeat step 9 to step 12 for frequencies up to 10 MHz.

14. Replace the function generator with the synthesized sweeper.
15. Set the synthesized sweeper CW frequency to 10 MHz and the amplitude to +6 dBm.
16. Adjust the synthesized sweeper power level to obtain a Channel A power meter reading of –20 dBm ± 0.1 dB.
17. Record the synthesized sweeper power level and both the Channel A and Channel B power meter readings in Table 2-55.
18. Repeat step 9 to step 12 for each remaining frequency in Table 2-55.
19. For each entry in Table 2-55, calculate the Splitter Tracking Error as follows:

    Splitter Tracking Error = Channel A Power – Channel B Power

    For example, if Channel A Power is –20.3 dBm and Channel B power is –0.23 dBm, the splitter tracking error is –20.07 dB.

Table 2-55 Source/Splitter Characterization

Frequency	Power Meter Reading		Splitter Tracking Error
	Channel A	Channel B	
1 MHz			
5 MHz			
10 MHz[a]			
10 MHz[b]			
20 MHz			
50 MHz			
75 MHz			
175 MHz			
275 MHz			
375 MHz			
475 MHz			
575 MHz			
675 MHz			
775 MHz			
875 MHz			
975 MHz			

Table 2-55 **Source/Splitter Characterization**

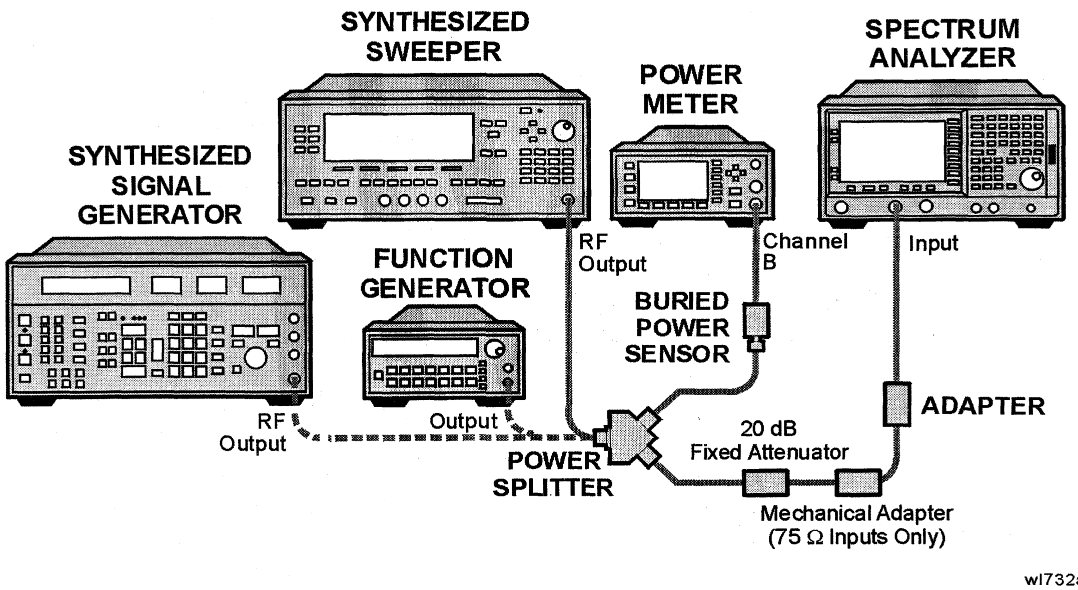
Frequency	Power Meter Reading		Splitter Tracking Error
	Channel A	Channel B	
1075 MHz			
1175 MHz			
1275 MHz			
1375 MHz			
1500 MHz			
1525 MHz			
1725 MHz			
1925 MHz			
2125 MHz			
2325 MHz			
2525 MHz			
2725 MHz			
2925 MHz			
3000 MHz			

a. This entry is for data taken with function generator as source.
b. This entry is for data taken with synthesized sweeper as source.

Measuring Frequency Response, Preamp On

1. Remove the reference sensor (Channel A sensor) from the 20 dB fixed attenuator. Connect the 20 dB fixed attenuator to the INPUT 50Ω of the analyzer using an adapter. Do not use a cable. Refer to Figure 2-36.
2. Set the source frequency at 10 MHz.
3. Set the source POWER LEVEL to –6 dBm.

Figure 2-36 Frequency Response Test Setup, Preamp On



4. Preset the analyzer and wait for the preset routine to complete. Set the analyzer controls as follows:

   FREQUENCY, Center Freq, 10 MHz
   CF Step, 100 MHz
   SPAN, 20 kHz
   AMPLITUDE, More, Int Preamp, On
   AMPLITUDE, More, Y Axis Units (or Amptd Units), dBm
   AMPLITUDE, Ref Level, –30 dBm
   Attenuation, 0 dB (Man)
   Scale/Div, 2 dB
   BW/Avg, Resolution BW, 3 kHz (Man)
   Video BW, 3 kHz (Man)

5. On the analyzer, press **Peak Search (or Search)**.
6. Adjust the source POWER LEVEL to obtain a marker amplitude reading on the analyzer of –32.00 dBm ±0.2 dB.
7. Record the current Channel B power reading in Table 2-56 as the Current Channel B Reading.
8. Record the Mkr1 amplitude reading in Table 2-56.
9. Set the source to the next frequency listed in Table 2-56.
10. Set the analyzer center frequency to the next frequency listed in Table 2-56.
11. On the analyzer, press **Peak Search (or Search)**.
12. Adjust the source POWER LEVEL to obtain a marker amplitude reading on the analyzer of –32.00 dBm ±0.2 dB.

13.Record the current Channel B power reading in Table 2-56 as the current Channel B reading.

14.Record the Mkr1 amplitude reading in Table 2-56.

15.Repeat step 9 to step 14 for frequencies up to 3.0 GHz in Table 2-56.

16.Replace the synthesized sweeper with a function generator.

17.Set the function generator amplitude to 112 mV rms (–6 dBm or –12 dBm plus nominal power splitter insertion loss).

18.Set the function generator frequency to 1 MHz.

19.Set the analyzer center frequency to 1 MHz.

20. On the analyzer, press **Peak Search (or Search)**.

21.Adjust the function generator amplitude to obtain a marker amplitude reading of –32.00 dBm ± 0.2 dB.

22.Record the current Channel B power reading in Table 2-56 as the current Channel B reading.

23.Record the analyzer Mkr1 amplitude reading in Table 2-56 as Mkr1 amplitude.

24.Repeat step 18 to step 23 for frequencies between 100 kHz and 10 MHz.

25.Copy the Splitter Tracking Error values from Table 2-55 into Table 2-56.

26.Calculate the flatness error for each frequency in Table 2-56 as follows:

$$\text{Flatness Error} = \text{Mkr1 Amptd} - \text{Current Channel B} - \text{Splitter Tracking Error}$$

For example, if Mkr1 Amptd is –33.32 dBm, Current Channel B is –12.4 dBm, and Splitter Tracking Error is –20.07 dB, Flatness Error would be –0.85 dB.

27.Record the flatness error for 50 MHz below as the 50 MHz Ref Amptd:

50 MHz Ref Amptd: _________

28.Calculate the Setup Change Error (error due to changing the test setup from using a synthesized sweeper to using a function generator) as follows:

a. Record the Flatness Error from Table 2-56 at 10 MHz using the function generator as FlatError_{FG}:

FlatError_{FG}=_________ dB

b. Record the Flatness Error from Table 2-56 at 10 MHz using the synthesized sweeper as $FlatError_{SS}$:

$FlatError_{SS}$=__________ dB

c. Subtract $FlatError_{FG}$ from $FlatError_{SS}$ and record the result as the Setup Change Error:

$$\text{Setup Change Error} = FlatError_{FG} - FlatError_{SS}$$

Setup Change Error =__________ dB

29. For frequencies less than 10 MHz calculate the flatness relative to 50 MHz for each frequency in Table 2-56 as follows:

$$\text{Flatness Relative to 50 MHz} = \text{Flatness Error} - \text{50 MHz Ref Amptd} - \text{Setup Change Error}$$

For example, if Flatness Error is –0.30 dB, 50 MHz Ref Amptd is +0.15 dB, and Setup Change Error is –0.19 dB, Flatness Relative to 50 MHz would be –0.26 dB.

30. For frequencies 10 MHz and above, calculate the flatness relative to 50 MHz for each frequency in Table 2-56 as follows:

$$\text{Flatness Relative to 50 MHz} = \text{Flatness Error} - \text{50 MHz Ref Amptd}$$

For example, if Flatness Error is –0.30 dB and 50 MHz Ref Amptd is +0.15 dB, Flatness Relative to 50 MHz would be –0.45 dB.

Table 2-56 Frequency Response Worksheet, Preamp On

Frequency	Current Channel B Reading	Mkr1 Amptd	Splitter Tracking Error	Flatness Error	Flatness Relative to 50 MHz
1 MHz					
5 MHz					
10 MHz[a]					
10 MHz[b]					
20 MHz					
50 MHz					0 dB (Ref)
75 MHz					
175 MHz					
275 MHz					
375 MHz					
475 MHz					
575 MHz					
675 MHz					
775 MHz					
875 MHz					
975 MHz					
1075 MHz					
1175 MHz					
1275 MHz					
1375 MHz					
1525 MHz					
1525 MHz					
1725 MHz					
1925 MHz					
2125 MHz					
2325 MHz					
2525 MHz					

Table 2-56 Frequency Response Worksheet, Preamp On

Frequency	Current Channel B Reading	Mkr1 Amptd	Splitter Tracking Error	Flatness Error	Flatness Relative to 50 MHz
2725 MHz					
2925 MHz					
3000 MHz					

a. This entry is for data taken with function generator as source.
b. This entry is for data taken with synthesized sweeper as source.

Test Results

1. Record the most positive number from the Flatness Relative to 50 MHz column of Table 2-56 as the Maximum Response in Table 2-57 and as TR Entry 1 in the performance verification test record.
2. Record the most negative number from the Flatness Relative to 50 MHz column of Table 2-56 as the Minimum Response in Table 2-57 and as TR Entry 2 in the performance verification test record.
3. Subtract the Minimum Response value in Table 2-57 from the Maximum Response value in Table 2-57 and record the result as the Peak-to-Peak Response in Table 2-57 and as TR Entry 3 in the performance verification test record.

Table 2-57 Frequency Response Results

Maximum Response		Minimum Response		Peak-to-peak Response	
dBm	TR Entry	dBm	TR Entry	dBm	TR Entry
	1		2		3

26. Frequency Response (Preamp On): HP E4404B, E4405B, and E4407B

This test measures the amplitude error of the spectrum analyzer as a function of frequency. The output of a source is fed through a power splitter to a power sensor and the spectrum analyzer. The power level of the source is adjusted at 50 MHz to place the displayed signal at approximately –32 dBm. At each new source frequency and spectrum analyzer center frequency, the power level of the source is adjusted to place the signal at approximately –32 dBm.

For improved amplitude accuracy the power splitter is characterized using a specially-calibrated power sensor (the "reference" sensor) connected to one power splitter output port. The other power splitter output port connects to the "buried" sensor; it is not removed from the power splitter. Once the characterization is done, the reference sensor is removed and replaced by the spectrum analyzer.

This procedure only tests frequency response with the optional preamplifier (Option 1DS) turned on. Perform the "Frequency Response" procedure to test all other frequency response specifications.

The related adjustment for this performance test is "Frequency Response."

Equipment Required

Function generator
Synthesized sweeper
Power meter
RF power sensor (*2 required*)
20 dB fixed attenuator
Power splitter
Cable, Type-N (m), 183 cm
Cable, BNC, 120 cm
Adapter, Type-N (m) to Type-N (m)
Adapter, Type-N (m) to BNC (f)

Additional Equipment for Option BAB

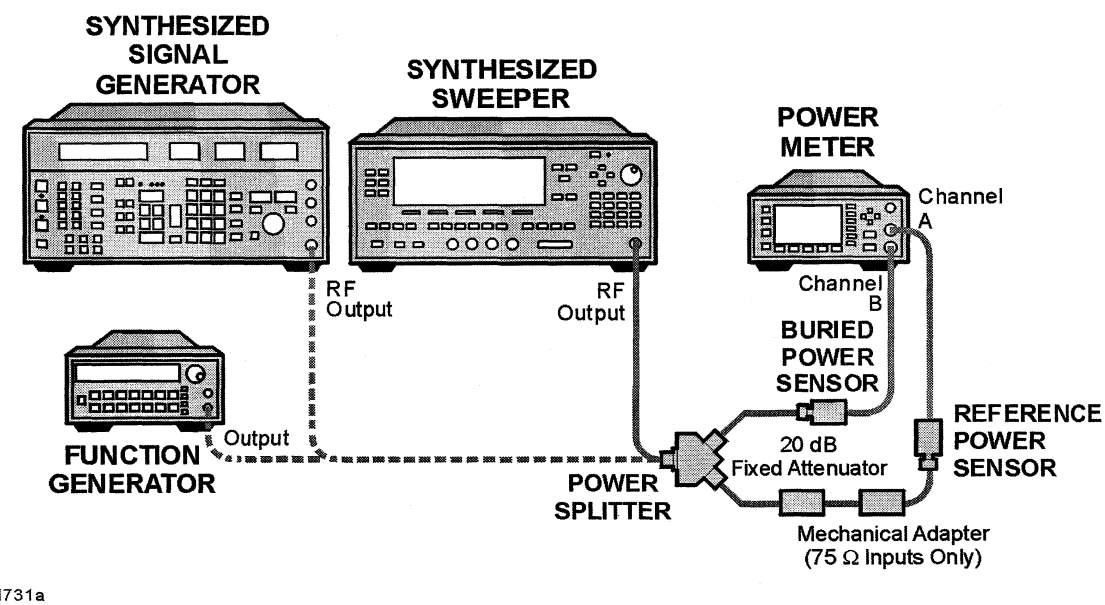
Adapter, Type-N (m) to APC 3.5 (f)

Procedure

Source/Splitter Characterization

1. Connect one RF power sensor to Channel A of the power meter. This will be the “reference” sensor. Connect the other RF power sensor to Channel B of the power meter. This will be the “buried” sensor.
2. Zero and calibrate both power sensors.
3. On the power meter, set the Channel A calibration factor to the calibration factor of the reference sensor at 1 MHz.
4. On the power meter, seth the Channel B calibration factor to 100%. Do not change this calibration factor during this test.
5. Connect the equipment as shown in Figure 2-37. Use the function generator as the source. Note that the reference sensor connects to the 20 dB fixed attenuator.

Figure 2-37 Source/Splitter Characterization Setup



6. Set the function generator frequency to 1 MHz and amplitude to 446 mV rms (approximately +6 dBm).
7. Adjust the source amplitude to obtain a Channel A power meter reading of –20 dBm ±0.1 dB.
8. Record the Channel A and Channel B power meter readings in Table 2-58.
9. Tune the source to the next frequency in Table 2-58.

10.On the power meter, set the Channel A calibration factor to the calibration factor of the reference sensor for the current source frequency.

11.Adjust the source amplitude to obtain a Channel A power meter reading of –20 dBm ±0.1 dB.

12.Record the Channel A and Channel B power meter readings in Table 2-58.

13.Repeat step 9 to step 12 for frequencies up to 10 MHz.

14.Replace the function generator with the synthesized sweeper.

15.Set the synthesized sweeper CW frequency to 10 MHz and the amplitude to +6 dBm.

16.Adjust the synthesized sweeper power level to obtain a Channel A power meter reading of –20 dBm ± 0.1 dB.

17.Record the synthesized sweeper power level and both the Channel A and Channel B power meter readings in Table 2-58.

18.Repeat step 9 to step 12 for each remaining frequency in Table 2-58.

19.For each entry in Table 2-58, calculate the Splitter Tracking Error as follows:

Splitter Tracking Error = Channel A Power – Channel B Power

For example, if Channel A Power is –20.3 dBm and Channel B power is –0.23 dBm, the splitter tracking error is –20.07 dB.

Table 2-58 **Source/Splitter Characterization**

Frequency	Power Meter Reading		Splitter Tracking Error
	Channel A	Channel B	
1 MHz			
5 MHz			
10 MHz[a]			
10 MHz[b]			
20 MHz			
50 MHz			
75 MHz			
175 MHz			
275 MHz			

Table 2-58 Source/Splitter Characterization

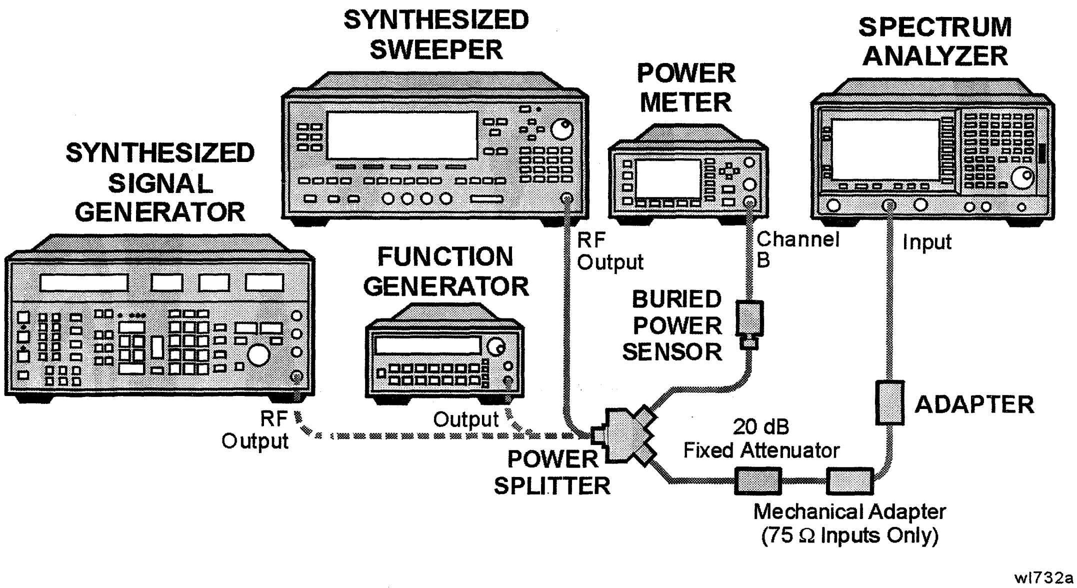
Frequency	Power Meter Reading		Splitter Tracking Error
	Channel A	Channel B	
375 MHz			
475 MHz			
575 MHz			
675 MHz			
775 MHz			
875 MHz			
975 MHz			
1075 MHz			
1175 MHz			
1275 MHz			
1375 MHz			
1500 MHz			
1525 MHz			
1725 MHz			
1925 MHz			
2125 MHz			
2325 MHz			
2525 MHz			
2725 MHz			
2925 MHz			
3000 MHz			

a. This entry is for data taken with function generator as source.
b. This entry is for data taken with synthesized sweeper as source.

Measuring Frequency Response, Preamp On

1. Remove the reference sensor (Channel A sensor) from the 20 dB fixed attenuator. Connect the 20 dB fixed attenuator to the INPUT 50Ω of the analyzer using an adapter. Do not use a cable. Refer to Figure 2-27.

Figure 2-38 Frequency Response Test Setup, Preamp On



2. Set the source frequency at 10 MHz.
3. Set the source POWER LEVEL to –6 dBm.
4. Preset the analyzer and wait for the preset routine to complete. Set the analyzer controls as follows:

   FREQUENCY, Center Freq, 10 MHz
   CF Step, 100 MHz
   SPAN, 20 kHz
   Input/Output (or Input), Coupling, (DC) *(HP E4404B and E4405B)*
   AMPLITUDE, More, Int Preamp, On
   AMPLITUDE, More, Y Axis Units (or Amptd Units), dBm
   AMPLITUDE, Ref Level, –30 dBm
   Attenuation, 0 dB (Man)
   Scale/Div, 2 dB
   BW/Avg, Resolution BW, 3 kHz (Man)
   Video BW, 3 kHz (Man)

5. On the analyzer, press **Peak Search (or Search).**
6. Adjust the source POWER LEVEL to obtain a marker amplitude reading on the analyzer of –32.00 dBm ±0.2 dB.

7. Record the current Channel B power reading in Table 2-59 as the Current Channel B Reading.
8. Record the Mkr1 amplitude reading in Table 2-59.
9. Set the source to the next frequency listed in Table 2-59.
10. Set the analyzer center frequency to the next frequency listed in Table 2-59.
11. On the analyzer, press **Peak Search (or Search)**.
12. Adjust the source POWER LEVEL to obtain a marker amplitude reading on the analyzer of –32.00 dBm ±0.2 dB.
13. Record the current Channel B power reading in Table 2-59 as the current Channel B reading.
14. Record the Mkr1 amplitude reading in Table 2-59.
15. Repeat step 9 to step 14 for frequencies up to 3.0 GHz in Table 2-59.
16. Replace the synthesized sweeper with a function generator.
17. Set the function generator amplitude to 112 mV rms (–6 dBm or –12 dBm plus nominal power splitter insertion loss).
18. Set the function generator frequency to 1 MHz.
19. Set the analyzer center frequency to 1 MHz.
20. On the analyzer, press **Peak Search (or Search)**.
21. Adjust the function generator amplitude to obtain a marker amplitude reading of –32.00 dBm ± 0.2 dB.
22. Record the current Channel B power reading in Table 2-59 as the current Channel B reading.
23. Record the analyzer Mkr1 amplitude reading in Table 2-59 as Mkr1 amplitude.
24. Repeat step 18 to step 23 for frequencies between 100 kHz and 10 MHz.
25. Copy the Splitter Tracking Error values from Table 2-58 into Table 2-59.
26. Calculate the flatness error for each frequency in Table 2-59 as follows:

$$\text{Flatness Error} = \text{Mkr1 Amptd} - \text{Current Channel B} - \text{Splitter Tracking Error}$$

For example, if Mkr1 Amptd is –33.32 dBm, Current Channel B is –12.4 dBm, and Splitter Tracking Error is –20.07 dB, Flatness Error would be –0.85 dB.

27. Record the flatness error for 50 MHz below as the 50 MHz Ref Amptd:

    50 MHz Ref Amptd: __________

28. Calculate the Setup Change Error (error due to changing the test setup from using a synthesized sweeper to using a function generator) as follows:

    a. Record the Flatness Error from Table 2-59 at 10 MHz using the function generator as $FlatError_{FG}$:

       $FlatError_{FG}$=__________ dB

    b. Record the Flatness Error from Table 2-59 at 10 MHz using the synthesized sweeper as $FlatError_{SS}$:

       $FlatError_{SS}$=__________ dB

    c. Subtract $FlatError_{FG}$ from $FlatError_{SS}$ and record the result as the Setup Change Error:

       $$\text{Setup Change Error} = FlatError_{FG} - FlatError_{SS}$$

       Setup Change Error =__________ dB

29. For frequencies less than 10 MHz calculate the flatness relative to 50 MHz for each frequency in Table 2-59 as follows:

$$\text{Flatness Relative to 50 MHz} = \text{Flatness Error} - \text{50 MHz Ref Amptd} - \text{Setup Change Error}$$

For example, if Flatness Error is –0.30 dB, 50 MHz Ref Amptd is +0.15 dB, and Setup Change Error is –0.19 dB, Flatness Relative to 50 MHz would be –0.26 dB.

30. For frequencies 10 MHz and above, calculate the flatness relative to 50 MHz for each frequency in Table 2-59 as follows:

$$\text{Flatness Relative to 50 MHz} = \text{Flatness Error} - \text{50 MHz Ref Amptd}$$

For example, if Flatness Error is –0.30 dB and 50 MHz Ref Amptd is +0.15 dB, Flatness Relative to 50 MHz would be –0.45 dB.

Table 2-59 Frequency Response Worksheet, Preamp On

Frequency	Current Channel B Reading	Mkr1 Amptd	Splitter Tracking Error	Flatness Error	Flatness Relative to 50 MHz
1 MHz					
5 MHz					
10 MHz[a]					
10 MHz[b]					
20 MHz					
50 MHz					0 dB (Ref)
75 MHz					
175 MHz					
275 MHz					
375 MHz					
475 MHz					
575 MHz					
675 MHz					
775 MHz					
875 MHz					
975 MHz					
1075 MHz					
1175 MHz					
1275 MHz					
1375 MHz					
1525 MHz					
1525 MHz					
1725 MHz					
1925 MHz					
2125 MHz					
2325 MHz					
2525 MHz					

Table 2-59 Frequency Response Worksheet, Preamp On

Frequency	Current Channel B Reading	Mkr1 Amptd	Splitter Tracking Error	Flatness Error	Flatness Relative to 50 MHz
2725 MHz					
2925 MHz					
3000 MHz					

a. This entry is for data taken with function generator as source.
b. This entry is for data taken with synthesized sweeper as source.

Test Results

1. Record the most positive number from the Flatness Relative to 50 MHz column of Table 2-59 as the Maximum Response in Table 2-60 and as TR Entry 1 in the performance verification test record.
2. Record the most negative number from the Flatness Relative to 50 MHz column of Table 2-59 as the Minimum Response in Table 2-60 and as TR Entry 2 in the performance verification test record.
3. Subtract the Minimum Response value in Table 2-60 from the Maximum Response value in Table 2-60 and record the result as the Peak-to-Peak Response in Table 2-60 and as TR Entry 3 in the performance verification test record.

Table 2-60 Frequency Response Results

Maximum Response		Minimum Response		Peak-to-peak Response	
dBm	TR Entry	dBm	TR Entry	dBm	TR Entry
	1		2		3

27. Other Input-Related Spurious Responses: HP E4401B and E4411B

This test measures the ability of the analyzer to reject image and multiple responses. A synthesized source and the analyzer are set to the same frequency and the amplitude of the source is set to –20 dBm. A marker amplitude reference is set on the spectrum analyzer. The source is then tuned to several different frequencies which should generate image and multiple responses. At each source frequency, the source amplitude is set to –20 dBm and the amplitude of the response, if any, is measured using the spectrum analyzer marker functions.

There are no related adjustment procedures for this performance test.

Equipment Required

Synthesized signal generator
Power meter
RF power sensor
Adapter, Type-N (f) to APC 3.5 (f)
Adapter, Type-N (f) to Type-N (f)
Cable, Type-N, 152-cm (60-in)

Additional Equipment for 75 Ω Input

Power sensor, 75 Ω
Adapter, Type-N (f), to BNC (m), 75 Ω
Adapter, BNC (m), to BNC (m), 75 Ω
Pad, minimum loss

Procedure

1. Zero and calibrate the power meter and RF power sensor in log mode (power reads out in dBm), as described in the power meter operation manual. Enter the 500 MHz calibration factor of the power sensor into the power meter.

   75 Ω Input only: Use a 75 Ω power sensor.

2. Press **Preset** on the synthesized sweeper and set the controls as follows:

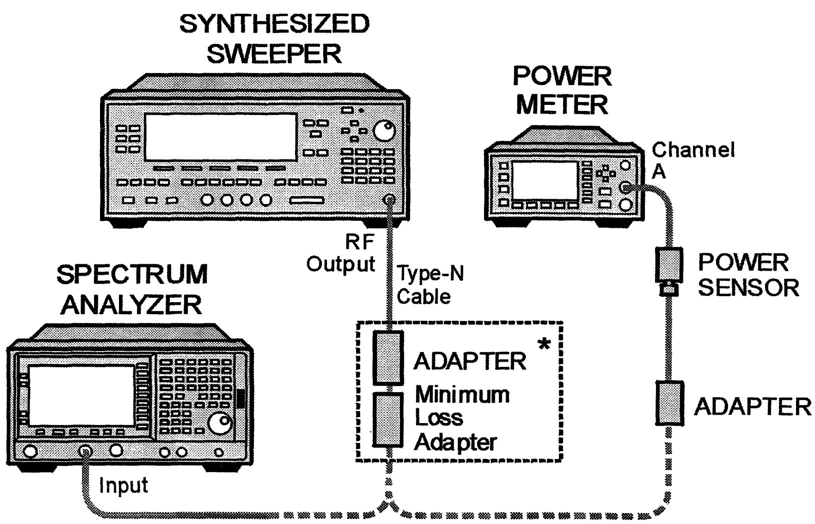
   CW, 542.8 MHz
   POWER LEVEL, –10 dBm

3. Connect the equipment as shown in Figure 2-39 with the output of the synthesized sweeper connected to the power sensor using an adapter between the cable and the power sensor.

75 Ω Input only: Use the minimum loss pad and 75 Ω adapters to connect to the 75 Ω power sensor.

4. Adjust the power level of the synthesized sweeper for a –10 dBm ±0.1 dB reading on the power meter.
5. On the synthesized sweeper, press **SAVE**, **1**.

Figure 2-39 Other Input Related Spurious Responses Power Setting Setup



6. Set the CW frequency on the synthesized sweeper to 510.7 MHz.
7. Adjust the synthesized sweeper power level for a –10 dBm ±0.1 dB reading on the power meter.
8. On the synthesized sweeper, press **SAVE 2**.
9. Enter the 1 GHz calibration factor for the power sensor into the power meter.
10. Set the CW frequency on the synthesized sweeper to 1310.7 MHz.
11. Adjust the synthesized sweeper power level for a –10 dBm ±0.1 dB reading on the power meter.
12. On the synthesized sweeper, press **SAVE 3**.
13. Enter the 100 MHz calibration factor of the power sensor into the power meter.
14. Set the CW frequency of the synthesized sweeper to 100 MHz.
15. Adjust the synthesized sweeper power level for a –10 dBm ±0.1 dB reading on the power meter.

16.On the synthesized sweeper, press **SAVE 4.**

Table 2-61 Other Input-Related Spurious Responses Worksheet

Synthesized Sweeper CW Frequency			TR Entry (Mkr Δ)
Save Register	CW	Power Level	
1	542.8 MHz[a]	542.8 MHz	1
2	510.7 MHz[b]	510.7 MHz	2
3	1310.7 MHz[b]	1310.7 MHz	3
4	100 MHz	1310.7 MHz	N/A

a. Image response
b. Multiple response

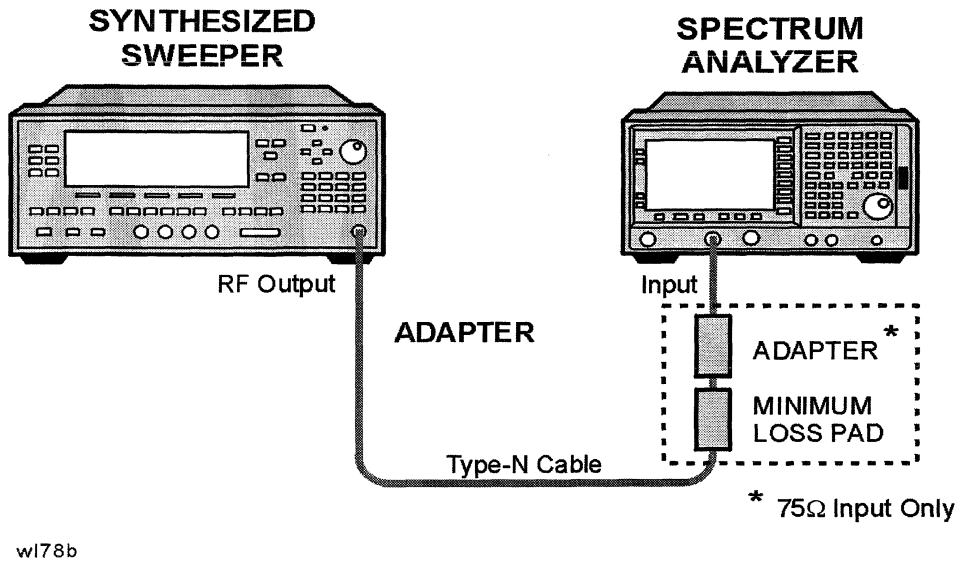
17.Set the CW frequency on the synthesized sweeper to 500 MHz.

18.Adjust the power level of the synthesized sweeper for a –10 dBm ±0.1 dB reading on the power meter.

19.Connect the synthesized sweeper to the Input of the analyzer using the appropriate cable and adapters. See Figure 2-40.

75 Ω *Input only: Use the minimum loss pad and a 75 Ω adapter as shown in* Figure 2-40.

Figure 2-40 Other Input Related Spurious Responses Measurement Setup



20. On the analyzer, press **Preset**, then wait for the preset routine to finish. Set the analyzer by pressing the following keys:

    FREQUENCY, Center Freq, 500 MHz
    SPAN, 200 kHz
    AMPLITUDE, Attenuation, 10 dB (Man)
    Peak Search (or Search), Meas Tools, Mkr → Ref Lvl
    Peak Search (or Search), Meas Tools, Delta
    Single

21. On the synthesized sweeper, press **RECALL, 1**.

22. On the analyzer, press **Single** and wait for the completion of a new sweep.

23. On the analyzer, press **Peak Search (or Search),** and record the ΔMkr1 amplitude in the performance verification test record as indicated in Table 2-61.

24. On the synthesized sweeper, press **RECALL, 2**.

25. On the analyzer, press **Single** and wait for the completion of a new sweep.

26. On the analyzer, press **Peak Search (or Search),** record the ΔMkr1 amplitude in the performance verification test record as indicated in Table 2-61.

27. On the synthesized sweeper, press **RECALL, 4.**

28. On the analyzer press the following keys:

FREQUENCY, 100 MHz
AMPLITUDE, –5 dBm *(50 Ω Input)*
AMPLITUDE, +48.75 dBmV *(75 Ω Input)*
Marker, Normal
Sweep, Sweep (Cont)
Peak Search (or Search), Meas Tools, Mkr → Ref Lvl
Peak Search (or Search), Meas Tools, Delta
Single

29.On the synthesized sweeper, press **RECALL 3** for a CW frequency of 1310.7 MHz.

30.Press **Single** on the analyzer and wait for a completion of a new sweep.

31.On the analyzer, press **Peak Search (or Search)** and record the ΔMkr1 amplitude in the performance test record as indicated in Table 2-61.

28. Other Input-Related Spurious Responses: HP E4402B, E4403B, E4404B, E4405B, E4407B, E4408B

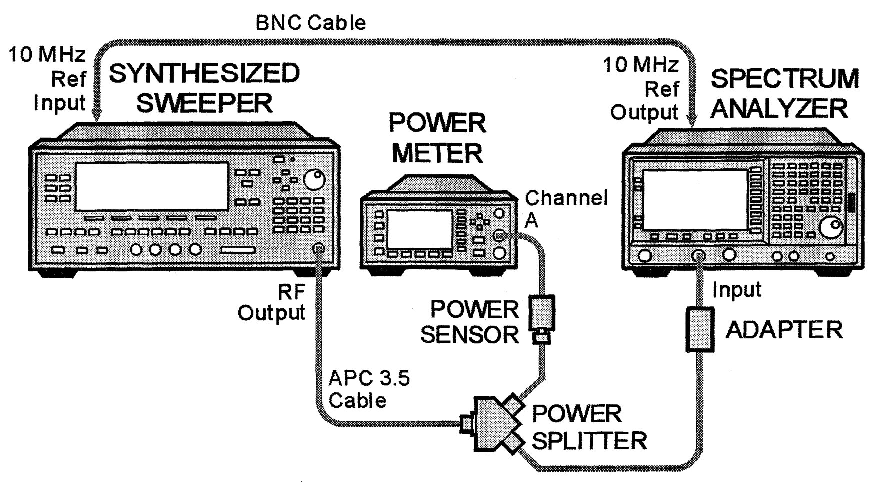
This test measures the ability of the analyzer to reject image, multiple, and out-of-band responses. A synthesized source and the spectrum analyzer are set to the same frequency and the amplitude of the source is set to –10 dBm and –20 dBm. A marker amplitude reference is set on the spectrum analyzer for each source amplitude setting. The source is then tuned to several different frequencies which should generate image, multiple, and out-of-band responses. At each source frequency, the source amplitude is set to the appropriate amplitude and the amplitude of the response, if any, is measured using the spectrum analyzer marker functions.

There are no related adjustment procedures for this performance test.

Equipment Required

Synthesized sweeper
Power meter
RF power sensor, (*HP E4402B, E4403B*)
Microwave power sensor (*HP E4404B, E4405B, E4407B, E4408B*)
RF power splitter (*HP E4402B, E4403B*)
Microwave power splitter (*HP E4404B, E4405B, E4407B, E4408B*)
Adapter, Type-N (m) to Type-N (m)
Adapter, Type-N (m) to APC 3.5 (m)
Adapter, APC 3.5 (f) to APC 3.5 (f)
Cable, APC 3.5, 91 cm (36 in)

Figure 2-41 Other Input-Related Spurious Responses Test Setup



Procedure

Band 0

1. Zero and calibrate the power meter and power sensor in log mode (power reads out in dBm), as described in the power meter operation manual. Enter the power sensor 2 GHz calibration factor into the power meter.
2. Preset the synthesized sweeper and set the controls as follows:

   CW, 2000 MHz
   POWER LEVEL, –4 dBm

3. Connect the equipment as shown in Figure 2-41. The analyzer provides the 10 MHz reference for the synthesized sweeper.
4. Press **Preset** on the analyzer, and wait for the preset routine to finish. Then, set the analyzer by pressing the following keys:

   FREQUENCY, Center Freq, 2 GHz
   SPAN, 200 kHz
   AMPLITUDE, Ref Level –10 dBm
   AMPLITUDE, Attenuation 0 dBm (Man)

5. Adjust the synthesized sweeper power level for a –10 dBm ±0.1 dB reading on the power meter.
6. On the analyzer, press **Single**, and wait for the sweep to finish. Then press following keys:

   Marker, Select Marker (1)
   Peak Search (or Search)
   Meas Tools
   Delta

   The signal peak might be slightly above the reference level, but the marker function can still make an accurate measurement.

7. Adjust the synthesized sweeper power level for a –20 dBm ±0.1 dB reading on the power meter.
8. On the analyzer, press **Single**, and wait for the sweep to finish. Press following keys:

   Marker, Select Marker (2)
   Peak Search (or Search)
   Meas Tools
   Delta

9. On the analyzer, press **AMPLITUDE**, **Ref Level, –30 dBm.**
10. Repeat step a through step h using the data in Table 2-62 for Band 0.

    a. Set the synthesized sweeper to the listed CW frequency.

Do not set the synthesized sweeper to frequencies outside the frequency range of the analyzer.

b. Enter the appropriate power sensor calibration factor into the power meter.

c. Adjust the synthesized sweeper power level until the power meter reading is equal to the Mixer Level in Table 2-62, ±0.1 dB.

d. On the analyzer, press **Single** and wait for the completion of a new sweep. Then, press **Peak Search (or Search).**

e. If the Mixer Level in Table 2-62 is –20 dBm, press **Marker**, **Select Marker** (2).

f. If the Mixer Level in Table 2-62 is –10 dBm, press **Marker, Select Marker** (1).

g. On the analyzer, press **Peak Search (or Search).**

h. Record the ΔMkr amplitude reading in Table 2-62.

11.On the analyzer, press the following keys:

Marker, More, Marker All Off
Auto Couple
SPAN, 1 MHz
AMPLITUDE, Ref Level, –10 dBm
AMPLITUDE, Attenuation, 0 dB
Sweep, Sweep, (Cont)

NOTE End of procedure for HP E4402B and E4403B

Band 1

12.On the spectrum analyzer, press the following keys:

FREQUENCY
Center Freq, 4 GHz

13.On the synthesized sweeper, press **CW, 4 GHz.**

14.Enter the power sensor 4 GHz calibration factor into the power meter.

15.On the analyzer, press **AMPLITUDE, Presel Center.**

16.On the analyzer, press the following keys:

Marker, More, Marker All Off

17.Repeat step 5 through step 11 for the synthesized sweeper CW frequencies listed in Table 2-62 for Band 1.

NOTE End of procedure for HP E4404B

Band 2

18. On the spectrum analyzer, press the following keys:

    FREQUENCY, Center Freq, 9 GHz

19. On the synthesized sweeper, press **CW, 9 GHz**.
20. Enter the power sensor 9 GHz calibration factor into the power meter.
21. On the analyzer press **AMPLITUDE, Presel Center**.
22. On the analyzer press the following keys:

    Marker, More, Marker All Off

23. Repeat step 5 through step 11 for the synthesized sweeper CW frequencies listed in Table 2-62 for Band 2.

NOTE End of procedure for HP E4405B.

Band 3

24. On the spectrum analyzer, press the following keys:

    FREQUENCY
    Center Freq, 15 GHz

25. On the synthesized sweeper, press: **CW, 15 GHz**.
26. Enter the power sensor 15 GHz calibration factor into the power meter.
27. On the analyzer press: **AMPLITUDE, Presel Center**.
28. On the analyzer press the following keys:

    Marker, More, Marker All Off

29. Repeat step 5 through step 11 for the synthesized sweeper CW frequencies listed in Table 2-62 for Band 3 for the 15 GHz spectrum analyzer center frequency.

Band 4

30. On the spectrum analyzer, press:

    FREQUENCY, Center Freq, 21 GHz

31. On the synthesized sweeper, press: **CW, 21 GHz**.
32. Enter the power sensor 21 GHz calibration factor into the power meter.
33. On the analyzer, press **AMPLITUDE, Presel Center**.

34. On the analyzer, press the following:

Marker, More, Marker All Off

35. Repeat step 5 through step 11 for the synthesized sweeper CW frequencies listed in Table 2-62 for Band 4 for the 21 GHz spectrum analyzer center frequency.

Table 2-62 Other Input-Related Spurious Responses

Band	Spectrum Analyzer Center Frequency, (GHz)	Synthesized Sweeper CW Frequency, (MHz)	Mixer Level, (dBm)	ΔMkr1 or ΔMkr2 Amplitude
0	2.0	2042.8[a]	–20	
	2.0	2642.8[a]	–20	
	2.0	1820.8[b]	–20	
	2.0	278.5[c]	–20	
Note: The following data applies only to the HP E4404B, E4405B, E4407B and E4408B				
0	2.0	5600.0[c]	–10	
	2.0	6242.8[b]	–10	
1	4.0	4042.8[a]	–20	
	4.0	4642.8[a]	–20	
	4.0	3742.9[b]	–20	
	4.0	2242.8[c]	–10	
Note: The following data applies only to the HP E4405B, E4407B and E4408B				
2	9.0	9042.8[a]	–20	
	9.0	9642.8[a]	–20	
	9.0	4982.1[b]	–20	
	9.0	9342.8[c]	–10	
Note: The following data applies only to the HP E4407B and E4408B				
3	15.0	15042.8[a]	–20	
	15.0	15642.8[a]	–20	

Table 2-62 Other Input-Related Spurious Responses

Band	Spectrum Analyzer Center Frequency, (GHz)	Synthesized Sweeper CW Frequency, (MHz)	Mixer Level, (dBm)	ΔMkr1 or ΔMkr2 Amplitude
	15.0	18830.35[b]	–20	
	15.0	4151.75[c]	–10	
4	21.0	21042.8[a]	–20	
	21.0	21642.8[a]	–20	
	21.0	21342.8[b]	–20	
	21.0	5008.95[c]	–10	

a. Image response
b. Multiple response
c. Out-of-band response

29. Spurious Responses: HP E4401B and E4411B

This test is performed in two parts. Part 1 measures third order intermodulation distortion; Part 2 measures second harmonic distortion.

To test second harmonic distortion, a low pass filter is used to filter the source output, ensuring that harmonics read by the spectrum analyzer are internally generated and not coming from the source. To measure the distortion products, the power at the mixer is set 25 dB higher than specified.

For example, the specification states that with –40 dBm at the input mixer, the distortion products should be suppressed by >75 dBc, the equivalent second harmonic intercept (SHI) is > +35 dBm (–40 dBm + 75 dBc). Measuring with –15 dBm at the mixer and verifying the distortion products suppressed by >50 dBc also ensures the SHI is > +35 dBm (–15 dBm + 50 dBc).

For third order intermodulation distortion, two signals are combined in a directional bridge to provide isolation. These two signals are applied to the spectrum analyzer input. The power level of the two signals is several dB higher than specified, so the distortion products should be suppressed by less than the amount specified. In this manner, the equivalent third order intercept (TOI) is measured.

For example, the specification states that with two –30 dBm signals at the input mixer, the distortion products should be suppressed by >80 dBc, which yields a third order intercept of > 10 dBm (–30 dBm + (80 dBc/2)). Measuring with –20 dBm at the mixer and verifying the distortion products are suppressed by >60 dBc, the equivalent TOI is also > 10 dBm (–20 dBm + (60 dBc/2)).

There are no related adjustment procedures for this performance test.

Equipment Required

Synthesized signal generator
Synthesized sweeper
Power meter, dual channel
RF power sensor
Power splitter
Directional bridge
50 MHz low pass filter
Cable, BNC, 120-cm
Cable, APC 3.5, 91-cm *(2 required)*
Adapter, Type-N (m) to APC 3.5 (f) *(3 required)*
Adapter, Type-N (m) to SMA (m)

Adapter, Type-N (m) to BNC (f)
Adapter, Type-N (m) to Type-N (m)
Adapter, SMA (f) to BNC (m)
Adapter, APC 3.5 (f) to APC 3.5 (f)

Additional Equipment for 75 Ω Input

Power sensor, 75 Ω
Adapter, mechanical, Type-N (m) 50 Ω, to Type-N (m), 75 Ω
Adapter, Type-N (m), to BNC (m), 75 Ω

Procedure

This performance test consists of two parts:

Part 1: Third Order Intermodulation Distortion

Part 2: Second Harmonic Distortion

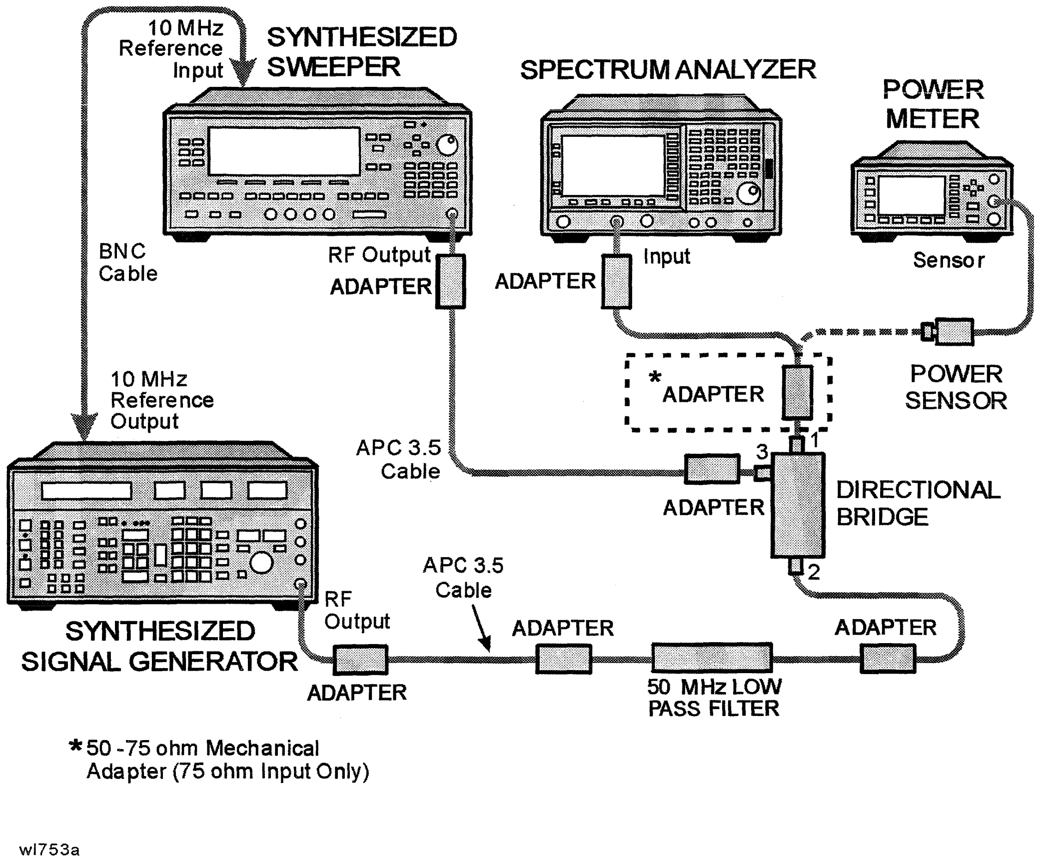
Perform Part 1 before Part 2.

Part 1: Third Order Intermodulation Distortion

1. Zero and calibrate the power meter and RF power sensor in log mode (power reads out in dBm), as described in the power meter operation manual.

   75 Ω *Input only: Use a* 75 Ω *power sensor.*

Figure 2-42 Third Order Intermodulation Distortion Test Setup



CAUTION Use only 75 Ω cables, connectors, or adapters on instruments with 75 Ω connectors, or damage to the connectors will occur.

2. Connect the equipment as shown in Figure 2-42 with the output of the directional bridge connected to the power sensor.

   75 Ω Input only: Use the 75 Ω power sensor with the 50 Ω to 75 Ω mechanical adapter.

Table 2-63 Test Equipment Settings for

TOI Test	F1, MHz	F2, MHz	Low Pass Filter, MHz
1	50.0	50.05	50
Option 1DR	50.0	50.05	50

3. Perform step 4 through step 29 using the information and entries from Table 2-63. Then continue on with step 30 through step 38.

4. Press **Blue Key, Special, 0, 0** on the signal generator. Set the frequency to the F1 value for TOI Test 1 in Table 2-63. Set the amplitude to –10 dBm.

5. Press **PRESET** on the synthesized sweeper. Set the CW frequency of the synthesized sweeper to the F2 value for TOI Test 1 in Table 2-63. Then press the following:

   POWER LEVEL, +4 dBm
   RF Off

6. Enter the power sensor calibration factor for the signal generator frequency into the power meter.

7. Adjust the amplitude of the signal generator until the power meter reads –12 dBm ±0.1 dB.

   75 Ω Input only: The power measured at the output of the 50 Ω directional bridge by the 75 Ω power sensor is the equivalent power "seen" by the 75 Ω analyzer.

8. Disconnect the power sensor from the directional bridge. Connect the directional bridge directly to the analyzer input using an adapter (do not use a cable).

   75 Ω Input only: Use a 50 Ω to 75 Ω mechanical adapter and a 75 Ω Type-N(m) to BNC(m) adapter.

CAUTION Support the directional bridge and low pass filter to minimize stress on the analyzer input connector.

9. On the analyzer, press **Preset**, then wait until the preset routine is finished. Press **System, Alignments, Auto Align, Off.** Set the analyzer center frequency to the F1 value for TOI Test 1 in Table 2-63. Then, set up the analyzer by pressing the following keys:

   FREQUENCY, CF Step, 50 kHz (Man)
   SPAN, 20 kHz
   AMPLITUDE, More, Y Axis Units (or Amptd Units), dBm
   AMPLITUDE, Ref Level, –5 dBm (50 Ω *Input only*)
   AMPLITUDE, Ref Level, –10 dBm (*75 Ω Input only*)
   AMPLITUDE, Attenuation, 5 dB (Man) (50 Ω *Input only*)
   AMPLITUDE, Attenuation, 0 dB(Man) (*75 Ω Input only*)
   BW/Avg, 1 kHz (Man)
   BW/Avg, Video BW, 300 Hz (Man)
   Peak Search (or Search), More, Search Param, Peak Excursn, 3 dB

10. On the analyzer, press the following keys:

   Peak Search (or Search)
   Meas Tools
   Mkr → CF
   Delta

11.On the analyzer, press **FREQUENCY**, ↑.

12.If the resolution bandwidth is ≥1kHz, press **SPAN, 4 kHz.**

13.On the synthesized sweeper, set the RF On.

14. On the analyzer, press **Peak Search (or Search).**

15.On the synthesized sweeper, adjust the power level until the ΔMkr1 amplitude reads 0 dB ±0.05 dB.

16.On the analyzer, press: **FREQUENCY**, ↓, ↓. The center frequency should now be lower than the signal generator frequency by the CF Step value.

17.Set the spectrum analyzer reference level to –15 dBm.

75 Ω *Input only: Set the reference level to –20 dBm.*

18.On the analyzer, press **BW/Avg, Average, 20**, and wait for "`Vavg 20`" to appear along the left side of the display.

19.On the analyzer, press: **Peak Search (or Search)** and record the marker amplitude reading in Table 2-64 as the Lower Distortion Amplitude.

20.On the analyzer, press **BW/Avg, Average Off.**

21.On the spectrum analyzer, increment the center frequency by three times the CF Step value. Press **FREQUENCY**, ↑, ↑, ↑. The center frequency should now be one CF Step value above the synthesized sweeper frequency.

22.Set the synthesized signal generator frequency to F2 as indicated in Table 2-63.

23.Set the synthesized sweeper CW frequency to F1 as indicated in Table 2-63.

24.On the analyzer, press **BW/Avg, Average, 20**, and wait for `Vavg 20` to appear along the left side of the display.

25.On the analyzer, press **Peak Search (or Search)** and record the marker amplitude reading in Table 2-64 as the Upper Distortion Amplitude.

26.On the analyzer, press **BW/Avg, Average Off.**

27.Of the Lower Distortion Amplitude and Upper Distortion Amplitudes recorded in Table 2-64, enter the most positive value as the Worst Distortion Amplitude in Table 2-64. For example, if the Upper Distortion Amplitude is –62 dBc and the Lower Distortion Amplitude is –63 dBc, enter –62 dBc as the Worst Distortion Amplitude.

28.If the analyzer has a 50 Ω input, enter –17 dBm as the Mixer Level in Table 2-64 (–12 dBm input power – 5 dB input attenuation). If the analyzer has a 75 Ω input, enter +36.75 dBmV as the Mixer Level in Table 2-64 (–12 dBm = +36.75 dBmV).

29.Calculate the equivalent TOI by subtracting one half of the Worst Distortion Amplitude (in dB) from the Mixer Level (in dBm or dBmV). Enter the result in Table 2-64 as the Calculated TOI. For example, if the Worst Distortion Amplitude is –62 dBc and the Mixer Level is –17 dBm, the Calculated TOI would be:

$$\text{TOI} = -17\text{ dBm} - (-62\text{ dB}/2) = -17\text{ dBm} + 31\text{ dB} = +14\text{ dBm}$$

Table 2-64 Third Order Intermodulation Distortion Worksheet

TOI Test	Lower Distortion Amplitude	Upper Distortion Amplitude	Worst Distortion Amplitude	Mixer Level	Calculated TOI
1					
Option 1DR					

30.If the analyzer is equipped with Option 1DR, Narrow Resolution Bandwidth, perform step 31 through step 36. Otherwise, continue with step 37.

31.Set synthesized signal generator frequency to the F1 value used in TOI Test 1 of Table 2-63.

32.Set synthesized sweeper CW frequency to the F2 value used in TOI Test 1 of Table 2-63.

33.On the spectrum analyzer, press **Preset**, then wait until the preset routine is finished. Press **System, Alignments, Auto Align, Off.** Set the spectrum analyzer by pressing the following keys:

FREQUENCY, CF Step, 50 kHz (Man)
SPAN, 20 kHz
AMPLITUDE, More, Y Axis Units (or Amptd Units), dBm
AMPLITUDE, Ref Level, –5 dBm (50 Ω *Input only*)
AMPLITUDE, Ref Level, –10 dBm (*75 Ω Input only*)
AMPLITUDE, Attenuation, 5 dB (Man) (50 Ω *Input only*)
AMPLITUDE, Attenuation, 0dB (Man) (*75 Ω Input only*)
BW/Avg, 1 kHz (Man)
BW/Avg, Video BW, 300 Hz (Man)
Peak Search (or Search), More, Search Param, Peak Excursn, 3 dB

34.On the analyzer, press the following keys:

Peak Search (or Search)
Meas Tools
Mkr → CF

35.Set the analyzer as follows:

SPAN, 500 Hz
BW/Avg, Resolution BW, 30 Hz
BW/Avg, Video BW, 10 Hz

36.Repeat step 10 through step 29. This is the TOI test for Option 1DR.

37.On the analyzer, press **System, Alignments, Auto Align, On.**

38.Part 1: Third Order Intermodulation Distortion is complete. Proceed to Part 2: Second Harmonic Distortion.

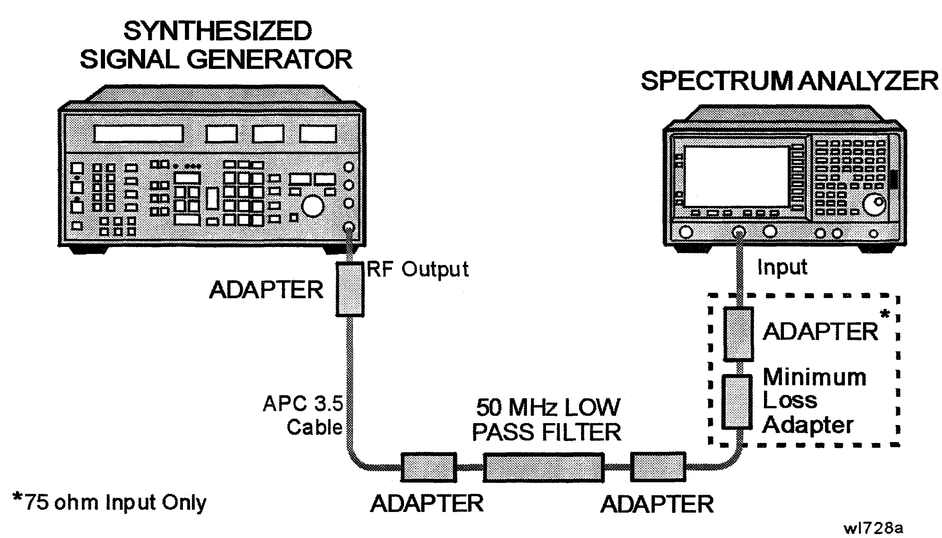
Part 2: Second Harmonic Distortion

1. Set the synthesized signal generator controls as follows:

FREQUENCY, 40 MHz
AMPLITUDE, –10 dBm (50 Ω *Input only)*
AMPLITUDE, –4.3 dBm (75 Ω *Input only*)

2. Connect the equipment as shown in Figure 2-43.

Figure 2-43 Second Harmonic Distortion Test Setup



75 Ω Input only: Connect the minimum loss adapter between the LPF and INPUT 75 Ω.

3. Press **Preset** on the spectrum analyzer, then wait for the preset routine to finish. Set the spectrum analyzer by pressing the following keys:

   FREQUENCY, 40 MHz
   SPAN, 1 MHz
   AMPLITUDE, –10 dBm (50 Ω *Input only*)
   AMPLITUDE, +44 dBmV (75 Ω *Input only*)
   Attenuation Auto Man 10 dB
   BW/Avg, 30 kHz

4. Adjust the synthesized signal generator amplitude to place the peak of the signal at the reference level.
5. Set the spectrum analyzer control as follows:

   SPAN, 50 kHz
   BW/Avg, 1 kHz
   Video BW Auto Man, 100 Hz

6. Wait for two sweeps to finish, then press the following spectrum analyzer keys:

   Peak Search (or Search)
   Mkr →, Mkr → CF Step
   Marker, Delta
   FREQUENCY, ↑

7. Press **Peak Search (or Search)**. The ΔMkr1 amplitude reading is the second harmonic suppression.
8. If the analyzer has a 50 Ω input, calculate the second harmonic intercept (SHI) using the second harmonic suppression value read in step 7 as follows:

   $$\text{SHI} = -20\ \text{dBm} - \text{Second Harmonic Suppression}$$

   For example, if the second harmonic suppression is –62 dB, the SHI would be +42 dBm:

   $$+42\ \text{dBm} = -20\ \text{dBm} - (-62\ \text{dB})$$

9. If the analyzer has a 75 Ω input, calculate the second harmonic intercept (SHI) using the second harmonic suppression value read in step 7 as follows:

   $$\text{SHI} = +34\ \text{dBmV} - \text{Second Harmonic Suppression}$$

   For example, if the second harmonic suppression is –65 dB, the SHI would be +99 dBmV:

   $$+99\ \text{dBmV} = +34\ \text{dBmV} - (-65\ \text{dB})$$

30. Spurious Responses: HP E4402B and E4403B

This test is performed in two parts. Part 1 measures third order intermodulation distortion; Part 2 measures second harmonic distortion.

To test second harmonic distortion, a low pass filter is used to filter the source output, ensuring that harmonics read by the spectrum analyzer are internally generated and not coming from the source. To measure the distortion products, the power at the mixer is set 25 dB higher than specified.

For example, the specification states that with –30 dBm at the input mixer, the distortion products should be suppressed by >75 dBc, the equivalent second harmonic intercept (SHI) is > +45 dBm (–30 dBm + 75 dBc). Measuring with –15 dBm at the mixer and verifying the distortion products suppressed by >60 dBc also ensures the SHI is > +45 dBm (–15 dBm + 60 dBc).

For third order intermodulation distortion, two signals are combined in a directional bridge to provide isolation. These two signals are applied to the spectrum analyzer input. The power level of the two signals is several dB higher than specified, so the distortion products should be suppressed by less than the amount specified. In this manner, the equivalent third order intercept (TOI) is measured.

For example, the specification states that with two –30 dBm signals at the input mixer, the distortion products should be suppressed by >82 dBc, which yields a third order intercept of > +11 dBm (–30 dBm + (75 dBc/2)). Measuring with –20 dBm at the mixer and verifying the distortion products are suppressed by >62 dBc, the equivalent TOI is also > +11 dBm (–20 dBm + (62 dBc/2)).

There are no related adjustment procedures for this performance test.

Equipment Required

Synthesized signal generator
Synthesized sweeper
Power meter, dual channel
RF power sensor
Power splitter
Directional bridge
300 MHz low pass filter
Cable, APC 3.5, 91-cm (2 required)
Cable, BNC, 120-cm
Adapter, Type-N (m) to APC 3.5 (f) *(3 required)*
Adapter, Type-N (m) to SMA (m)

Adapter, Type-N (m) to BNC (f)
Adapter, Type-N (m) to Type-N (m)
Adapter, SMA (f) to BNC (m)
Adapter, APC 3.5 (f) to APC 3.5 (f)

Procedure

This performance test consists of two parts:

Part 1: Third Order Intermodulation Distortion

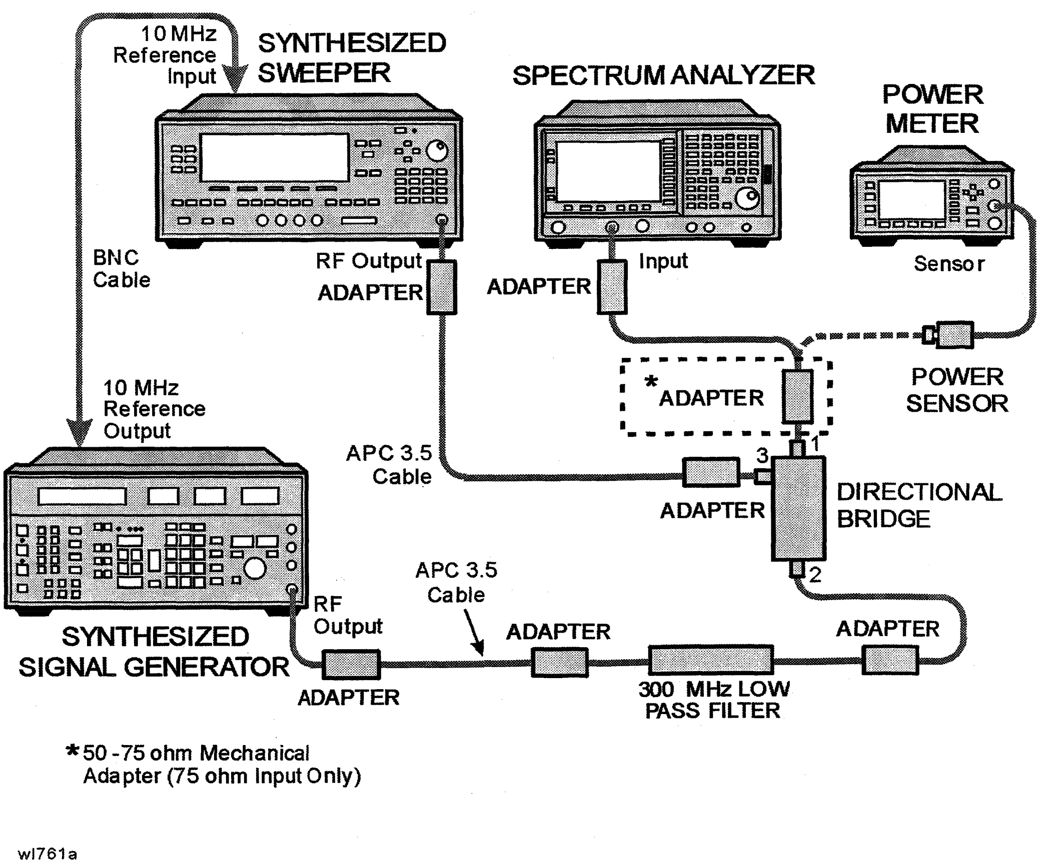
Part 2: Second Harmonic Distortion

Perform Part 1 before Part 2.

Part 1: Third Order Intermodulation Distortion

1. Zero and calibrate the power meter and RF power sensor in log mode (power reads out in dBm), as described in the power meter operation manual.

Figure 2-44 Third Order Intermodulation Distortion Test Setup



2. Connect the equipment as shown in Figure 2-44 with the output of the directional bridge connected to the power sensor.

3. Perform step 4 through step 29 using the information and entries from Table 2-65. Then continue on with step 30 through step 38.

Table 2-65 Test Equipment Settings for TOI

TOI Test	F1, MHz	F2, MHz	Low Pass Filter, MHz
1	300.0	300.05	300
Option 1DR	300.0	300.05	300

4. Press **Blue Key, Special, 0, 0** on the signal generator. Set the frequency to F1 in Table 2-65 for TOI Test 1. Set the amplitude to –10 dBm.

5. Press **PRESET** on the synthesized sweeper, and set the frequency to F2 in Table 2-65 for TOI Test 1. Set the synthesized sweeper controls as follows:

   POWER LEVEL, +4 dBm
   RF Off

6. Enter the power sensor calibration factor for the signal generator frequency into the power meter.

7. Adjust the amplitude of the signal generator until the power meter reads –12 dBm ±0.1 dB.

8. Disconnect the power sensor from the directional bridge. Connect the directional bridge directly to the analyzer input using an adapter (do not use a cable).

CAUTION Support the directional bridge and low pass filter to minimize stress on the analyzer input connector.

9. On the analyzer, press **Preset**, then wait until the preset routine is finished. Press: **System, Alignments, Auto Align, Off.** Set up the analyzer by pressing the following keys:

   FREQUENCY, CF Step, 50 kHz (Man)
   SPAN, 20 kHz
   AMPLITUDE, More, Y Axis Units (or Amptd Units), dBm
   AMPLITUDE, Ref Level, –5 dBm
   AMPLITUDE, Attenuation, 5 dB (Man)
   BW/Avg, 1 kHz (Man)
   BW/Avg, Video BW, 300 Hz (Man)
   Peak Search (or Search), More, Search Param, Peak Excursn, 3 dB

10.On the analyzer, press the following keys:

Peak Search (or Search)
Meas Tools
Mkr → CF
Delta

11.On the analyzer, press: **FREQUENCY**, ↑.

12.If the resolution bandwidth is ≥1 kHz, press: **SPAN, 4 kHz**.

13.On the synthesized sweeper, set the RF on.

14. On the analyzer, press **Peak Search (or Search)**.

15.On the synthesized sweeper, adjust the power level until the ΔMkr1 amplitude reads 0 dB ±0.05 dB.

16.On the analyzer, press **FREQUENCY**, ↓, ↓. The center frequency should now be lower than the signal generator frequency by the CF Step value.

17.Set the spectrum analyzer reference level to –15 dBm.

18.On the analyzer, press: **BW/Avg**, **Average**, **20**, and wait for "`Vavg 20`" to appear along the left side of the display.

19.On the analyzer, press: **Peak Search (or Search)** and record the marker amplitude reading in Table 2-66 as the Lower Distortion Amplitude.

20.On the analyzer, press: **BW/Avg**, **Average Off**.

21.On the spectrum analyzer, press **FREQUENCY**, ↑, ↑, ↑. The center frequency should now be one CF Step value above the synthesized sweeper frequency.

22.Set the synthesized signal generator frequency to F2 as indicated in Table 2-65.

23.Set the synthesized sweep CW frequency to F1 as indicated in Table 2-65.

24.On the analyzer, press **BW/Avg**, **Average**, **20**, and wait for "`Vavg 20`" to appear along the left side of the display.

25.On the analyzer, press **Peak Search (or Search)** and record the marker amplitude reading in Table 2-66 as the Upper Distortion Amplitude.

26.On the analyzer, press **BW/Avg**, **Average Off**.

27.Of the Lower Distortion Amplitude and Upper Distortion Amplitudes recorded in Table 2-66, enter the most positive value as the Worst Distortion Amplitude in Table 2-66. For example, if the Upper Distortion Amplitude is –62 dBc and the Lower Distortion Amplitude is –63 dBc, enter –62 dBc as the Worst Distortion Amplitude.

28.Enter –17 dBm as the Mixer Level in Table 2-66 (–12 dBm input power – 5 dB input attenuation).

29.Calculate the equivalent TOI by subtracting one half of the Worst Distortion Amplitude (in dB) from the Mixer Level (in dBm). Enter the result in Table 2-66 as the Calculated TOI. For example, if the Worst Distortion Amplitude is –62 dBc and the Mixer Level is –17 dBm, the Calculated TOI would be:

$$\text{TOI} = -17\text{ dBm} - (-62\text{ dB}/2) = -17\text{ dBm} + 31\text{ dBm} = +14\text{ dBm}$$

Table 2-66 Third Order Intermodulation Distortion Worksheet

TOI Test	Lower Distortion Amplitude	Upper Distortion Amplitude	Worst Distortion Amplitude	Mixer Level	Calculated TOI
1					
Option 1DR					

30.If the analyzer is equipped with Option 1DR, Narrow Resolution Bandwidth, perform step 31 through step 36. Otherwise, continue with step 37.

31.Set synthesized signal generator frequency to F1 as indicated in Table 2-65 for TOI Test 1.

32.Set synthesized sweeper CW frequency to F2 as indicated in Table 2-65 for TOI Test 1.

33.On the spectrum analyzer, press **Preset**, then wait until the preset routine is finished. Press **System, Alignments, Auto Align, Off.** Set the spectrum analyzer by pressing the following keys:

FREQUENCY, CF Step, 50 kHz (Man)
SPAN, 20 kHz
AMPLITUDE, More, Y Axis Units (or Amptd Units), dBm
AMPLITUDE, Ref Level, –5 dBm
AMPLITUDE, Attenuation, 5 dB (Man)
BW/Avg, 1 kHz (Man)
BW/Avg, Video BW, 300 Hz (Man)
Peak Search (or Search), More, Search Param, Peak Excursn, 3 dB

34.On the analyzer, press the following keys:

Peak Search (or Search)
Meas Tools
Mkr → CF

35. Set the analyzer as follows:

SPAN, 500 Hz
BW/Avg, Resolution BW, 30 Hz
Video BW, 10 Hz

36. Repeat step 10 through step 29. This is the TOI test for Option 1DR.

37. On the analyzer, press **System, Alignments, Auto Align, On.**

38. Part 1: Third Order Intermodulation Distortion is complete. Proceed to Part 2: Second Harmonic Distortion.

Part 2: Second Harmonic Distortion

1. Zero and calibrate the power meter and RF power sensor. Enter the power sensor 300 MHz calibration factor into the power meter.

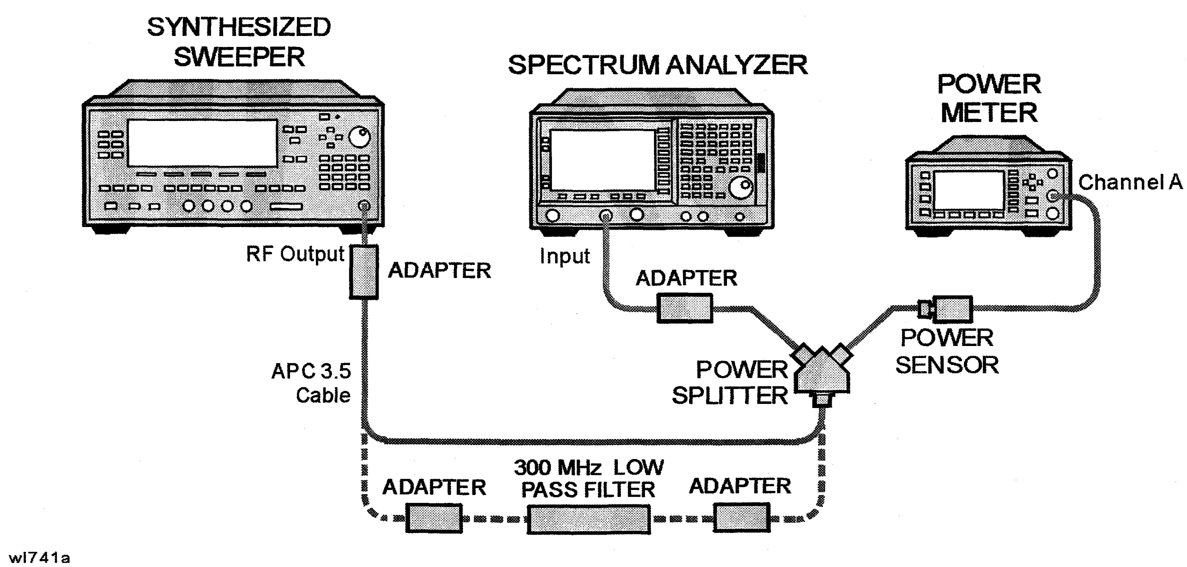
Measuring the 300 MHz Frequency Response Error

2. Press **Preset** on the analyzer, and set the controls as follows:

   FREQUENCY, 300 MHz
   SPAN, 10 MHz

3. Connect the equipment as shown in Figure 2-45, with the output of the synthesized sweeper connected to the power splitter input and the power splitter outputs connected to the analyzer and power sensor.

Figure 2-45 Second Harmonic Distortion Test Setup



4. Preset the synthesized sweeper and set the controls as follows:

   CW, 300 MHz
   POWER LEVEL, 0 dBm

5. On the analyzer, press **Peak Search (or Search), Marker, Delta.**
6. Record the power meter reading at 300 MHz in Table 2-67.
7. Set the synthesized sweeper CW to 600 MHz.
8. On the analyzer, press **FREQUENCY, 600 MHz**, then **Peak Search (or Search).**
9. Adjust the synthesized sweeper POWER LEVEL until the ΔMkr1 amplitude reads 0 dB ±0.10 dB.
10. Enter the power sensor 600 MHz calibration factor into the power meter.
11. Record the power meter reading at 600 MHz in Table 2-67.
12. Subtract the power meter reading at 600 MHz from the power meter reading at 300 MHz. Record this difference as the 300 MHz Frequency Response Error in Table 2-67. For example, if the power meter reading at 600 MHz is –6.45 dBm and the power meter reading at 300 MHz is –7.05 dBm, the 300 MHz Frequency Response Error would be –0.60 dB:

$$-0.60 \text{ dB} = -7.05 \text{ dBm} - (-6.45 \text{ dBm})$$

Table 2-67 Second Harmonic Distortion Worksheet

Description	Measurement
Power Meter Reading at 300 MHz	_______________ dBm
Power Meter Reading at 600 MHz	_______________ dBm
300 MHz Frequency Response Error (FRE)	_______________ dB

Measuring the 300 MHz Second Harmonic Distortion

1. Connect the equipment as shown in Figure 2-45 using the 300 MHz Low Pass Filter.
2. On the synthesized sweeper, press:

   CW, 300 MHz
   POWER LEVEL, –10 dBm

3. Enter the power sensor 300 MHz calibration factor into the power meter.

4. On the analyzer, press the following:

   FREQUENCY, 300 MHz
   SPAN, 100 kHz
   AMPLITUDE, Ref Level, –10 dBm
   AMPLITUDE, Attenuation, 10 dB (Man)
   BW/Avg, Resolution BW 1 kHz (Man)
   Video BW, 1 kHz (Man)
   Markers, Off

5. Adjust the synthesized sweeper POWER LEVEL until the power meter reading is –10 dBm ±0.2 dB.

6. On the analyzer, press the following:

   Peak Search (or Search), Marker, Delta
   FREQUENCY, 600 MHz
   BW/Avg, 10

   Wait for the "`Vavg 10`" to appear along the left side of the display.

7. On the analyzer, press **Peak Search (or Search)**. The ΔMkr1 amplitude is the second harmonic suppression.

8. Calculate the 300 MHz Second Harmonic Intercept (SHI) using the second harmonic suppression value read in step 7 and the 300 MHz Frequency Response Error (FRE) from Table 2-67 as follows:

$$300\text{ MHz SHI} = -20\text{ dBm} - \text{Second Harmonic Suppression} + 300\text{ MHz FRE}$$

   For example, if the second harmonic suppression is –59 dB, and the 300 MHz FRE is –0.60 dB, the SHI would be +38.4 dBm:

$$+38.4\text{ dBm} = -20\text{ dBm} - (-59\text{ dB}) + (-0.60\text{ dB})$$

9. On the synthesized sweeper, press **Marker, Off**.

31. Spurious Responses: HP E4404B, E4405B, E4407B, and E4408B

This test is performed in two parts. Part 1 measures third order intermodulation distortion; Part 2 measures second harmonic distortion.

To test second harmonic distortion, a low pass filter is used to filter the source output, ensuring that harmonics read by the spectrum analyzer are internally generated and not coming from the source. To measure the distortion products, the power at the mixer is set 25 dB higher than specified.

A power meter, power sensor, and power splitter are used to characterize the frequency response of the analyzer so this uncertainty can be eliminated.

For example, the specification states that with –30 dBm at the input mixer, the distortion products should be suppressed by >75 dBc, the equivalent second harmonic intercept (SHI) is > +45 dBm (–30 dBm + 75 dBc). Measuring with –15 dBm at the mixer and verifying the distortion products suppressed by >60 dBc also ensures the SHI is > +45 dBm (–15 dBm + 60 dBc).

For third order intermodulation distortion, two signals are combined in a directional bridge or directional coupler to provide isolation. These two signals are applied to the spectrum analyzer input. The power level of the two signals is several dB higher than specified, so the distortion products should be suppressed by less than the amount specified. In this manner, the equivalent third order intercept (TOI) is measured.

For example, the specification states that with two –30 dBm signals at the input mixer, the distortion products should be suppressed by >75 dBc, which yields a third order intercept of > +7.5 dBm (–30 dBm +(75 dBc/2)). Measuring with –20 dBm at the mixer and verifying the distortion products are suppressed by >55 dBc, the equivalent TOI is also > +7.5 dBm (–20 dBm + (55 dBc/2)).

There are no related adjustment procedures for this performance test.

Equipment Required

Synthesized sweeper (2 required)
Power meter, dual channel
Microwave power sensor
Microwave power splitter
Directional bridge
Directional coupler
300 MHz low pass filter
1 GHz low pass filter

1.8 GHz low pass filter *(2 required)*
4.4 GHz low pass filter *(2 required)*
Cable, BNC, 120-cm (48-in)
Cable, APC 3.5, 91-cm (48-in) *(2 required)*
Adapter, Type-N (m) to APC 3.5 (f) *(3 required)*
Adapter, Type-N (m) to SMA (m)
Adapter, Type-N (m) to BNC (f)
Adapter, Type-N (m) to Type-N (m)
Adapter, SMA (f) to BNC (m)
Adapter, APC 3.5 (f) to APC 3.5 (f)

Procedure

This performance test consists of two parts:

Part 1: Third Order Intermodulation Distortion

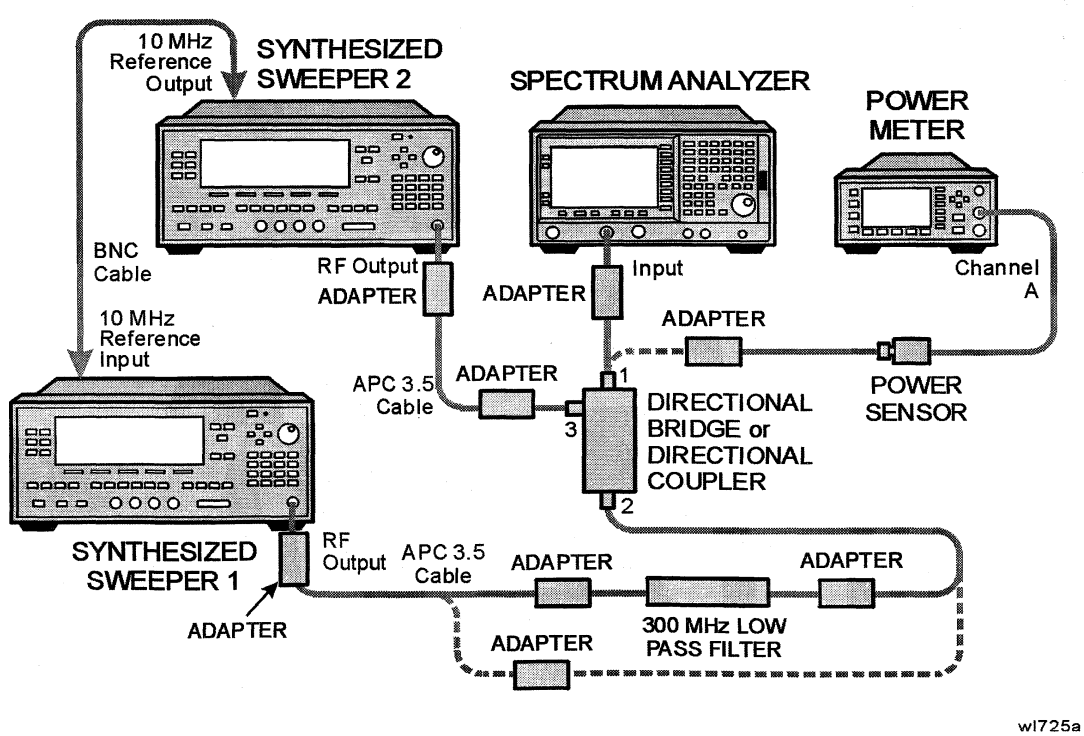
Part 2: Second Harmonic Distortion

Perform Part 1 before Part 2.

Part 1: Third Order Intermodulation Distortion

1. Zero and calibrate the power meter and microwave power sensor in log mode (power reads out in dBm), as described in the power meter operation manual.

Figure 2-46 Third Order Intermodulation Distortion Test Setup



2. Connect the equipment as shown in Figure 2-46 using the 300 MHz low pass filter with the output of the directional bridge connected to the power sensor.

3. Perform step 4 through step 29 using the information and entries from Table 2-68. Then continue on with step 31 through step 44.

Table 2-68 Test Equipment Settings for TOI

TOI Test	F1, MHz	F2, MHz	Low Pass Filter, MHz	Bridge or Coupler	Presel Center
1	300.0	300.05	300	Bridge	No
Option 1DR	300.0	300.05	300	Bridge	No
2	5000.0	5000.05	None	Coupler	Yes
3	8000.0	8000.05	None	Coupler	Yes

4. Press **PRESET** on synthesized sweeper 1. Set the CW frequency to F1 as indicated in Table 2-68, and set the power level to –10 dBm.

5. Press **PRESET** on synthesized sweeper 2. Set the CW frequency to F2 as indicated in Table 2-68, and set the controls as follows:

   POWER LEVEL, +4 dBm
   RF Off

6. Enter the power sensor calibration factor for F1 into the power meter.

7. Adjust the power level of synthesized sweeper 1 until the power meter reads –12 dBm ±0.1 dB.

8. Disconnect the power sensor from the directional bridge (or directional coupler). Connect the directional bridge (or directional coupler) directly to the analyzer input using an adapter (do not use a cable).

CAUTION Support the directional bridge (or directional coupler) and low pass filter to minimize stress on the analyzer input connector.

9. On the analyzer, press **Preset**, then wait until the preset routine is finished. Press **System, Alignments, Auto Align, Off.** Set up the analyzer by pressing the following keys:

   FREQUENCY, CF Step, 50 kHz (Man)
   SPAN, 20 kHz
   AMPLITUDE, Ref Level, –5 dBm
   AMPLITUDE, Attenuation, 5 dB (Man)
   BW/Avg, 1 kHz (Man)
   BW/Avg, Video BW, 300 Hz (Man)

Peak Search (or Search), More, Search Param, Peak Excursn, 3 dB

10.On the analyzer, press the following keys:

Peak Search (or Search)
Meas Tools
Mkr → CF
Delta

11.On the analyzer, Press **FREQUENCY**, ↑. The center frequency should now be equal to synthesized sweeper 2 frequency.

12.If the resolution bandwidth is ≥ 1 kHz, press **SPAN, 4 kHz**.

13.On the synthesized sweeper 2, set the RF On.

14. On the analyzer, press **Peak Search (or Search)**.

15.Adjust the power level of synthesized sweeper 2 until the ΔMkr1 amplitude reads 0 dB ±0.05 dB.

16.On the analyzer, press **FREQUENCY**, ↓, ↓. The center frequency should now be lower than synthesized sweeper 1 by the CF Step value.

17.Set the spectrum analyzer reference level to –15 dBm.

18.On the analyzer, press **BW/Avg, Average, 20**, and wait for "`Vavg 20`" to appear along the left side of the display.

19.On the analyzer, press **Peak Search (or Search)** and record the marker amplitude reading in Table 2-69 as the Lower Distortion Amplitude.

20.On the analyzer, press **BW/Avg, Average Off**.

21.On the analyzer, press **FREQUENCY**, ↑, ↑, ↑. The center frequency should now be one CF Step value above synthesized sweeper 2 frequency.

22.Set synthesized sweeper 1 CW to F2 as indicated in Table 2-68.

23.Set synthesized sweeper 2 CW to F1 as indicated in Table 2-68.

24.On the analyzer, press **BW/Avg, Average, 20**, and wait for "Vavg 20" to appear along the left side of the display.

25.On the analyzer, press **Peak Search (or Search)** and record the marker amplitude reading in Table 2-69 as the Upper Distortion Amplitude.

26.On the analyzer, press **BW/Avg, Average Off**.

27.Of the Lower Distortion Amplitude and Upper Distortion Amplitudes recorded in Table 2-69, enter the most positive value as the Worst Distortion Amplitude in Table 2-69. For example, if the Upper Distortion Amplitude is –62 dBc and the Lower Distortion Amplitude is –63 dBc, enter –62 dBc as the Worst Distortion Amplitude.

28.Enter –17 dBm as the Mixer Level in Table 2-69 (–12 dBm input power – 5 dB input attenuation).

29.Calculate the equivalent TOI by subtracting one half of the Worst Distortion Amplitude (in dB) from the Mixer Level (in dBm). Enter the result in Table 2-69 as the Calculated TOI. For example, if the Worst Distortion Amplitude is –62 dBc and the Mixer Level is –17 dBm, the Calculated TOI would be:

$$TOI = -17\ dBm - (-62\ dB/2) = -17\ dBm + 31\ dBm = +14\ dBm$$

30.Record the Calculated TOI in the performance verification test record as specified in Table 2-69.

Table 2-69 Third Order Intermodulation Distortion Worksheet

TOI Test	Lower Distortion Amplitude	Upper Distortion Amplitude	Worst Distortion Amplitude	Mixer Level	Calculated TOI (TR Entry)
1					**1**
Option 1DR					**2**
2					**3**
3					**4**

31.If the analyzer is equipped with Option 1DR, Narrow Resolution Bandwidth, perform step 32 through step 37. Otherwise, continue with step 38.

32.Set synthesized sweeper 1 CW frequency to F1 as indicated in TOI Test 1 of Table 2-68.

33.Set synthesized sweeper 2 CW frequency to F2 as indicated in TOI Test 1 of Table 2-68.

34.On the analyzer, press **Preset**, and wait until the preset routine is finished. Press **System, Alignments, Auto Align, Off.** Set the analyzer by pressing the following keys:

FREQUENCY, CF Step, 50 kHz (Man)
SPAN, 20 kHz
AMPLITUDE, Ref Level, –5 dBm
AMPLITUDE, Attenuation, 5 dB (Man)
BW/Avg, 1 kHz (Man)
BW/Avg, Video BW, 300 Hz (Man)
Peak Search (or Search), More, Search Param, Peak Excursn, 3 dB

35.On the analyzer, press the following keys:

Peak Search (or Search)
Meas Tools
Mkr → CF

36.On the analyzer, press the following keys:

SPAN, 500 Hz
BW/Avg, Resolution BW, 30 Hz
BW/Avg, Video BW, 10 Hz

37.Repeat step 9 through step 26. This is the TOI test for Option 1DR.

38.Replace the directional bridge with the directional coupler. The cable from synthesized sweeper 1 should be connected directly to the input of the directional coupler; no low pass filter is required when testing frequencies >3 GHz. See Figure 2-46.

39.Connect the output of the directional coupler to the power sensor.

40.Repeat step 4 through step 29 using information and entries for TOI Test 2 in Table 2-68 and Table 2-69.

41.Connect the output of the directional bridge to the power sensor.

42. Repeat step 4 through step 29 using information and entries for TOI Test 3 in Table 2-68 and Table 2-69.

43.On the analyzer, press **System, Alignments, Auto Align, All.**

44.Part 1: Third Order Intermodulation Distortion is complete. Proceed to Part 2: Second Harmonic Distortion.

Part 2: Second Harmonic Distortion

1. Zero and calibrate the power meter and microwave power sensor. Enter the power sensor 300 MHz calibration factor into the power meter.

Measuring the Noise Level at 6.2 GHz

2. Remove any cables or adapters from the analyzer INPUT.
3. On the analyzer, press **Preset**, and wait until the preset routine is finished. Set the analyzer by pressing the following keys:

FREQUENCY, 6.2 GHz
SPAN, 0 Hz
AMPLITUDE, Ref Level, –40 dBm
AMPLITUDE, Attenuation, 10 dB
BW/Ave, Resolution BW 1 kHz
Video BW, 30 Hz
Sweep, Sweep time, 5 s

4. Wait until “VAvg 10” is displayed along the left side of the display.
5. Press **Peak Search (or Search)** and record the marker amplitude reading as the 6.2 GHz Noise Level in Table 2-70.

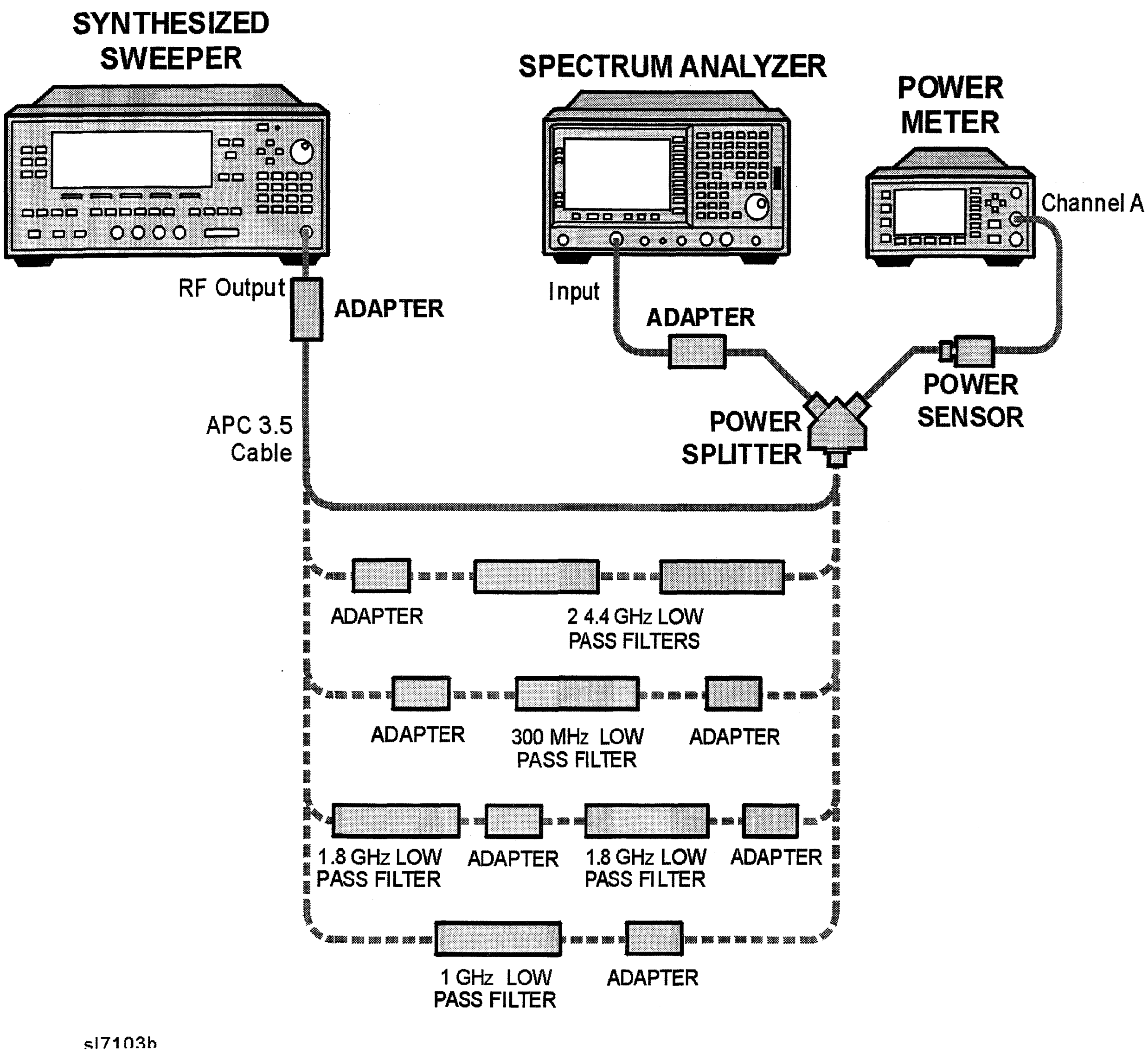
Measuring 300 MHz Frequency Response Error

1. Press **Preset** on the analyzer, and set the controls as follows:

   FREQUENCY, 300 MHz
   SPAN, 10 MHz

2. Connect the equipment as shown in Figure 2-47, with the output of the synthesized sweeper connected to the power splitter input and the power splitter outputs connected to the analyzer and power sensor.

Figure 2-47 Second Harmonic Distortion Test Setup



3. Preset the synthesized sweeper and set the controls as follows:

   CW, 300 MHz
   POWER LEVEL, 0 dBm

4. On the analyzer, press **Peak Search (or Search), Marker, Delta.**
5. Record the power meter reading at 300 MHz in Table 2-70.
6. Set the synthesized sweeper CW to 600 MHz.
7. On the analyzer, press **FREQUENCY, 600 MHz**, then **Peak Search (or Search).**
8. Adjust the synthesized sweeper POWER LEVEL until the ΔMkr1 amplitude reads 0 dB ±0.10 dB.
9. Enter the power sensor 600 MHz calibration factor into the power meter.
10. Record the power meter reading at 600 MHz in Table 2-70.
11. Subtract the power meter reading at 600 MHz from the power meter reading at 300 MHz. Record this difference as the 300 MHz Frequency Response Error in Table 2-70. For example, if the power meter reading at 600 MHz is –6.45 dBm and the power meter reading at 300 MHz is –7.05 dBm, the 300 MHz Frequency Response Error would be –0.60 dB:

$$-0.60 \text{ dB} = -7.05 \text{ dBm} - (-6.45 \text{ dBm})$$

Measuring 900 MHz Frequency Response Error

12. On the synthesized sweeper, press the following:

    CW, 900 MHz
    POWER LEVEL, 0 dBm

13. On the analyzer, press **FREQUENCY, 900 MHz.**
14. Enter the power sensor 1 GHz calibration factor into the power meter.
15. On the analyzer, press **Marker, Off.**
16. On the analyzer, press **Peak Search (or Search).**
17. On the analyzer, press **Peak Search (or Search), Marker, Delta.**
18. Record the power meter reading in Table 2-70 as the 900 MHz power meter reading.
19. On the synthesized sweeper, press **CW, 1.8 GHz.**
20. On the analyzer, press **FREQUENCY, 1.8 GHz.**
21. On the analyzer, press the following:

Peak Search (or Search)
AMPLITUDE
Presel Center

22.On the analyzer, press **Peak Search (or Search).**

23.Adjust the synthesized sweeper POWER LEVEL until the ΔMkr1 amplitude reads 0 dB ±0.1 dB.

24.Enter the power sensor 2 GHz calibration factor into the power meter.

25.Record the power meter reading in Table 2-70 as the 1.8 GHz power meter reading.

26.On the analyzer, press **Marker, Off.**

27.Subtract the power meter reading at 1.8 GHz from the power meter reading at 900 MHz. Record this difference as the 900 MHz Frequency Response Error in Table 2-70. For example, if the power meter reading at 1.8 GHz is –6.35 dBm and the power meter reading at 900 MHz is –7.05 dBm, the 900 MHz Frequency Response Error would be –0.7 dB:

$$-0.70\text{ dB} = -7.05\text{ dBm} - (-6.35\text{ dBm})$$

Measuring 1.55 GHz Frequency Response Error

1. On the synthesized sweeper, press the following:

   CW, 1.55 GHz
   POWER LEVEL, 0 dBm

2. On the analyzer, press **FREQUENCY, 1.55 GHz.**
3. Enter the power sensor 2 GHz calibration factor into the power meter.
4. On the analyzer, press **Marker, Off.**
5. On the analyzer, press the following:

   Peak Search (or Search)
   AMPLITUDE
   Presel Center

6. On the analyzer, press **Peak Search (or Search), Marker, Delta.**
7. Record the power meter reading in Table 2-70 as the 1.55 GHz power meter reading.
8. On the synthesized sweeper, press **CW, 3.1 GHz.**
9. On the analyzer, press **FREQUENCY, 3.1 GHz.**
10. On the analyzer, press the following:

Peak Search (or Search)
AMPLITUDE
Presel Center

11.On the analyzer, press **Peak Search (or Search).**

12.Adjust the synthesized sweeper POWER LEVEL until the ΔMkr1 amplitude reads 0 dB ±0.1 dB.

13.Enter the power sensor 3 GHz calibration factor into the power meter.

14.Record the power meter reading in Table 2-70 as the 3.1 GHz power meter reading.

15.On the analyzer, press **Marker, Off.**

16.Subtract the power meter reading at 3.1 GHz from the power meter reading at 1.55 GHz. Record this difference as the 1.55 GHz Frequency Response Error in Table 2-70. For example, if the power meter reading at 3.1 GHz is –6.05 dBm and the power meter reading at 1.55 GHz is –7.35 dBm, the 3.1 GHz Frequency Response Error would be –1.2 dB:

$$-1.2\text{ dB} = -7.35\text{ dBm} - (-6.15\text{ dBm})$$

Measuring 3.1 GHz Frequency Response Error

1. On the synthesized sweeper, press the following:

   CW, 3.1 GHz
   POWER LEVEL, 0 dBm

2. On the analyzer, press **FREQUENCY, 3.1 GHz.**
3. Enter the power sensor 3 GHz calibration factor into the power meter.
4. On the analyzer, press **Marker, Off.**
5. On the analyzer, press the following:

   Peak Search (or Search)
   AMPLITUDE
   Presel Center

6. On the analyzer, press **Peak Search (or Search), Marker, Delta.**
7. Record the power meter reading in Table 2-70 as the 3.1 GHz power meter reading.
8. On the synthesized sweeper, press **CW, 6.2 GHz.**
9. On the analyzer, press **FREQUENCY, 6.2 GHz.**
10. On the analyzer, press the following:

Peak Search (or Search)
AMPLITUDE
Presel Center

11.On the analyzer, press **Peak Search (or Search)**.

12.Adjust the synthesized sweeper POWER LEVEL until the ΔMkr1 amplitude reads 0 dB ±0.1 dB.

13.Enter the power sensor 6 GHz calibration factor into the power meter.

14.Record the power meter reading in Table 2-70 as the 6.2 GHz power meter reading.

15.On the analyzer, press **Marker, Off**.

16.Subtract the power meter reading at 6.2 GHz from the power meter reading at 3.1 GHz. Record this difference as the 3.1 GHz Frequency Response Error in Table 2-70. For example, if the power meter reading at 6.2 GHz is –6.05 dBm and the power meter reading at 3.1 GHz is –7.25 dBm, the 3.1 GHz Frequency Response Error would be –1.2 dB:

$$-1.2\ \text{dB} = -7.25\ \text{dBm} - (-6.05\ \text{dBm})$$

Table 2-70 Second Harmonic Distortion Worksheet

Description	Measurement
6.2 GHz Noise Level	________ dBm
Power Meter Reading at 300 MHz	________ dBm
Power Meter Reading at 600 MHz	________ dBm
300 MHz Frequency Response Error (FRE)	________ dB
Power Meter Reading at 900 MHz	________ dBm
Power Meter Reading at 1.8 GHz	________ dBm
900 MHz Frequency Response Error (FRE)	________ dB
Power Meter Reading at 1.55 GHz	________ dBm
Power Meter Reading at 3.1 GHz	________ dBm
1.55 GHz Frequency Response Error (FRE)	________ dB
Power Meter Reading at 3.1 GHz	________ dBm
Power Meter Reading at 6.2 GHz	________ dBm
3.1 GHz Frequency Response Error (FRE)	________ dB

Measuring 300 MHz Second Harmonic Distortion

1. Connect the equipment as shown in Figure 2-47 using the 300 MHz Low Pass Filter.
2. On the synthesized sweeper, press the following:

   CW, 300 MHz
   POWER LEVEL, –10 dBm

3. Enter the power sensor 300 MHz calibration factor into the power meter.
4. On the analyzer, press the following:

   FREQUENCY, 300 MHz
   SPAN, 100 kHz
   AMPLITUDE, Ref Level, –10 dBm
   AMPLITUDE, Attenuation, 10 dB (Man)
   BW/Avg, Resolution BW 1 kHz (Man)
   Video BW, 1 kHz (Man)
   Markers, Off

5. Adjust the synthesized sweeper POWER LEVEL until the power meter reading is –10 dBm ±0.2 dB.
6. On the analyzer, press the following:

   Peak Search (or Search), Marker, Delta
   FREQUENCY, 600 MHz
   BW/Avg, 10

   Wait for the "`VAvg 10`" to appear along the left side of the display.

7. On the analyzer, press **Peak Search (or Search)**. The ΔMkr1 amplitude is the second harmonic suppression.
8. Calculate the 300 MHz Second Harmonic Intercept (SHI) using the second harmonic suppression value read in step 7 and the 300 MHz Frequency Response Error (FRE) from Table 2-70 as follows:

$$300\text{ MHz SHI} = -20\text{ dBm} - \text{Second Harmonic Suppression} + 300\text{ MHz FRE}$$

   For example, if the second harmonic suppression is –59 dB, and the 300 MHz FRE is –0.60 dB, the SHI would be +38.4 dBm:

$$+38.4\text{ dBm} = -20\text{ dBm} - (-59\text{ dB}) + (-0.60\text{ dB})$$

9. Record the 300 MHz SHI as TR Entry 5 in the performance verification test record.

Measuring 900 MHz Second Harmonic Distortion

1. Replace the 300 MHz low pass filter with the 1 GHz low pass filters as shown in Figure 2-47.
2. On the synthesized sweeper, press the following:

   CW, 900 MHz
   POWER LEVEL, –10 dBm

3. Enter the power sensor 1 GHz calibration factor into the power meter.
4. On the analyzer, press **FREQUENCY, Center Freq, 900 MHz**.
5. On the analyzer, press **Peak Search (or Search)**.
6. Adjust the synthesized sweeper POWER LEVEL until the power meter reading is –10 dBm ±0.1 dB.
7. On the analyzer, press the following:

   Peak Search (or Search)
   Marker
   Delta

8. On the analyzer, press the following:

   FREQUENCY
   Center Freq, 1.8 GHz

9. On the analyzer, press the following:

   AMPLITUDE, Ref Level, –20 dBm
   Video BW, 30 Hz (Man)

10. On the analyzer, press **BW/Avg, Average, 10 Hz**. Wait until "`VAvg 10`" is displayed along the left side of the display.
11. On the analyzer, press **Peak Search (or Search)**. The ΔMkr1 amplitude reading is the second harmonic suppression.
12. Calculate the 900 MHz Second Harmonic Intercept (SHI) using the second harmonic suppression value read in step 11 and the 300 MHz Frequency Response Error (FRE) from Table 2-70 as follows:

$$900\text{ MHz SHI} = -20\text{ dBm} - \text{Second Harmonic Suppression} + 900\text{ GHz FRE}$$

For example, if the second harmonic suppression is –73 dB, and the 900 MHz FRE is 0.70 dB, the SHI would be +52.3 dBm:

$$+52.3\text{ dBm} = -20\text{ dBm} - (-73\text{ dB}) + (-0.70\text{ dB})$$

13. Record the 900 MHz SHI as TR Entry 6 in the performance verification test record.

Measuring 1.55 GHz Second Harmonic Distortion

1. Replace the 1.GHz low pass filter with the two 1.8 GHz low pass filters as shown in Figure 2-47. Two filters are necessary to reduce the second harmonics from the source to less than –100 dBc.
2. On the synthesized sweeper, press the following:

   CW, 1.55 GHz
   POWER LEVEL, +6 dBm

3. Enter the power sensor 2 GHz calibration factor into the power meter.
4. On the analyzer, press the following:

   FREQUENCY, 1.55 GHz
   AMPLITUDE, Ref Level, 0 dBm
   AMPLITUDE, Attenuation, 10 dB (man)

5. On the analyzer, press **Peak Search (or Search).**
6. Adjust the synthesized sweeper POWER LEVEL until the power meter reading is 0 dBm ±0.1 dB.
7. On the analyzer, press the following:

   Peak Search (or Search)
   Marker
   Delta

8. On the analyzer, press the following:

   FREQUENCY
   Center Freq, 3.1 GHz

9. Remove the 1.8 GHz low pass filters and connect the synthesized sweeper output directly to the power splitter input. See Figure 2-47.
10. On the analyzer, press the following:

    Peak Search (or Search)
    AMPLITUDE
    Presel Center

11. Reinstall the filters between the synthesized sweeper and the power splitter.
12. On the analyzer, press the following:

    AMPLITUDE, Ref Level, –40 dBm
    Video BW, 30 Hz (Man)

13. On the analyzer, press **BW/Avg, Average, 10 Hz**. Wait until "`VAvg 10`" is displayed along the left side of the display.
14. On the analyzer, press **Peak Search (or Search)**. The ΔMkr1 amplitude reading is the second harmonic suppression.

15.Calculate the 1.55 GHz Second Harmonic Intercept (SHI) using the second harmonic suppression value read in step 14 and the 300 MHz Frequency Response Error (FRE) from Table 2-70 as follows:

$$1.55\text{ GHz SHI} = -10\text{ dBm} - \text{Second Harmonic Suppression} + 1.55\text{ GHz FRE}$$

For example, if the second harmonic suppression is –93 dB, and the 1.55 GHz FRE is –1.05 dB, the SHI would be +81.95 dBm:

$$+81.95\text{ dBm} = -10\text{ dBm}-(-93\text{ dB}) + (-1.05\text{ dB})$$

16.ecord the 1.55 GHz SHI as TR Entry 7 in the performance verification test record.

Measuring 3.1 GHz Second Harmonic Distortion

1. Replace the 300 MHz low pass filter with the two 4.4 GHz low pass filters as shown in Figure 2-47. Two filters are necessary to reduce the second harmonics from the source to less than –110 dBc.
2. On the synthesized sweeper, press the following:

   CW, 3.1 GHz
   POWER LEVEL, +6 dBm

3. Enter the power sensor 3 GHz calibration factor into the power meter.
4. On the analyzer, press the following:

   FREQUENCY, 3.1 GHz
   AMPLITUDE, Ref Level, 0 dBm
   AMPLITUDE, Attenuation, 10 dB (man)

5. On the analyzer, press the following:

   Peak Search (or Search)
   AMPLITUDE
   Presel Center

6. Adjust the synthesized sweeper POWER LEVEL until the power meter reading is 0 dBm ±0.1 dB.
7. On the analyzer, press the following:

   Peak Search (or Search)
   Marker
   Delta

8. On the analyzer, press the following:

   FREQUENCY
   Center Freq, 6.2 GHz

9. Remove the 4.4 GHz low pass filters and connect the synthesized sweeper output directly to the power splitter input. See Figure 2-47.

10. On the analyzer, press the following:

    Peak Search (or Search)
    AMPLITUDE
    Presel Center

11. Reinstall the filters between the synthesized sweeper and the power splitter.

12. On the analyzer, press the following:

    AMPLITUDE, Ref Level, –40 dBm
    Video BW, 30 Hz (Man)

13. On the analyzer, press **BW/Avg, Average, 10 Hz**. Wait until "`VAvg 10`" is displayed along the left side of the display.

14. On the analyzer, press **Peak Search (or Search)**. The ΔMkr1 amplitude reading is the second harmonic suppression.

15. If the marker does not appear to be on a signal, do the following:

    a. Press **Marker, Select Marker (2)**

    b. Compare the Mkr2 and the 6.2 GHz Noise Level recorded in Table 2-70.

    c. If the difference between Mkr2 and the 6.2 GHz Noise Level recorded in Table 2-70 is less than 2 dB, check the box on the performance verification test record that the 3.1 GHz SHI test was noise limited.

16. If the measurement is not noise limited, calculate the 3.1 GHz Second Harmonic Intercept (SHI) using the second harmonic suppression value read in step 14 and the 3.1 GHz Frequency Response Error (FRE) from Table 2-70 as follows:

$$3.1\ \text{GHz SHI} = -10\ \text{dBm} - \text{Second Harmonic Suppression} + 3.1\ \text{GHz FRE}$$

For example, if the second harmonic suppression is –103 dB, and the 3.1 GHz FRE is –1.20 dB, the SHI would be +91.8 dBm:

$$+91.8\ \text{dBm} = -10\ \text{dBm} - (-103\ \text{dB}) + (-1.20\ \text{dB})$$

17. Record the 3.1 GHz SHI as TR Entry 8 in the performance verification test record.

32. Gain Compression: HP E4401B, E4402B, E4403B, and E4411B

This test verifies the ability of the analyzer to measure relatively low-amplitude signals in the presence of higher-amplitude signals. Gain compression is measured by applying two signals, separated by a defined amount in frequency. The higher-amplitude signal is set to yield the specified total power at the input mixer (the power at the input mixer is defined as the input power level minus the input attenuation). The lower-amplitude signal is set at least 35 dB below the higher-amplitude signal, such that its power does not significantly add to the total power. The higher-amplitude signal is turned off and the lower-amplitude signal level is measured. This is the uncompressed amplitude.

The higher-amplitude signal is turned on and the amplitude of the lower-amplitude signal is again measured. This is the compressed amplitude. The difference between the uncompressed and compressed amplitude is the measured gain compression.

There are no adjustments related to this performance test.

Equipment Required

Synthesized sweeper
Synthesized signal generator
Power meter, dual channel
RF power sensor
Directional bridge
Cable, BNC, 120-cm (48-in)
Cable, APC 3.5 (m) (*2 required*)
Adapter, Type-N (m) to Type-N (m)
Adapter, Type-N (m) to APC 3.5 (f) (*3 required*)
Adapter, Type-N (m) to SMA (m)

Additional Equipment for 75 Ω Input

Power sensor, 75 Ω
Adapter, Type-N (m), to BNC (m), 75 Ω
Adapter, mechanical, Type-N (m), 50 Ω to Type-N (f), 75 Ω

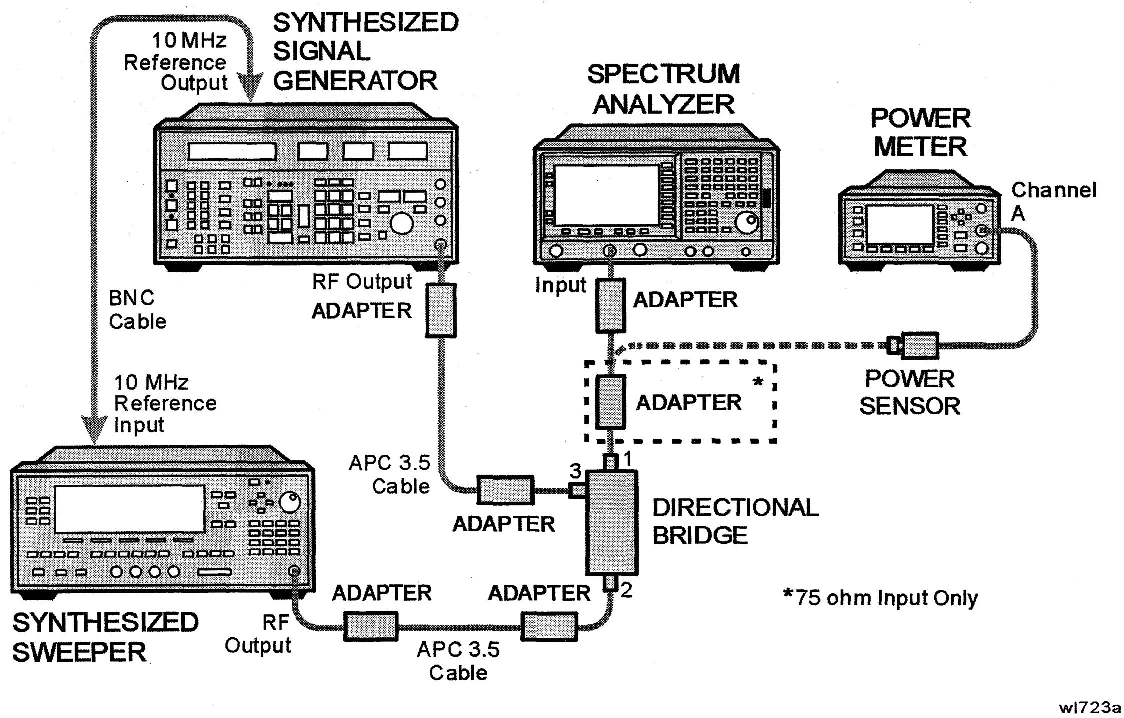
Procedure

1. Zero and calibrate the power meter and power sensor combination in log mode (power reads out in dBm) as described in the power meter operation manual.

2. Connect the equipment as shown in Figure 2-48, with port 1 of the directional bridge connected to the power sensor.

   75 Ω Input only: Use the 75 Ω power sensor with the mechanical adapter. The power measured at the output of the 50 Ω directional bridge by the 75 Ω power sensor is the equivalent power "seen" by the 75 Ω analyzer.

Figure 2-48 Gain Compression Test Setup



CAUTION Use only 75 Ω cables, connectors, or adapters on instruments with 75 Ω connectors, or damage to the connectors will occur.

3. Set the synthesized signal generator controls as follows:

   FREQUENCY, 50 MHz
   AMPLITUDE, −100 dBm

4. Press **INSTRUMENT PRESET** on the synthesized sweeper, then set the controls as follows:

   CW, 53 MHz
   POWER LEVEL, −3 dBm

5. Enter the power sensor calibration factor for the synthesizer frequency into the power meter.

6. Adjust the synthesized sweeper power level setting until the power meter reading is the same as indicated in Table 2-71.

7. Record the actual synthesized sweeper power level setting in Table 2-71 for each frequency indicated.

Table 2-71 Source Frequency and Amplitude Settings

Synthesized Signal Generator		Synthesized Sweeper		
Frequency, GHz	Amplitude, dBm	CW Frequency, MHz	Desired Power Level, dBm	Actual Power Level, dBm
0.05	–40	53	0.0	
0.05	–40	50.004	0.0	
1.40	–40	1403	0.0	
2.50[a]	–40[a]	2503[a]	0.0[a]	

a. E4402B and E4403B only.

Table 2-72 Spectrum Analyzer Settings

Test Frequency	Spectrum Analyzer							TR Entry
MHz	Center Freq GHz	Span kHz	RBW kHz	VBW kHz	Ref Lvl dBm	Scale dB/	Atten dB	
53	0.05	150	30	0.300	–10.0	10	0.0	1
50.004[a]	0.05[a]	1.0[a]	0.030[a]	0.030[a]	–10.0[a]	10[a]	0.0[a]	2
1403	1.40	150	30	0.300	–10.0	10	0.0	3
2503[b]	2.50[b]	150[b]	30[b]	0.300[b]	–10.0[b]	10[b]	0.0[b]	4

a. Option 1DR only.
b. E4402B and E4403B only.

8. Repeat step 3 through step 7 for each of the settings listed in Table 2-71.

9. Disconnect the power sensor from the directional bridge and connect the directional bridge to the input of the analyzer using an adapter. Do not use a cable.

   75 Ω *Input only: Use a 75* Ω *adapter, Type-N (m) to BNC (m) and a mechanical adapter, Type-N (m) 50* Ω to *Type-N (f) 75* Ω

10. Set the synthesized sweeper amplitude Off.

11. Set the synthesized signal generator amplitude to –24 dBm.

12. On the analyzer, press **Preset**, then wait for the preset routine to finish. Press **System**, **Alignments**, **Auto Align**, **Off**. Set up the analyzer as follows:

    FREQUENCY, **Center Freq, 50 MHz** (*or as indicated in* Table 2-72)
    SPAN, **150 kHz** (*or as indicated in* Table 2-72)
    AMPLITUDE, **More 1 of 2**, **Y Axis Units (or Amptd Units)**, **dBm**
    AMPLITUDE, **Ref Level**, **−10 dBm**, **Attenuation 0 dB**
    AMPLITUDE, **Scale/Div**, **10 dB**
    BW/Avg, **Resolution BW**, **30 kHz** (*or as indicated in* Table 2-72)
    BW/Avg, **Video BW**, **300 Hz** (*or as indicated in* Table 2-72)

13. On the synthesized sweeper, set the appropriate power level to the setting recorded in Table 2-71. Then set RF to Off.

    75 Ω *Input only: Adjust the power level for a 2.0 dBm reading.*

14. On the analyzer, press **Peak Search (or Search)**.

15. Adjust the amplitude of the synthesized signal generator to achieve a marker amplitude reading within 0.5 dB of the value indicated in Table 2-71. The marker amplitude is the uncompressed amplitude.

16. On the analyzer, press the following keys:

    Peak Search (or Search)
    Marker
    Delta

17. On the synthesized sweeper, set RF to On. The amplitude should be the same as recorded in Table 2-71.

18. On the spectrum analyzer, press **Peak Search (or Search)**. This is the compressed amplitude. The ΔMkr1 amplitude is the measured gain compression.

19. Record the measured gain compression in the performance test record as the TR Entry listed in Table 2-72.

20. Repeat step 6 through step 19 for each set of settings in Table 2-71 and Table 2-72.

33. Gain Compression: HP E4404B, E4405B, E4407B, and E4408B

This test verifies the ability of the analyzer to measure relatively low-amplitude signals in the presence of higher-amplitude signals. Gain compression is measured by applying two signals, separated by a defined amount in frequency. The higher-amplitude signal is set to yield the specified total power at the input mixer (the power at the input mixer is defined as the input power level minus the input attenuation). The lower-amplitude signal is set at least 35 dB below the higher-amplitude signal, such that its power does not significantly add to the total power. The higher-amplitude signal is turned off and the lower-amplitude signal level is measured. This is the uncompressed amplitude.

The higher-amplitude signal is turned on and the amplitude of the lower-amplitude signal is again measured. This is the compressed amplitude. The difference between the uncompressed and compressed amplitude is the measured gain compression.

There are no adjustments related to this performance test.

Equipment Required

Synthesized sweeper (*2 required*)
Power meter, dual channel
Microwave power sensor
Directional bridge
Directional coupler
Cable, BNC, 120-cm (48-in)
Cable, APC 3.5 (m) (*2 required*)
Adapter, Type-N (m) to Type-N (m)
Adapter, Type-N (m) to APC 3.5 (f) (3 *required*)
Adapter, Type-N (m) to SMA (m)

Additional Equipment for Option BAB

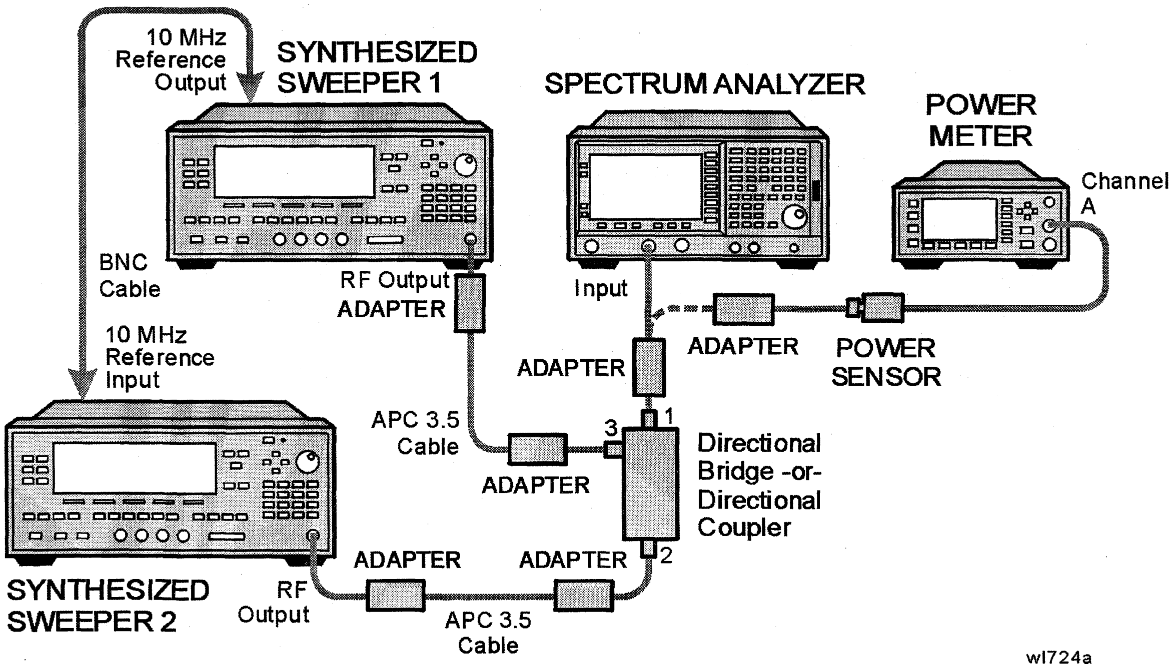
Adapter, Type-N (m), to APC 3.5 (f)

Procedure

1. Zero and calibrate the power meter and power sensor combination in log mode (power reads out in dBm) as described in the power meter operation manual.

2. Connect the equipment as shown in Figure 2-49, with the load port of the directional bridge connected to the power sensor. The directional bridge should be used for measurements of frequencies less than or equal to 2.5 GHz. Use the directional coupler for higher frequency measurements.

Figure 2-49 Gain Compression Test Setup



3. Press PRESET on synthesized sweeper 1, then set the controls as follows:

   CW, 50 MHz
   POWER LEVEL, −100 dBm

4. Press **PRESET** on synthesized sweeper 2, then set the controls as follows:

   CW, 53 MHz
   POWER LEVEL, −3 dBm

5. Enter the power sensor calibration factor for the synthesized sweeper 2 frequency into the power meter.

6. Adjust the synthesized sweeper 2 power level setting until the power meter reading is the same as indicated in Table 7.

7. Record the actual synthesized sweeper 2 power level setting in

Table 7 for each frequency indicated.

Table 2-73 Source Frequency and Amplitude Settings

First Synthesized Sweeper		Second Synthesized Sweeper		
CW Frequency, MHz	Power Level, dBm	CW Frequency, MHz	Desired Power Level, dBm	Actual Power Level, dBm
50	–40	53	–5.0	
50	–40	50.004	–5.0	
1400	–40	1403	0.0	
2500	–40	2503	0.0	
4400	–40	4403	0.0	
7600[b]	–40	7603	0.0	
14000[b]	–40	14003	0.0	

Table 2-74 Spectrum Analyzer Settings

Test Frequency	Spectrum Analyzer							TR Entry
MHz	Center Freq GHz	Span kHz	RBW kHz	VBW kHz	Ref Lvl dBm	Scale dB/	Atten dB	
53	0.05	150	30	0.300	–10.0	10	0.0	1
50.004[a]	0.05[a]	1.0[a]	0.030[a]	0.030[a]	–10.0[a]	10[a]	0.0[a]	2
1403	1.40	150	30	0.300	–10.0	10	0.0	3
2503	2.50	150	30	0.300	–10.0	10	0.0	4
4403	4.40	150	30	0.300	–10.0	10	0.0	5
7603[b]	7.60	150	30	0.300	–10.0	10	0.0	6
14003[b]	14.0	150	30	0.300	–10.0	10	0.0	7

a. Option 1DR only.
b. HP E4405B, E4407B and E4408B only.

8. Repeat step 3 through step 7 for each of the settings listed in Table 7. Use the directional bridge in place of the coupler for frequencies less than or equal to 2503 MHz.

9. Disconnect the power sensor from the directional bridge and connect the directional bridge to the input of the analyzer using an adapter. Do not use a cable.

10. Set the synthesized sweeper 2 power level to Off.

11. Set the synthesized sweeper 1 power level to –24 dBm.

12. On the analyzer, press **Preset**, then wait for the preset routine to finish. Press: **System, Alignments, Auto Align, Off**. Set up the analyzer as follows:

    FREQUENCY, Center Freq, 50 MHz (*or as indicated in* Table 2-74)
    SPAN, 150 kHz (*or as indicated in* Table 2-74)
    AMPLITUDE, Ref Level, –10 dBm, Attenuation 0 dB
    AMPLITUDE, Scale/Div, 10 dB
    BW/Avg, Resolution BW, 30 kHz (*or as indicated in* Table 2-74)
    BW/Avg, Video BW, 300 Hz (*or as indicated in* Table 2-74)

13. On the synthesized sweeper 2, set the appropriate power level to the setting recorded in Table 2-73. Then set RF to Off.

14. On the analyzer, press **Peak Search (or Search).**

15. Adjust the power level of the synthesized sweeper 1 to achieve a marker amplitude reading within 0.5 dB of the value indicated in Table 2-73. The marker amplitude is the uncompressed amplitude.

16. On the analyzer, press the following keys:

    Peak Search (or Search)
    Marker
    Delta

17. On the synthesized sweeper 2, set RF to On. The amplitude should be the same as recorded in Table 2-73.

18. On the spectrum analyzer, press **Peak Search (or Search)**. This is the compressed amplitude. The ΔMkr1 amplitude is the measured gain compression.

19. Record the measured gain compression in the performance test record as the TR Entries indicated in Table 2-74.

20. Repeat step 10 through step 19 for each set of settings in Table 2-73 and Table 2-74 for frequencies less than or equal to 2503 MHz.

21. Replace the directional bridge with the directional coupler.

22. Repeat step 10 through step 19 for the remaining frequencies in Table 2-73.

34. Displayed Average Noise Level: HP E4401B and HP E4411B

This performance test measures the displayed average noise level (DANL) within the frequency range specified. The analyzer input is terminated in its characteristic impedance. If the analyzer is also equipped with a tracking generator (Option 1DN or 1DQ), the tracking generator is also terminated in its characteristic impedance and set for maximum leveled output power.

The test tunes the analyzer frequency across the band, uses the marker to locate the frequency with the highest response, and then reads the average noise in a narrow span.

To reduce measurement uncertainty due to input attenuator switching and resolution bandwidth switching, a reference level offset is added. The 50 MHz alignment signal is used as the amplitude reference for determining the amount of offset required. The offset is removed at the end of the test by pressing instrument preset.

For analyzers equipped with narrow resolution bandwidths (Option 1DR), DANL is also tested in the 10 Hz resolution bandwidth setting.

The related adjustment for this procedure is “Frequency Response.”

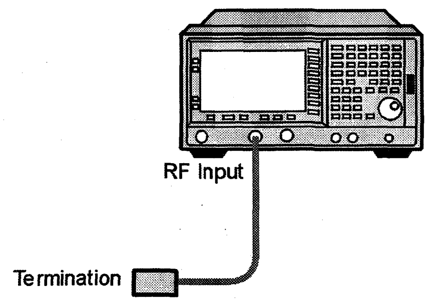
Equipment Required

Termination, 50 Ω, Type-N (m) (*2 required for Options 1DN or 1DQ*)

Additional Equipment for 75 Ω Input

Termination, 75 Ω, Type-N (m) (*2 required for Option 1DQ*)
Adapter, Type-N (f), to BNC (m), 75 Ω

Figure 2-50 **Displayed Average Noise Level Test Setup**



CAUTION Use only 75 Ω cables, connectors, or adapters on instruments with 75 Ω connectors, or damage to the connectors will occur.

Procedure

1. Set up the analyzers as shown in Figure 2-50.
2. On the analyzer, press **Preset**, then wait for the preset routine to finish. Set the analyzer by pressing the following keys:

   Input/Output (or Input), Amptd Ref Out (On)
   FREQUENCY, 50 MHz
   SPAN, 2 kHz
   AMPLITUDE, –25 dBm (*50 Ω Input only*)
   AMPLITUDE, +28.75 dBmV (75 Ω *Input only*)
   AMPLITUDE, Attenuation, 10 dB
   AMPLITUDE, More, Y Axis Units (or Amptd Units), dBm
   BW/Avg, Resolution BW, 1 kHz
   BW/Avg, Video BW, 1 kHz
   Det/Demod, Detector, Sample, Return

3. On the analyzer, press **Single**.
4. On the analyzer, press **Peak Search (or Search)** and record the Ref Amptd reading below.

   Ref Amptd ___________ dB

5. On the analyzer, press the following keys:

   AMPLITUDE, Attenuation, 0 dB
   SPAN, 20 kHz
   BW/Avg, Resolution BW, 1 kHz

BW/Avg, Video BW, 30 Hz

6. On the analyzer, press **Single**.
7. On the analyzer, press **Peak Search (or Search)** and record the amplitude reading below as Meas Amptd(1 kHz RBW).

   Meas Amptd(1 kHz RBW)__________ dB

8. Calculate the necessary reference level offset by subtracting the Meas Amptd in step 7 from the Ref Amptd in step 4. If the calculated Ref Lvl Offst is greater that +0.05 dB or less than –0.05 dB, record the Ref Lvl Offst value below. Otherwise, enter 0.

$$\text{Ref Lvl Offset(1 kHz RBW)} = \text{Ref Amptd} - \text{Meas Amptd(1 kHz RBW)}$$

   Ref Lvl Offst(1 kHz RBW)__________ dB

9. If the analyzer is not equipped with Option 1DR, proceed to step 14.
10. On the analyzer, press the following keys:

    AMPLITUDE, Attenuation, 0 dB
    SPAN, 500 Hz
    BW/Avg, Resolution BW, 10 Hz
    BW/Avg, Video BW, 1 Hz

11. On the analyzer, press **Single**.
12. On the analyzer, press **Peak Search (or Search)** and record the amplitude reading below as Meas Amptd(10 Hz RBW).

    Meas Amptd(10 Hz RBW)__________ dB

13. Calculate the necessary reference level offset by subtracting the Meas Amptd in step 12 from the Ref Amptd in step 4. If the calculated Ref Lvl Offst is greater that +0.05 dB or less than –0.05 dB, record the Ref Lvl Offst value below. Otherwise, enter 0.

$$\text{Ref Lvl Offset(10 Hz RBW)} = \text{Ref Amptd} - \text{Meas Amptd(10 Hz RBW)}$$

    Ref Lvl Offst(10 Hz RBW)__________ dB

14. On the analyzer, press **Input, Amptd Ref** (Off), then **AMPLITUDE, More, Ref Lvl Offst**, and enter the value recorded in step 8.
15. Connect the 50 Ω termination to the analyzer input as shown in Figure 2-50.

75 Ω Input only: Connect the 75 Ω termination to the analyzer Input 75 Ω using an adapter.

16. If the analyzer is equipped with Option 1DN, 50 Ω tracking generator, do the following:

    a. On the analyzer, press **Source, Amplitude, 0 dBm**.

    b. Connect a 50 Ω termination to the RF OUT 50 Ω.

17. If the analyzer is equipped with Option 1DQ, 75 Ω Tracking Generator, do the following:

    a. On the analyzer, press **Source, Amplitude, –6 dBm**.

    b. Connect a 75 Ω termination to the RF OUT 75 Ω.

Measurement Sequence

The DANL Measurement Sequence tables, for analyzers with 50 Ω inputs and for analyzers with 75 Ω inputs, list the procedures to be performed and the parameters to be used in each procedure. The table also lists the TR Entry number for recording the results in the performance verification test record.

1. If the analyzer is not equipped with Option 1DR, narrow bandwidths, or Option 1DS, preamplifier, perform only those procedures with an "X" ("X" = "Don't Care") in each of the Analyzer Options columns. For each procedure performed, use the appropriate Procedure Parameters as described in the DANL Measurement Sequence table. Record the display line amplitude setting as the indicated TR Entry in the performance verification test record.

2. If the analyzer is equipped with Option 1DR, but not Option 1DS, perform those procedures with an "X" in each of the Analyzer Options columns, and those procedures with a "Y" in the 1DR option column. For each procedure performed, use the appropriate Procedure Parameters as described in the DANL Measurement Sequence table. Record the display line amplitude setting as the indicated TR Entry in the performance verification test record.

3. If the analyzer is equipped with Option 1DS, but not Option 1DR, perform those procedures with an "X" in each of the Analyzer Options columns, and those procedures with a "Y" in the 1DS Option column. For each procedure performed, use the appropriate Procedure Parameters as described in the DANL Measurement Sequence table. Record the display line amplitude setting as the indicated TR Entry in the performance verification test record.

4. If the analyzer is equipped with both Option 1DS and Option 1DR, perform all procedures. For each procedure performed, use the appropriate Procedure Parameters as described in the DANL Measurement Sequence table. Record the display line amplitude setting as the indicated TR Entry in the performance verification test record.

5. After performing all applicable DANL measurement procedures, proceed to Remove Reference Level Offset.

Table 2-75 **DANL Measurement Sequence, 50 Ω Inputs**

Analyzer Options		Procedure	Procedure Parameters				TR Entry
1DR	1DS		Start Freq	Stop Freq	Test RBW	Preamp State	
X	X	Measure DANL at 400 kHz	N/A	N/A	1 kHz	Off	1
X	X	Measure DANL	1 MHz	10 MHz	1 kHz	Off	2
X	X	Measure DANL	10 MHz	500 MHz	1 kHz	Off	3
X	X	Measure DANL	500 MHz	1 GHz	1 kHz	Off	4
X	X	Measure DANL	1 GHz	1.5 GHz	1 kHz	Off	5
X	Y	Measure DANL at 400 kHz	N/A	N/A	1 kHz	On	6
X	Y	Measure DANL	1 MHz	10 MHz	1 kHz	On	7
X	Y	Measure DANL	10 MHz	500 MHz	1 kHz	On	8
X	Y	Measure DANL	500 MHz	1 GHz	1 kHz	On	9
X	Y	Measure DANL	1 GHz	1.5 GHz	1 kHz	On	10
Y	X	Measure DANL at 400 kHz	N/A	N/A	10 Hz	Off	11
Y	X	Measure DANL	1 MHz	10 MHz	10 Hz	Off	12
Y	X	Measure DANL	10 MHz	500 MHz	10 Hz	Off	13
Y	X	Measure DANL	500 MHz	1 GHz	10 Hz	Off	14
Y	X	Measure DANL	1 GHz	1.5 GHz	10 Hz	Off	15
Y	Y	Measure DANL at 400 kHz	N/A	N/A	10 Hz	On	16
Y	Y	Measure DANL	1 MHz	10 MHz	10 Hz	On	17
Y	Y	Measure DANL	10 MHz	500 MHz	10 Hz	On	18
Y	Y	Measure DANL	500 MHz	1 GHz	10 Hz	On	19
Y	Y	Measure DANL	1 GHz	1.5 GHz	10 Hz	On	20

Table 2-76 DANL Measurement Sequence, 75 Ω Inputs

Analyzer Options		Procedure	Procedure Parameters				TR Entry
1DR	1DS		Start Freq	Stop Freq	Test RBW	Preamp State	
X	X	Measure DANL	1 MHz	10 MHz	1 kHz	Off	21
X	X	Measure DANL	10 MHz	500 MHz	1 kHz	Off	22
X	X	Measure DANL	500 MHz	1 GHz	1 kHz	Off	23
X	X	Measure DANL	1 GHz	1.5 GHz	1 kHz	Off	24
X	X	Measure DANL	1 MHz	10 MHz	1 kHz	On	25
X	Y	Measure DANL	10 MHz	500 MHz	1 kHz	On	26
X	Y	Measure DANL	500 MHz	1 GHz	1 kHz	On	27
X	Y	Measure DANL	1 GHz	1.5 GHz	1 kHz	On	28
X	X	Measure DANL	1 MHz	10 MHz	1 kHz	Off	29
Y	X	Measure DANL	10 MHz	500 MHz	10 Hz	Off	30
Y	X	Measure DANL	500 MHz	1 GHz	10 Hz	Off	31
Y	X	Measure DANL	1 GHz	1.5 GHz	10 Hz	Off	32
X	X	Measure DANL	1 MHz	10 MHz	1 kHz	On	33
Y	Y	Measure DANL	10 MHz	500 MHz	10 Hz	On	34
Y	Y	Measure DANL	500 MHz	1 GHz	10 Hz	On	35
Y	Y	Measure DANL	1 GHz	1.5 GHz	10 Hz	On	36

Measuring Displayed Average Noise Level (DANL)

1. Set the analyzer as follows using the start and stop frequencies, test RBW and preamp state as specified in Table 2-75 or Table 2-76:

   Auto Couple
   FREQUENCY, Start Freq, *(enter specified start frequency)*
   FREQUENCY, Stop Freq, *(enter specified stop frequency)*
   AMPLITUDE, –70 dBm *(50 Ω Input only)*
   Attenuation, 0 dB
   AMPLITUDE, More, Y Axis Units (or Amptd Units), dBmV, More, Ref Level, –21.24 dBmV *(75 Ω Input only)*
   AMPLITUDE, More, Ref Lvl Offset, *(enter Ref Lvl Offset (1 kHz) if test RBW = 1 kHz)*
   AMPLITUDE, More, Ref Lvl Offset, *(enter Ref Lvl Offset (10 Hz) if test RBW = 10 Hz)*
   BW/Avg, Resolution BW, 100 kHz

BW/Avg, Video BW, 10 kHz
AMPLITUDE, More, Int Preamp (Off) (*if preamp state = Off*)
AMPLITUDE, More, Int Preamp (On) (*if preamp state = On*)
Sweep, Sweep (Cont)
Sweep, Sweep Time (Auto)

3. On the analyzer, press **Single, View/Trace, Trace 1, Clear Write, BW/Avg, Average Type (Video), Averages, 3, Enter, Single.**

   Wait until `VAvg 3` is displayed to the left of the graticule (the analyzer will take three sweeps, then stop).

2. On the analyzer, press **Peak Search (or Search).**
3. On the analyzer, press **BW/Avg, Average** (Off).
4. On the analyzer, press **Marker →,Mkr→ CF**.
5. If the test RBW is 1 kHz, press **Span, 20 kHz.**

   If the test RBW is 10 Hz, press **Span, 500 Hz.**
6. If the test RBW is 1 kHz, press **BW/Avg, Resolution BW, 1 kHz, Video BW, 30 Hz.**

   If the test RBW is 10 Hz, press **BW/Avg, Resolution BW, 10 Hz, Video BW, 1 Hz.**
7. On the analyzer, press **Single** and wait for the new sweep to finish.
8. On the analyzer, press **Display, Display Line** (On), and adjust the display line so that it is centered on the average trace noise, ignoring any residual responses (refer to the Residual Responses verification test for any suspect residuals).

Measuring Displayed Average Noise Level at 400 kHz

1. Press **FREQUENCY, Center Freq, 400 kHz**. Set the analyzer by pressing the following keys:

   SPAN, 20 kHz (*if test RBW = 1 kHz*)
   SPAN, 500 Hz (*if test RBW = 10 Hz*)
   AMPLITUDE, –70 dBm (*50 Ω Input only*)
   Attenuation, 0 dB
   AMPLITUDE, More, Y Axis Units (or Amptd Units), dBmV, More, Ref Level, –21.24 dBmV (*75 Ω Input only*)
   AMPLITUDE, More, Ref Lvl Offset, (*enter Ref Lvl Offset (1 kHz) if test RBW = 1 kHz*)
   AMPLITUDE, More, Ref Lvl Offset, (*enter Ref Lvl Offset (10 Hz) if test RBW = 10 Hz*)
   AMPLITUDE, More, Int Preamp (Off) (*if preamp state = Off*)
   AMPLITUDE, More, Int Preamp (On) (*if preamp state = On*)
   BW/Avg, Resolution BW, 1 kHz (*if test RBW = 1 kHz*)
   BW/Avg, Resolution BW, 10 Hz (*if test RBW = 10 Hz*)
   BW/Avg, Video BW, 30 Hz (*if test RBW = 1 kHz*)

BW/Avg, Video BW, 30 Hz (*if test RBW = 10 Hz*)

2. On the analyzer, press **Single** and wait for a new sweep to complete.
3. On the analyzer, press **Display**, **Display Line** (On). Adjust the display line so that it is centered on the average trace noise, ignoring any residual responses (refer to the Residual Responses verification test for any suspect residuals).

Remove Reference Level Offset

1. Press **AMPLITUDE, More, Ref Lvl Offst, 0 dB.**
2. On the analyzer, press **Preset**.

35. Displayed Average Noise Level: HP E4402B and HP E4403B

This performance test measures the displayed average noise level (DANL) within the frequency range specified. The analyzer input is terminated in its characteristic impedance. If the analyzer is also equipped with a tracking generator (Option 1DN), the tracking generator is also terminated in its characteristic impedance and set for maximum leveled output power.

The test tunes the analyzer frequency across the band, uses the marker to locate the frequency with the highest response, and then reads the average noise in a narrow span.

To reduce measurement uncertainty due to input attenuator switching and resolution bandwidth switching, a reference level offset is added. The 50 MHz alignment signal is used as the amplitude reference for determining the amount of offset required. The offset is removed at the end of the test by pressing instrument preset.

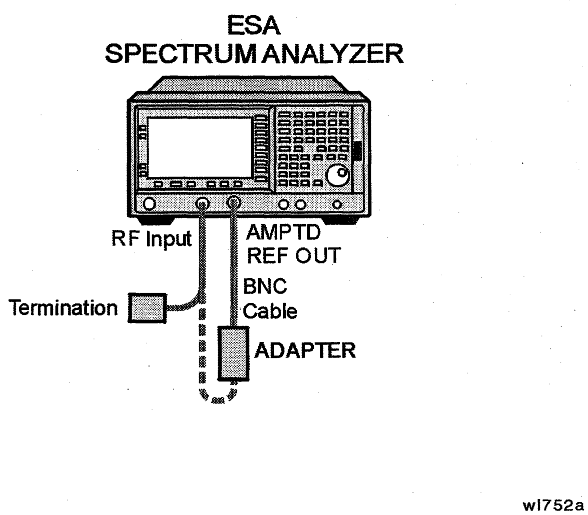
For analyzers equipped with narrow resolution bandwidths (Option 1DR), DANL is also tested in the 10 Hz resolution bandwidth setting.

The related adjustment for this procedure is “Frequency Response.”

Equipment Required

Termination, 50 Ω, Type-N (m) (*2 required for Option 1DN*)
Cable, BNC
Adapter, Type-N (m) to BNC (f)

Figure 2-51 **Displayed Average Noise Level Test Setup**



Procedure

1. Connect the AMPTD REF OUT to the Input 50 Ω using a BNC cable and adapter as shown in Figure 2-51.
2. On the analyzer, press **Preset**, then wait for the preset routine to finish. Set the analyzer by pressing the following keys:

   Input/Output (or Input), Amptd Ref Out (On)
   FREQUENCY, 50 MHz
   SPAN, 2 kHz
   AMPLITUDE, –20 dBm
   AMPLITUDE, Attenuation, 10 dB
   AMPLITUDE, More, Y Axis Units (or Amptd Units), dBm
   BW/Avg, Resolution BW, 1 kHz
   BW/Avg, Video BW, 1 kHz
   Det/Demod, Detector, Sample, Return

3. On the analyzer, press **Single**.
4. On the analyzer, press **Peak Search (or Search)** and record the Ref Amptd reading below.

   Ref Amptd ___________ dB

5. On the analyzer, press the following keys:

   AMPLITUDE, Attenuation, 0 dB
   SPAN, 20 kHz
   BW/Avg, Resolution BW, 1 kHz
   BW/Avg, Video BW, 30 Hz

6. On the analyzer, press **Single**.

7. On the analyzer, press **Peak Search (or Search)** and record the amplitude reading below as Meas Amptd(1 kHz RBW).

   Meas Amptd(1 kHz RBW)__________ dB

8. Calculate the necessary reference level offset by subtracting the Meas Amptd in step 7 from the Ref Amptd in step 4. If the calculated Ref Lvl Offst is greater that +0.05 dB or less than –0.05 dB, record the Ref Lvl Offst value below. Otherwise, enter 0.

$$\text{Ref Lvl Offset(1 kHz RBW)} = \text{Ref Amptd} - \text{Meas Amptd(1 kHz RBW)}$$

   Ref Lvl Offst(1 kHz RBW)__________ dB

9. If the analyzer is not equipped with Option 1DR, proceed to step 14.

10. On the analyzer, press the following keys:

    AMPLITUDE, Attenuation, 0 dB
    SPAN, 500 Hz
    BW/Avg, Resolution BW, 10 Hz
    BW/Avg, Video BW, 1 Hz

11. On the analyzer, press **Single**.

12. On the analyzer, press **Peak Search (or Search)** and record the amplitude reading below as Meas Amptd(10 Hz RBW).

    Meas Amptd(10 Hz RBW)__________ dB

13. Calculate the necessary reference level offset by subtracting the Meas Amptd in step 12 from the Ref Amptd in step 4. If the calculated Ref Lvl Offst is greater that +0.05 dB or less than –0.05 dB, record the Ref Lvl Offst value below. Otherwise, enter 0.

$$\text{Ref Lvl Offset(10 Hz RBW)} = \text{Ref Amptd} - \text{Meas Amptd(10 Hz RBW)}$$

    Ref Lvl Offst(10 Hz RBW)__________ dB

14. On the analyzer, press **Input, Amptd Ref Out** (Off), then **AMPLITUDE, More, Ref Lvl Offst**, and enter the value recorded in step 8.

15. Connect the 50 Ω termination to the analyzer input as shown in Figure 2-51.

16. Disconnect the BNC cable and adapter from the AMPTD REF OUT and the Input 50 Ω.

17. If the analyzer is equipped with Option 1DN, 50 Ω tracking generator, do the following:

    a. On the analyzer, press **Source, Amplitude, 0 dBm**.

    b. Connect a 50 Ω termination to the RF OUT 50 Ω.

Measurement Sequence

The DANL Measurement Sequence tables list the procedures to be performed and the parameters to be used in each procedure. The table also lists the TR Entry number for recording the results in the performance verification test record.

1. If the analyzer is not equipped with Option 1DR, narrow bandwidths, or Option 1DS, preamplifier, perform only those procedures with an “X” (“X” = “Don’t Care”) in each of the Analyzer Options columns. For each procedure performed, use the appropriate Procedure Parameters as described in the DANL Measurement Sequence table. Record the display line amplitude setting as the indicated TR Entry in the performance verification test record.
2. If the analyzer is equipped with Option 1DR, but not Option 1DS, perform those procedures with an “X” in each of the Analyzer Options columns, and those procedures with a “Y” in the 1DR option column. For each procedure performed, use the appropriate Procedure Parameters as described in the DANL Measurement Sequence table. Record the display line amplitude setting as the indicated TR Entry in the performance verification test record.
3. If the analyzer is equipped with Option 1DS, but not Option 1DR, perform those procedures with an “X” in each of the Analyzer Options columns, and those procedures with a “Y” in the 1DS Option column. For each procedure performed, use the appropriate Procedure Parameters as described in the DANL Measurement Sequence table. Record the display line amplitude setting as the indicated TR Entry in the performance verification test record.
4. If the analyzer is equipped with both Option 1DS and Option 1DR, perform all procedures. For each procedure performed, use the appropriate Procedure Parameters as described in the DANL Measurement Sequence table. Record the display line amplitude setting as the indicated TR Entry in the performance verification test record.
5. After performing all applicable DANL measurement procedures, proceed to Remove Reference Level Offset.

Table 2-77 DANL Measurement Sequence

Analyzer Options		Procedure	Procedure Parameters				TR Entry[a]
1DR	1DS		Start Freq	Stop Freq	Test RBW	Preamp State	
X	X	Measure DANL	10 MHz	1 GHz	1 kHz	Off	1
X	X	Measure DANL	1 GHz	2 GHz	1 kHz	Off	2
X	X	Measure DANL	2 GHz	3 GHz	1 kHz	Off	3
X	Y	Measure DANL	10 MHz	1 GHz	1 kHz	On	4/13
X	Y	Measure DANL	1 GHz	2 GHz	1 kHz	On	5/14
X	Y	Measure DANL	2 GHz	3 GHz	1 kHz	On	6/15
Y	X	Measure DANL	10 MHz	1 GHz	10 Hz	Off	7
Y	X	Measure DANL	1 GHz	2 GHz	10 Hz	Off	8
Y	X	Measure DANL	2 GHz	3 GHz	10 Hz	Off	9
Y	Y	Measure DANL	10 MHz	1 GHz	10 Hz	On	10/16
Y	Y	Measure DANL	1 GHz	2 GHz	10 Hz	On	11/17
Y	Y	Measure DANL	2 GHz	3 GHz	10 Hz	On	12/18

a. There are two possible TR Entries for measurements made with Preamp On, depending upon the ambient temperature. The first entry is for measurements made with an ambient temperature outside of the 20 to 30 °C range, but within the 0 to 55 °C range. The second entry is for measurements made with an ambient temperature within the 20 to 30 °C range.

Measuring Displayed Average Noise Level (DANL)

1. Set the analyzer as follows using the start and stop frequencies, test RBW and preamp state as specified in Table 2-77:

   Auto Couple
   FREQUENCY, Start Freq, (*enter specified start frequency*)
   FREQUENCY, Stop Freq, (*enter specified stop frequency*)
   AMPLITUDE, –70 dBm
   Attenuation, 0 dB
   AMPLITUDE, More, Ref Lvl Offset, (*enter Ref Lvl Offset (1 kHz) if test RBW = 1 kHz*)
   AMPLITUDE, More, Ref Lvl Offset, (*enter Ref Lvl Offset (10 Hz) if test RBW = 10 Hz*)
   BW/Avg, Resolution BW, 1 MHz
   BW/Avg, Video BW, 10 kHz
   AMPLITUDE, More, Int Preamp (Off) (*if preamp state = Off*)
   AMPLITUDE, More, Int Preamp (On) (*if preamp state = On*)
   Sweep, Sweep (Cont)
   Sweep, Sweep Time (Auto)

3. On the analyzer, press **Single, View/Trace, Trace 1, Clear Write, BW/Avg, Average Type (Video), Averages, 3, Enter, Single.**

   Wait until `VAvg 3` is displayed to the left of the graticule (the analyzer will take three sweeps, then stop).

2. On the analyzer, press **Peak Search (or Search)**.
3. On the analyzer, press **BW/Avg, Average** (Off).
4. On the analyzer, press **Marker →,Mkr→ CF**.
5. If the test RBW is 1 kHz, press **Span, 20 kHz.**

   If the test RBW is 10 Hz, press **Span, 500 Hz.**

6. If the test RBW is 1 kHz, press **BW/Avg, Resolution BW, 1 kHz, Video BW, 30 Hz.**

   If the test RBW is 10 Hz, press **BW/Avg, Resolution BW, 10 Hz, Video BW, 1 Hz.**

7. On the analyzer, press **Single** and wait for the new sweep to finish.
8. On the analyzer, press **Display, Display Line** (On), and adjust the display line so that it is centered on the average trace noise, ignoring any residual responses (refer to the Residual Responses verification test for any suspect residuals).

Remove Reference Level Offset

1. Press **AMPLITUDE, More, Ref Lvl Offst, 0 dB.**
2. On the analyzer, press **Preset.**

36. Displayed Average Noise Level: HP E4404B and E4405B

This performance test measures the displayed average noise level (DANL) within the frequency range specified. The analyzer input is terminated in its characteristic impedance. If the analyzer is also equipped with a tracking generator (Option 1DN), the tracking generator is also terminated in its characteristic impedance and set for maximum leveled output power.

The test tunes the analyzer frequency across the band, uses the marker to locate the frequency with the highest response, and then reads the average noise in a narrow span.

To reduce measurement uncertainty due to input attenuator switching and resolution bandwidth switching, a reference level offset is added. The 50 MHz alignment signal is used as the amplitude reference for determining the amount of offset required. The offset is removed at the end of the test by pressing instrument preset.

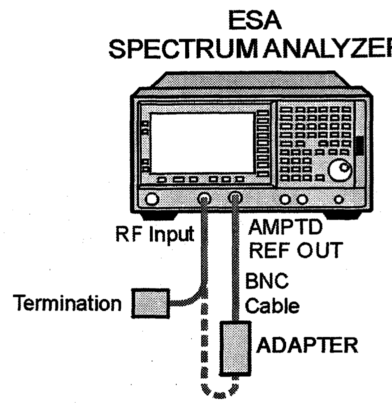
For analyzers equipped with narrow resolution bandwidths (Option 1DR), DANL is also tested in the 10 Hz resolution bandwidth setting.

The related adjustment for this procedure is “Frequency Response”.

Equipment Required

Termination, 50 Ω, Type-N (m) (*2 required for Option 1DN*)
Cable, BNC
Adapter, Type-N (m) to BNC (f)

Figure 2-52 **Displayed Average Noise Level Test Setup**



Procedure

1. Connect the AMPTD REF OUT to the Input 50 Ω using a BNC cable and adapter as shown in Figure 2-52.
2. On the analyzer, press **Preset**, then wait for the preset routine to finish. Set the analyzer by pressing the following keys:

   Input/Output (or Input), Amptd Ref Out (On)
   FREQUENCY, 50 MHz
   SPAN, 2 kHz
   AMPLITUDE, –20 dBm
   AMPLITUDE, Attenuation, 10 dB
   BW/Avg, Resolution BW, 1 kHz
   BW/Avg, Video BW, 1 kHz
   Det/Demod, Detector, Sample, Return

3. On the analyzer, press **Single.**
4. On the analyzer, press **Peak Search (or Search)** and record the Ref Amptd reading below.

   Ref Amptd ___________ dB

5. On the analyzer, press the following keys:

   AMPLITUDE, Attenuation, 0 dB
   SPAN, 20 kHz
   BW/Avg, Resolution BW, 1 kHz
   BW/Avg, Video BW, 30 Hz

6. On the analyzer, press **Single.**
7. On the analyzer, press **Peak Search (or Search)** and record the amplitude reading below as Meas Amptd(1 kHz RBW).

Meas Amptd(1 kHz RBW)__________ dB

8. Calculate the necessary reference level offset by subtracting the Meas Amptd in step 7 from the Ref Amptd in step 4. If the calculated Ref Lvl Offst is greater that +0.05 dB or less than –0.05 dB, record the Ref Lvl Offst value below. Otherwise, enter 0.

$$\text{Ref Lvl Offset(1 kHz RBW)} = \text{Ref Amptd} - \text{Meas Amptd(1 kHz RBW)}$$

Ref Lvl Offst(1 kHz RBW)__________ dB

9. If the analyzer is not equipped with Option 1DR, proceed to step 14.

10. On the analyzer, press the following keys:

AMPLITUDE, Attenuation, 0 dB
SPAN, 500 Hz
BW/Avg, Resolution BW, 10 Hz
BW/Avg, Video BW, 1 Hz

11. On the analyzer, press **Single**.

12. On the analyzer, press **Peak Search (or Search)** and record the amplitude reading below as Meas Amptd(10 Hz RBW).

Meas Amptd(10 Hz RBW)__________ dB

13. Calculate the necessary reference level offset by subtracting the Meas Amptd in step 12 from the Ref Amptd in step 4. If the calculated Ref Lvl Offst is greater that +0.05 dB or less than –0.05 dB, record the Ref Lvl Offst value below. Otherwise, enter 0.

$$\text{Ref Lvl Offset(10 Hz RBW)} = \text{Ref Amptd} - \text{Meas Amptd(10 Hz RBW)}$$

Ref Lvl Offst(10 Hz RBW)__________ dB

14. On the analyzer, press **Input, Amptd Ref Out** (Off), then **AMPLITUDE, More, Ref Lvl Offst**, and enter the value recorded in step 7.

15. Connect the 50 Ω termination to the analyzer input as shown in Figure 2-52.

16. Disconnect the BNC cable and adapter from the AMPTD REF OUT and the Input 50 Ω.

17. If the analyzer is equipped with Option 1DN, 50 Ω tracking generator, do the following:

    a. On the analyzer, press **Source, Amplitude, 0 dBm**.

    b. Connect a 50 Ω termination to the RF OUT 50 Ω.

Measurement Sequence

The DANL Measurement Sequence tables list the procedures to be performed and the parameters to be used in each procedure. The tables also list the TR Entry number for recording the results in the performance verification test record.

1. If the analyzer is not equipped with Option 1DR, narrow bandwidths, or Option 1DS, preamplifier, perform only those procedures with an “X” (“X” = “Don’t Care”) in each of the Analyzer Options columns. For each procedure performed, use the appropriate Procedure Parameters as described in the DANL Measurement Sequence table. Record the display line amplitude setting as the indicated TR Entry in the performance verification test record.
2. If the analyzer is equipped with Option 1DR, but not Option 1DS, perform those procedures with an “X” in each of the Analyzer Options columns, and those procedures with a “Y” in the 1DR option column. For each procedure performed, use the appropriate Procedure Parameters as described in the DANL Measurement Sequence table. Record the display line amplitude setting as the indicated TR Entry in the performance verification test record.
3. If the analyzer is equipped with Option 1DS, but not Option 1DR, perform those procedures with an “X” in each of the Analyzer Options columns, and those procedures with a “Y” in the 1DS Option column. For each procedure performed, use the appropriate Procedure Parameters as described in the DANL Measurement Sequence table. Record the display line amplitude setting as the indicated TR Entry in the performance verification test record.
4. If the analyzer is equipped with both Option 1DS and Option 1DR, perform all procedures. For each procedure performed, use the appropriate Procedure Parameters as described in the DANL Measurement Sequence table. Record the display line amplitude setting as the indicated TR Entry in the performance verification test record.
5. After performing all applicable DANL measurement procedures, proceed to Remove Reference Level Offset.

Table 2-78 DANL Measurement Sequence, HP E4404B

Analyzer Options		Procedure	Procedure Parameters				TR Entry[a]
1DR	1DS		Start Freq	Stop Freq	Test RBW	Preamp State	
X	X	Measure DANL	10 MHz	1 GHz	1 kHz	Off	1
X	X	Measure DANL	1 GHz	2 GHz	1 kHz	Off	2
X	X	Measure DANL	2 GHz	3 GHz	1 kHz	Off	3
X	X	Measure DANL	3 GHz	6 GHz	1 kHz	Off	4
X	X	Measure DANL	6 GHz	6.7 GHz	1 kHz	Off	5
X	Y	Measure DANL	10 MHz	1 GHz	1 kHz	On	6/20
X	Y	Measure DANL	1 GHz	2 GHz	1 kHz	On	7/21
X	Y	Measure DANL	2 GHz	3 GHz	1 kHz	On	8/22
Y	X	Measure DANL	10 MHz	1 GHz	10 Hz	Off	9
Y	X	Measure DANL	1 GHz	2 GHz	10 Hz	Off	10
Y	X	Measure DANL	2 GHz	3 GHz	10 Hz	Off	11
Y	X	Measure DANL	3 GHz	6 GHz	10 Hz	Off	12
Y	X	Measure DANL	6 GHz	6.7 GHz	10 Hz	Off	13
Y	Y	Measure DANL	10 MHz	1 GHz	10 Hz	On	14/23
Y	Y	Measure DANL	1 GHz	2 GHz	10 Hz	On	15/24
Y	Y	Measure DANL	2 GHz	3 GHz	10 Hz	On	16/25

a. There are two possible TR Entries for measurements made with Preamp On, depending upon the ambient temperature. The first entry is for measurements made with an ambient temperature outside of the 20 to 30 °C range, but within the 0 to 55 °C range. The second entry is for measurements made with an ambient temperature within the 20 to 30 °C range.

Table 2-79 DANL Measurement Sequence, HP E4405B

Analyzer Options		Procedure	Procedure Parameters				TR Entry[a]
1DR	1DS		Start Freq	Stop Freq	Test RBW	Preamp State	
X	X	Measure DANL	10 MHz	1 GHz	1 kHz	Off	1
X	X	Measure DANL	1 GHz	2 GHz	1 kHz	Off	2
X	X	Measure DANL	2 GHz	3 GHz	1 kHz	Off	3
X	X	Measure DANL	3 GHz	6 GHz	1 kHz	Off	4
X	X	Measure DANL [c]	6 GHz	12 GHz	1 kHz	Off	5
X	X	Measure DANL [c]	12 GHz	13.2 GHz	1 kHz	Off	6
X	Y	Measure DANL	10 MHz	1 GHz	1 kHz	On	7/26
X	Y	Measure DANL	1 GHz	2 GHz	1 kHz	On	8/27
X	Y	Measure DANL	2 GHz	3 GHz	1 kHz	On	9/28
Y	X	Measure DANL	10 MHz	1 GHz	10 Hz	Off	10
Y	X	Measure DANL	1 GHz	2 GHz	10 Hz	Off	11
Y	X	Measure DANL	2 GHz	3 GHz	10 Hz	Off	12
Y	X	Measure DANL	3 GHz	6 GHz	10 Hz	Off	13
Y	X	Measure DANL	6 GHz	12 GHz	10 Hz	Off	14
Y	X	Measure DANL	12 GHz	13.2 GHz	10 Hz	Off	16
Y	Y	Measure DANL	10 MHz	1 GHz	10 Hz	On	17/29
Y	Y	Measure DANL	1 GHz	2 GHz	10 Hz	On	18/30
Y	Y	Measure DANL	2 GHz	3 GHz	10 Hz	On	19/31

a. There are two possible TR Entries for measurements made with Preamp On, depending upon the ambient temperature. The first entry is for measurements made with an ambient temperature outside of the 20 to 30 °C range, but within the 0 to 55 °C range. The second entry is for measurements made with an ambient temperature within the 20 to 30 °C range.

Measuring Displayed Average Noise Level (DANL)

1. Set the analyzer as follows using the start and stop frequencies, test RBW and preamp state as specified in Table 2-78 for HP E4404B or Table 2-79 for HP E4405B:

    Auto Couple
    FREQUENCY, Start Freq, *(enter specified start frequency)*
    FREQUENCY, Stop Freq, *(enter specified stop frequency)*
    AMPLITUDE, –70 dBm
    Attenuation 0 dB
    AMPLITUDE, More, Ref Lvl Offset, *(enter Ref Lvl Offset (1 kHz) if test RBW = 1 kHz)*
    AMPLITUDE, More, Ref Lvl Offset, *(enter Ref Lvl Offset (10 Hz) if test RBW = 10 Hz)*
    BW/Avg, Resolution BW, 1 MHz
    BW/Avg, Video BW, 10 kHz
    AMPLITUDE, More, Int Preamp (Off) *(if preamp state = Off)*
    AMPLITUDE, More, Int Preamp (On) *(if preamp state = On)*
    Sweep, Sweep (Cont)
    Sweep, Sweep Time (Auto)

2. If the analyzer is equipped with Option 1DN and the current stop frequency is > 3 GHz, press **Source, Amplitude** (Off).
3. On the analyzer, press **Single, View/Trace, Trace 1, Clear Write, BW/Avg, Average Type (Video), Averages, 3, Enter, Single.**

    Wait until `VAvg 3` is displayed to the left of the graticule (the analyzer will take three sweeps, then stop).
4. On the analyzer, press **Peak Search (or Search).**
5. On the analyzer, press **BW/Avg, Average** (Off).
6. On the analyzer, press **Marker →,Mkr→ CF.**
7. If the test RBW is 1 kHz, press **Span, 20 kHz.**

    If the test RBW is 10 Hz, press **Span, 500 Hz.**
8. If the test RBW is 1 kHz, press **BW/Avg, Resolution BW, 1 kHz, Video BW, 30 Hz.**

    If the test RBW is 10 Hz, press **BW/Avg, Resolution BW, 10 Hz, Video BW, 1 Hz.**
9. On the analyzer, press **Single** and wait for the new sweep to finish.
10. On the analyzer, press **Display, Display Line** (On), and adjust the display line so that it is centered on the average trace noise, ignoring any residual responses (refer to the Residual Responses verification test for any suspect residuals).

Remove Reference Level Offset

1. Press **AMPLITUDE, More, Ref Lvl Offst, 0 dB**.
2. On the analyzer, press **Preset**.

37. Displayed Average Noise Level: HP E4407B and HP E4408B

This performance test measures the displayed average noise level (DANL) within the frequency range specified. The analyzer input is terminated in its characteristic impedance. If the analyzer is also equipped with a tracking generator (Option 1DN), the tracking generator is also terminated in its characteristic impedance and set for maximum leveled output power.

The test tunes the analyzer frequency across the band, uses the marker to locate the frequency with the highest response, and then reads the average noise in a narrow span.

To reduce measurement uncertainty due to input attenuator switching and resolution bandwidth switching, a reference level offset is added. The 50 MHz alignment signal is used as the amplitude reference for determining the amount of offset required. The offset is removed at the end of the test by pressing instrument preset.

For analyzers equipped with narrow resolution bandwidths (Option 1DR), DANL is also tested in the 10 Hz resolution bandwidth setting.

The related adjustment for this procedure is "Frequency Response."

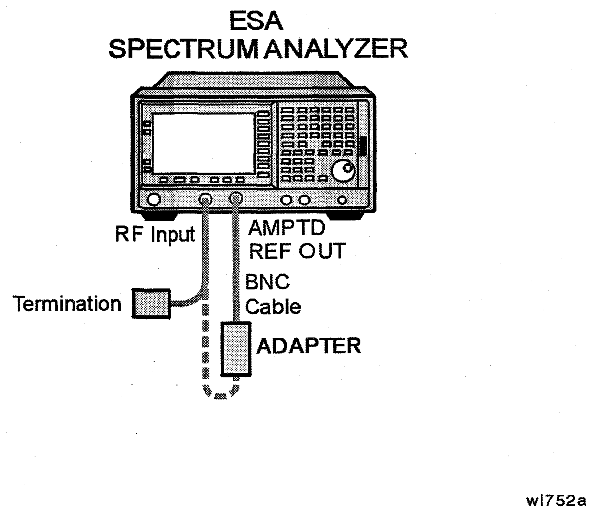
Equipment Required

Termination, 50 Ω, Type-N (m) (*2 required for Option 1DN*)
Cable, BNC
Adapter, Type-N (m) to BNC (f)

Additional Equipment for Option BAB

Adapter, APC 3.5 (f) to Type-N (f)

Figure 2-53 **Displayed Average Noise Level Test Setup**



Procedure

1. Connect the AMPTD REF OUT to the Input 50 Ω using a BNC cable and adapter as shown in Figure 2-53.
2. On the analyzer, press **Preset**, then wait for the preset routine to finish. Set the analyzer by pressing the following keys:

   Input/Output (or Input), Amptd Ref Out (On)
   FREQUENCY, 50 MHz
   SPAN, 2 kHz
   AMPLITUDE, –20 dBm
   AMPLITUDE, Attenuation, 10 dB
   BW/Avg, Resolution BW, 1 kHz
   BW/Avg, Video BW, 1 kHz
   Det/Demod, Detector, Sample, Return

3. On the analyzer, press **Single**.
4. On the analyzer, press **Peak Search (or Search)** and record the Ref Amptd reading below.

   Ref Amptd ___________ dB

5. On the analyzer, press the following keys:

   AMPLITUDE, Attenuation, 0 dB
   SPAN, 20 kHz
   BW/Avg, Resolution BW, 1 kHz
   BW/Avg, Video BW, 30 Hz

6. On the analyzer, press **Single**.
7. On the analyzer, press **Peak Search (or Search)** and record the amplitude reading below as Meas Amptd(1 kHz RBW).

Meas Amptd(1 kHz RBW)__________ dB

8. Calculate the necessary reference level offset by subtracting the Meas Amptd in step 7 from the Ref Amptd in step 4. If the calculated Ref Lvl Offst is greater that +0.05 dB or less than –0.05 dB, record the Ref Lvl Offst value below. Otherwise, enter 0.

$$\text{Ref Lvl Offset(1 kHz RBW)} = \text{Ref Amptd} - \text{Meas Amptd(1 kHz RBW)}$$

Ref Lvl Offst(1 kHz RBW)__________ dB

9. If the analyzer is not equipped with Option 1DR, proceed to step 14.

10. On the analyzer, press the following keys:

AMPLITUDE, Attenuation, 0 dB
SPAN, 500 Hz
BW/Avg, Resolution BW, 10 Hz
BW/Avg, Video BW, 1 Hz

11. On the analyzer, press **Single**.

12. On the analyzer, press **Peak Search (or Search)** and record the amplitude reading below as Meas Amptd(10 Hz RBW).

Meas Amptd(10 Hz RBW)__________ dB

13. Calculate the necessary reference level offset by subtracting the Meas Amptd in step 12 from the Ref Amptd in step 4. If the calculated Ref Lvl Offst is greater that +0.05 dB or less than –0.05 dB, record the Ref Lvl Offst value below. Otherwise, enter 0.

$$\text{Ref Lvl Offset(10 Hz RBW)} = \text{Ref Amptd} - \text{Meas Amptd(10 Hz RBW)}$$

Ref Lvl Offst(10 Hz RBW)__________ dB

14. On the analyzer, press **Input, Amptd Ref Out** (Off), then **AMPLITUDE, More, Ref Lvl Offst**, and enter the value recorded in step 7.

15. Connect the 50 Ω termination to the analyzer input as shown in Figure 2-53.

16. Disconnect the BNC cable and adapter from the AMPTD REF OUT and the Input 50 Ω.

17. If the analyzer is equipped with Option 1DN, 50 Ω tracking generator, do the following:

    a. On the analyzer, press **Source, Amplitude, 0 dBm**.

    b. Connect a 50 Ω termination to the RF OUT 50 Ω.

Measurement Sequence

The DANL Measurement Sequence tables list the procedures to be performed and the parameters to be used in each procedure. The table also lists the TR Entry number for recording the results in the performance verification test record.

1. If the analyzer is not equipped with Option 1DR, narrow bandwidths, or Option 1DS, preamplifier, perform only those procedures with an "X" ("X" = "Don't Care") in each of the Analyzer Options columns. For each procedure performed, use the appropriate Procedure Parameters as described in the DANL Measurement Sequence table. Record the display line amplitude setting as the indicated TR Entry in the performance verification test record.
2. If the analyzer is equipped with Option 1DR, but not Option 1DS, perform those procedures with an "X" in each of the Analyzer Options columns, and those procedures with a "Y" in the 1DR option column. For each procedure performed, use the appropriate Procedure Parameters as described in the DANL Measurement Sequence table. Record the display line amplitude setting as the indicated TR Entry in the performance verification test record.
3. If the analyzer is equipped with Option 1DS, but not Option 1DR, perform those procedures with an "X" in each of the Analyzer Options columns, and those procedures with a "Y" in the 1DS Option column. For each procedure performed, use the appropriate Procedure Parameters as described in the DANL Measurement Sequence table. Record the display line amplitude setting as the indicated TR Entry in the performance verification test record.
4. If the analyzer is equipped with both Option 1DS and Option 1DR, perform all procedures. For each procedure performed, use the appropriate Procedure Parameters as described in the DANL Measurement Sequence table. Record the display line amplitude setting as the indicated TR Entry in the performance verification test record.
5. After performing all applicable DANL measurement procedures, proceed to Remove Reference Level Offset.

Table 2-80 **DANL Measurement Sequence**

Analyzer Options		Procedure	Procedure Parameters				TR Entry[a]
1DR	1DS		Start Freq	Stop Freq	Test RBW	Preamp State	
X	X	Measure DANL	10 MHz	1 GHz	1 kHz	Off	1
X	X	Measure DANL	1 GHz	2 GHz	1 kHz	Off	2
X	X	Measure DANL	2 GHz	3 GHz	1 kHz	Off	3
X	X	Measure DANL	3 GHz	6 GHz	1 kHz	Off	4
X	X	Measure DANL	6 GHz	12 GHz	1 kHz	Off	5
X	X	Measure DANL	12 GHz	22 GHz	1 kHz	Off	6
X	X	Measure DANL	22 GHz	26.5 GHz	1 kHz	Off	7
X	Y	Measure DANL	10 MHz	1 GHz	1 kHz	On	8/21
X	Y	Measure DANL	1 GHz	2 GHz	1 kHz	On	9/22
X	Y	Measure DANL	2 GHz	3 GHz	1 kHz	On	10/23
Y	X	Measure DANL	10 MHz	1 GHz	10 Hz	Off	11
Y	X	Measure DANL	1 GHz	2 GHz	10 Hz	Off	12
Y	X	Measure DANL	2 GHz	3 GHz	10 Hz	Off	13
Y	X	Measure DANL	3 GHz	6 GHz	10 Hz	Off	14
Y	X	Measure DANL	6 GHz	12 GHz	10 Hz	Off	15
Y	X	Measure DANL	12 GHz	22 GHz	10 Hz	Off	16
Y	X	Measure DANL	22 GHz	26.5 GHz	10 Hz	Off	17
Y	Y	Measure DANL	10 MHz	1 GHz	10 Hz	On	18/24
Y	Y	Measure DANL	1 GHz	2 GHz	10 Hz	On	19/25
Y	Y	Measure DANL	2 GHz	3 GHz	10 Hz	On	20/26

a. There are two possible TR Entries for measurements made with Preamp On, depending upon the ambient temperature. The first entry is for measurements made with an ambient temperature outside of the 20 to 30 °C range, but within the 0 to 55 °C range. The second entry is for measurements made with an ambient temperature within the 20 to 30 °C range.

Measuring Displayed Average Noise Level

1. Set the analyzer as follows using the start and stop frequencies, test RBW and preamp state as specified in Table 2-77:

   Auto Couple
   FREQUENCY, Start Freq, *(enter specified start frequency)*
   FREQUENCY, Stop Freq, *(enter specified stop frequency)*
   AMPLITUDE, –70 dBm
   Attenuation, 0 dB
   AMPLITUDE, More, Ref Lvl Offset, *(enter Ref Lvl Offset (1 kHz) if test RBW = 1 kHz)*
   AMPLITUDE, More, Ref Lvl Offset, *(enter Ref Lvl Offset (10 Hz) if test RBW = 10 Hz)*
   BW/Avg, Resolution BW, 1 MHz
   BW/Avg, Video BW, 10 kHz
   AMPLITUDE, More, Int Preamp (Off) *(if preamp state = Off)*
   AMPLITUDE, More, Int Preamp (On) *(if preamp state = On)*
   Sweep, Sweep (Cont)
   Sweep, Sweep Time (Auto)

2. If the analyzer is equipped with Option 1DN, press **Source, Amplitude** (Off).

3. On the analyzer, press **Single, View/Trace, Trace 1, Clear Write, BW/Avg, Average Type (Video), Averages, 3, Enter, Single.**

   Wait until `VAvg 3` is displayed to the left of the graticule (the analyzer will take three sweeps, then stop).

4. On the analyzer, press **Peak Search (or Search).**

5. On the analyzer, press **BW/Avg, Average** (Off).

6. On the analyzer, press **Marker →,Mkr→ CF.**

7. If the test RBW is 1 kHz, press **Span, 20 kHz.**

   If the test RBW is 10 Hz, press **Span, 500 Hz.**

8. If the test RBW is 1 kHz, press **BW/Avg, Resolution BW, 1 kHz, Video BW, 30 Hz.**

   If the test RBW is 10 Hz, press **BW/Avg, Resolution BW, 10 Hz, Video BW, 1 Hz.**

9. On the analyzer, press **Single** and wait for the new sweep to finish.

10. On the analyzer, press **Display, Display Line** (On), and adjust the display line so that it is centered on the average trace noise, ignoring any residual responses (refer to the Residual Responses verification test for any suspect residuals).

Remove Reference Level Offset

11.Press **AMPLITUDE, More, Ref Lvl Offst, 0 dB**.

12.On the analyzer, press **Preset**.

38. Residual Responses

The analyzer input is terminated and the analyzer is swept from 150 kHz to 1 MHz. Then the analyzer is swept in incremental 10 MHz spans from 1 MHz to the upper frequency range. Any responses above the specification are noted.

There are no related adjustment procedures for this performance test.

Equipment Required

Termination, 50 Ω Type-N (m)

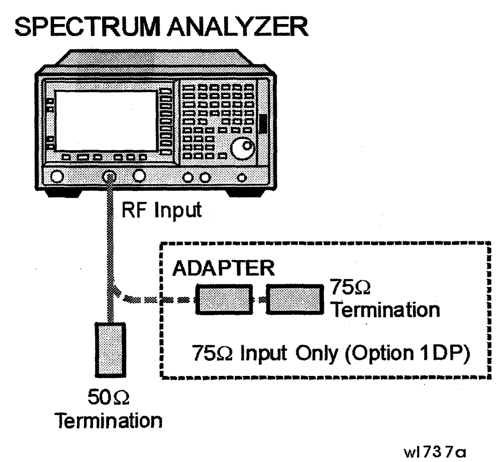
Additional Equipment for 75 Ω Input

Termination, 75 Ω, BNC (m)
Adapter, Type-N (f) to BNC (m), 75 Ω

Additional Equipment for Option BAB

Adapter, Type-N (f) to APC 3.5 (f)

Figure 2-54 Residual Response Test Setup



CAUTION Use only 75 Ω cables, connectors, or adapters on instruments with 75 Ω input, or damage to the input connector will occur.

Procedure

150 kHz to 1 MHz

1. Connect the 50 Ω termination to the analyzer input as shown in Figure 2-54.

   75 Ω Input: Use the adapter to connect the 75 Ω termination, and proceed with step 4.

2. Press **Preset** on the analyzer, and initialize the instrument by pressing the following keys:

   FREQUENCY, Start Freq, 150 kHz
   FREQUENCY, Stop Freq, 1 MHz
   AMPLITUDE, –60 dBm
   AMPLITUDE, Attenuation, 0 dB
   BW/Avg, 3 kHz
   BW/Avg, Video BW, 1 kHz
   Display, Display Line On, –90 dBm

3. Press **Single** and wait for a new sweep to finish. Look for any residual responses at or above the display line.

   If a residual is suspected, press **Single** again. A residual response will persist on successive sweeps, but a noise peak will not. Note the frequency and amplitude of any residual responses above the display line in Table 1.

4. Press **Preset** on the analyzer, and initialize the instrument by pressing the following keys:

   FREQUENCY, 5.9 MHz
   FREQUENCY, CF Step, 9.9 MHz
   SPAN, 10 MHz
   AMPLITUDE, –60 dBm (*50 Ω Input only*)
   AMPLITUDE, –11.2 dBmV (*75 Ω Input only*)
   AMPLITUDE, Attenuation, 0 dB
   BW/Avg, 10 kHz
   BW/Avg, Video BW, 3 kHz
   Display, Display Line On, –90 dBm (*50 Ω Input only*)
   Display, Display Line On, –36 dBmV (*75 Ω Input only*)

5. Repeat step 6 and step 7 until the complete range of frequencies has been checked for the model and frequency ranges below.

Model	Frequency Range
HP E4401B and E4411B	1 MHz to 1.5 GHz
HP E4402B and E4403B	1 MHz to 3.0 GHz
HP E4404B, E4405B, E4407B, and E4408B	1 MHz to 6.7 GHz

6. Press **Single** and wait for a new sweep to finish. Look for any residual responses at or above the display line.

   If a residual is suspected, press **Single** again. A residual response will persist on successive sweeps, but a noise peak will not. Record the frequency and amplitude of any residual responses above the display line in Table 2-81.

7. Press **FREQUENCY** ↑.

   If there are any residuals at or near the frequency specification limits (1 MHz, 1.5 GHz, 3 GHz, or 6.7 GHz), it is recommended that a known frequency source be used as a frequency marker. This will ensure that testing is done at or below the specification limits.

Table 2-81 **Residual Responses Worksheet**

Frequency, MHz	Amplitude, dBm or dBmV

8. Record the highest residual from Table 2-81 as TR Entry 1 in the performance verification test record. If no residuals are found, then record "N/A" in the performance verification test record.

39. Fast Time Domain Amplitude Accuracy: HP E4401B, E4402B, E4404B, E4405B, and E4407B, Option AYX

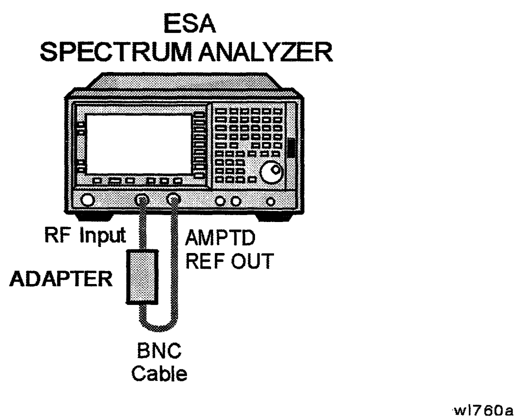
The analyzer amplitude reference signal is used to compare the amplitude level of a normal sweep time (≥5 ms) to a fast sweep time (≤5 ms) using the marker functions. The difference should be less than the marker readout resolution specification for the fast sweep times.

Equipment Required

Cable, BNC, 122 cm (48 in)
Adapter, Type-N (m) to BNC (f)

Procedure

Figure 2-55 Fast Time Domain Amplitude Accuracy Test Setup



Fast Sweep Time Amplitude Accuracy

1. Connect the equipment as shown in Figure 2-55.

NOTE No test setup is required for HP E4401B.

2. On the spectrum analyzer, press **PRESET**, then wait for the preset routine to finish.

3. Set the analyzer as follows:

   FREQUENCY, 50 MHz
   SPAN, Zero Span
   Sweep 5 ms
   Input/Output (or Input), Amptd Ref (On) *(HP E4401B only)*
   Input/Output (or Input), Amptd Ref Out (On) *(HP E4402B, E4404B, E4405B,*
   E4407B only)
   AMPLITUDE, Scale Type (Lin)
   AMPLITUDE, Ref Level, 12.57 mV *(HP E4401B, 50 Ω only)*
   AMPLITUDE, Ref Level, 15.05 mV *(HP E4401B, 75 Ω only)*
   AMPLITUDE, Ref Level, 30.73 mV *(HP E4402B, E4404B, E4405B, E4407B only)*

4. On the analyzer, press:

   Marker, More 1 of 2, Function, Marker Noise
   Single
   Marker, Delta
   Sweep, 1 ms

5. If the ΔMkr1 amplitude readout (the second line) is <u>not</u> expressed as a percentage, subtract 1 from the ΔMkr1 amplitude (ignore the "X") and multiply the result by 100 to obtain the amplitude error in percent:

$$\text{Amplitude Error} = (\Delta\text{Mkr1} - 1.0) \times 100$$

6. If the ΔMkr1 amplitude readout is expressed as a percentage, subtract 100% from the ΔMkr1 amplitude reading to obtain the amplitude error in percent:

$$\text{Amplitude Error} = \Delta\text{Mkr1} - 100$$

7. Record the Amplitude Error as TR Entry 1 in the performance verification test record.

40. Tracking Generator Absolute Amplitude and Vernier Accuracy: HP E4401B and E4411B, Option 1DN or 1DQ

A calibrated power sensor is connected to the tracking generator output to measure the power level at 50 MHz.

The power meter is set to relative mode so that future power level readings are in dB relative to the reference power level setting. The output power level setting is decreased in 1 dB steps and the power level is measured at each step. The difference between the ideal and actual power levels is calculated at each step.

Since a power sweep is accomplished by stepping through the vernier settings, the peak-to-peak variation of the vernier accuracy is equal to the power sweep accuracy.

The related adjustments for this performance test are “Tracking Generator ALC Calibration” and “Tracking Generator Frequency Slope.”

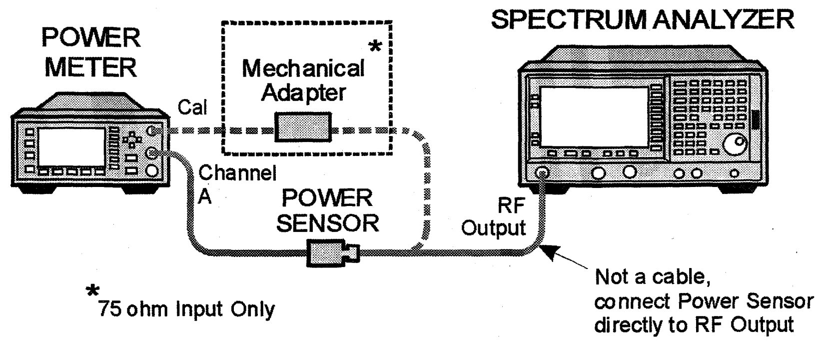
Equipment Required

Power meter, compatible with power sensor
RF power sensor, 50 Ω

Additional Equipment for Option 1DQ

Power sensor, 75 Ω
Adapter, Type-N (f) to BNC (m), 75 Ω
Adapter, Type-N (f), 75 Ω to Type-N (m), 50 Ω

Figure 2-56 **Absolute Amplitude, Vernier, and Power Sweep Accuracy Test Setup**



CAUTION Use only 75 Ω cables, connectors, or adapters on instruments with 75 Ω connectors, or damage to the connectors will occur.

Procedure

For E4411B analyzers, this test must be performed at 20 to 30 °C.

1. Press **Preset** on the analyzer, then wait for the preset routine to finish. Set the analyzer by pressing the following keys:

   FREQUENCY, **50 MHz**
   SPAN, **Zero Span**
   AMPLITUDE, **0 dBm** (*Option 1DN*)
   AMPLITUDE, **42.76 dBmV** (*Option 1DQ*)
   Source, **Amplitude (On)**, **0 dBm** (*Option 1DN*)
   Source Amptd, **Amplitude (On)**, **+42.76 dBmV** (*Option 1DQ*)
   Source Amptd, **Attenuation**, **0 dB**
   Single

2. Zero and calibrate the power meter and power sensor in log mode (power reads out in dBm), as described in the power meter operation manual. Enter the 50 MHz Cal Factor of the power sensor into the power meter.

3. Connect the 50 Ω power sensor to the RF OUT as shown in Figure 2-56.

   Option 1DQ: Connect the 75 Ω power sensor to the RF OUT 75 Ω as shown in Figure 2-56.

4. Read the power level displayed on the power meter and record the result as TR Entry 1 of the performance verification test record as the Absolute Amplitude Accuracy.

   Absolute Amplitude Accuracy at 50 MHz = __________dB

Option 1DQ: Add 6 dB to the power level displayed on the power meter and record the result as TR Entry 1 of the performance verification test record as the Absolute Amplitude Accuracy.

5. Set the power meter to dB relative mode as described in the power meter operation manual so that the readout is in power level relative to the power level at 50 MHz (press **Rel/Offset**, **Rel**).

6. Set the source amplitude to the settings indicated in Table 2-82.

   Option 1DQ: Use the source amplitude settings for Option 1DQ analyzers.

7. Press **Single** on the analyzer. At each setting, record the power level displayed on the power meter as Measured Power Level in Table 2-82.

8. Calculate the Vernier Accuracy by subtracting the Source Vernier Setting from the Measured Power Level for each Source Amplitude Setting in Table 2-82.

$$\text{Vernier Accuracy} = \text{Measured Power Level (dB)} - \text{Source Vernier Setting (dB)}$$

9. Locate the most positive and most negative Vernier Accuracy Values for Source Vernier Settings of −1 dBm to −10 dBm recorded in Table 2-82. Record the Positive Vernier Accuracy as TR entry 2 and the Negative Vernier Accuracy as TR entry 3 in the performance verification test record.

   Option 1DQ: For source amplitudes of +41.76 dBmV to +27.76 dBmV.

   Positive Vernier Accuracy ___________ dB

   Negative Vernier Accuracy ___________ dB

10. Locate the most positive and most negative Vernier Accuracy values for all Source Amplitude Settings in Table 2-82 and record these values below:

    Positive Power Sweep Accuracy ___________ dB

    Negative Power Sweep Accuracy ___________ dB

11. Calculate the Power Sweep Accuracy by subtracting the Negative Power Sweep Accuracy recorded in the previous step from the Positive Power Sweep Accuracy recorded in the previous step. Record the Power Sweep Accuracy as TR Entry 4 in the performance verification test record.

$$\text{Power Sweep Accuracy} = \text{Positive Power Sweep Accuracy} - \text{Negative Power Sweep Accuracy}$$

Power Sweep Accuracy ___________ dB

Table 2-82 Vernier Accuracy Worksheet

Source Amplitude Setting		**Source Vernier Setting**	**Measured Power Level**	**Vernier Accuracy**
Option 1DN dBm	Option 1DQ dBmV	(dB)	(dB)	(dB)
0 (Ref)	+42.76 (Ref)	0 (Ref)	NA	NA
–1	+41.76	–1		
–2	+40.76	–2		
–3	+39.76	–3		
–4	+38.76	–4		
–5	+37.76	–5		
–6	+36.76	–6		
–7	+35.76	–7		
–8	+34.76	–8		
–9	+33.76	–9		
–10	+32.76	–10		
–11	+31.76	–11		
–12	+30.76	–12		
–13	+29.76	–13		
–14	+28.76	–14		
–15	+27.76	–15		

41. Tracking Generator Absolute Amplitude and Vernier Accuracy: HP E4402B, E4403B, E4404B, E4405B, E4407B and E4408B, Option 1DN

A calibrated power sensor is connected to the tracking generator output to measure the power level at 50 MHz.

The power meter is set to relative mode so that future power level readings are in dB relative to the reference power level setting. The output power level setting is decreased in 1 dB steps and the power level is measured at each step. The difference between the ideal and actual power levels is calculated at each step.

Since a power sweep is accomplished by stepping through the vernier settings, the peak-to-peak variation of the vernier accuracy is equal to the power sweep accuracy.

The related adjustments for this performance test are "Tracking Generator ALC Calibration" and "Tracking Generator Frequency Slope."

Equipment Required

Power meter, compatible with power sensor
Power sensor, 50 Ω

Procedure

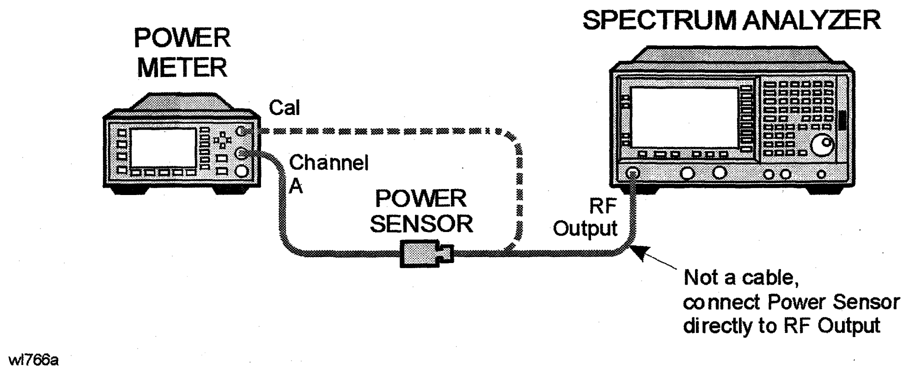
1. Press **Preset** on the analyzer, then wait for the preset routine to finish. Set the analyzer by pressing the following keys:

   FREQUENCY, 50 MHz
   SPAN, Zero Span
   AMPLITUDE, 0 dBm
   System, Alignments, Auto Align, Off
   Source Amptd, Amplitude (On), –20 dBm
   Source Amptd, Attenuation Auto Man, –20 dB
   Single Sweep

2. Zero and calibrate the power meter and power sensor in log mode (power reads out in dBm), as described in the power meter operation manual. Enter the 50 MHz Cal Factor of the power sensor into the power meter.

3. Connect the 50 Ω power sensor to the as shown in Figure 2-57.

Figure 2-57 **Absolute Amplitude, Vernier, and Power Sweep Accuracy Test Setup**



4. Read the power level displayed on the power meter, add 20 dB, and record the result as TR Entry 1 of the performance verification test record as the Absolute Amplitude Accuracy.

   Absolute Amplitude Accuracy at 50 MHz = __________dB

5. Set the power meter to dB relative mode as described in the power meter operation manual so that the readout is in power level relative to the power level at 50 MHz (press **Rel/Offset**, **Rel**).

6. Press **Single** on the analyzer. At each setting, record the power level displayed on the power meter in Table 2-83.

7. Set the source amplitude to the settings indicated in Table 2-83.

Table 2-83 **Vernier and Power Sweep Accuracy Worksheet**

Source Amplitude Setting (dBm)	Source Vernier Setting (dB)	Measured Power Level (dB)	Vernier Accuracy (dB)
−18	−2		2)
−19	−3		3)
−20 (Ref)	−4	N/A	N/A
−21	−5		4)
−22	−6		5)
−23	−7		6)
−24	−8		7)
−25	−9		8)
−26	−10		9)

8. Calculate the Vernier Accuracy by adding 4 dB to the Source Vernier setting and subtracting the result from the Measured Power Level for each Source Amplitude Setting in Table 2-83.

$$\text{Vernier Accuracy} = \text{Measured Power Level (dB)} - (\text{Source Vernier Setting (dB)} + 4\text{ dB})$$

9. Record the vernier accuracy values from Table 2-83 as test record entries 2 through 9 in the performance test record.

10. Press **System, Alignments, Auto Align, All**

42. Tracking Generator Level Flatness: HP E4401B and E4411B, Option 1DN or 1DQ

This test verifies that spectrum analyzers with the tracking generator option (1DN or 1DQ) meet their tracking generator level flatness specification. A calibrated power sensor is connected to the tracking generator output to measure the power level at 50 MHz. The power meter is set for dB relative mode so that future power level readings are in dB, relative to the power level at 50 MHz.

Next, the tracking generator is stepped to several frequencies throughout its range, and the output power difference relative to the power level at 50 MHz is measured for each frequency recorded.

For frequencies below 100 kHz, a digital voltmeter and precision 50 Ω termination are used to measure the power of the tracking generator output. The DVM is set to read out in dBm using the MATH function with R value set to 50 Ω. The following equation is used to calculate dBm:

$$dBm = 10\log((E^2/R)/1mW)$$

The DVM readout is corrected by making the readings relative to the 100 kHz reading from the power sensor.

Option 1DN, 50 Ω tracking generators are tested from 9 kHz to 1500 MHz.

Option 1DQ, 75 Ω tracking generators are tested from 1 MHz to 1500 MHz.

The related adjustments for this procedure are "Tracking Generator ALC Calibration" and "Tracking Generator Frequency Slope."

Equipment Required

Power meter
Power sensor, 50 Ω, 100 kHz to 1.5 GHz
Digital multimeter
Termination, 50 Ω
Cable, BNC
Adapter, Type-N tee, (m) (f) (f)
Adapter, Type-N (m) to BNC (f)
Adapter, BNC (f) to dual banana plug

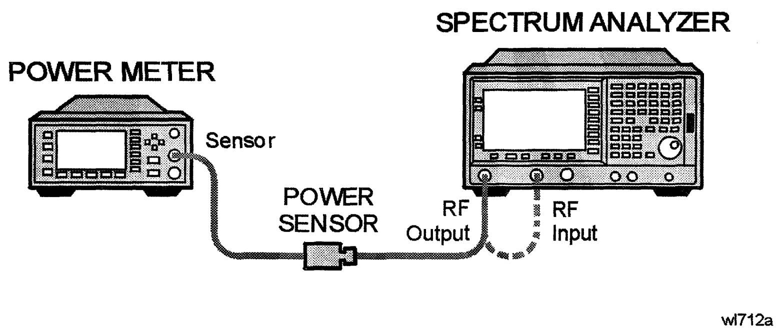
Additional Equipment for Option 1DQ

Power sensor, 75 Ω, 1 MHz to 1.5 GHz
Adapter, Type-N (f) to BNC (m), 75 Ω

CAUTION Use only 75 Ω cables, connectors, or adapters on the 75 Ω input of an Option 1DQ or damage to the input connector will occur.

Procedure

Figure 2-58 Tracking Generator Level Flatness Test Setup, ≥100 kHz



Tracking Generator Level Flatness, Center Frequency ≥100 kHz

1. Press **Preset** on the spectrum analyzer, then wait for the preset routine to finish.
2. Set the analyzer by pressing the following keys:

   FREQUENCY, 50 MHz
   FREQUENCY, CF Step, 100 MHz
   SPAN, Zero Span
   Source, Amplitude On, 0 dBm (*Option 1DN*)
   Source, Amplitude On, 42.76 dBmV (*Option 1DQ*)
   Single

3. Zero and calibrate the power meter with the power sensor in log mode (power reads out in dBm), as described in the power meter operation manual.

   Option 1DQ: Use a 75 Ω power sensor.

4. Connect the power sensor to the RF Out on the analyzer. See Figure 2-58.
5. Set the power meter to relative mode, as described in the power meter operation manual. Power levels now read out in power level relative to the power level at 50 MHz.

Perform the next four steps for each measurement value in Table 2-84.

1. Set the center frequency of the analyzer according to the values in Table 2-84. For 100 kHz, press **FREQUENCY**, **100 kHz**. The ⇑ (step up key) may be used to tune to center frequencies above 100 MHz.

   Option 1DQ: Start at 1 MHz by pressing **FREQUENCY, 1 MHz**.

2. Press **Single** on the analyzer.
3. Enter the appropriate power sensor Cal Factor into the power meter as indicated in Table 2-84.
4. Record the power level displayed on the power meter in the Level Flatness column in Table 2-84.

Table 2-84 Tracking Generator Level Flatness Worksheet, ≥ 100 kHz

Center Frequency	Level Flatness (dB)	Cal Factor (MHz)
100 kHz[a]		0.1
300 kHz[a]		0.3
500 kHz[a]		0.3
1 MHz		1
2 MHz		3
5 MHz		3
10 MHz		10
20 MHz		30
40 MHz		50
50 MHz	0 (Ref)	50
80 MHz		100
100 MHz		100
200 MHz		300
300 MHz		300
400 MHz		300
500 MHz		300
600 MHz		300
700 MHz		1000
800 MHz		1000
900 MHz		1000
1000 MHz		1000

Table 2-84 Tracking Generator Level Flatness Worksheet, ≥ 100 kHz

Center Frequency	Level Flatness (dB)	Cal Factor (MHz)
1100 MHz		1000
1200 MHz		1000
1300 MHz		1000
1400 MHz		1000
1500 MHz		2000

a. *These frequencies do not apply to analyzers with Option 1DQ Tracking Generators (75 Ω RF Output).*

5. Disconnect the power sensor from the RF Out on the analyzer.

Tracking Generator Level Flatness, Center Frequency ≤ 100 kHz

NOTE Perform step 2 to step 7 for 50 Ω tracking generators only (*Option 1DN*).

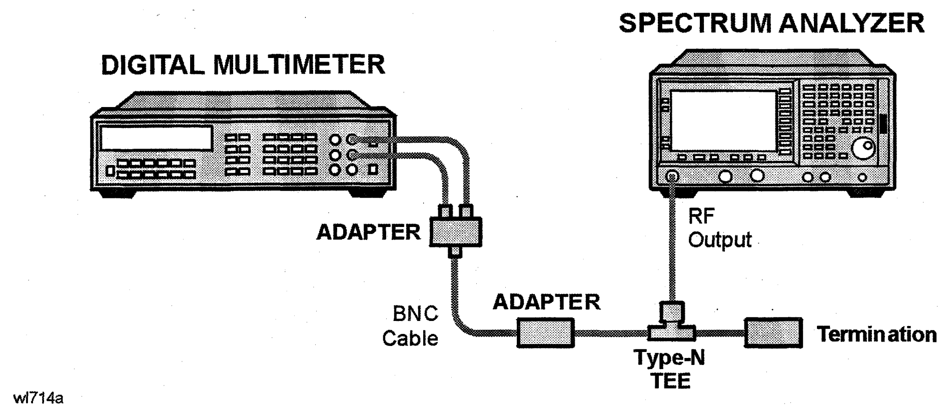
1. Set up the digital multimeter as follows.

Parameter	Setting
AC/DC	AC Volts
Impedance & Units:	
Set to 50 Ω impedance	SMATH 10[a]
Set to dBm	MATH 5[a]
Set to Synchronous Sub-sampled mode	SETACV 3[a]

a. *To set the HP 3458A multi-meter functions from the front panel, press the blue shift key, then Recall State (T) key, then use the ⇑ (up) and ⇓ (down) arrows to select the appropriate function, then enter the value from the numeric keypad and press enter.*

NOTE Perform step 2 to step 7 for each measurement value in Table 2-86.

Figure 2-59 Tracking Generator Level Flatness Test Setup, ≤ 100 kHz



2. Refer to Figure 2-59 to set up the equipment.
3. To set the analyzer center frequency to 9 kHz, press **FREQUENCY**, **9 kHz** (or as indicated in Table 2-85).
4. Press **Single**.
5. Record the DVM readout in Table 2-85.
6. Subtract the 100 kHz Level Flatness readout in Table 2-84 from the 100 kHz DVM Readout in Table 2-85 and record as the DVM Offset at 100 kHz.
   - DVM Offset at 100 kHz __________ dB
   - For example, if the Level Flatness reading from Table 2-84 is + 0.7 dB and the DVM Readout from Table 2-85 is - 0.53 dBm, the DVM offset would be - 1.23 dB.

$$\text{DVM Offset} = \text{DVM Readout} - \text{Level Flatness}$$

7. Add the DVM Offset at 100 kHz from step 6, above, to each of the DVM Readouts in Table 2-85 and record as the Corrected Level Flatness in column 3.
   - For example, if the DVM Readout from Table 2-85 is + 0.22 dBm, and the DVM Offset is - 1.23 dB, the Corrected Level Flatness would be - 1.01 dB.

$$\text{Corrected Level Flatness} = \text{DVM} + \text{DVM Offset}$$

Table 2-85 **Tracking Generator Level Flatness Worksheet, ≤ 100 kHz**

Center Frequency	DVM Readout (dBm)	Corrected Level Flatness (dBm)
9 kHz[a]		
20 kHz[a]		
40 kHz[a]		
60 kHz[a]		
80 kHz[a]		
100 kHz[a]		

a. *These frequencies do not apply to analyzers with Option 1DQ, 75 Ω tracking generators.*

8. For 50 Ω tracking generators only, locate the most positive Level Flatness reading in Table 2-84 and Table 2-85 for frequencies < 1 MHz and enter this value as Test Record Entry 1 of the performance verification test record.

9. For 50 Ω tracking generators only, locate the most negative Level Flatness reading in Table 2-84 and Table 2-85 for frequencies < 1 MHz and enter this value as Test Record Entry 2 of the performance verification test record.

10. Locate the most positive Level Flatness reading in Table 2-84 and Table 2-85 for frequencies ≥ 1 MHz and ≤ 10 MHz and enter this value as Test Record Entry 3 of the performance verification test record.

11. Locate the most negative Level Flatness reading in Table 2-84 and Table 2-85 for frequencies ≥ 1 MHz and ≤ 10 MHz and enter this value as Test Record Entry 4 of the performance verification test record.

12. Locate the most positive Level Flatness reading in Table 2-84 for frequencies ≥ 10 MHz and ≤ 1.5 GHz and enter this value as Test Record Entry 5 of the performance verification test record.

13. Locate the most negative Level Flatness reading in Table 2-84 for frequencies ≥ 10 MHz and ≤ 1.5 GHz and enter this value as Test Record Entry 6 of the performance verification test record.

43. Tracking Generator Level Flatness: HP E4402B, E4403B, E4404B, E4405B, E4407B, E4408B, Option 1DN

This test verifies that spectrum analyzers with the tracking generator option 1DN meet their tracking generator level flatness specification. In this test, a calibrated power sensor is connected to the tracking generator output to measure the power level at 50 MHz. The power meter is set for dB Relative mode so that future power level readings are in dB, relative to the power level at 50 MHz.

Next, the tracking generator is stepped to several frequencies throughout its range, and the output power difference relative to the power level at 50 MHz is measured for each frequency recorded.

For frequencies below 100 kHz, a digital voltmeter and precision 50 Ω termination are used to measure the power of the tracking generator output. The DVM is set to read out in dBm using the MATH function with R value set to 50 Ω. The following equation is used to calculate dBm:

$$\text{dBm} = 10\log((E^2/R)/1\text{mW})$$

The DVM readout is corrected by making the readings relative to the 100 kHz reading from the power sensor.

Option 1DN, 50 Ω *tracking generators are tested from 9 kHz to 3000 MHz.*

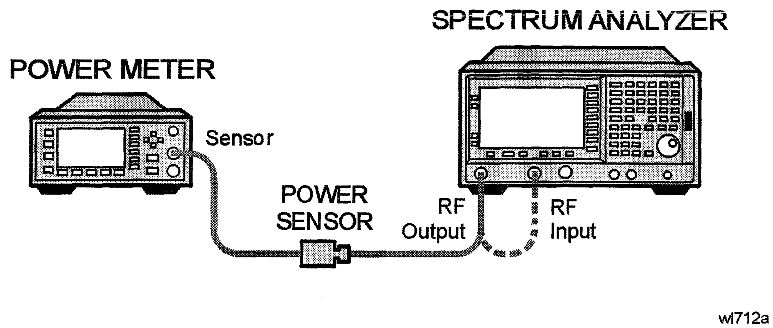
The related adjustment for this procedure is "Modulator Gain and Offset Adjustment."

Equipment Required

Power meter
Power sensor, 50 Ω
Digital multimeter
Termination, 50 Ω
Cable, BNC
Cable, Type-N (m) (m)
Adapter, Type-N tee, (m) (f) (f)
Adapter, Type-N (m) to BNC (f)
Adapter, BNC (f) to dual banana plug

Procedure

Figure 2-60 Tracking Generator Level Flatness Test Setup ≥ 100 kHz



Tracking Generator Level Flatness, Center Frequency ≥ 100 kHz

1. Press **Preset** on the spectrum analyzer, then wait for the preset routine to finish.
2. Connect the Type-N cable between the RF Input and the tracking generator RF OUT, as shown in Figure 2-60. Do not connect the power sensor to the analyzer yet.
3. Disconnect the Type-N cable.
4. Set up the spectrum analyzer by pressing the following keys:

   FREQUENCY, 50 MHz
   FREQUENCY, CF Step, 100 MHz
   SPAN, Zero Span
   System, Alignments, Auto Align, Off
   Marker
   Source, Amplitude (On)
   Source, Tracking Peak
   (*After pressing, wait for the* `Peaking` *message to disappear.*)
   Source, Amplitude, –20 dBm
   Single

5. Zero and calibrate the power meter with the power sensor in log mode (power reads out in dBm), as described in the power meter operation manual.
6. Connect the 50 Ω power sensor to the RF OUT 50 Ω on the analyzer. See Figure 2-60.
7. Set the power meter to relative mode, as described in the power meter operation manual. Power levels now read out in power level relative to the power level at 50 MHz.

Perform the next four steps for each measurement value in Table 2-86.

8. Set the center frequency of the analyzer according to the values in Table 2-86. For 100 kHz, press **FREQUENCY**, **100 kHz**.
   The ⇑ (step up key) may be used to tune to center frequencies above 100 MHz.
9. Press **Single** on the analyzer.
10. Enter the appropriate power sensor Cal Factor into the power meter as indicated in Table 2-86.
11. Record the power level displayed on the power meter in the Level Flatness column in Table 2-86.

Table 2-86 Tracking Generator Level Flatness Worksheet, ≥ 100 kHz

Center Frequency	Level Flatness (dB)	Cal Factor (MHz)
100 kHz		0.1
300 kHz		0.3
500 kHz		0.3
1 MHz		1
2 MHz		3
5 MHz		3
10 MHz		10
20 MHz		30
40 MHz		50
50 MHz	0 (Ref)	50
80 MHz		100
100 MHz		100
200 MHz		300
300 MHz		300
400 MHz		300
500 MHz		300
600 MHz		300
700 MHz		1000
800 MHz		1000
900 MHz		1000
1000 MHz		1000
1100 MHz		1000

Table 2-86 Tracking Generator Level Flatness Worksheet, ≥ 100 kHz

Center Frequency	Level Flatness (dB)	Cal Factor (MHz)
1200 MHz		1000
1300 MHz		1000
1400 MHz		1000
1500 MHz		2000
1600 MHz		2000
1700 MHz		2000
1800 MHz		2000
1900 MHz		2000
2000 MHz		2000
2100 MHz		2000
2200 MHz		2000
2300 MHz		2000
2400 MHz		2000
2500 MHz		3000
2600 MHz		3000
2700 MHz		3000
2800 MHz		3000
2900 MHz		3000
3000 MHz		3000

12. Disconnect the power sensor from the RF Out 50 Ω on the analyzer. See Figure 2-60.

Tracking Generator Level Flatness, Center Frequency ≤100 kHz

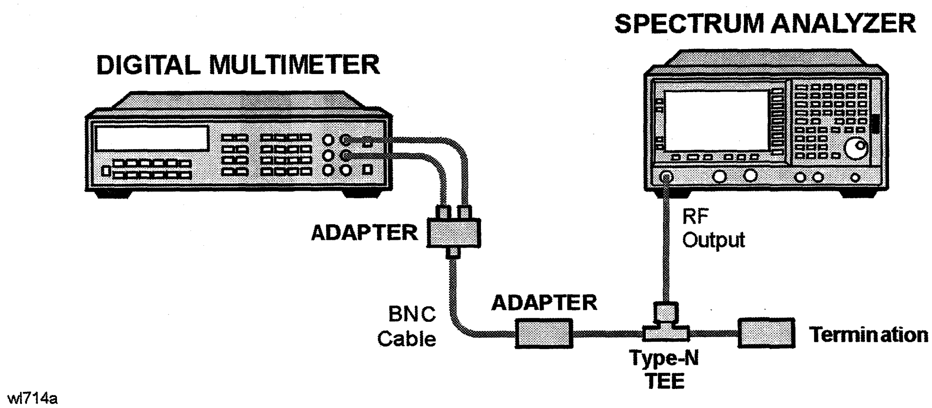
1. Set up the digital multimeter as follows.

Parameter	Setting
AC/DC	AC Volts
Impedance & Units:	
Set to 50 Ω impedance	SMATH 10[a]
Set to dBm	MATH 5[a]

Parameter	Setting
Set to Synchronous Sub-sampled mode	SETACV 3[a]

a. *To set the HP 3458A multi-meter functions from the front panel, press the blue shift key, then Recall State (T) key, then use the ⇑ (up) and ⇓ (down) arrows to select the appropriate function, then enter the value from the numeric keypad and press enter.*

Figure 2-61 Tracking Generator Level Flatness Test Setup, ≤ 100 kHz



2. Refer to Figure 2-61 to set up the equipment.

   Repeat step 3 to step 7 for each Center Frequency value in Table 2-87.

3. Set the spectrum analyzer center frequency to 9 kHz, by pressing the following keys:

   FREQUENCY, **9 kHz**

4. Press **Single**.
5. Record the DVM readout in Table 2-87.
6. Subtract the 100 kHz Level Flatness readout in Table 2-86 from the 100 kHz DVM Readout in Table 2-87 and record as the DVM Offset at 100 kHz.

   DVM Offset at 100 kHz __________ dB

   - For example, if the Level Flatness reading from Table 2-86 is + 0.7 dB and the DVM Readout from Table 2-87 is – 0.53 dBm, the DVM offset would be – 1.23 dB.

   DVM Offset= DVM Readout – Level Flatness

7. Add the DVM Offset at 100 kHz from step 6, above, to each of the DVM Readouts in Table 2-87 and record as the Corrected Level Flatness in column 3.
   - For example, if the DVM Readout from Table 2-87 is + 0.22 dBm, and the DVM Offset is – 1.23 dB, the Corrected Level Flatness would be – 1.01 dB.

     Corrected Level Flatness= DVM Readout + DVM Offset
8. Press **System, Alignments, Auto Align, All**

Table 2-87 Tracking Generator Level Flatness Worksheet, 100 kHz

Center Frequency	DVM Readout (dBm)	Corrected Level Flatness (dBm)
9 kHz		
20 kHz		
40 kHz		
60 kHz		
80 kHz		
100 kHz		

1. Locate the most positive Level Flatness reading in Table 2-86 and Table 2-87 for frequencies < 1 MHz and enter this value as Test Record Entry 1 of the performance verification test record.
2. Locate the most negative Level Flatness reading in Table 2-86 and Table 2-87 for frequencies < 1 MHz and enter this value as Test Record Entry 2 of the performance verification test record.
3. Locate the most positive Level Flatness reading in Table 2-86 and Table 2-87 for frequencies ≥ 1 MHz and ≤ 10 MHz and enter this value as Test Record Entry 3 of the performance verification test record.
4. Locate the most negative Level Flatness reading in Table 2-86 and Table 2-87 for frequencies ≥ 1 MHz and ≤ 10 MHz and enter this value as Test Record Entry 4 of the performance verification test record.
5. Locate the most positive Level Flatness reading in Table 2-86 for frequencies ≥ 10 MHz and ≤ 1.5 GHz and enter this value as Test Record Entry 5 of the performance verification test record.

6. Locate the most negative Level Flatness reading in Table 2-86 for frequencies ≥ 10 MHz and ≤ 1.5 GHz and enter this value as Test Record Entry 6 of the performance verification test record.
7. Locate the most positive Level Flatness reading in Table 2-86 for frequencies > 1.5 GHz and enter this value as Test Record Entry 7 of the performance verification test record.
8. Locate the most negative Level Flatness reading in Table 2-86 for frequencies > 1.5 GHz and enter this value as Test Record Entry 8 of the performance verification test record.

44. Tracking Generator Harmonic Spurious Outputs: HP E4401B and E4411B, Option 1DN or 1DQ

The measurement for tracking generator harmonic spurious outputs determines the maximum level of tracking generator harmonics. The tracking generator output is connected to the input of a microwave spectrum analyzer, then tuned to several different frequencies as the amplitude of the second and third harmonics relative to the fundamental are measured at each frequency.

There are no related adjustment procedures for this performance test.

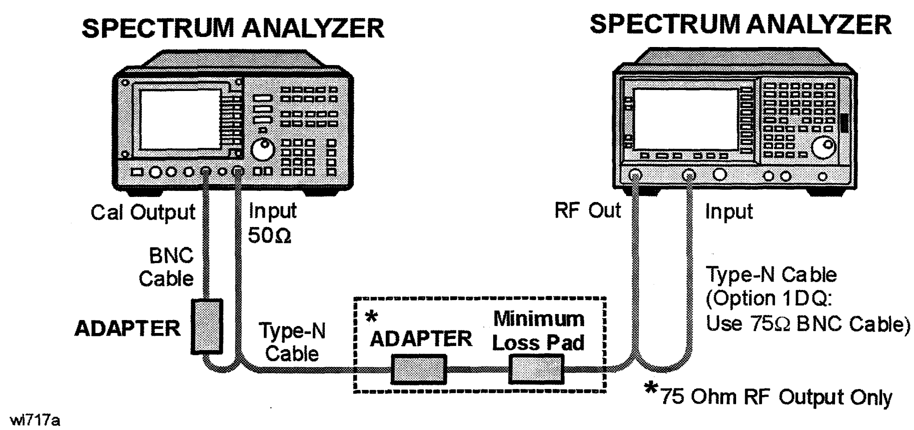
Equipment Required

Microwave spectrum analyzer
Cable, Type-N, 62 cm (24 in)
Cable, BNC to BNC, 23 cm (9 in)
Adapter, Type-N (m) to BNC (f)

Additional Equipment Required for Option 1DQ

50 Ω to 75 Ω Minimum loss pad
Adapter, Type-N (f) to BNC (m), 75 Ω

Figure 2-62 Harmonic Spurious Outputs Test Setup



CAUTION Use only 75 Ω cables, connectors, or adapters on instruments with 75 Ω connectors or damage to the connectors will occur.

Procedure

NOTE The following steps are for an HP 8563E microwave spectrum analyzer, the steps may be different if you are using another microwave spectrum analyzer.

1. Connect the 10 MHz reference output from the microwave spectrum analyzer to the 10 MHz reference input of the spectrum analyzer as shown in Figure 2-62.
2. *Complete this step only if more than 24 hours have elapsed since performing a front-panel calibration of the microwave spectrum analyzer.*

   The microwave spectrum analyzer should be allowed to warm up for at least 5 minutes before proceeding.

   Complete a front-panel calibration of the microwave spectrum analyzer by performing the following steps:

   a. **Preset** the microwave spectrum analyzer.

   b. Connect a BNC cable between CAL OUTPUT and INPUT 50 Ω.

   c. Press **CAL, REALIGN LO & IF.**

   d. Set **FREQUENCY, 300 MHz.**

   e. Set **SPAN, 20 MHz.**

   f. Set **AMPLITUDE, –10 dBm.**

   g. Press **PEAK SEARCH.**

   h. Press **CAL, REF LVL ADJ** and use the ⇑ ⇓ arrows to adjust the DAC value to a marker amplitude reading of –10 dBm. Press **STORE REF LVL.**

   i. Disconnect the BNC cable from between the CAL OUTPUT and INPUT 50 Ω.
3. On the spectrum analyzer, press **Preset** and wait for the preset routine to finish.
4. Set up the spectrum analyzer by pressing the following keys:

   FREQUENCY, 10 MHz
   SPAN, Zero Span
   BW/Avg, 10 kHz
   Source, Amplitude (On)
   Source, Amplitude (On), **0 dBm** (*Option 1DN*)
   Source, Amplitude (On), **+42.76 dBmV** (*Option 1DQ*)
   Single

5. Set up the microwave spectrum analyzer controls as follows:

   FREQUENCY, 10 MHz
   FREQUENCY, CF STEP, 10 MHz
   SPAN, 10 kHz
   AMPLITUDE, 5 dBm (*Option 1DN*)
   AMPLITUDE, 0 dBm (*Option 1DQ*)
   BW, 1 kHz

6. Refer to Figure 2-62 to connect the Type-N cable from the spectrum analyzer RF OUT to the input of the microwave spectrum analyzer.

NOTE The following steps are for an HP 8563E microwave spectrum analyzer, the steps may be different if you are using another microwave spectrum analyzer.

Perform step 7 and step 8 for each measurement value in Table 2-88.

7. Set the spectrum analyzer center frequency to the next frequency listed in Table 2-88. Similarly, set the microwave spectrum analyzer frequency and step size to match the spectrum analyzer center frequency. Press **Single** on the spectrum analyzer.
8. On the microwave spectrum analyzer:
   a. Press **MKR**, **SIG TRK** (On). Wait for the signal to be displayed at center screen.
   b. Press **PEAK SEARCH**, **MKR**, **SIG TRK** (Off), **MARKER DELTA**.
   c. Press **FREQUENCY** and ⇑ (step-up key) to tune to the second harmonic.
   d. Press **PEAK SEARCH** and record the marker amplitude reading in Table 2-88 as the 2nd Harmonic Level for the appropriate Tracking Generator Output Frequency.
   e. Perform this step only if the Tracking Generator Output Frequency is ≤ 500 MHz. Press **FREQUENCY** and ⇑ (step-up key) to tune to the third harmonic. Press **PEAK SEARCH**.

      Record the marker amplitude reading in Table 2-88 as the 3rd Harmonic Level for the appropriate Tracking Generator Output Frequency.
   f. Press **MKR**, **MARKERS** (Off).

Table 2-88 Tracking Generator Harmonic Spurious Response Worksheet

1.5 GHz Tracking Generator Output Frequency	2^{nd} Harmonic Level (dBc)	3^{rd} Harmonic Level (dBc)
10 MHz		
100 MHz		
300 MHz		
750 MHz		N/A

9. From Table 2-88, enter the 2^{nd} Harmonic Level at 10 MHz as Test Record Entry 1 and copy this value into the performance verification test record.

   Test Record Entry 1:
   TG 2^{nd} Harmonic Spurious Output __________ dB

10. From Table 2-88, locate the most positive 2^{nd} Harmonic Level for tracking generator frequencies of 100 MHz to 750 MHz and record this value as Test Record Entry 2 and copy this value into the performance verification test record.

   Test Record Entry 2:
   TG 2^{nd} Harmonic Spurious Output __________ dB

11. From Table 2-88, enter the 3^{rd} Harmonic Level at 10 MHz as Test Record Entry 3 and copy this value into the performance verification test record.

   Test Record Entry 3:
   TG 3^{rd} Harmonic Spurious Output __________ dB

12. From Table 2-88, locate the most positive 3^{rd} Harmonic Level for tracking generator frequencies of 100 MHz to 750 MHz and record this value as Test Record Entry 4 and copy this value into the performance verification test record.

   Test Record Entry 4:
   TG 3^{rd} Harmonic Spurious Output __________ dB

45. Tracking Generator Harmonic Spurious Outputs: HP E4402B, E4403B, E4404B, E4405B, E4407B, and E4408B, Option 1DN

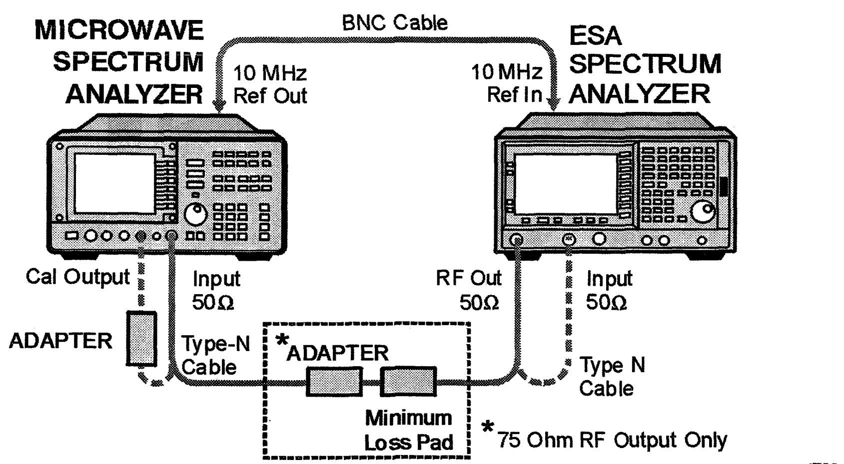
The measurement for tracking generator harmonic spurious outputs determines the maximum level of tracking generator harmonics. The tracking generator output is connected to the input of a microwave spectrum analyzer, then tuned to several different frequencies as the amplitude of the second and third harmonics (relative to the fundamental) are measured at each frequency.

There are no related adjustment procedures for this performance test.

Equipment Required

Microwave spectrum analyzer
Cable, Type-N, 62 cm (24 in)
Cable, BNC to BNC, 23 cm (9 in)
Adapter, Type-N (m) to BNC (f)

Figure 2-63 **Harmonic Spurious Outputs Test Setup**



Procedure

NOTE The following steps are for an HP 8563E microwave spectrum analyzer, the steps may be different if you are using another microwave spectrum analyzer.

1. *Complete this step only if more than 24 hours have elapsed since performing a front-panel calibration of the microwave spectrum analyzer.*

   The microwave spectrum analyzer should be allowed to warm up for at least 5 minutes before proceeding.

   Complete a front-panel calibration of the microwave spectrum analyzer by performing the following steps:

   a. **Preset** the microwave spectrum analyzer.

   b. Connect a BNC cable between CAL OUTPUT and INPUT 50 Ω.

   c. Press **CAL, REALIGN LO & IF.**

   d. Set **FREQUENCY, 300 MHz.**

   e. Set **SPAN, 20 MHz.**

   f. Set **AMPLITUDE, –10 dBm.**

   g. Press **PEAK SEARCH.**

   h. Press **CAL, REF LVL ADJ** and use the ⇑ ⇓ arrows to adjust the DAC value to a marker amplitude reading of –10 dBm. Press **STORE REF LVL.**

   i. Disconnect the BNC cable from between the CAL OUTPUT and INPUT 50 Ω.

2. On the spectrum analyzer, press **Preset** and wait for the preset routine to finish.

3. Use the Type-N cable to connect the RF INPUT to the tracking generator RF OUT as shown in Figure 2-63. Do not connect the Type-N cable to the microwave analyzer yet. Connect the 10 MHz Reference from the output of the microwave spectrum analyzer to the 10 MHz Reference Input of the analyzer being tested.

4. Set up the spectrum analyzer by pressing the following keys:

   FREQUENCY, 10 MHz
   SPAN, Zero Span
   BW/Avg, 10 kHz
   System, Alignments, Auto Align, Off
   Marker
   Source, Amplitude (On)
   Source, Tracking Peak *(Wait for the* `Peaking` *message to appear.)*

Source, **Amplitude** (On), –**2 dBm**
Single

5. Set up the microwave spectrum analyzer controls as follows:

   FREQUENCY, 9 kHz
   FREQUENCY, CF STEP, 9 kHz
   SPAN, 10 kHz
   AMPLITUDE, 5 dBm
   BW, 1 kHz

6. Disconnect the Type-N cable from between the analyzer RF INPUT and the tracking generator RF OUT. Refer to Figure 2-63 to connect the Type-N cable from the analyzer RF OUT to the input of the microwave spectrum analyzer.

NOTE The following steps are for an HP 8563E microwave spectrum analyzer, the steps may be different if you are using another microwave spectrum analyzer.

Perform step 7 and step 8 for each measurement value in Table 2-89.

7. Set the spectrum analyzer center frequency to the next frequency listed in Table 2-89. Similarly, set the microwave spectrum analyzer frequency and step size to match the spectrum analyzer center frequency. Press **Single** on the spectrum analyzer.
8. On the microwave spectrum analyzer:
   a. Press **MKR**, **SIG TRK** (On). Wait for the signal to be displayed at center screen.
   b. Press **PEAK SEARCH**, **MKR**, **SIG TRK** (Off), **MARKER DELTA**.
   c. Press **FREQUENCY** and ⇑ (step-up key) to tune to the second harmonic.
   d. Press **PEAK SEARCH** and record the marker amplitude reading in Table 2-89 as the 2nd Harmonic Level for the appropriate Tracking Generator Output Frequency.
   e. Perform this step only if the Tracking Generator Output Frequency is ≤ 900 MHz. Press **FREQUENCY** and ⇑ (step-up key) to tune to the third harmonic. Press **PEAK SEARCH**.

      Record the marker amplitude reading in Table 2-89 as the 3rd Harmonic Level for the appropriate Tracking Generator Output Frequency.
   f. Press **MKR**, **MARKERS** (Off).

Table 2-89 **Tracking Generator Harmonic Spurious Response Worksheet**

1.5 GHz Tracking Generator Output Frequency	2^{nd} Harmonic Level (dBc)	3^{rd} Harmonic Level (dBc)
9 kHz		
25 kHz		
100 MHz		
300 MHz		
900 MHz		
1500 MHz		N/A

9. From Table 2-89, enter the 2^{nd} Harmonic Level at 9 kHz as Test Record Entry 1 and copy this value into the performance verification test record.

   Test Record Entry 1:
   TG 2^{nd} Harmonic Spurious Output _________ dB

10. From Table 2-89, locate the most positive 2^{nd} Harmonic Level for tracking generator frequencies of 9 kHz to 750 MHz and record this value as Test Record Entry 2 and copy this value into the performance verification test record.

   Test Record Entry 2:
   TG 2^{nd} Harmonic Spurious Output _________ dB

11. From Table 2-89, enter the 3^{rd} Harmonic Level at 9 kHz as Test Record Entry 3 and copy this value into the performance verification test record.

   Test Record Entry 3:
   TG 3^{rd} Harmonic Spurious Output _________ dB

12. From Table 2-89, locate the most positive 3^{rd} Harmonic Level for tracking generator frequencies of 25 kHz to 1500 MHz and record this value as Test Record Entry 4 and copy this value into the performance verification test record.

   Test Record Entry 4:
   TG 3^{rd} Harmonic Spurious Output _________ dB

13. Press **System, Alignments, Auto Align, All.**

46. Tracking Generator Non-Harmonic Spurious Outputs: HP E4401B and E4411B, Option 1DN or 1DQ

This procedure determines the maximum level of the non-harmonic spurious outputs of the tracking generator. The tracking generator output is set to several different output frequencies. For each output frequency, several sweeps are taken on the microwave spectrum analyzer over different frequency spans and the highest displayed spurious response is measured in each span. Responses at the fundamental frequency of the tracking generator output or their harmonics are ignored. The amplitude of the highest spurious response is recorded.

There are no related adjustments for this performance test.

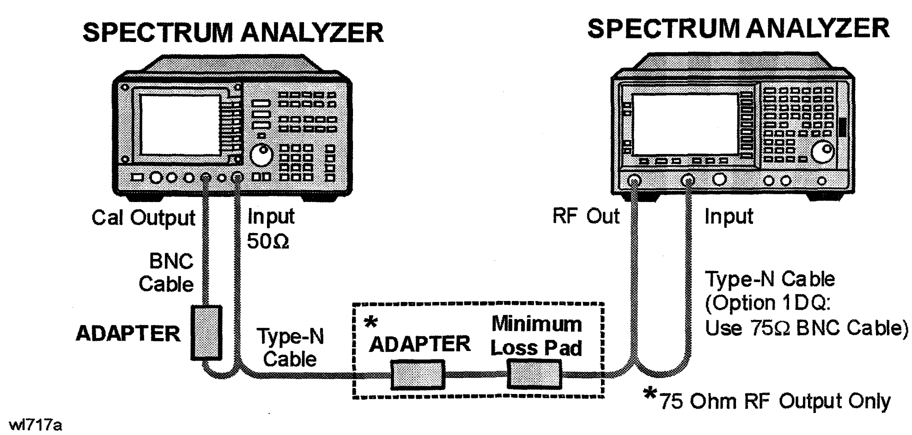
Equipment Required

Microwave spectrum analyzer
Cable, Type-N, 62 cm (24 in)
Cable, BNC, 23 cm (9 in)
Adapter, Type-N (m) to BNC (f)

Additional Equipment for 75 Ω Input

Pad, minimum loss
Adapter, Type-N (f) to BNC (m), 75 Ω

Figure 2-64 **Non-Harmonic Spurious Outputs Test Setup**



Procedure

NOTE The following steps are for an HP 8563E microwave spectrum analyzer, the steps may be different if you are using another microwave spectrum analyzer.

1. *Complete this step only if more than two hours have elapsed since performing a front-panel calibration of the microwave spectrum analyzer.*

   The microwave spectrum analyzer should be allowed to warm up for at least 30 minutes before proceeding.

   Complete a front-panel calibration of the microwave spectrum analyzer by performing the following steps:

   a. **PRESET** the microwave spectrum analyzer.

   b. Connect a BNC cable between CAL OUTPUT and INPUT 50 Ω.

   c. Press **CAL, REALIGN LO & IF.**

   d. Set **FREQUENCY, 300 MHz.**

   e. Set **SPAN, 20 MHz.**

   f. Set **AMPLITUDE, –10 dBm.**

   g. Press **PEAK SEARCH.**

   h. Press **CAL, REF LVL ADJ** and use the ⇑ ⇓ arrows to adjust the DAC value to a marker amplitude reading of –10 dBm. Press **STORE REF LVL.**

   i. Disconnect the BNC cable from between the CAL OUTPUT and INPUT 50 Ω.

2. Press **Preset** on the spectrum analyzer, then wait for the preset routine to finish. Set up the spectrum analyzer by pressing the following keys:

   FREQUENCY, 50 MHz
   SPAN, Zero Span
   BW/Avg, 30 kHz
   Marker
   Source, Amplitude On, 0 dBm
   Source, Amplitude On, 42.76 dBmV *(75 Ω Option only)*

3. Set up the microwave spectrum analyzer by pressing the following keys:

   SPAN, 100 kHz
   AMPLITUDE, 5 dBm
   AMPLITUDE, 0 dBm *(75 Ω Option only)*
   AMPLITUDE, ATTEN, 20 dB

AMPLITUDE, LOG dB/DIV, 10 dB

4. Disconnect the Type-N cable from between the spectrum analyzer RF INPUT and the tracking generator RF OUT. Refer to Figure 2-64 to connect the Type-N cable from the spectrum analyzer RF OUT to the microwave spectrum analyzer INPUT 50 Ω.

Measuring Fundamental Amplitudes

Perform the following two steps for each fundamental frequency in Table 2-90.

1. Set the spectrum analyzer center frequency to the fundamental frequency listed in Table 1 and press **Single** to activate a single sweep. Set the microwave spectrum analyzer to the same frequency.
2. On the microwave spectrum analyzer, press **PEAK SEARCH**. Press **MKR →**, **MARKER → REF LVL**. Wait for another sweep to finish. Press **PEAK SEARCH**. Record the marker amplitude reading in Table 2-90 as the Fundamental Amplitude.

Table 2-90 Tracking Generator Fundamental Response Worksheet

Fundamental Frequency	Fundamental Amplitude (dBm)
10 MHz	
750 MHz	
1.5 GHz	

Measuring Non-Harmonic Responses

1. On the spectrum analyzer, set the center frequency to the initial value indicated in the first row of Table 2-90. Press **Single** on the ESA spectrum analyzer to trigger a single sweep.
2. Set the microwave spectrum analyzer Start Freq, Stop Freq, and Res BW as indicated in the first row of Table 2-91.

   75 Ω outputs only: Measure only at start frequencies of 1 MHz and greater.
3. Press **SGL SWP** on the microwave spectrum analyzer to activate a single sweep and wait for the sweep to finish. Press **PEAK SEARCH** to locate the largest spurious response.
4. Verify that the marked signal is not the fundamental or a harmonic of the fundamental by performing the following steps:

NOTE The following steps are for an HP 8563E microwave spectrum analyzer, the steps may be different if you are using another microwave spectrum analyzer.

a. Divide the marker frequency by the fundamental frequency (the spectrum analyzer center frequency setting). For example, if the marker frequency is 30.3 MHz and the fundamental frequency is 10 MHz, dividing 30.3 MHz by 10 MHz yields 3.03.

b. Round the number calculated in step a to the nearest whole number. In the example above, 3.03 should be rounded to 3. Values less than 1 should be rounded up to 1.

c. Multiply the fundamental frequency by the number calculated in step b. Following the example, multiplying 10 MHz by 3 yields 30 MHz.

d. Calculate the difference between the marker frequency and the frequency calculated in step c above. Continuing the example, the difference would be 300 kHz.

e. Due to span accuracy uncertainties in the microwave spectrum analyzer, the marker frequency might not equal the actual frequency. Given the marker frequency, check if the difference calculated in step d is within the appropriate tolerance:

   For marker frequencies <5 MHz, tolerance = ±200 kHz
   For marker frequencies <55 MHz, tolerance = ±750 kHz
   For marker frequencies >55 MHz, tolerance = ±10 MHz

f. If the difference in step d is within the indicated tolerance, the signal in question is the fundamental signal (if the number in step b = 1) or a harmonic of the fundamental (if the number in step b >1). This response should be ignored.

5. Verify that the marked signal is a true response and not a random noise peak by pressing **SINGLE** to trigger a new sweep and press **PEAK SEARCH**. A true response will remain at the same frequency and amplitude on successive sweeps but a noise peak will not.

   If the marked signal is not the fundamental or a harmonic of the fundamental and is a true response, proceed with step 7.

6. If the marked signal is either the fundamental or a harmonic of the fundamental or a noise peak, move the marker on the microwave spectrum analyzer to the next highest signal by pressing **NEXT PEAK**. Repeat step 4 above.

   Perform step 7 only if the marker signal is a true response and not a fundamental or harmonic of the fundamental. Otherwise, continue with step 8.

7. Calculate the difference between the amplitude of marked signal and the fundamental amplitude as listed in Table 2-90.

   For example, if the fundamental amplitude for a fundamental frequency of 10 MHz is +1.2 dBm and the marker amplitude is –40.8 dBm, the difference is –42 dBc.

   Record this difference as the non-harmonic response amplitude for the appropriate spectrum analyzer center frequency and microwave spectrum analyzer start and stop frequency settings in Table 2-91.

Non-harmonic Amplitude = Marker Amplitude – Fundamental Amplitude

8. If a true non-harmonic spurious response is not found, record “NOISE” as the Amplitude of Non-Harmonic Response in Table 2-91 for the appropriate spectrum analyzer center frequency and microwave spectrum analyzer start and stop frequency settings.

9. Repeat step 1 to step 8 for the remaining spectrum analyzer center frequency and microwave spectrum analyzer settings in Table 2-91.

Table 2-91 1.5 GHz Tracking Generator Non-Harmonic Spurious Response Worksheet

Spectrum Analyzer Center Frequency	Microwave Spectrum Analyzer Start Frequency	Microwave Spectrum Analyzer Stop Frequency	Microwave Spectrum Analyzer Resolution Bandwidth	Amplitude of Non-Harmonic Response (dBc)
10 MHz	9 kHz[a]	100 kHz[a]	300 Hz[a]	
10 MHz	100 kHz[b]	5 MHz	10 kHz	
10 MHz	5 MHz	55 MHz	100 kHz	
10 MHz	55 MHz	1240 MHz	1 MHz	
10 MHz	1240 MHz	1500 MHz	1 MHz	
750 MHz	9 kHz[a]	100 kHz[a]	300 Hz[a]	
750 MHz	100 kHz[b]	5 MHz	10 kHz	
750 MHz	5 MHz	55 MHz	100 kHz	
750 MHz	55 MHz	1240 MHz	1 MHz	

Table 2-91 1.5 GHz Tracking Generator Non-Harmonic Spurious Response Worksheet

Spectrum Analyzer Center Frequency	Microwave Spectrum Analyzer Start Frequency	Microwave Spectrum Analyzer Stop Frequency	Microwave Spectrum Analyzer Resolution Bandwidth	Amplitude of Non-Harmonic Response (dBc)
750 MHz	1240 MHz	1500 MHz	1 MHz	
1.5 GHz	9 kHz[a]	100 kHz[a]	300 Hz[a]	
1.5 GHz	100 kHz[b]	5 MHz	10 kHz	
1.5 GHz	5 MHz	55 MHz	100 kHz	
1.5 GHz	55 MHz	1240 MHz	1 MHz	
1.5 GHz	1240 MHz	1500 MHz	1 MHz	

a. 75 Ω RF Outputs: Omit this frequency range.
b. 75 Ω RF Outputs: Set the start frequency to 1 MHz.

Determining the Highest Non-harmonic Spurious Response

1. In Table 2-91, locate the most positive non-harmonic response amplitude. Record this amplitude as the highest non-harmonic response amplitude in TR Entry 1 of the performance verification test record.

47. Tracking Generator Non-harmonic Spurious Outputs: HP E4402B, E4403B, E4404B, E4405B, E4407B and E4408B, Option 1DN

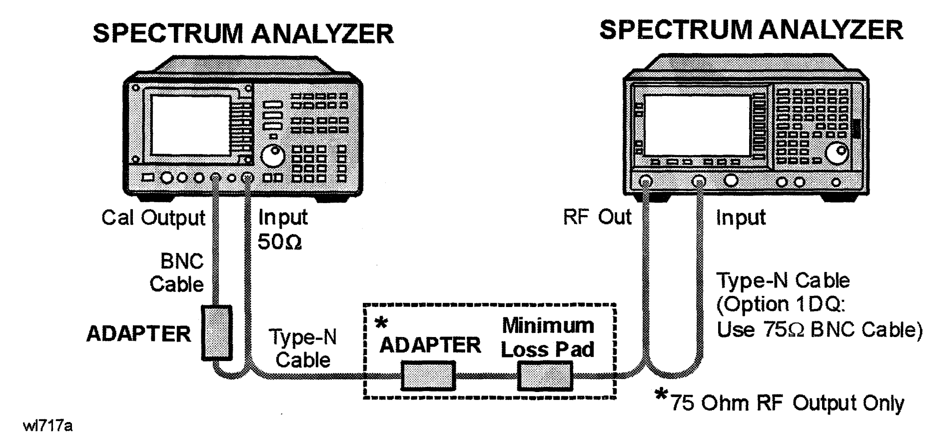
This procedure determines the maximum level of the non-harmonic spurious outputs of the tracking generator. The tracking generator output is set to several different output frequencies. For each output frequency, several sweeps are taken on the microwave spectrum analyzer over different frequency spans and the highest displayed spurious response is measured in each span. Responses at the fundamental frequency of the tracking generator output or their harmonics are ignored. The amplitude of the highest spurious response is recorded.

There are no related adjustments for this performance test.

Equipment Required

Microwave spectrum analyzer
Cable, Type-N, 62 cm (24 in)
Cable, BNC, 23 cm (9 in)
Adapter, Type-N (m) to BNC (f)

Figure 2-65 Non-Harmonic Spurious Outputs Test Setup



Procedure

NOTE The following steps are for an HP 8563E microwave spectrum analyzer, the steps may be different if you are using another microwave spectrum analyzer.

1. *Complete this step only if more than two hours have elapsed since performing a front-panel calibration of the microwave spectrum analyzer.*

   The microwave spectrum analyzer should be allowed to warm up for at least 30 minutes before proceeding.

   Complete a front-panel calibration of the microwave spectrum analyzer by performing the following steps:

   a. **Preset** the microwave spectrum analyzer.

   b. Connect a BNC cable between CAL OUTPUT and INPUT 50 Ω.

   c. Press **CAL, REALIGN LO & IF**.

   d. Set **FREQUENCY, 300 MHz**.

   e. Set **SPAN, 20 MHz**.

   f. Set **AMPLITUDE, –10 dBm**.

   g. Press **PEAK SEARCH**.

   h. Press **CAL, REF LVL ADJ** and use the ⇑ ⇓ arrows to adjust the DAC value to a marker amplitude reading of –10 dBm. Press **STORE REF LVL**.

   i. Disconnect the BNC cable from between the CAL OUTPUT and INPUT 50 Ω

2. Use the Type-N cable to connect the RF Input to the RF OUT of the tracking generator as shown in Figure 2-65. Do not connect to the RF Input of the microwave analyzer yet.

3. Press **Preset** on the spectrum analyzer, then wait for the preset routine to finish. Set up the analyzer by pressing the following keys:

   FREQUENCY, 50 MHz
   SPAN, Zero Span
   BW/Avg, 30 kHz
   System, Alignments, Auto Align, Off
   Marker
   Source, Tracking Peak (*wait for the* `Peaking` *message to appear*)
   Source, Amplitude On, –2 dBm
   Single

4. Set up the microwave spectrum analyzer by pressing the following keys:

   SPAN, 100 kHz
   AMPLITUDE, 5 dBm
   AMPLITUDE, Attenuation, 20 dB
   AMPLITUDE, LOG dB/DIV, 10 dB

5. Disconnect the Type-N cable from between the spectrum analyzer RF INPUT and the tracking generator RF OUT. Refer to Figure 2-65 to connect the Type-N cable from the spectrum analyzer RF OUT to the microwave spectrum analyzer INPUT 50 Ω.

Measuring Fundamental Amplitudes

Perform the following two steps for each measurement value in Table 2-92.

6. Set the spectrum analyzer center frequency to the Fundamental Frequency listed in Table 2-92 and press **Single** to activate a single sweep. Set the microwave spectrum analyzer to the same frequency.
7. On the microwave spectrum analyzer, press **PEAK SEARCH**. Press **MARKER →**, **MKR → REF LVL**. Wait for another sweep to finish. Press **PEAK SEARCH**. Record the marker amplitude reading in Table 2-92 as the fundamental amplitude.

Table 2-92 Tracking Generator Fundamental Response Worksheet

Fundamental Frequency	Fundamental Amplitude, dBm
10 MHz	
1.5 GHz	
3.0 GHz	

Measuring Non-Harmonic Responses

8. On the spectrum analyzer, set the center frequency to the initial value indicated in the first row of Table 2-92. Press **Single** on the ESA spectrum analyzer to trigger a single sweep.
9. Set the Start Freq, Stop Freq, and Res BW of the microwave spectrum analyzer as indicated in the first row of Table 2-93.
10. Press **SGL SWP** on the microwave spectrum analyzer to activate a single sweep and wait for the sweep to finish. Press **PEAK SEARCH** to locate the largest spurious response.
11. Verify that the marked signal is not the fundamental or a harmonic of the fundamental by performing the following steps:

NOTE The following steps are for an HP 8563E microwave spectrum analyzer, the steps may be different if you are using another microwave spectrum analyzer.

   a. Divide the marker frequency by the fundamental frequency (the spectrum analyzer center frequency setting). For example, if the marker frequency is 30.3 MHz and the fundamental frequency is 10 MHz, dividing 30.3 MHz by 10 MHz yields 3.03.

b. Round the number calculated in step a to the nearest whole number. In the example above, 3.03 should be rounded to 3. Values less than 1 should be rounded up to 1.

c. Multiply the fundamental frequency by the number calculated in step b. Following the example, multiplying 10 MHz by 3 yields 30 MHz.

d. Calculate the difference between the marker frequency and the frequency calculated in step c above. Continuing the example, the difference would be 300 kHz.

e. Due to span accuracy uncertainties in the microwave spectrum analyzer, the marker frequency might not equal the actual frequency. Given the marker frequency, check if the difference calculated in step d is within the appropriate tolerance:

   For marker frequencies <5 MHz, tolerance = ±200 kHz
   For marker frequencies <55 MHz, tolerance = ±750 kHz
   For marker frequencies >55 MHz, tolerance = ±10 MHz

f. If the difference in step d is within the indicated tolerance, the signal in question is the fundamental signal (if the number in step b = 1) or a harmonic of the fundamental (if the number in step b >1). This response should be ignored.

12. Verify that the marked signal is a true response and not a random noise peak by pressing **SINGLE** to trigger a new sweep and press **PEAK SEARCH**. A true response will remain at the same frequency and amplitude on successive sweeps but a noise peak will not.

    If the marked signal is not the fundamental or a harmonic of the fundamental and is a true response, proceed with step 14.

13. If the marked signal is either the fundamental or a harmonic of the fundamental or a noise peak, move the marker on the microwave spectrum analyzer to the next highest signal by pressing **NEXT PEAK**. Repeat step 11 above.

    Perform step 14 only if the marker signal is a true response and not a fundamental or harmonic of the fundamental. Otherwise, continue with step 15.

14. Calculate the difference between the amplitude of marked signal and the fundamental amplitude as listed in Table 2-92.

    For example, if the fundamental amplitude for a fundamental frequency of 10 MHz is +1.2 dBm and the marker amplitude is –40.8 dBm, the difference is –42 dBc.

    Record this difference as the non-harmonic response amplitude for the appropriate spectrum analyzer center frequency and microwave spectrum analyzer start and stop frequency settings in Table 2-93.

Non-harmonic Amplitude = Marker Amplitude – Fundamental Amplitude

15.If a true non-harmonic spurious response is not found, record "NOISE" as the non-harmonic response Amplitude in Table 2-93 for the appropriate spectrum analyzer center frequency and microwave spectrum analyzer start and stop frequency settings.

16.Repeat step 8 to step 15 for the remaining spectrum analyzer center frequency and microwave spectrum analyzer settings in Table 2-93.

17.Press **System, Alignments, Auto Align, All**

Table 2-93 3.0 GHz Tracking Generator Non-Harmonic Spurious Response Worksheet

Spectrum Analyzer Center Frequency	Microwave Spectrum Analyzer Start Frequency	Microwave Spectrum Analyzer Stop Frequency	Microwave Spectrum Analyzer Resolution Bandwidth	Amplitude of Non-Harmonic Response, dBc
10 MHz	9 kHz	100 kHz	300 Hz	
10 MHz	100 kHz	5 MHz	10 kHz	
10 MHz	5 MHz	55 MHz	100 kHz	
10 MHz	55 MHz	1240 MHz	1 MHz	
10 MHz	1240 MHz	2000 MHz	1 MHz	
10 MHz	2000 MHz	3000 MHz	1 MHz	
1.5 GHz	9 kHz	100 kHz	300 Hz	
1.5 GHz	100 kHz	5 MHz	10 kHz	
1.5 GHz	5 MHz	55 MHz	100 kHz	
1.5 GHz	55 MHz	1240 MHz	1 MHz	
1.5 GHz	1240 MHz	2000 MHz	1 MHz	
1.5 GHz	2000 MHz	3000 MHz	1 MHz	
3.0 GHz	9 kHz	100 kHz	300 Hz	
3.0 GHz	100 kHz	5 MHz	10 kHz	
3.0 GHz	5 MHz	55 MHz	100 kHz	
3.0 GHz	55 MHz	1240 MHz	1 MHz	
3.0 GHz	1240 MHz	2000 MHz	1 MHz	
3.0 GHz	2000 MHz	3000 MHz	1 MHz	

Determining the Highest Non-harmonic Spurious Response

1. In Table 2-93, locate the most positive non-harmonic response amplitude for microwave spectrum analyzer stop frequency settings ≤ 2000 MHz. Record this amplitude as the highest non-harmonic response amplitude in TR Entry 1 of the performance verification test record.

2. In Table 2-93, locate the most positive non-harmonic response amplitude for microwave spectrum analyzer start frequency settings ≥ 2000 MHz. Record this amplitude as the highest non-harmonic response amplitude in TR Entry 2 of the performance verification test record.

48. Tracking Generator LO Feedthrough Amplitude: HP E4402B, E4403B, E4404B, E4405B, E4407B, and E4408B, Option 1DN

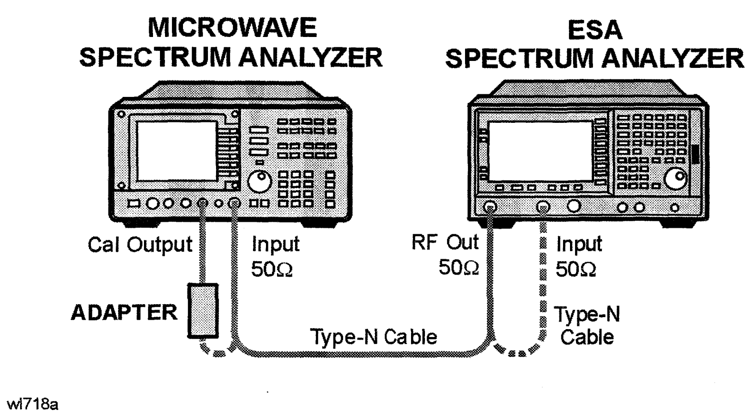
The tracking generator output is connected to the spectrum analyzer INPUT 50 Ω and the tracking is adjusted at 50 MHz for a maximum signal level. The tracking generator output is then connected to the input of a microwave spectrum analyzer. The tracking generator is turned to several different frequencies and the LO Feedthrough is measured at the frequency extremes of the LO.

The related adjustment for this procedure is "TG LO Leveling."

Equipment Required

Microwave spectrum analyzer
Cable, Type-N, 62 cm (24 in)
Cable, BNC, 23 cm (9 in)
Adapter, Type-N (m) to BNC (f)

Figure 2-66 LO Feedthrough Amplitude Test Setup



Procedure

NOTE Note that the following steps are for an HP 8563E microwave spectrum analyzer, the steps may be different if you are using another microwave spectrum analyzer.

1. Press **PRESET** on the microwave spectrum analyzer.

   The microwave spectrum analyzer should be allowed to warm up for at least five minutes before proceeding.

Complete step 2 only if more than 24 hours have elapsed since performing a front-panel calibration of the microwave spectrum analyzer.

2. Perform a front-panel calibration of the microwave spectrum analyzer by performing the following steps:
   a. Connect a BNC cable between CAL OUTPUT and INPUT 50 Ω.
   b. Press **CAL**, **REALIGN LO & IF**.
   c. Set **FREQUENCY**, **300 MHz**.
   d. Set **SPAN**, **20 MHz**.
   e. Set **AMPLITUDE**, **–10 dBm**.
   f. Press **PEAK SEARCH**.
   g. Press **CAL**, **REF LVL ADJ** and use the ⇑ ⇓ arrows to adjust the DAC value to a marker amplitude reading of –10 dBm. Press **STORE REF LVL**.
   h. Disconnect the BNC cable from between the CAL OUTPUT and INPUT 50 Ω.
3. Press **Preset** on the spectrum analyzer.
4. Use the type-N cable to connect the RF Input to the tracking generator RF OUT on the spectrum analyzer as shown in Figure 2-66. *Do not connect to the microwave analyzer RF Input yet.*
5. Initialize the test equipment by pressing the following keys on the spectrum analyzer:

   FREQUENCY, 50 MHz
   SPAN, Zero Span
   BW / Avg, 30 kHz
   System, Alignments, Auto Align, Off
   Marker
   Source, Amplitude On, –5 dBm
   Source, Tracking Peak (*After pressing, wait for the* `PEAKING SIGNAL` *message to disappear.*)
   FREQUENCY, 9 kHz
   Source, Amplitude On, –2 dBm
   Single

6. On the microwave spectrum analyzer, press the following keys:

   FREQUENCY, 3.921409 GHz
   SPAN, 100 kHz
   AMPLITUDE, 0 dBm
   BW, 1 kHz

7. Disconnect the type-N cable from between the spectrum analyzer RF INPUT and the Tracking Generator RF OUT. Refer to Figure 2-66 to connect the type-N cable from the spectrum analyzer RF OUT to the microwave spectrum analyzer INPUT 50 Ω

8. On the microwave spectrum analyzer, press:

   PEAK SEARCH
   MKR, SIG TRK (On)

   Wait for the signal to be displayed at center screen, then press **SIG TRK** (Off).

9. On the microwave spectrum analyzer, press **AUX CTRL**, **INTERNAL MIXER**, **PRESEL AUTO PK** then wait for the `PEAKING` message to disappear.

10. Record the microwave spectrum analyzer marker amplitude in Table 2-94 as the LO Feedthrough Amplitude for the Microwave Spectrum Analyzer CENTER FREQUENCY at 3.921409 GHz.

11. Repeat step 8 through step 10 for the remaining Spectrum Analyzer CENTER FREQUENCY and Microwave Spectrum Analyzer CENTER FREQUENCY settings listed in Table 2-94. Press **Single** on the spectrum analyzer to activate a single sweep each time the center frequency is changed.

12. Press **System, Alignments, Auto Align, All.**

13. In Table 2-94, for spectrum analyzer center frequencies of 9 kHz to 1.5 GHz, locate the highest LO Feedthrough Amplitude then record this amplitude as TR Entry 1 of the performance verification test record.

14. In Table 2-94, for the Spectrum Analyzer Center Frequency of 3.0 GHz, record this LO Feedthrough Amplitude as TR Entry 2 of the performance verification test record.

Table 2-94 Tracking Generator LO Feedthrough Amplitude Worksheet

Spectrum Analyzer CENTER FREQUENCY	Microwave Spectrum Analyzer CENTER FREQUENCY	LO Feedthrough Amplitude (dBm)
9 kHz	3.921409 GHz	
70 MHz	3.9914 GHz	
150 MHz	4.0714 GHz	
1.5 GHz	5.4214 GHz	
3.0 GHz	6.9214 GHz	

49. Gate Delay Accuracy and Gate Length Accuracy: HP E4401B, E4402B, E4404B, E4405B, and E4407B, Option 1D6

The method used for measuring the gate length times is determined by the length of the gate. Shorter gate-length times are measured with an oscilloscope, and longer gate-length times are measured with a counter.

For shorter gate-length times, the output signal of a pulse generator is used to trigger the gate circuitry. To measure the gate delay, Δt markers are used. The oscilloscope pulse width measurement feature is used to measure the short gate-length.

For longer gate-length times, a universal counter is used to measure the time period from the rising edge of the gate output to its falling edge. Because the gate-length time is equivalent to the clock accuracy of the spectrum analyzer, the gate-length time is compared to the specification for clock accuracy.

There are no related adjustments for this procedure.

Equipment Required

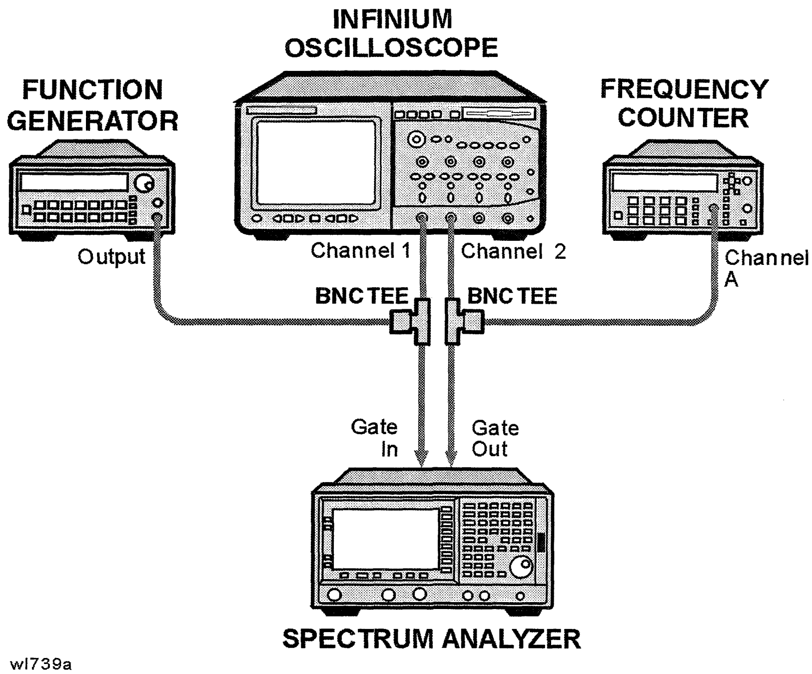
Universal counter
Function generator
Oscilloscope *(This procedure is written for the HP 54820A.)*
Cable, BNC, 120 cm (48 in) *(four required)*
Adapter, BNC tee (m) (f) (f) *(two required)*

Procedure

1. Connect the equipment as shown in Figure 2-67. Connect the GATE OUT to Channel 2.
2. Press **Preset** on the analyzer and wait for the preset routine to finish. Set up the analyzer by pressing the following keys:

   Span, **Zero Span**
   Sweep, **Sweep Time**, **20ms**
   Sweep, **Gate** (On), **Gate Setup**, **Edge Setup**, **Gate Delay**, **1 μs**
   Gate Length, **1 μs**

Figure 2-67 Gate Delay and Gate Length Test Setup



3. Set up the function generator as follows:

Waveform	Square
Frequency	100 Hz
Amplitude	2.5 V
Offset	+1.25 V

4. Press **Default Setup** on the oscilloscope and set the controls as follows:

Timebase	500 ns/div
Trigger	Edge
Trigger Source	2
Trigger Level	+2.0 V
Channel 1	
V/Div	1 V
Coupling	DC
Offset	+2.0 V
Channel 2	
V/Div	1 V
Coupling	DC
Offset	+3.0 V

5. On the oscilloscope, adjust the horizontal position to place the area between the rising edges of channel 1 and channel 2 at the center of the display. The horizontal position at the bottom of the grid should be between –500 ns and –650 ns.
6. Set the oscilloscope timebase to 200 ns/div. The rising edges of channel 1 and channel 2 should still be displayed. If not, adjust the horizontal position so the rising edges of channel 1 and channel 2 are displayed.
7. Use the mouse connected to the oscilloscope and click on the mouse icon in the upper right-hand corner of the display.
8. Set the oscilloscope statistics on.

   Click on **Measure** and verify that "Show Statistics" is checked.
9. Define the conditions for a delta time measurement on the oscilloscope.
   a. Click on **Measure, Customize, Measurement Definitions.**
   b. Set Threshold Definition to "10%, 50%, 90%".
   c. Set Top-Base Definition to "Standard".
   d. Set From Edge # to 1, and set To Edge # to 2.
   e. Set both Direction selections to "Rising".
   f. Set both Threshold selections to "Middle Level".
   g. Click **Close**.
10. Activate the delta time measurement.
   a. Click **Measure, Time, Delta Time.**
   b. Set Source 1 to "Channel 1".
   c. Set Source 2 to "Channel 2".
   d. Click **OK**.
11. Wait a few seconds for the minimum and maximum values displayed at the bottom of the oscilloscope grid to stabilize.
12. Refer to the measurement statistics at the bottom of the oscilloscope grid.

   Record the ΔTime (1)-(2) min value as Minimum Gate Delay in Table 2-95.

   Record the ΔTime (1)-(2) max value as the Maximum Gate Delay in Table 2-95.
13. Clear all current oscilloscope measurements. Click on **Measure, Clear,** and **All Measurements.**

14. Adjust the oscilloscope horizontal position to center the pulse on Channel 2 on the display.

15. Activate the pulse width measurement function for channel 2 of the oscilloscope.

    Click on **Measure, Time**, and click on **+width.**

    Set the Source to be channel 2 and click **OK.**

16. Record the +width (2) mean value in Table 2-95 as the 1 μs Gate Length.

17. On the analyzer, press

    Sweep, Sweep Time, 150 ms
    Sweep, Gate Setup, Edge Setup, Gate Delay, 10 ms
    Sweep, Gate Setup, Edge Setup, Length, 65 ms

18. Set the universal counter controls as follows:

Function	Time Interval 1 - 2
Gate Time	0.1 s
Auto Trigger	On
Channel 1	
Coupling	DC
Impedance	1 MΩ
X10 Atten	Off
100 kHz Filter	Off
Common 1	On
Slope	Pos
Channel 2	
Coupling	DC
Impedance	1 MΩ
X10 Atten	Off
100 kHz Filter	Off
Common 1	On
Slope	Neg

19. Record the universal counter readout value as the 65ms Gate Length in Table 2-95.

Table 2-95 **Gate Delay and Gate Length Accuracy Worksheet**

Description	Value	TR Entry
Minimum Gate Delay		1
Maximum Gate Delay		2
1 μs Gate Length		3
65 ms Gate Length		4

50. Gate Mode Additional Amplitude Error: HP E4401B, E4402B, E4404B, E4405B and E4407B, Option 1D6

This procedure measures the additional amplitude error while gate mode is turned on. An amplitude reference is established while gate mode is off. Gate mode is then turned on with a function generator providing the gate trigger input. The amplitude with gate mode on is then measured using the marker delta function.

There are no related adjustments for this procedure.

Equipment Required

Synthesized signal generator
Function generator
Cable, Type-N (f), 50 Ω
Cable, BNC, 120 cm

Additional Equipment for Option 1DP

Adapter, Type-N (f) to BNC (m), 75 Ω
Minimum loss pad

Additional Equipment for Option BAB

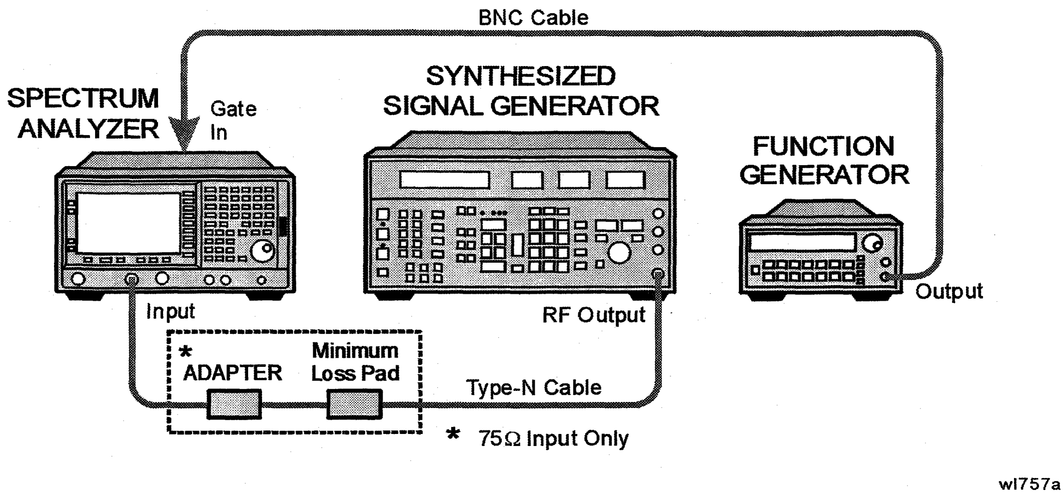
Adapter, Type-N (f) to APC 3.5 (f)

Procedure

1. Connect the equipment as shown in Figure 2-68.
2. On the analyzer, press **Preset** and wait for the preset routine to finish. Set the analyzer as follows:

   FREQUENCY, 300 MHz
   SPAN, Zero Span
   AMPLITUDE, MORE, Y Axis Units (or Amptd Units), dBm
   AMPLITUDE, Ref Level, –20 dBm (*50 Ω Inputs only*)
   AMPLITUDE, Ref Level, –10 dBm (*75 Ω Inputs only*)
   Sweep, 20 ms

Figure 2-68 **Gate Delay and Gate Length Accuracy Test Setup**



3. Set the function generator as follows:

Waveform	Square
Duty Cycle	50%
Frequency	100 Hz
Amplitude	2.5 V pk-pk
Offset	+2.5V

4. On the synthesized signal generator, press **Blue Key, Special, 0, 0.** Set the signal generator as follows:

FREQUENCY	300 MHz
AMPLITUDE	–20 dBm (*50 Ω Inputs only*)
AMPLITUDE	–10 dBm (*75 Ω Inputs only*)

5. On the analyzer, press **Single** and wait for the sweep to finish. Press **Peak Search (or Search).**
6. On the analyzer, press **Meas Tools, Delta.**
7. Set the analyzer as follows:

   Trig, External
   Sweep, Gate (On)
   Gate Setup, Edge Setup, Gate Delay, 1 μs
   Gate Length, 1 μs
   Sweep, Gate Setup, Trig Type (Level)

8. On the analyzer, press **Single** and wait for the sweep to finish. Press **Peak Search (or Search).**
9. Record the ΔMkr1 amplitude reading as TR Entry 1 in the performance test record.

51. First LO OUTPUT Amplitude Accuracy (Option AYZ only)

This test applies only to spectrum analyzers equipped with external mixing (Option AYZ).

This test verifies that spectrum analyzers with external mixing (Option AYZ) meet their specification for First LO (local oscillator) output level. The flatness of the First LO output determines the flatness of measurements made using external mixers. In this test, a calibrated power sensor is connected to the First LO output to measure the power level at frequencies between 2.9 GHz and 7.1 GHz.

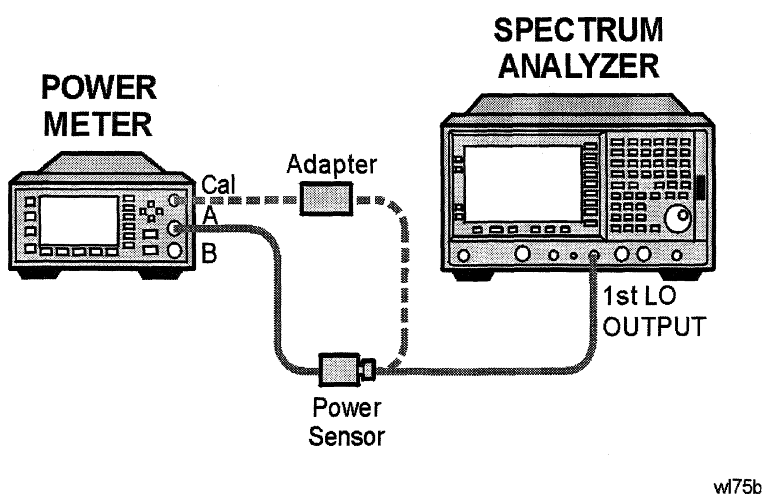
The spectrum analyzer is put into external mixing mode using a harmonic number of –10. The tuned frequency of the spectrum will therefore be 321.4 MHz (the frequency of the Second IF) below the Tenth harmonic of the First LO. A 321.4 MHz frequency offset is used so that the center frequency will be exactly 10 times the First LO frequency. Setting the center frequency step size to 2 GHz allows the LO frequency to be stepped in 200 MHz increments.

The related adjustment for this performance test is "LO Power Adjustment."

Equipment Required

Power meter
Microwave power sensor
Adapter, type-N (m) to SMA (f)

Figure 2-69 **First LO Output Amplitude Accuracy Test Setup**



Procedure

1. Zero and calibrate the power sensor and power meter combination at 50 MHz. Set the power meter for dBm output.
2. Enter the 3 GHz calibration factor of the power sensor into the power meter.
3. Remove the termination from the First LO OUTPUT connector of the spectrum analyzer.
4. Connect the power sensor to the First LO OUTPUT connector of the spectrum analyzer as shown in Figure 2-69.
5. Preset the spectrum analyzer and set as follows:

   Input/Output, Input Mixer, Input Mixer (Ext)
   Mixer Config, Harmonic, –10
   SPAN, Zero Span
   FREQUENCY, 30 GHz
   CF Step, 2 GHz
   Freq Offset, 321.4 MHz
   System, Alignments, Auto Align, Off

6. Press **FREQUENCY** on the analyzer.
7. Read the power displayed on the power meter and record it as TR Entry 1 in the Performance Verification Test Record.
8. Press the ⇑ key on the analyzer to select the next center frequency and First LO frequency.
9. Enter the appropriate power sensor calibration factor into the power meter as shown in Table 2-96.
10. Read the power displayed on the power meter and record it in the Performance Verification Test Record as indicated in the TR Entry column of Table 2-96.
11. Repeat step 8 through step 10 for the remaining center frequency and First LO frequencies listed in Table 2-96.

Table 2-96 First LO Output Amplitude Accuracy Worksheet

First LO Frequency (GHz)	Center Frequency (GHz)	Calibration Factor Frequency (GHz)	TR Entry
2.9	29	3.0	1
3.1	31	3.0	2
3.3	33	3.0	3
3.5	35	4.0	4
3.7	37	4.0	5
3.9	39	4.0	6
4.1	41	4.0	7
4.3	43	4.0	8
4.5	45	5.0	9
4.7	47	5.0	10
4.9	49	5.0	11
5.1	51	5.0	12
5.3	53	5.0	13
5.5	55	6.0	14
5.7	57	6.0	15
5.9	59	6.0	16
6.1	61	6.0	17
6.3	63	6.0	18
6.5	65	7.0	19
6.7	67	7.0	20
6.9	69	7.0	21
7.1	71	7.0	22

Post-Test Instrument Restoration

12.Disconnect the power sensor from the First LO OUTPUT connector.

13.Replace the 50 Ω termination on the First LO OUTPUT connector.

14.Preset the spectrum analyzer.

15.Press **System, Alignments, Auto Align, All.**

52. IF INPUT Accuracy (Option AYZ only)

This test only applies to spectrum analyzers equipped with external mixing (Option AYZ).

This test measures the accuracy of the IF INPUT. A nominal –30 dBm, 321.4 MHz signal is applied to a power sensor and the power level is recorded. The actual frequency must be offset slightly to compensate for the IF centering error of the 1 kHz resolution bandwidth. This frequency offset is measured using the 321.4 MHz signal applied to the INPUT 50 Ω connector. The signal is measured with frequency corrections on and off. The difference between these two measurements is the IF centering error. The 321.4 MHz signal is then offset by the IF centering error.

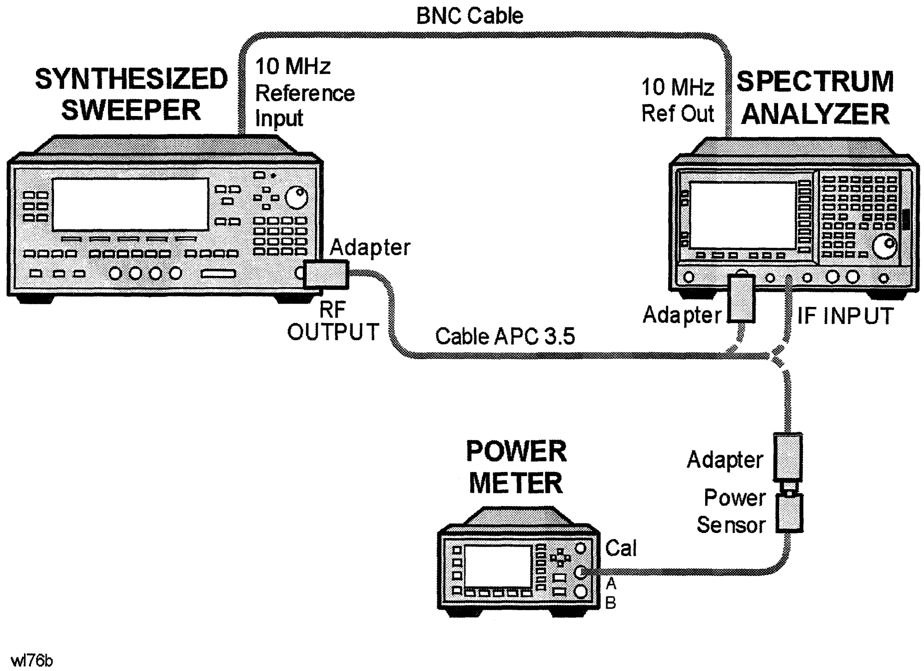
This signal is then applied to the IF INPUT of the spectrum analyzer which is set to external mixing mode in A band (26.5 GHz to 40 GHz). Amplitude corrections are set to 0 dB. The amplitude is measured by the spectrum analyzer and then recorded. The difference between the two measurements is the IF INPUT accuracy.

The related adjustment procedure for this performance test is "IF INPUT Correction."

Equipment Required

Synthesized sweeper
Power meter
Low-power power sensor
30 dB reference attenuator
Cable, APC 3.5
Cable, BNC
Adapter, type-N (m) to APC 3.5 (f) (*not required for Option BAB*)
Adapter, APC 3.5 (f) to APC 3.5 (f) (*two required for Option BAB*)
Adapter, type-N (f) to APC 3.5 (f)

Figure 2-70 **IF INPUT Accuracy Test Setup**



Procedure

Determining the IF Centering Error

1. Preset the synthesized sweeper and set the controls as follows:

   CW . . . . 321.4 MHz
   POWER LEVEL . . . . –30 dBm
   RF . . . . On

2. Connect the synthesized sweeper output to the spectrum analyzer INPUT 50 Ωconnector. The analyzer provides the frequency reference for the synthesized sweeper.
3. Preset the spectrum analyzer and set as follows:

   System, Alignments, Auto Align, Off
   FREQUENCY, 321.4 MHz
   SPAN, 5 kHz
   AMPLITUDE, –30 dBm
   BW/Avg, Resolution BW, 1 kHz

4. On the analyzer, press **Single** and wait for the sweep to finish.
5. On the analyzer, press **Peak Search** (or **Search**), **Marker, Delta.**
6. On the analyzer, press **System, Alignments, Freq Correct** (Off).
7. On the analyzer, press **Single** and wait for the sweep to finish.
8. On the analyzer, press **Peak Search** (or **Search**).

9. Note the ΔMkr1 frequency.

10.Calculate the new synthesized sweeper CW frequency by adding the ΔMkr1 frequency to 321.4 MHz. Set the synthesized sweeper CW frequency to the new calculated frequency.

$$\text{New CW Frequency} = 321.4\text{ MHz} + \Delta\text{Mkr1 Frequency}$$

For example, if the ΔMkr1 frequency is 725 Hz, the new CW frequency would be 321.400725 MHz.

11.On the analyzer, press **System, Alignments, Freq Correct (On)**.

Setting the Synthesized Sweeper Power Level

12.Zero and calibrate the low-power sensor and power meter in dBm mode using the 30 dB reference attenuator. Enter the 300 MHz calibration factor of the power sensor into the power meter.

13.Connect the equipment as shown in Figure 2-70, with the output of the synthesized sweeper connected to the power sensor using an adapter between the cable and the power sensor.

14.Adjust the synthesized sweeper power level for a power meter reading of –30 dBm ±0.1 dB.

15.Record the power meter reading as Input Power.

Input Power ____________dBm

Measuring the IF INPUT Accuracy

16.Connect the APC 3.5 cable from the RF OUTPUT of the synthesized sweeper to the IF INPUT of the analyzer..

17.Preset the spectrum analyzer and set as follows:

System, Alignments, Auto Align, Off
AMPLITUDE, More 1 of 2, Corrections, Corrections (Off)
AMPLITUDE, –30 dBm
Input/Output, Input Mixer, Input Mixer (Ext)
Ext Mix Band, 26.5–40 GHz
FREQUENCY, 30 GHz
SPAN, Zero Span
BW/Avg, Resolution Bandwidth, 1 kHz

18.Press **Peak Search** on the analyzer. Record the Mkr1 amplitude reading as the Measured Power.

Measured Power ____________dBm

19.Subtract the Input Power (step 15) from the Measured Power (step 18) and record the difference as the IF INPUT Accuracy.

IF INPUT Accuracy = Measured Power – Input Power

For example, if the Measured Power is –29.34 dBm and the Input Power is –30.08 dBm, the IF INPUT Accuracy would be 0.74 dB.

20. Record the IF INPUT Accuracy as TR Entry 1 in the Performance Verification Test Record.

Post-Test Instrument Restoration

21. Disconnect the cable from the IF INPUT connector.

22. Preset the spectrum analyzer.

23. On the analyzer, press **System, Alignments, Auto Align, All.**

3 Performance Verification Test Records

HP E4401B Performance Verification Test Record

Only the tests for HP E4401B are included in this test record, therefore not all test numbers are included.

Table 3-1 HP E4401B Performance Verification Test Record

Hewlett-Packard Company	
Address: ____________________	Report No. ____________
____________________	Date ____________
____________________	
Model HP E4401B	
Serial No. ____________	Ambient temperature _____ °C
Options ____________	Power mains line frequency _____ Hz (nominal)
Firmware Revision ________	Relative humidity _____ %
Customer ____________________	Tested by ____________________

Test Equipment Used:

Description	**Model No.**	**Trace No.**	**Cal Due Date**
Synthesized Signal Generator	________	________	________
Synthesized Sweeper	________	________	________
Function Generator	________	________	________
Power Meter, Dual-Channel	________	________	________
RF Power Sensor #1	________	________	________
RF Power Sensor #2 *(Non-Option 1DP only)*	________	________	________
Low-Power Power Sensor	________	________	________
75 Ω Power Sensor *(Option 1DP only)*	________	________	________
Digital Multimeter	________	________	________
Universal Counter	________	________	________
Frequency Standard	________	________	________
Power Splitter	________	________	________

Table 3-1 HP E4401B Performance Verification Test Record

50 Ω Termination	________	________	________
Minimum Loss Pad *(Option 1DP only)*	________	________	________
1 dB Step Attenuator	________	________	________
10 dB Step Attenuator	________	________	________
6 dB Fixed Attenuator	________	________	________
20 dB Fixed Attenuator *(Option 1DS only)*	________	________	________
Oscilloscope *(Option 1D6 only)*	________	________	________
Microwave Spectrum Analyzer *(Option 1DN or 1DQ only)*	________	________	________
Notes/comments:	________________		

Table 3-2 HP E4401B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4401B **Report No.** ________

Serial No. ________ **Date** ________

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
1. 10 MHz Reference Output Accuracy (*Non-Option 1D5 only*)				
Settability	–5.0 Hz	(1)______	+5.0 Hz	±293.3 μHz
2. 10 MHz Precision Frequency Reference Output Accuracy (*Option 1D5 only*)				
5 Minute Warm-Up Error	–0.1 ppm	(1)______	+0.1 ppm	±0.000072 ppm
15 Minute Warm-Up Error	–0.01 ppm	(2)______	+0.01 ppm	±0.000070 ppm

Table 3-2 HP E4401B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4401B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
3. Frequency Readout Accuracy and Marker Count Accuracy				
Frequency Readout Accuracy				
Center Freq Span				
1490 MHz 20 MHz	1489.784990 MHz	(1)______	1490.215010 MHz	±0 Hz
1490 MHz 10 MHz	1489.884990 MHz	(2)______	1490.115010 MHz	±0 Hz
1490 MHz 1 MHz	1489.988490 MHz	(3)______	1490.011510 MHz	±0 Hz
Marker Count Accuracy				
Center Freq Span				
1490 MHz 10 MHz	1489.999999 MHz	(4)______	1490.000001 MHz	±0 Hz
1490 MHz 1 MHz	1489.999999 MHz	(5)______	1490.000001 MHz	±0 Hz
5. Frequency Span Readout Accuracy				
Span Start Freq				
1500 MHz 0 Hz	1185 MHz	(1)______	1215 MHz	±3.06 MHz
100 MHz 10 MHz	79 MHz	(2)______	81 MHz	±204 kHz
100 kHz 10 MHz	79 kHz	(3)______	81 kHz	±204 Hz
100 MHz 800 MHz	79 MHz	(4)______	81 MHz	±204 kHz
100 kHz 800 MHz	79 kHz	(5)______	81 kHz	±204 Hz
100 MHz 1400 MHz	79 MHz	(6)______	81 MHz	±204 kHz
100 kHz 1499 MHz	79 kHz	(7)______	81 kHz	±204 Hz

Table 3-2 HP E4401B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4401B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
7. Noise Sidebands				
Offset from 1 GHz signal				
10 kHz		(1)______	–90 dBc/Hz	±1.154 dB
20 kHz		(2)______	–100 dBc/Hz	±1.154 dB
30 kHz		(3)______	–102 dBc/Hz	±1.154 dB
100 kHz		(4)______	–112 dBc/Hz	±1.154 dB
8. System Related Sidebands				
Offset from 500 MHz signal				
30 kHz to 230 kHz		(1)______	–65 dBc	±1.154 dB
–30 kHz to –230 kHz		(2)______	–65 dBc	±1.154 dB
9. Residual FM				
1 kHz Res BW, (*Non-Option 1D5)*		(1)______	150 Hz	±9.24 Hz
1 kHz Res BW, (*Option 1D5)*		(1)______	100 Hz	±9.24 Hz
10 Hz Res BW (*Options 1DR and 1D5 only*)		(2)______	2 Hz	±0.274 Hz
10. Sweep Time Accuracy				
Sweep Time				
5 ms	–1.0%	(1)______	±1.0%	±0.28%
20 ms	–1.0%	(2)______	±1.0%	±0.28%
100 ms	–1.0%	(3)______	±1.0%	±0.28%
1 s	–1.0%	(4)______	±1.0%	±0.28%
10 s	–1.0%	(5)______	±1.0%	±0.28%
1 ms (*Option AYX only)*	–1.0%	(6)______	±1.0%	±0.28%

Table 3-2 HP E4401B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4401B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
500 µs (*Option AYX only*)	–1.0%	(7)______	±1.0%	±0.28%
100 µs (*Option AYX only*)	–1.0%	(8)______	±1.0%	±0.28%
11. Display Scale Fidelity				
Cumulative Log Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–0.34 dB	(1)______	+0.34 dB	±0.064 dB
–8	–0.38 dB	(2)______	+0.38 dB	±0.064 dB
–12	–0.42 dB	(3)______	+0.42 dB	±0.064 dB
–16	–0.46 dB	(4)______	+0.46 dB	±0.064 dB
–20	–0.50 dB	(5)______	+0.50 dB	±0.063 dB
–24	–0.54 dB	(6)______	+0.54 dB	±0.064 dB
–28	–0.58 dB	(7)______	+0.58 dB	±0.064 dB
–32	–0.62 dB	(8)______	+0.62 dB	±0.064 dB
–36	–0.66 dB	(9)______	+0.66 dB	±0.064 dB
–40	–0.70 dB	(10)______	+0.70 dB	±0.063 dB
–44	–0.74 dB	(11)______	+0.74 dB	±0.064 dB
–48	–0.78 dB	(12)______	+0.78 dB	±0.064 dB
–52	–0.82 dB	(13)______	+0.82 dB	±0.089 dB
–56	–0.86 dB	(14)______	+0.86 dB	±0.089 dB
–60	–0.90 dB	(15)______	+0.90 dB	±0.088 dB
–64	–0.94 dB	(16)______	+0.94 dB	±0.089 dB
–68	–0.98 dB	(17)______	+0.98 dB	±0.089 dB
–72	–1.02 dB	(18)______	+1.02 dB	±0.089 dB
–76	–1.06 dB	(19)______	+1.06 dB	±0.089 dB
–80	–1.10 dB	(20)______	+1.10 dB	±0.088 dB

Table 3-2 HP E4401B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4401B		Report No. _________		
Serial No. _________		Date _________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–84	–1.14 dB	(21)_______	+1.14 dB	±0.089 dB
Incremental Log Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–0.4 dB	(22)_______	+0.4 dB	±0.064 dB
–8	–0.4 dB	(23)_______	+0.4 dB	±0.064 dB
–12	–0.4 dB	(24)_______	+0.4 dB	±0.064 dB
–16	–0.4 dB	(25)_______	+0.4 dB	±0.064 dB
–20	–0.4 dB	(26)_______	+0.4 dB	±0.063 dB
–24	–0.4 dB	(27)_______	+0.4 dB	±0.064 dB
–28	–0.4 dB	(28)_______	+0.4 dB	±0.064 dB
–32	–0.4 dB	(29)_______	+0.4 dB	±0.064 dB
–36	–0.4 dB	(30)_______	+0.4 dB	±0.064 dB
–40	–0.4 dB	(31)_______	+0.4 dB	±0.063 dB
–44	–0.4 dB	(32)_______	+0.4 dB	±0.064 dB
–48	–0.4 dB	(33)_______	+0.4 dB	±0.064 dB
–52	–0.4 dB	(34)_______	+0.4 dB	±0.089 dB
–56	–0.4 dB	(35)_______	+0.4 dB	±0.089 dB
–60	–0.4 dB	(36)_______	+0.4 dB	±0.088 dB
–64	–0.4 dB	(37)_______	+0.4 dB	±0.089 dB
–68	–0.4 dB	(38)_______	+0.4 dB	±0.089 dB
–72	–0.4 dB	(39)_______	+0.4 dB	±0.089 dB
–76	–0.4 dB	(40)_______	+0.4 dB	±0.089 dB
–80	–0.4 dB	(41)___	+0.4 dB	±0.088 dB

Table 3-2 HP E4401B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4401B **Report No. ________**

Serial No. ________ **Date ________**

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
Cumulative Log Fidelity, Res BW ≤ 300 Hz *(Option 1DR only)*				
dB from Ref Level				
–4	–0.34 dB	(43)______	+0.34 dB	±0.064 dB
–8	–0.38 dB	(44)______	+0.38 dB	±0.064 dB
–12	–0.42 dB	(45)______	+0.42 dB	±0.064 dB
–16	–0.46 dB	(46)______	+0.46 dB	±0.064 dB
–20	–0.50 dB	(47)______	+0.50 dB	±0.063 dB
–24	–0.54 dB	(48)______	+0.54 dB	±0.064 dB
–28	–0.58 dB	(49)______	+0.58 dB	±0.064 dB
–32	–0.62 dB	(50)______	+0.62 dB	±0.064 dB
–36	–0.66 dB	(51)______	+0.66 dB	±0.064 dB
–40	–0.70 dB	(52)______	+0.70 dB	±0.063 dB
–44	–0.74 dB	(53)______	+0.74 dB	±0.064 dB
–48	–0.78 dB	(54)______	+0.78 dB	±0.064 dB
–52	–0.82 dB	(55)______	+0.82 dB	±0.089 dB
–56	–0.86 dB	(56)______	+0.86 dB	±0.089 dB
–60	–0.90 dB	(57)______	+0.90 dB	±0.088 dB
–64	–0.94 dB	(58)______	+0.94 dB	±0.089 dB
–68	–0.98 dB	(59)______	+0.98 dB	±0.089 dB
–72	–1.02 dB	(60)______	+1.02 dB	±0.089 dB
–76	–1.06 dB	(61)______	+1.06 dB	±0.089 dB
–80	–1.10 dB	(62)______	+1.10 dB	±0.088 dB
–84	–1.14 dB	(63)______	+1.14 dB	±0.089 dB
–88	–1.18 dB	(64)______	+1.18 dB	±0.089 dB

Table 3-2 HP E4401B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4401B		Report No. __________		
Serial No. __________		Date __________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–92	–1.22 dB	(65)_______	+1.22 dB	±0.089 dB
–96	–1.26 dB	(66)_______	+1.26 dB	±0.088 dB
–98	–1.28 dB	(67)_______	+1.28 dB	±0.089 dB
Incremental Log Fidelity, Res BW ≤ 300 Hz *(Option 1DR only)*				
dB from Ref Level				
–4	–0.4 dB	(68)_______	+0.4 dB	±0.064 dB
–8	–0.4 dB	(69)_______	+0.4 dB	±0.064 dB
–12	–0.4 dB	(70)_______	+0.4 dB	±0.064 dB
–16	–0.4 dB	(71)_______	+0.4 dB	±0.064 dB
–20	–0.4 dB	(72)_______	+0.4 dB	±0.063 dB
–24	–0.4 dB	(73)_______	+0.4 dB	±0.064 dB
–28	–0.4 dB	(74)_______	+0.4 dB	±0.064 dB
–32	–0.4 dB	(75)_______	+0.4 dB	±0.064 dB
–36	–0.4 dB	(76)_______	+0.4 dB	±0.064 dB
–40	–0.4 dB	(77)_______	+0.4 dB	±0.063 dB
–44	–0.4 dB	(78)_______	+0.4 dB	±0.064 dB
–48	–0.4 dB	(79)_______	+0.4 dB	±0.064 dB
–52	–0.4 dB	(80)_______	+0.4 dB	±0.089 dB
–56	–0.4 dB	(81)_______	+0.4 dB	±0.089 dB
–60	–0.4 dB	(82)_______	+0.4 dB	±0.088 dB
–64	–0.4 dB	(83)_______	+0.4 dB	±0.089 dB
–68	–0.4 dB	(84)_______	+0.4 dB	±0.089 dB
–72	–0.4 dB	(85)_______	+0.4 dB	±0.089 dB
–76	–0.4 dB	(86)_______	+0.4 dB	±0.089 dB

Table 3-2 HP E4401B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4401B		**Report No. __________**		
Serial No. __________		**Date __________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–80	–0.4 dB	(87)_______	+0.4 dB	±0.088 dB
Linear Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–2.0%	(89)_______	+2.0%	±0.064 %
–8	–2.0%	(90)_______	+2.0%	±0.064 %
–12	–2.0%	(91)_______	+2.0%	±0.064 %
–16	–2.0%	(92)_______	+2.0%	±0.064 %
–20	–2.0%	(93)_______	+2.0%	±0.063 %
Linear Fidelity, Res BW ≤ 300 Hz *(Option 1DR only)*				
dB from Ref Level				
–4	–2.0%	(94)_______	+2.0%	±0.064 %
–8	–2.0%	(95)_______	+2.0%	±0.064 %
–12	–2.0%	(96)_______	+2.0%	±0.064 %
–16	–2.0%	(97)_______	+2.0%	±0.064 %
–20	–2.0%	(98)_______	+2.0%	±0.063 %
Zero Span, Res BW≤ 300 Hz *(Option 1DR only)*				
dB from Ref Level				
–4	–0.36 dB	(99)_______	+0.36 dB	±0.064 dB
–8	–0.42 dB	(100)_______	+0.42 dB	±0.064 dB
–12	–0.48 dB	(101)_______	+0.48 dB	±0.064 dB
–16	–0.54 dB	(102)_______	+0.54 dB	±0.064 dB
–20	–0.60 dB	(103)_______	+0.60 dB	±0.063 dB
–24	–0.66 dB	(104)_______	+0.66 dB	±0.064 dB

Table 3-2 HP E4401B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4401B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–28	–0.72 dB	(105)______	+0.72 dB	±0.064 dB
–32	–0.78 dB	(106)______	+0.78 dB	±0.064 dB
–36	–0.84 dB	(107)______	+0.84 dB	±0.064 dB
–40	–0.90 dB	(108)______	+0.90 dB	±0.063 dB
–44	–0.96 dB	(109)______	+0.96 dB	±0.064 dB
–48	–1.02 dB	(110)______	+1.02 dB	±0.064 dB
–52	–1.08 dB	(111)______	+1.08 dB	±0.089 dB
–56	–1.14 dB	(112)______	+1.14 dB	±0.089 dB
–60	–1.20 dB	(113)______	+1.20 dB	±0.088 dB
–64	–1.5 dB	(114)______	+1.5 dB	±0.089 dB
–68	–1.5 dB	(115)______	+1.5 dB	±0.089 dB
–70	–1.5 dB	(116)______	+1.5 dB	±0.089 dB
12. Input Attenuation Switching Uncertainty				
Input Attenuation Setting				
0 dB	–0.3 dB	(1)______	+0.3 dB	±0.108 dB
5 dB	–0.3 dB	(2)______	+0.3 dB	±0.107 dB
15 dB	–0.3 dB	(3)______	+0.3 dB	±0.107 dB
20 dB	–0.3 dB	(4)______	+0.3 dB	±0.089 dB
25 dB	–0.35 dB	(5)______	+0.35 dB	±0.089 dB
30 dB	–0.40 dB	(6)______	+0.40 dB	±0.089 dB
35 dB	–0.45 dB	(7)______	+0.45 dB	±0.089 dB
40 dB	–0.50 dB	(8)______	+0.50 dB	±0.089 dB
45 dB	–0.55 dB	(9)______	+0.55 dB	±0.089 dB
50 dB	–0.60 dB	(10)______	+0.60 dB	±0.089 dB
55 dB	–0.65 dB	(11)______	+0.65 dB	±0.089 dB

Table 3-2 HP E4401B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4401B **Report No. ________**

Serial No. ________ **Date ________**

Test Description		Minimum	Results Measured	Maximum	Measurement Uncertainty
60 dB		–0.70 dB	(12)_______	+0.70 dB	±0.089 dB
13. Reference Level Accuracy					
Log, Res BW ≥ 1 kHz					
Reference Level					
50 Ω (dBm)	75 Ω (dBmV)				
–15	+33.75	–0.3 dB	(1)_______	+0.3 dB	±0.144 dB
–5	+43.75	–0.3 dB	(2)_______	+0.3 dB	±0.144 dB
–35	+13.75	–0.3 dB	(3)_______	+0.3 dB	±0.144 dB
–45	+3.75	–0.3 dB	(4)_______	+0.3 dB	±0.144 dB
–55	–6.25	–0.5 dB	(5)_______	+0.5 dB	±0.156 dB
–65	–16.25	–0.5 dB	(6)_______	+0.5 dB	±0.156 dB
–75	–26.25	–0.7 dB	(7)_______	+0.7 dB	±0.156 dB
Linear, Res BW ≤ 300 Hz					
Reference Level					
50 Ω (dBm)	75 Ω (dBmV)				
–15	+33.75	–0.3 dB	(8)_______	+0.3 dB	±0.144 dB
–5	+43.75	–0.3 dB	(9)_______	+0.3 dB	±0.144 dB
–35	+13.75	–0.3 dB	(10)_______	+0.3 dB	±0.144 dB
–45	+3.75	–0.3 dB	(11)_______	+0.3 dB	±0.144 dB
–55	–6.25	–0.5 dB	(12)_______	+0.5 dB	±0.156 dB
–65	–16.25	–0.5 dB	(13)_______	+0.5 dB	±0.156 dB
–75	–26.25	–0.7 dB	(14)_______	+0.7 dB	±0.156 dB

Table 3-2 HP E4401B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4401B **Report No. __________**

Serial No. __________ **Date __________**

Test Description		Minimum	Results Measured	Maximum	Measurement Uncertainty
Log, Res BW ≤ 300 Hz *(Option 1DR only)*					
Reference Level					
50 Ω (dBm)	75 Ω (dBmV)				
–15	+33.75	–0.3 dB	(15)________	+0.3 dB	±0.144 dB
–5	+43.75	–0.3 dB	(16)________	+0.3 dB	±0.144 dB
–35	+13.75	–0.3 dB	(17)________	+0.3 dB	±0.144 dB
–45	+3.75	–0.3 dB	(18)________	+0.3 dB	±0.144 dB
–55	–6.25	–0.5 dB	(19)________	+0.5 dB	±0.156 dB
–65	–16.25	–0.5 dB	(20)________	+0.5 dB	±0.156 dB
–75	–26.25	–0.7 dB	(21)________	+0.7 dB	±0.156 dB
Linear, Res BW ≤ 300 Hz *(Option 1DR only)*					
Reference Level					
50 Ω (dBm)	75 Ω (dBmV)				
–15	+33.75	–0.3 dB	(22)________	+0.3 dB	±0.144 dB
–5	+43.75	–0.3 dB	(23)________	+0.3 dB	±0.144 dB
–35	+13.75	–0.3 dB	(24)________	+0.3 dB	±0.144 dB
–45	+3.75	–0.3 dB	(25)________	+0.3 dB	±0.144 dB
–55	–6.25	–0.5 dB	(26)________	+0.5 dB	±0.156 dB
–65	–16.25	–0.5 dB	(27)________	+0.5 dB	±0.156 dB
–75	–26.25	–0.7 dB	(28)________	+0.7 dB	±0.156 dB

Table 3-2 HP E4401B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4401B **Report No.** __________

Serial No. __________ **Date** __________

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
15. Resolution Bandwidth Switching Uncertainty				
Resolution Bandwidth				
3 kHz	–0.3 dB	(1)_______	+0.3 dB	±0.064 dB
9 kHz	–0.3 dB	(2)_______	+0.3 dB	±0.064 dB
10 kHz	–0.3 dB	(3)_______	+0.3 dB	±0.064 dB
30 kHz	–0.3 dB	(4)_______	+0.3 dB	±0.064 dB
100 kHz	–0.3 dB	(5)_______	+0.3 dB	±0.064 dB
120 kHz	–0.3 dB	(6)_______	+0.3 dB	±0.064 dB
300 kHz	–0.3 dB	(7)_______	+0.3 dB	±0.064 dB
1 MHz	–0.3 dB	(8)_______	+0.3 dB	±0.064 dB
3 MHz	–0.3 dB	(9)_______	+0.3 dB	±0.064 dB
5 MHz	–0.6 dB	(10)_______	+0.6 dB	±0.083 dB
300 Hz *(Option 1DR only)*	–0.3 dB	(11)_______	+0.3 dB	±0.064 dB
200 Hz *(Option 1DR only)*	–0.3 dB	(12)_______	+0.3 dB	±0.064 dB
100 Hz *(Option 1DR only)*	–0.3 dB	(13)_______	+0.3 dB	±0.064 dB
30 Hz *(Option 1DR only)*	–0.3 dB	(14)_______	+0.3 dB	±0.064 dB
10 Hz *(Option 1DR only)*	–0.3 dB	(15)_______	+0.3 dB	±0.064 dB
16. Absolute Amplitude Accuracy (Reference Settings)				
Log, Preamp Off	–0.34 dB	(1)_______	+0.34 dB	±0.148 dB
Lin, Preamp Off	–0.34 dB	(2)_______	+0.34 dB	±0.148 dB
Log, Preamp On	–0.5 dB	(3)_______	+0.5 dB	±0.148 dB
Lin, Preamp On	–0.5 dB	(4)_______	+0.5 dB	±0.148 dB

Table 3-2 HP E4401B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4401B		Report No. ______		
Serial No. ______		Date ______		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
18. Overall Absolute Amplitude Accuracy				
0 dBm Reference Level				
0 dBm input	–0.54 dB	(1)______	+0.54 dB	±0.08 dB
–10 dBm input	–0.54 dB	(2)______	+0.54 dB	±0.081 dB
–20 dBm input	–0.54 dB	(3)______	+0.54 dB	±0.082 dB
–30 dBm input	–0.54 dB	(4)______	+0.54 dB	±0.083 dB
–40 dBm input	–0.54 dB	(5)______	+0.54 dB	±0.084 dB
–50 dBm input	–0.54 dB	(6)______	+0.54 dB	±0.086 dB
–20 dBm Reference Level				
–20 dBm input	–0.54 dB	(7)______	+0.54 dB	±0.082 dB
–30 dBm input	–0.54 dB	(8)______	+0.54 dB	±0.083 dB
–40 dBm input	–0.54 dB	(9)______	+0.54 dB	±0.084 dB
–50 dBm input	–0.54 dB	(10)______	+0.54 dB	±0.086 dB
–40 dBm Reference Level				
–40 dBm input	–0.54 dB	(11)______	+0.54 dB	±0.084 dB
–50 dBm input	–0.54 dB	(12)______	+0.54 dB	±0.086 dB
–50 dBm Reference Level				
–50 dBm input	–0.54 dB	(13)______	+0.54 dB	±0.086 dB
20. Resolution Bandwidth Accuracy				
Resolution Bandwidth				
5 MHz	3.5 MHz	(1)______	6.5 MHz	±38.2 kHz
3 MHz	2.55 MHz	(2)______	3.45 MHz	±22.9 kHz
1 MHz	0.85 MHz	(3)______	1.15 MHz	±7.64 kHz
300 kHz	255 kHz	(4)______	345 kHz	±2.29 kHz

Table 3-2 HP E4401B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4401B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
100 kHz	85 kHz	(5)________	115 kHz	±764 Hz
30 kHz	25.5 kHz	(6)________	34.5 kHz	±229 Hz
10 kHz	8.5 kHz	(7)________	11.5 kHz	±76.4 Hz
3 kHz	2.55 kHz	(8)________	3.45 kHz	±22.9 Hz
1 kHz	850 Hz	(9)________	1.15 kHz	±7.64 Hz
120 kHz	102 kHz	(10)________	138 kHz	±154 Hz
9 kHz	7.65 kHz	(11)________	10.35kHz	±11.5 Hz
21. Frequency Response	Note: Enter data in the appropriate section below depending upon the input impedance of the analyzer and the ambient temperature at which the test was performed.			
50 Ω, 20 to 30 °C:				
Maximum Response		(1)________	+0.5 dB	±0.245 dB
Minimum Response	–0.5 dB	(2)________		±0.245 dB
Peak-to-Peak Response		(3)________	1.0 dB	±0.245 dB
50 Ω, 0 to 55 °C:				
Maximum Response		(1)________	+1.0 dB	±0.245 dB
Minimum Response	–1.0 dB	(2)________		±0.245 dB
Peak-to-Peak Response		(3)________	2.0 dB	±0.245 dB
75 Ω, 20 to 30 °C:				
Maximum Response		(1)________	+0.5 dB	±0.189 dB
Minimum Response	–0.5 dB	(2)________		±0.189 dB
Peak-to-Peak Response		(3)________	1.0 dB	±0.189 dB
75 Ω, 0 to 55 °C:				
Maximum Response		(1)________	+1.0 dB	±0.189 dB
Minimum Response	–1.0 dB	(2)________		±0.189 dB
Peak-to-Peak Response		(3)________	2.0 dB	±0.189 dB

Table 3-2 HP E4401B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4401B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
24. Frequency Response (Preamp On) *(Option 1DS only)*	Note: Enter data in the appropriate section below depending upon the input impedance of the analyzer and the ambient temperature at which the test was performed.			
50 Ω, 20 to 30 °C:				
Maximum Response		(1)_______	+1.0 dB	±0.358 dB
Minimum Response	–1.0 dB	(2)_______		±0.358 dB
Peak-to-Peak Response		(3)_______	2.0 dB	±0.358 dB
50 Ω, 0 to 55 °C:				
Maximum Response		(1)_______	+1.5 dB	±0.358 dB
Minimum Response	–1.5 dB	(2)_______		±0.358 dB
Peak-to-Peak Response		(3)_______	3.0 dB	±0.358 dB
75 Ω, 20 to 30 °C:				
Maximum Response		(1)_______	+1.5 dB	±0.337 dB
Minimum Response	–1.5 dB	(2)_______		±0.337 dB
Peak-to-Peak Response		(3)_______	3.0 dB	±0.337 dB
75 Ω, 0 to 55 °C:				
Maximum Response		(1)_______	+2.0 dB	±0.337 dB
Minimum Response	–2.0 dB	(2)_______		±0.337 dB
Peak-to-Peak Response		(3)_______	4.0 dB	±0.337 dB
27. Other Input Related Spurious Responses				
Input Frequency				
542.8 MHz		(1)_______	–65 dBc	±1.08 dB
510.7 MHz		(2)_______	–65 dBc	±1.08 dB
1310.7 MHz		(3)_______	–45 dBc	±1.08 dB

Table 3-2 HP E4401B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4401B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
29. Spurious Responses	Note: Enter the results in the appropriate lines below based upon the input impedance of the analyzer.			
50 MHz TOI, 1 kHz RBW, 50 Ω	+10 dBm	(1)_______		±0.489 dB
50 MHz TOI, 1 kHz RBW, 75 Ω	+58.75 dBmV	(1)_______		±0.481 dB
50 MHz TOI, 30 Hz RBW, 50 Ω *(Option 1DR only)*	+10 dBm	(2)_______		±0.489 dB
50 MHz TOI, 30 Hz RBW, 75 Ω *(Option 1DR only)*	+58.75 dBmV	(2)_______		±0.481 dB
40 MHz SHI, 50 Ω	+35 dBm	(3)_______		±1.11 dB
40 MHz SHI, 75 Ω	+83.75 dBmV	(3)_______		±1.11 dB
32. Gain Compression				
Test Frequency				
53 MHz		(1)_______	1.0 dB	±0.127 dB
50.004 MHz *(Option 1DR only)*		(2)_______	1.0 dB	±0.127 dB
1403 MHz		(3)_______	1.0 dB	±0.127 dB
34. Displayed Average Noise Level	Note: Enter results in the appropriate section below based upon the input impedance of the analyzer.			
50 Ω, 1 kHz RBW, Preamp Off:				
400 kHz		(1)_______	–115 dBm	±1.82 dB
1 MHz to 10 MHz		(2)_______	–115 dBm	±1.82 dB
10 MHz to 500 MHz		(3)_______	–119 dBm	±1.82 dB
500 MHz to 1 GHz		(4)_______	–117 dBm	±1.82 dB
1 GHz to 1.5 GHz		(5)_______	–113 dBm	±1.82 dB

Table 3-2 HP E4401B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4401B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
50 Ω, 1 kHz RBW, Preamp On:				
400 kHz		(6)______	–131 dBm	±1.82 dB
1 MHz to 10 MHz		(7)______	–131 dBm	±1.82 dB
10 MHz to 500 MHz		(8)______	–135 dBm	±1.82 dB
500 MHz to 1 GHz		(9)______	–133 dBm	±1.82 dB
1 GHz to 1.5 GHz		(10)______	–129 dBm	±1.82 dB
50 Ω, 10 Hz RBW, Preamp Off:				
400 kHz		(11)______	–134 dBm	±1.82 dB
1 MHz to 10 MHz		(12)______	–134 dBm	±1.82 dB
10 MHz to 500 MHz		(13)______	–138 dBm	±1.82 dB
500 MHz to 1 GHz		(14)______	–136 dBm	±1.82 dB
1 GHz to 1.5 GHz		(15)______	–132 dBm	±1.82 dB
50 Ω, 10 Hz RBW, Preamp On:				
400 kHz		(16)______	–149 dBm	±1.82 dB
1 MHz to 10 MHz		(17)______	–149 dBm	±1.82 dB
10 MHz to 500 MHz		(18)______	–153 dBm	±1.82 dB
500 MHz to 1 GHz		(19)______	–151 dBm	±1.82 dB
1 GHz to 1.5 GHz		(20)______	–147 dBm	±1.82 dB
75 Ω, 1 kHz RBW, Preamp Off:				
1 MHz to 10 MHz		(21)______	–63 dBmV	±1.82 dB
10 MHz to 500 MHz		(22)______	–65 dBmV	±1.82 dB
500 MHz to 1 GHz		(23)______	–60 dBmV	±1.82 dB
1 GHz to 1.5 GHz		(24)______	–53 dBmV	±1.82 dB

Table 3-2 HP E4401B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4401B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
75 Ω, 1 kHz RBW, Preamp On:				
1 MHz to 10 MHz		(25)_______	–80 dBmV	±1.82 dB
10 MHz to 500 MHz		(26)_______	–81 dBmV	±1.82 dB
500 MHz to 1 GHz		(27)_______	–76 dBmV	±1.82 dB
1 GHz to 1.5 GHz		(28)_______	–69 dBmV	±1.82 dB
75 Ω, 10 Hz RBW, Preamp Off:				
1 MHz to 10 MHz		(29)_______	–82 dBmV	±1.82 dB
10 MHz to 500 MHz		(30)_______	–84 dBmV	±1.82 dB
500 MHz to 1 GHz		(31)_______	–79 dBmV	±1.82 dB
1 GHz to 1.5 GHz		(32)_______	–72 dBmV	±1.82 dB
75 Ω, 10 Hz RBW, Preamp On:				
1 MHz to 10 MHz		(33)_______	–98 dBmV	±1.82 dB
10 MHz to 500 MHz		(34)_______	–99 dBmV	±1.82 dB
500 MHz to 1 GHz		(35)_______	–94 dBmV	±1.82 dB
1 GHz to 1.5 GHz		(36)_______	–87 dBmV	±1.82 dB
38. Residual Responses	Note: Enter results in the appropriate section below based upon the input impedance of the analyzer.			
50 Ω, 150 kHz to 1.5 GHz		(1)_______	–90 dBm	±0.90 dB
75 Ω, 1 MHz to 1.5 GHz		(1)_______	–36 dBmV	±0.90 dB
39. Fast Time Domain Amplitude Accuracy *(Option AYX only)*				
Amplitude Error	–0.3 %	(1)_______	+0.3 %	±0.029 %

Table 3-2 HP E4401B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4401B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
40. Tracking Generator Absolute Amplitude and Vernier Accuracy	Note: Enter results in the appropriate section below based upon the input impedance of the analyzer.			
50 Ω *(Option 1DN)*				
Absolute Amplitude Accuracy	–0.5 dB	(1)______	+0.5 dB	±0.14 dB
Positive Vernier Accuracy		(2)______	+0.75 dB	±0.19 dB
Negative Vernier Accuracy	–0.75 dB	(3)______		±0.19 dB
Power Sweep Accuracy		(4)______	1.5 dB	±0.19 dB
75 Ω *(Option 1DQ)*				
Absolute Amplitude Accuracy	–1.5 dB	(1)______	+1.5 dB	±0.14 dB
Positive Vernier Accuracy		(2)______	+0.9 dB	±0.19 dB
Negative Vernier Accuracy	–0.9 dB	(3)______		±0.19 dB
Power Sweep Accuracy		(4)______	1.8 dB	±0.19 dB
42. Tracking Generator Level Flatness	Note: Enter results in the appropriate section below based upon the input impedance of the analyzer.			
50 Ω *(Option 1DN)*				
Positive Level Flatness, <1 MHz		(1)______	+2.0 dB	±0.588 dB
Negative Level Flatness, <1 MHz	–2.0 dB	(2)______		±0.588 dB
Positive Level Flatness, 1 MHz to 10 MHz		(3)______	+2.0 dB	±0.281 dB
Negative Level Flatness, 1 MHz to 10 MHz	–2.0 dB	(4)______		±0.281 dB
Positive Level Flatness, >10 MHz		(5)______	+1.5 dB	±0.202 dB

Table 3-2 HP E4401B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4401B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
Negative Level Flatness, >10 MHz	–1.5 dB	(6)______		±0.202 dB
75 Ω *(Option 1DQ)*				
Positive Level Flatness, 1 MHz to 10 MHz		(3)______	+2.5 dB	±0.314 dB
Negative Level Flatness, 1 MHz to 10 MHz	–2.5 dB	(4)______		±0.314 dB
Positive Level Flatness, >10 MHz		(5)______	+2.0 dB	±0.314 dB
Negative Level Flatness, >10 MHz	–2.0 dB	(6)______		±0.314 dB
44. Tracking Generator Harmonic Spurious Outputs *(Option 1DN or Option 1DQ only)*				
2^{nd} Harmonic, <20 MHz		(1)______	–20 dBc	±2.6 dB
2^{nd} Harmonic, ≥ 20 MHz		(2)______	–25 dBc	±2.6 dB
3^{rd} Harmonic, <20 MHz		(3)______	–20 dBc	±2.6 dB
3^{rd} Harmonic, ≥20 MHz		(4)______	–25 dBc	±2.6 dB
46. Tracking Generator Non-Harmonic Spurious Outputs *(Option 1DN or Option 1DQ only)*				
Highest Non-Harmonic Spurious Output Amplitude		(1)______	–35 dBc	±2.67 dB

Table 3-2 HP E4401B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4401B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
49. Gate Delay Accuracy and Gate Length Accuracy *(Option 1D6 only)*				
Minimum Gate Delay	499.9 ns	(1)______	1.5001 µs	±475 ps
Maximum Gate Delay	499.9 ns	(2)______	1.5001 µs	±475 ps
1 µs Gate Length	499.9 ns	(3)______	1.5001 µs	±450 ps
65 ms Gate Length	64.993 ms	(4)______	65.007 ms	±561 ns
50. Gate Mode Amplitude Error *(Option 1D6 only)*				
Amplitude Error	–0.2 dB	(1)______	+0.2 dB	±0.023 dB

HP E4402B Performance Verification Test Record

Only the tests for HP E4402B are included in this test record, therefore not all test numbers are included.

Table 3-3 HP E4402B Performance Verification Test Record

Hewlett-Packard Company

Address: ______________________________ Report No. ____________________

______________________________ Date ____________________

____

Model HP E4402B

Serial No. ______________ Ambient temperature ______ °C

Options ______________ Power mains line frequency ______ Hz (nominal)

Firmware Revision __________ Relative humidity ______ %

Customer ______________________________ Tested by ______________________________

Test Equipment Used:

Description	**Model No.**	**Trace No.**	**Cal Due Date**
Synthesized Signal Generator	________	________	________
Synthesized Sweeper	________	________	________
Function Generator	________	________	________
Power Meter, Dual-Channel	________	________	________
RF Power Sensor #1	________	________	________
RF Power Sensor #2	________	________	________
Low-Power Power Sensor	________	________	________
Digital Multimeter	________	________	________
Universal Counter	________	________	________
Frequency Standard	________	________	________
Power Splitter	________	________	________
50 Ω Termination	________	________	________
1 dB Step Attenuator	________	________	________
10 dB Step Attenuator	________	________	________

Table 3-3 HP E4402B Performance Verification Test Record

6 dB Fixed Attenuator	________	________	________
20 dB Fixed Attenuator *(Option 1DS only)*	________	________	________
Oscilloscope *(Option 1D6 only)*	________	________	________
Microwave Spectrum Analyzer *(Option 1DN only)*	________	________	________
Notes/comments:	________________		

Table 3-4 HP E4402B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4402B **Report No.** ________

Serial No. ________ **Date** ________

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
1. 10 MHz Reference Output Accuracy (*Non-Option 1D5 only*)				
Settability	−5.0 Hz	(1)______	+5.0 Hz	±293.3 μHz
2. 10 MHz Precision Frequency Reference Output Accuracy (*Option 1D5 only*)				
5 Minute Warm-Up Error	−0.1 ppm	(1)______	+0.1 ppm	±0.000072 ppm
15 Minute Warm-Up Error	−0.01 ppm	(2)______	+0.01 ppm	±0.000070 ppm
3. Frequency Readout Accuracy and Marker Count Accuracy				
Frequency Readout Accuracy				
Center Freq / Span				
1500 MHz / 20 MHz	1499.784990 MHz	(1)______	1500.215010 MHz	0 Hz
1500 MHz / 10 MHz	1499.884990 MHz	(2)______	1500.115010 MHz	0 Hz

Table 3-4 HP E4402B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4402B		Report No. __________		
Serial No. __________		Date __________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
1500 MHz 1 MHz	1499.988490 MHz	(3)_______	1500.011510 MHz	±0 Hz
Marker Count Accuracy				
Center Freq Span				
1500 MHz 10 MHz	1499.999999 MHz	(4)_______	1500.000001 MHz	±0 Hz
1500 MHz 1 MHz	1499.999999 MHz	(5)_______	1500.000001 MHz	±0 Hz
6. Frequency Span Readout Accuracy				
Span Start Freq				
3000 MHz 0 Hz	2370 MHz	(1)_______	2430 MHz	±6.12 MHz
100 MHz 10 MHz	79 MHz	(2)_______	81 MHz	±204 kHz
100 kHz 10 MHz	79 kHz	(3)_______	81 kHz	±204 Hz
100 MHz 800 MHz	79 MHz	(4)_______	81 MHz	±204 kHz
100 kHz 800 MHz	79 kHz	(5)_______	81 kHz	±204 Hz
100 MHz 1400 MHz	79 MHz	(6)_______	81 MHz	±204 kHz
100 kHz 1499 MHz	79 kHz	(7)_______	81 kHz	±204 Hz
7. Noise Sidebands				
Offset from 1 GHz signal				
10 kHz		(1)_______	–90 dBc/Hz	±1.154 dB
20 kHz		(2)_______	–98 dBc/Hz	±1.154 dB
30 kHz		(3)_______	–100 dBc/Hz	±1.154 dB
100 kHz		(4)_______	–112 dBc/Hz	±1.154 dB

Table 3-4 HP E4402B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4402B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
8. System Related Sidebands				
Offset from 500 MHz signal				
30 kHz to 230 kHz		(1)______	–65 dBc	±1.154 dB
–30 kHz to –230 kHz		(2)______	–65 dBc	±1.154 dB
9. Residual FM				
1 kHz Res BW, (*Non-Option 1D5*)		(1)______	150 Hz	±9.24 Hz
1 kHz Res BW, (*Option 1D5*)		(1)______	100 Hz	±9.24 Hz
10 Hz Res BW (*Options 1DR and 1D5 only*)		(2)______	2 Hz	±0.274 Hz
10. Sweep Time Accuracy				
Sweep Time				
5 ms	–1.0%	(1)______	+1.0%	±0.28%
20 ms	–1.0%	(2)______	+1.0%	±0.28%
100 ms	–1.0%	(3)______	+1.0%	±0.28%
1 s	–1.0%	(4)______	+1.0%	±0.28%
10 s	–1.0%	(5)______	+1.0%	±0.28%
1 ms (*Option AYX only*)	–1.0%	(6)______	+1.0%	±0.28%
500 µs (*Option AYX only*)	–1.0%	(7)______	+1.0%	±0.28%
100 µs (*Option AYX only*)	–1.0%	(8)______	+1.0%	±0.28%

Table 3-4 HP E4402B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4402B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
11. Display Scale Fidelity				
Cumulative Log Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–0.34 dB	(1)________	+0.34 dB	±0.064 dB
–8	–0.38 dB	(2)________	+0.38 dB	±0.064 dB
–12	–0.42 dB	(3)________	+0.42 dB	±0.064 dB
–16	–0.46 dB	(4)________	+0.46 dB	±0.064 dB
–20	–0.50 dB	(5)________	+0.50 dB	±0.063 dB
–24	–0.54 dB	(6)________	+0.54 dB	±0.064 dB
–28	–0.58 dB	(7)________	+0.58 dB	±0.064 dB
–32	–0.62 dB	(8)________	+0.62 dB	±0.064 dB
–36	–0.66 dB	(9)________	+0.66 dB	±0.064 dB
–40	–0.70 dB	(10)________	+0.70 dB	±0.063 dB
–44	–0.74 dB	(11)________	+0.74 dB	±0.064 dB
–48	–0.78 dB	(12)________	+0.78 dB	±0.064 dB
–52	–0.82 dB	(13)________	+0.82 dB	±0.089 dB
–56	–0.86 dB	(14)________	+0.86 dB	±0.089 dB
–60	–0.90 dB	(15)________	+0.90 dB	±0.088 dB
–64	–0.94 dB	(16)________	+0.94 dB	±0.089 dB
–68	–0.98 dB	(17)________	+0.98 dB	±0.089 dB
–72	–1.02 dB	(18)________	+1.02 dB	±0.089 dB
–76	–1.06 dB	(19)________	+1.06 dB	±0.089 dB
–80	–1.10 dB	(20)________	+1.10 dB	±0.088 dB
–84	–1.14 dB	(21)________	+1.14 dB	±0.089 dB

Table 3-4 HP E4402B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4402B		**Report No. __________**		
Serial No. __________		**Date __________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
Incremental Log Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–0.4 dB	(22)_______	+0.4 dB	±0.064 dB
–8	–0.4 dB	(23)_______	+0.4 dB	±0.064 dB
–12	–0.4 dB	(24)_______	+0.4 dB	±0.064 dB
–16	–0.4 dB	(25)_______	+0.4 dB	±0.064 dB
–20	–0.4 dB	(26)_______	+0.4 dB	±0.063 dB
–24	–0.4 dB	(27)_______	+0.4 dB	±0.064 dB
–28	–0.4 dB	(28)_______	+0.4 dB	±0.064 dB
–32	–0.4 dB	(29)_______	+0.4 dB	±0.064 dB
–36	–0.4 dB	(30)_______	+0.4 dB	±0.064 dB
–40	–0.4 dB	(31)_______	+0.4 dB	±0.063 dB
–44	–0.4 dB	(32)_______	+0.4 dB	±0.064 dB
–48	–0.4 dB	(33)_______	+0.4 dB	±0.064 dB
–52	–0.4 dB	(34)_______	+0.4 dB	±0.089 dB
–56	–0.4 dB	(35)_______	+0.4 dB	±0.089 dB
–60	–0.4 dB	(36)_______	+0.4 dB	±0.088 dB
–64	–0.4 dB	(37)_______	+0.4 dB	±0.089 dB
–68	–0.4 dB	(38)_______	+0.4 dB	±0.089 dB
–72	–0.4 dB	(39)_______	+0.4 dB	±0.089 dB
–76	–0.4 dB	(40)_______	+0.4 dB	±0.089 dB
–80	–0.4 dB	(41)_______	+0.4 dB	±0.088 dB

Table 3-4 HP E4402B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4402B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
Cumulative Log Fidelity, Res BW ≤ 300 Hz *(Option 1DR only)*				
dB from Ref Level				
–4	–0.34 dB	(43)________	+0.34 dB	±0.064 dB
–8	–0.38 dB	(44)________	+0.38 dB	±0.064 dB
–12	–0.42 dB	(45)________	+0.42 dB	±0.064 dB
–16	–0.46 dB	(46)________	+0.46 dB	±0.064 dB
–20	–0.50 dB	(47)________	+0.50 dB	±0.063 dB
–24	–0.54 dB	(48)________	+0.54 dB	±0.064 dB
–28	–0.58 dB	(49)________	+0.58 dB	±0.064 dB
–32	–0.62 dB	(50)________	+0.62 dB	±0.064 dB
–36	–0.66 dB	(51)________	+0.66 dB	±0.064 dB
–40	–0.70 dB	(52)________	+0.70 dB	±0.063 dB
–44	–0.74 dB	(53)________	+0.74 dB	±0.064 dB
–48	–0.78 dB	(54)________	+0.78 dB	±0.064 dB
–52	–0.82 dB	(55)________	+0.82 dB	±0.089 dB
–56	–0.86 dB	(56)________	+0.86 dB	±0.089 dB
–60	–0.90 dB	(57)________	+0.90 dB	±0.088 dB
–64	–0.94 dB	(58)________	+0.94 dB	±0.089 dB
–68	–0.98 dB	(59)________	+0.98 dB	±0.089 dB
–72	–1.02 dB	(60)________	+1.02 dB	±0.089 dB
–76	–1.06 dB	(61)________	+1.06 dB	±0.089 dB
–80	–1.10 dB	(62)________	+1.10 dB	±0.088 dB
–84	–1.14 dB	(63)________	+1.14 dB	±0.089 dB
–88	–1.18 dB	(64)________	+1.18 dB	±0.089 dB

Table 3-4 HP E4402B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4402B		**Report No. __________**		
Serial No. __________		**Date __________**		

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
–92	–1.22 dB	(65)_______	+1.22 dB	±0.089 dB
–96	–1.26 dB	(66)_______	+1.26 dB	±0.088 dB
–98	–1.28 dB	(67)_______	+1.28 dB	±0.089 dB
Incremental Log Fidelity, Res BW ≤ 300 Hz *(Option 1DR only)*				
dB from Ref Level				
–4	–0.4 dB	(68)_______	+0.4 dB	±0.064 dB
–8	–0.4 dB	(69)_______	+0.4 dB	±0.064 dB
–12	–0.4 dB	(70)_______	+0.4 dB	±0.064 dB
–16	–0.4 dB	(71)_______	+0.4 dB	±0.064 dB
–20	–0.4 dB	(72)_______	+0.4 dB	±0.063 dB
–24	–0.4 dB	(73)_______	+0.4 dB	±0.064 dB
–28	–0.4 dB	(74)_______	+0.4 dB	±0.064 dB
–32	–0.4 dB	(75)_______	+0.4 dB	±0.064 dB
–36	–0.4 dB	(76)_______	+0.4 dB	±0.064 dB
–40	–0.4 dB	(77)_______	+0.4 dB	±0.063 dB
–44	–0.4 dB	(78)_______	+0.4 dB	±0.064 dB
–48	–0.4 dB	(79)_______	+0.4 dB	±0.064 dB
–52	–0.4 dB	(80)_______	+0.4 dB	±0.089 dB
–56	–0.4 dB	(81)_______	+0.4 dB	±0.089 dB
–60	–0.4 dB	(82)_______	+0.4 dB	±0.088 dB
–64	–0.4 dB	(83)_______	+0.4 dB	±0.089 dB
–68	–0.4 dB	(84)_______	+0.4 dB	±0.089 dB
–72	–0.4 dB	(85)_______	+0.4 dB	±0.089 dB
–76	–0.4 dB	(86)_______	+0.4 dB	±0.089 dB

Table 3-4 HP E4402B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4402B		**Report No.** ________		
Serial No. ________		**Date** ________		

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
–80	–0.4 dB	(87)___	+0.4 dB	±0.088 dB
Linear Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–2.0%	(89)_______	+2.0%	±0.064 %
–8	–2.0%	(90)_______	+2.0%	±0.064 %
–12	–2.0%	(91)_______	+2.0%	±0.064 %
–16	–2.0%	(92)_______	+2.0%	±0.064 %
–20	–2.0%	(93)_______	+2.0%	±0.063 %
Linear Fidelity, Res BW ≤ 300 Hz *(Option 1DR only)*				
dB from Ref Level				
–4	–2.0%	(94)_______	+2.0%	±0.064 %
–8	–2.0%	(95)_______	+2.0%	±0.064 %
–12	–2.0%	(96)_______	+2.0%	±0.064 %
–16	–2.0%	(97)_______	+2.0%	±0.064 %
–20	–2.0%	(98)_______	+2.0%	±0.063 %
Zero Span, Res BW≤ 300 Hz *(Option 1DR only)*				
dB from Ref Level				
–4	–0.36 dB	(99)_______	+0.36 dB	±0.064 dB
–8	–0.42 dB	(100)_______	+0.42 dB	±0.064 dB
–12	–0.48 dB	(101)_______	+0.48 dB	±0.064 dB
–16	–0.54 dB	(102)_______	+0.54 dB	±0.064 dB
–20	–0.60 dB	(103)_______	+0.60 dB	±0.063 dB
–24	–0.66 dB	(104)_______	+0.66 dB	±0.064 dB

Table 3-4 HP E4402B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4402B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–28	–0.72 dB	(105)______	+0.72 dB	±0.064 dB
–32	–0.78 dB	(106)______	+0.78 dB	±0.064 dB
–36	–0.84 dB	(107)______	+0.84 dB	±0.064 dB
–40	–0.90 dB	(108)______	+0.90 dB	±0.063 dB
–44	–0.96 dB	(109)______	+0.96 dB	±0.064 dB
–48	–1.02 dB	(110)______	+1.02 dB	±0.064 dB
–52	–1.08 dB	(111)______	+1.08 dB	±0.089 dB
–56	–1.14 dB	(112)______	+1.14 dB	±0.089 dB
–60	–1.20 dB	(113)______	+1.20 dB	±0.088 dB
–64	–1.5 dB	(114)______	+1.5 dB	±0.089 dB
–68	–1.5 dB	(115)______	+1.5 dB	±0.089 dB
–70	–1.5 dB	(116)______	+1.5 dB	±0.089 dB
12. Input Attenuation Switching Uncertainty				
Input Attenuation Setting				
0 dB	–0.3 dB	(1)______	+0.3 dB	±0.108 dB
5 dB	–0.3 dB	(2)______	+0.3 dB	±0.107 dB
15 dB	–0.3 dB	(3)______	+0.3 dB	±0.107 dB
20 dB	–0.3 dB	(4)______	+0.3 dB	±0.089 dB
25 dB	–0.35 dB	(5)______	+0.35 dB	±0.089 dB
30 dB	–0.40 dB	(6)______	+0.40 dB	±0.089 dB
35 dB	–0.45 dB	(7)______	+0.45 dB	±0.089 dB
40 dB	–0.50 dB	(8)______	+0.50 dB	±0.089 dB
45 dB	–0.55 dB	(9)______	+0.55 dB	±0.089 dB
50 dB	–0.60 dB	(10)______	+0.60 dB	±0.089 dB
55 dB	–0.65 dB	(11)______	+0.65 dB	±0.089 dB

Table 3-4 HP E4402B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4402B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
60 dB	–0.70 dB	(12)_______	+0.70 dB	±0.089 dB
65 dB	–0.75 dB	(13)_______	+0.75 dB	±0.089 dB
14. Reference Level Accuracy				
Log, Res BW ≥ 1 kHz				
Reference Level				
–10	–0.3 dB	(1)_______	+0.3 dB	±0.144 dB
0	–0.3 dB	(2)_______	+0.3 dB	±0.144 dB
–30	–0.3 dB	(3)_______	+0.3 dB	±0.144 dB
–40	–0.3 dB	(4)_______	+0.3 dB	±0.144 dB
–50	–0.5 dB	(5)_______	+0.5 dB	±0.156 dB
–60	–0.5 dB	(6)_______	+0.5 dB	±0.156 dB
–70	–0.5 dB	(7)_______	+0.5 dB	±0.156 dB
–80	–0.7 dB	(8)_______	+0.7 dB	±0.156 dB
Linear, Res BW ≥ 1 kHz				
Reference Level				
–10	–0.3 dB	(9)_______	+0.3 dB	±0.144 dB
0	–0.3 dB	(10)_______	+0.3 dB	±0.144 dB
–30	–0.3 dB	(11)_______	+0.3 dB	±0.144 dB
–40	–0.3 dB	(12)_______	+0.3 dB	±0.144 dB
–50	–0.5 dB	(13)_______	+0.5 dB	±0.156 dB
–60	–0.5 dB	(14)_______	+0.5 dB	±0.156 dB
–70	–0.5 dB	(15)_______	+0.5 dB	±0.156 dB
–80	–0.7 dB	(16)_______	+0.7 dB	±0.156 dB

Table 3-4 HP E4402B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4402B **Report No. ________**

Serial No. ________ **Date ________**

Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
Log, Res BW ≤ 300 Hz *(Option 1DR only)*				
Reference Level				
–10	–0.3 dB	(17)________	+0.3 dB	±0.144 dB
0	–0.3 dB	(18)________	+0.3 dB	±0.144 dB
–30	–0.3 dB	(19)________	+0.3 dB	±0.144 dB
–40	–0.3 dB	(20)________	+0.3 dB	±0.144 dB
–50	–0.5 dB	(21)________	+0.5 dB	±0.156 dB
–60	–0.5 dB	(22)________	+0.5 dB	±0.156 dB
–70	–0.5 dB	(23)________	+0.5 dB	±0.156 dB
–80	–0.7 dB	(24)________	+0.7 dB	±0.156 dB
Linear, Res BW ≤ 300 Hz *(Option 1DR only)*				
Reference Level				
–10	–0.3 dB	(25)________	+0.3 dB	±0.144 dB
0	–0.3 dB	(26)________	+0.3 dB	±0.144 dB
–30	–0.3 dB	(27)________	+0.3 dB	±0.144 dB
–40	–0.3 dB	(28)________	+0.3 dB	±0.144 dB
–50	–0.5 dB	(29)________	+0.5 dB	±0.156 dB
–60	–0.5 dB	(30)________	+0.5 dB	±0.156 dB
–70	–0.5 dB	(31)________	+0.5 dB	±0.156 dB
–80	–0.7 dB	(32)________	+0.7 dB	±0.156 dB

Table 3-4 HP E4402B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4402B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
15. Resolution Bandwidth Switching Uncertainty				
Resolution Bandwidth				
3 kHz	–0.3 dB	(1)_______	+0.3 dB	±0.064 dB
9 kHz	–0.3 dB	(2)_______	+0.3 dB	±0.064 dB
10 kHz	–0.3 dB	(3)_______	+0.3 dB	±0.064 dB
30 kHz	–0.3 dB	(4)_______	+0.3 dB	±0.064 dB
100 kHz	–0.3 dB	(5)_______	+0.3 dB	±0.064 dB
120 kHz	–0.3 dB	(6)_______	+0.3 dB	±0.064 dB
300 kHz	–0.3 dB	(7)_______	+0.3 dB	±0.064 dB
1 MHz	–0.3 dB	(8)_______	+0.3 dB	±0.064 dB
3 MHz	–0.3 dB	(9)_______	+0.3 dB	±0.064 dB
5 MHz	–0.6 dB	(10)_______	+0.6 dB	±0.083 dB
300 Hz *(Option 1DR only)*	–0.3 dB	(11)_______	+0.3 dB	±0.064 dB
200 Hz *(Option 1DR only)*	–0.3 dB	(12)_______	+0.3 dB	±0.064 dB
100 Hz *(Option 1DR only)*	–0.3 dB	(13)_______	+0.3 dB	±0.064 dB
30 Hz *(Option 1DR only)*	–0.3 dB	(14)_______	+0.3 dB	±0.064 dB
10 Hz *(Option 1DR only)*	–0.3 dB	(15)_______	+0.3 dB	±0.064 dB
17. Absolute Amplitude Accuracy (Reference Settings)				
Log, Preamp Off	–0.34 dB	(1)_______	+0.34 dB	±0.148 dB
Lin, Preamp Off	–0.34 dB	(2)_______	+0.34 dB	±0.148 dB
Log, Preamp On	–0.5 dB	(3)_______	+0.5 dB	±0.148 dB
Lin, Preamp On	–0.5 dB	(4)_______	+0.5 dB	±0.148 dB

Table 3-4 **HP E4402B Performance Verification Test Record**

Hewlett-Packard Company				
Model HP E4402B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
19. Overall Absolute Amplitude Accuracy				
0 dBm Reference Level				
0 dBm input	–0.54 dB	(1)_______	+0.54 dB	±0.08 dB
–10 dBm input	–0.54 dB	(2)_______	+0.54 dB	±0.081 dB
–20 dBm input	–0.54 dB	(3)_______	+0.54 dB	±0.082 dB
–30 dBm input	–0.54 dB	(4)_______	+0.54 dB	±0.083 dB
–40 dBm input	–0.54 dB	(5)_______	+0.54 dB	±0.084 dB
–50 dBm input	–0.54 dB	(6)_______	+0.54 dB	±0.086 dB
–20 dBm Reference Level				
–20 dBm input	–0.54 dB	(7)_______	+0.54 dB	±0.082 dB
–30 dBm input	–0.54 dB	(8)_______	+0.54 dB	±0.083 dB
–40 dBm input	–0.54 dB	(9)_______	+0.54 dB	±0.084 dB
–50 dBm input	–0.54 dB	(10)_______	+0.54 dB	±0.086 dB
–40 dBm Reference Level				
–40 dBm input	–0.54 dB	(11)_______	+0.54 dB	±0.084 dB
–50 dBm input	–0.54 dB	(12)_______	+0.54 dB	±0.086 dB
–50 dBm Reference Level				
–50 dBm input	–0.54 dB	(13)_______	+0.54 dB	±0.086 dB
20. Resolution Bandwidth Accuracy				
Resolution Bandwidth				
5 MHz	3.5 MHz	(1)_______	6.5 MHz	±38.2 kHz
3 MHz	2.55 MHz	(2)_______	3.45 MHz	±22.9 kHz
1 MHz	0.85 MHz	(3)_______	1.15 MHz	±7.64 kHz
300 kHz	255 kHz	(4)_______	345 kHz	±2.29 kHz

Table 3-4 HP E4402B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4402B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
100 kHz	85 kHz	(5)______	115 kHz	±764 Hz
30 kHz	25.5 kHz	(6)______	34.5 kHz	±229 Hz
10 kHz	8.5 kHz	(7)______	11.5 kHz	±76.4 Hz
3 kHz	2.55 kHz	(8)______	3.45 kHz	±22.9 Hz
1 kHz	850 Hz	(9)______	1.15 kHz	±7.64 Hz
120 kHz	102 kHz	(10)______	138 kHz	±154 Hz
9 kHz	7.65 kHz	(11)______	10.35kHz	±11.5 Hz
22. Frequency Response	Note: Enter data in the appropriate section below depending upon the ambient temperature at which the test was performed.			
20 to 30 °C:				
Maximum Response		(1)______	+0.5 dB	±0.245 dB
Minimum Response	–0.5 dB	(2)______		±0.245 dB
Peak-to-Peak Response		(3)______	1.0 dB	±0.245 dB
0 to 55 °C:				
Maximum Response		(1)______	+1.0 dB	±0.245 dB
Minimum Response	–1.0 dB	(2)______		±0.245 dB
Peak-to-Peak Response		(3)______	2.0 dB	±0.245 dB
26. Frequency Response (Preamp On) *(Option 1DS only)*				
Maximum Response		(1)______	+2.0 dB	±0.343 dB
Minimum Response	–2.0 dB	(2)______		±0.343 dB
Peak-to-Peak Response		(3)______	4.0 dB	±0.343 dB

Table 3-4 HP E4402B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4402B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
28. Other Input Related Spurious Responses				
Input Frequency				
2042.8 MHz		(1)______	–65 dBc	±1.14 dB
2642.8 MHz		(2)______	–65 dBc	±1.14 dB
1820.8 MHz		(3)______	–65 dBc	±1.14 dB
278.5 MHz		(4)______	–65 dBc	±1.14 dB
30. Spurious Responses				
300 MHz TOI, 1 kHz RBW	+11 dBm	(1)______		±0.49 dB
300 MHz TOI, 30 Hz RBW (*Option 1DR only)*	+11 dBm	(2)______		±0.49 dB
300 MHz SHI	+35 dBm	(3)______		±0.90 dB
900 MHz SHI	+45 dBm	(4)______		±0.90 dB
33. Gain Compression				
Test Frequency				
53 MHz		(1)______	1.0 dB	±0.127 dB
50.004 MHz (*Option 1DR only)*		(2)______	1.0 dB	±0.127 dB
1403 MHz		(3)______	1.0 dB	±0.127 dB
2503 MHz		(4)______	1.0 dB	±0.144 dB
35. Displayed Average Noise Level	Note: Enter results with preamp on in the appropriate section based upon the ambient temperature when the test was performed.			
1 kHz RBW, Preamp Off:				
10 MHz to 1 GHz		(1)______	–117 dBm	±1.82 dB
1 GHz to 2 GHz		(2)______	–116 dBm	±1.82 dB
2 GHz to 3 GHz		(3)______	–114 dBm	±1.82 dB

Table 3-4 HP E4402B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4402B **Report No. ________**

Serial No. ________ **Date ________**

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
1kHz RBW, Preamp On, 0 to 55 °C:				
10 MHz to 1 GHz		(4)_______	–132 dBm	±1.82 dB
1 GHz to 2 GHz		(5)_______	–131 dBm	±1.82 dB
2 GHz to 3 GHz		(6)_______	–129 dBm	±1.82 dB
10 Hz RBW, Preamp Off:				
10 MHz to 1 GHz		(7)_______	–136 dBm	±1.82 dB
1 GHz to 2 GHz		(8)_______	–135 dBm	±1.82 dB
2 GHz to 3 GHz		(9)_______	–133 dBm	±1.82 dB
10 Hz RBW, Preamp On, 0 to 55 °C:				
10 MHz to 1 GHz		(10)_______	–150 dBm	±1.82 dB
1 GHz to 2 GHz		(11)_______	–149 dBm	±1.82 dB
2 GHz to 3 GHz		(12)_______	–147 dBm	±1.82 dB
1kHz RBW, Preamp On, 20 to 30 °C:				
10 MHz to 1 GHz		(13)_______	–133 dBm	±1.82 dB
1 GHz to 2 GHz		(14)_______	–133 dBm	±1.82 dB
2 GHz to 3 GHz		(15)_______	–132 dBm	±1.82 dB
10 Hz RBW, Preamp On, 20–30 °C:				
10 MHz to 1 GHz		(16)_______	–151 dBm	±1.82 dB
1 GHz to 2 GHz		(17)_______	–151 dBm	±1.82 dB
2 GHz to 3 GHz		(18)_______	–150 dBm	±1.82 dB

Table 3-4 HP E4402B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4402B **Report No.** ________

Serial No. ________ **Date** ________

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
38. Residual Responses				
150 kHz to 3.0 GHz		(1)______	–90 dBm	±0.93 dB
39. Fast Time Domain Amplitude Accuracy *(Option AYX only)*				
Amplitude Error	–0.3 %	(1)______	+0.3 %	±0.029 %
41. Tracking Generator Absolute Amplitude and Vernier Accuracy				
Absolute Amplitude Accuracy	–0.75 dB	(1)______	+0.75 dB	±0.087 dB
Vernier Accuracy, –2 dB	–0.4 dB	(2)______	+0.4 dB	±0.11 dB
Vernier Accuracy, –3 dB	–0.5 dB	(3)______	+0.5 dB	±0.16 dB
Vernier Accuracy, –5 dB	–0.5 dB	(4)______	+0.5 dB	±0.16 dB
Vernier Accuracy, –6 dB	–0.5 dB	(5)______	+0.5 dB	±0.16 dB
Vernier Accuracy, –7 dB	–0.5 dB	(6)______	+0.5 dB	±0.16 dB
Vernier Accuracy, –8 dB	–0.5 dB	(7)______	+0.5 dB	±0.16 dB
Vernier Accuracy, –9 dB	–0.5 dB	(8)______	+0.5 dB	±0.16 dB
Vernier Accuracy, –10 dB	–0.5 dB	(9)______	+0.5 dB	±0.16 dB
43. Tracking Generator Level Flatness				
Positive Level Flatness, <1 MHz		(1)______	+3.0 dB	±0.255 dB
Negative Level Flatness, <1 MHz	–3.0 dB	(2)______		±0.255 dB
Positive Level Flatness, 1 MHz to 10 MHz		(3)______	+3.0 dB	±0.145 dB
Negative Level Flatness, 1 MHz to 10 MHz	–3.0 dB	(4)______		±0.145 dB

Table 3-4 HP E4402B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4402B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
Positive Level Flatness, >10 MHz to 1.5 GHz		(5)_______	+2.0 dB	±0.122 dB
Negative Level Flatness, >10 MHz to 1.5 GHz	–2.0 dB	(6)_______		±0.122 dB
Positive Level Flatness, >1.5 GHz		(7)_______	+2.0 dB	±0.172 dB
Negative Level Flatness, >1.5 GHz	–2.0 dB	(8)_______		±0.172 dB
45. Tracking Generator Harmonic Spurious Outputs *(Option 1DN only)*				
2nd Harmonic, <20 kHz		(1)_______	–15 dBc	±2.6 dB
2nd Harmonic, ≥ 20 kHz		(2)_______	–25 dBc	±2.6 dB
3rd Harmonic, <20 kHz		(3)_______	–15 dBc	±2.6 dB
3rd Harmonic, ≥ 20 kHz		(4)_______	–25 dBc	±2.6 dB
47. Tracking Generator Non-Harmonic Spurious Outputs *(Option 1DN only)*				
Highest Non-Harmonic Spurious Output Amplitude, 9 kHz to 2 GHz		(1)_______	–27 dBc	±2.67 dB
Highest Non-Harmonic Spurious Output Amplitude, 2 GHz to 3 GHz		(2)_______	–23 dBc	±3.12 dB

Table 3-4 HP E4402B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4402B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
48. Tracking Generator LO Feedthrough Amplitude *(Option 1DN only)*				
9 kHz to 2.9 GHz		(1)______	–16 dBm	±1.94 dB
2.9 GHz to 3.0 GHz		(2)______	–16 dBm	±2.49 dB
49. Gate Delay Accuracy and Gate Length Accuracy *(Option 1D6 only)*				
Minimum Gate Delay	499.9 ns	(1)______	1.5001 µs	±475 ps
Maximum Gate Delay	499.9 ns	(2)______	1.5001 µs	±475 ps
1 µs Gate Length	499.9 ns	(3)______	1.5001 µs	±450 ps
65 ms Gate Length	64.993 ms	(4)______	65.007 ms	±561 ns
50. Gate Mode Amplitude Error *(Option 1D6 only)*				
Amplitude Error	–0.2 dB	(1)______	+0.2 dB	±0.023 dB

HP E4403B Performance Verification Test Record

Only the tests for HP E4403B are included in this test record, therefore not all test numbers are included.

Table 3-5 HP E4403B Performance Verification Test Record

Hewlett-Packard Company

Address: ______________________ Report No. ______________

______________________ Date ______________

____

Model HP E4403B

Serial No. ____________ Ambient temperature ______ °C

Options ____________ Power mains line frequency ______ Hz (nominal)

Firmware Revision ________ Relative humidity ______ %

Customer ______________________ Tested by ______________________

Test Equipment Used:

Description	**Model No.**	**Trace No.**	**Cal Due Date**
Synthesized Signal Generator	________	________	________
Synthesized Sweeper	________	________	________
Function Generator	________	________	________
Power Meter, Dual-Channel	________	________	________
RF Power Sensor #1	________	________	________
RF Power Sensor #2	________	________	________
Low-Power Power Sensor	________	________	________
Digital Multimeter	________	________	________
Universal Counter	________	________	________
Frequency Standard	________	________	________
Power Splitter	________	________	________
50 Ω Termination	________	________	________
1 dB Step Attenuator	________	________	________

Table 3-5 HP E4403B Performance Verification Test Record

10 dB Step Attenuator	________	________	________
6 dB Fixed Attenuator	________	________	________
Microwave Spectrum Analyzer *(Option 1DN only)*	________	________	________
Notes/comments:	________________________		

Table 3-6 HP E4403B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4403B **Report No.** ________

Serial No. ________ **Date** ________

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
1. 10 MHz Reference Output Accuracy				
Settability	–5.0 Hz	(1)______	+5.0 Hz	±293.3 μHz
3. Frequency Readout Accuracy and Marker Count Accuracy				
Frequency Readout Accuracy				
Center Freq / Span				
1500 MHz / 20 MHz	1499.784990 MHz	(1)______	1500.215010 MHz	±0 Hz
1500 MHz / 10 MHz	1499.884990 MHz	(2)______	1500.115010 MHz	±0 Hz
1500 MHz / 1 MHz	1499.988490 MHz	(3)______	1500.011510 MHz	±0 Hz
Marker Count Accuracy				
Center Freq / Span				
1500 MHz / 10 MHz	1499.999999 MHz	(4)______	1500.000001 MHz	±0 Hz
1500 MHz / 1 MHz	1499.999999 MHz	(5)______	1500.000001 MHz	±0 Hz

Table 3-6 HP E4403B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4403B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
6. Frequency Span Readout Accuracy				
Span Start Freq				
3000 MHz 0 Hz	2370 MHz	(1)________	2430 MHz	±6.12 MHz
100 MHz 10 MHz	79 MHz	(2)________	81 MHz	±204 kHz
100 kHz 10 MHz	79 kHz	(3)________	81 kHz	±204 Hz
100 MHz 800 MHz	79 MHz	(4)________	81 MHz	±204 kHz
100 kHz 800 MHz	79 kHz	(5)________	81 kHz	±204 Hz
100 MHz 1400 MHz	79 MHz	(6)________	81 MHz	±204 kHz
100 kHz 1499 MHz	79 kHz	(7)________	81 kHz	±204 Hz
7. Noise Sidebands				
Offset from 1 GHz signal				
10 kHz		(1)________	–90 dBc/Hz	±1.154 dB
20 kHz		(2)________	–98 dBc/Hz	±1.154 dB
30 kHz		(3)________	–100 dBc/Hz	±1.154 dB
100 kHz		(4)________	–112 dBc/Hz	±1.154 dB
8. System Related Sidebands				
Offset from 500 MHz signal				
30 kHz to 230 kHz		(1)________	–65 dBc	±1.154 dB
–30 kHz to –230 kHz		(2)________	–65 dBc	±1.154 dB
9. Residual FM				
1 kHz Res BW		(1)________	150 Hz	±9.24 Hz

Table 3-6 HP E4403B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4403B **Report No. __________**

Serial No. __________ **Date __________**

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
10. Sweep Time Accuracy				
Sweep Time				
5 ms	–1.0%	(1)_______	+1.0%	±0.28%
20 ms	–1.0%	(2)_______	+1.0%	±0.28%
100 ms	–1.0%	(3)_______	+1.0%	±0.28%
1 s	–1.0%	(4)_______	+1.0%	±0.28%
10 s	–1.0%	(5)_______	+1.0%	±0.28%
10 s	–1.0%	(5)_______	+1.0%	±0.28%
11. Display Scale Fidelity				
Cumulative Log Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–0.34 dB	(1)_______	+0.34 dB	±0.064 dB
–8	–0.38 dB	(2)_______	+0.38 dB	±0.064 dB
–12	–0.42 dB	(3)_______	+0.42 dB	±0.064 dB
–16	–0.46 dB	(4)_______	+0.46 dB	±0.064 dB
–20	–0.50 dB	(5)_______	+0.50 dB	±0.063 dB
–24	–0.54 dB	(6)_______	+0.54 dB	±0.064 dB
–28	–0.58 dB	(7)_______	+0.58 dB	±0.064 dB
–32	–0.62 dB	(8)_______	+0.62 dB	±0.064 dB
–36	–0.66 dB	(9)_______	+0.66 dB	±0.064 dB
–40	–0.70 dB	(10)_______	+0.70 dB	±0.063 dB
–44	–0.74 dB	(11)_______	+0.74 dB	±0.064 dB
–48	–0.78 dB	(12)_______	+0.78 dB	±0.064 dB
–52	–0.82 dB	(13)_______	+0.82 dB	±0.089 dB
–56	–0.86 dB	(14)_______	+0.86 dB	±0.089 dB

Table 3-6 HP E4403B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4403B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–60	–0.90 dB	(15)______	+0.90 dB	±0.088 dB
–64	–0.94 dB	(16)______	+0.94 dB	±0.089 dB
–68	–0.98 dB	(17)______	+0.98 dB	±0.089 dB
–72	–1.02 dB	(18)______	+1.02 dB	±0.089 dB
–76	–1.06 dB	(19)______	+1.06 dB	±0.089 dB
–80	–1.10 dB	(20)______	+1.10 dB	±0.088 dB
–84	–1.14 dB	(21)______	+1.14 dB	±0.089 dB
Incremental Log Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–0.4 dB	(22)______	+0.4 dB	±0.064 dB
–8	–0.4 dB	(23)______	+0.4 dB	±0.064 dB
–12	–0.4 dB	(24)______	+0.4 dB	±0.064 dB
–16	–0.4 dB	(25)______	+0.4 dB	±0.064 dB
–20	–0.4 dB	(26)______	+0.4 dB	±0.063 dB
–24	–0.4 dB	(27)______	+0.4 dB	±0.064 dB
–28	–0.4 dB	(28)______	+0.4 dB	±0.064 dB
–32	–0.4 dB	(29)______	+0.4 dB	±0.064 dB
–36	–0.4 dB	(30)______	+0.4 dB	±0.064 dB
–40	–0.4 dB	(31)______	+0.4 dB	±0.063 dB
–44	–0.4 dB	(32)______	+0.4 dB	±0.064 dB
–48	–0.4 dB	(33)______	+0.4 dB	±0.064 dB
–52	–0.4 dB	(34)______	+0.4 dB	±0.089 dB
–56	–0.4 dB	(35)______	+0.4 dB	±0.089 dB
–60	–0.4 dB	(36)______	+0.4 dB	±0.088 dB
–64	–0.4 dB	(37)______	+0.4 dB	±0.089 dB

Table 3-6 **HP E4403B Performance Verification Test Record**

Hewlett-Packard Company

Model HP E4403B **Report No.** __________

Serial No. __________ **Date** __________

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
–68	–0.4 dB	(38)_______	+0.4 dB	±0.089 dB
–72	–0.4 dB	(39)_______	+0.4 dB	±0.089 dB
–76	–0.4 dB	(40)_______	+0.4 dB	±0.089 dB
–80	–0.4 dB	(41)_______	+0.4 dB	±0.088 dB
Linear Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–2.0%	(89)_______	+2.0%	±0.064 %
–8	–2.0%	(90)_______	+2.0%	±0.064 %
–12	–2.0%	(91)_______	+2.0%	±0.064 %
–16	–2.0%	(92)_______	+2.0%	±0.064 %
–20	–2.0%	(93)_______	+2.0%	±0.063 %
12. Input Attenuation Switching Uncertainty				
Input Attenuation Setting				
0 dB	–0.3 dB	(1)_______	+0.3 dB	±0.108 dB
5 dB	–0.3 dB	(2)_______	+0.3 dB	±0.107 dB
15 dB	–0.3 dB	(3)_______	+0.3 dB	±0.107 dB
20 dB	–0.3 dB	(4)_______	+0.3 dB	±0.089 dB
25 dB	–0.35 dB	(5)_______	+0.35 dB	±0.089 dB
30 dB	–0.40 dB	(6)_______	+0.40 dB	±0.089 dB
35 dB	–0.45 dB	(7)_______	+0.45 dB	±0.089 dB
40 dB	–0.50 dB	(8)_______	+0.50 dB	±0.089 dB
45 dB	–0.55 dB	(9)_______	+0.55 dB	±0.089 dB
50 dB	–0.60 dB	(10)_______	+0.60 dB	±0.089 dB
55 dB	–0.65 dB	(11)_______	+0.65 dB	±0.089 dB

Table 3-6 HP E4403B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4403B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
60 dB	−0.70 dB	(12)______	+0.70 dB	±0.089 dB
65 dB	−0.75 dB	(13)______	+0.75 dB	±0.089 dB
13. Reference Level Accuracy				
Log				
Reference Level				
−10	−0.3 dB	(1)______	+0.3 dB	±0.144 dB
0	−0.3 dB	(2)______	+0.3 dB	±0.144 dB
−30	−0.3 dB	(3)______	+0.3 dB	±0.144 dB
−40	−0.3 dB	(4)______	+0.3 dB	±0.144 dB
−50	−0.5 dB	(5)______	+0.5 dB	±0.156 dB
−60	−0.5 dB	(6)______	+0.5 dB	±0.156 dB
−70	−0.5 dB	(7)______	+0.5 dB	±0.156 dB
−80	−0.7 dB	(8)______	+0.7 dB	±0.156 dB
Linear				
Reference Level				
−10	−0.3 dB	(9)______	+0.3 dB	±0.144 dB
0	−0.3 dB	(10)______	+0.3 dB	±0.144 dB
−30	−0.3 dB	(11)______	+0.3 dB	±0.144 dB
−40	−0.3 dB	(12)______	+0.3 dB	±0.144 dB
−50	−0.5 dB	(13)______	+0.5 dB	±0.156 dB
−60	−0.5 dB	(14)______	+0.5 dB	±0.156 dB
−70	−0.5 dB	(15)______	+0.5 dB	±0.156 dB
−80	−0.7 dB	(16)______	+0.7 dB	±0.156 dB

Table 3-6 HP E4403B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4403B		**Report No. __________**		
Serial No. __________		**Date __________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
15. Resolution Bandwidth Switching Uncertainty				
Resolution Bandwidth				
3 kHz	–0.3 dB	(1)_______	+0.3 dB	±0.064 dB
9 kHz	–0.3 dB	(2)_______	+0.3 dB	±0.064 dB
10 kHz	–0.3 dB	(3)_______	+0.3 dB	±0.064 dB
30 kHz	–0.3 dB	(4)_______	+0.3 dB	±0.064 dB
100 kHz	–0.3 dB	(5)_______	+0.3 dB	±0.064 dB
120 kHz	–0.3 dB	(6)_______	+0.3 dB	±0.064 dB
300 kHz	–0.3 dB	(7)_______	+0.3 dB	±0.064 dB
1 MHz	–0.3 dB	(8)_______	+0.3 dB	±0.064 dB
3 MHz	–0.3 dB	(9)_______	+0.3 dB	±0.064 dB
5 MHz	–0.6 dB	(10)_______	+0.6 dB	±0.083 dB
17. Absolute Amplitude Accuracy (Reference Settings)				
Log, Preamp Off	–0.4 dB	(1)_______	+0.4 dB	±0.148 dB
Lin, Preamp Off	–0.4 dB	(2)_______	+0.4 dB	±±0.148 dB
19. Overall Absolute Amplitude Accuracy				
0 dBm Reference Level				
0 dBm input	–0.6 dB	(1)_______	+0.6 dB	±0.08 dB
–10 dBm input	–0.6 dB	(2)_______	+0.6 dB	±0.081 dB
–20 dBm input	–0.6 dB	(3)_______	+0.6 dB	±0.082 dB
–30 dBm input	–0.6 dB	(4)_______	+0.6 dB	±0.083 dB
–40 dBm input	–0.6 dB	(5)_______	+0.6 dB	±0.084 dB
–50 dBm input	–0.6 dB	(6)_______	+0.6 dB	±0.086 dB

Table 3-6 HP E4403B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4403B		**Report No. __________**		
Serial No. __________		**Date __________**		

Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–20 dBm Reference Level				
–20 dBm input	–0.6 dB	(7)_______	+0.6 dB	±0.082 dB
–30 dBm input	–0.6 dB	(8)_______	+0.6 dB	±0.083 dB
–40 dBm input	–0.6 dB	(9)_______	+0.6 dB	±0.084 dB
–50 dBm input	–0.6 dB	(10)_______	+0.6 dB	±0.086 dB
–40 dBm Reference Level				
–40 dBm input	–0.6 dB	(11)_______	+0.6 dB	±0.084 dB
–50 dBm input	–0.6 dB	(12)_______	+0.6 dB	±0.086 dB
–50 dBm Reference Level				
–50 dBm input	–0.6 dB	(13)_______	+0.6 dB	±0.086 dB
20. Resolution Bandwidth Accuracy				
Resolution Bandwidth				
5 MHz	3.5 MHz	(1)_______	6.5 MHz	±38.2 kHz
3 MHz	2.55 MHz	(2)_______	3.45 MHz	±22.9 kHz
1 MHz	0.85 MHz	(3)_______	1.15 MHz	±7.64 kHz
300 kHz	255 kHz	(4)_______	345 kHz	±2.29 kHz
100 kHz	85 kHz	(5)_______	115 kHz	±764 Hz
30 kHz	25.5 kHz	(6)_______	34.5 kHz	±229 Hz
10 kHz	8.5 kHz	(7)_______	11.5 kHz	±76.4 Hz
3 kHz	2.55 kHz	(8)_______	3.45 kHz	±22.9 Hz
1 kHz	850 Hz	(9)_______	1.15 kHz	±7.64 Hz
120 kHz	102 kHz	(10)_______	138 kHz	±154 Hz
9 kHz	7.65 kHz	(11)_______	10.35kHz	±11.5 Hz

Table 3-6 HP E4403B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4403B		**Report No.** ______		
Serial No. ______		**Date** ______		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
22. Frequency Response	Note: Enter data in the appropriate section below depending upon the ambient temperature at which the test was performed.			
20 to 30 °C:				
Maximum Response		(1)______	+0.5 dB	±0.245 dB
Minimum Response	–0.5 dB	(2)______		±0.245 dB
Peak-to-Peak Response		(3)______	1.0 dB	±0.245 dB
0 to 55 °C:				
Maximum Response		(1)______	+1.0 dB	±0.245 dB
Minimum Response	–1.0 dB	(2)______		±0.245 dB
Peak-to-Peak Response		(3)______	2.0 dB	±0.245 dB
28. Other Input Related Spurious Responses				
Input Frequency				
2042.8 MHz		(1)______	–65 dBc	±1.14 dB
2642.8 MHz		(2)______	–65 dBc	±1.14 dB
1820.8 MHz		(3)______	–65 dBc	±1.14 dB
278.5 MHz		(4)______	–65 dBc	±1.14 dB
31. Spurious Responses				
300 MHz TOI	+7.5 dBm	(1)______		±0.49 dB
300 MHz SHI	+30 dBm	(3)______		±0.90 dB
900 MHz SHI	+40 dBm	(4)______		±0.90 dB
33. Gain Compression				
Test Frequency				
53 MHz		(1)______	1.0 dB	±0.127 dB
1403 MHz		(3)______	1.0 dB	±0.127 dB
2503 MHz		(4)______	1.0 dB	±0.144 dB

Table 3-6 HP E4403B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4403B		**Report No. ______**		
Serial No. ______		**Date ______**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
35. Displayed Average Noise Level				
10 MHz to 1 GHz		(1)______	–117 dBm	±1.82 dB
1 GHz to 2 GHz		(2)______	–116 dBm	±1.82 dB
2 GHz to 3 GHz		(3)______	–114 dBm	±1.82 dB
38. Residual Responses				
150 kHz to 3.0 GHz		(1)______	–90 dBm	±0.93 dB
39. Fast Time Domain Amplitude Accuracy *(Option AYX only)*				
Amplitude Error	–0.3 %	(1)______	+0.3 %	±0.029 %
41. Tracking Generator Absolute Amplitude and Vernier Accuracy				
Absolute Amplitude Accuracy	–0.75 dB	(1)______	+0.75 dB	±0.087 dB
Vernier Accuracy, –2 dB	–0.4 dB	(2)______	+0.4 dB	±0.11 dB
Vernier Accuracy, –3 dB	–0.5 dB	(3)______	+0.5 dB	±0.16 dB
Vernier Accuracy, –5 dB	–0.5 dB	(4)______	+0.5 dB	±0.16 dB
Vernier Accuracy, –6 dB	–0.5 dB	(5)______	+0.5 dB	±0.16 dB
Vernier Accuracy, –7 dB	–0.5 dB	(6)______	+0.5 dB	±0.16 dB
Vernier Accuracy, –8 dB	–0.5 dB	(7)______	+0.5 dB	±0.16 dB
Vernier Accuracy, –9 dB	–0.5 dB	(8)______	+0.5 dB	±0.16 dB
Vernier Accuracy, –10 dB	–0.5 dB	(9)______	+0.5 dB	±0.16 dB

Table 3-6 HP E4403B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4403B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
43. Tracking Generator Level Flatness				
Positive Level Flatness, <1 MHz		(1)______	+3.0 dB	±0.255 dB
Negative Level Flatness, <1 MHz	–3.0 dB	(2)______		±0.255 dB
Positive Level Flatness, 1 MHz to 10 MHz		(3)______	+3.0 dB	±0.145 dB
Negative Level Flatness, 1 MHz to 10 MHz	–3.0 dB	(4)______		±0.145 dB
Positive Level Flatness, >10 MHz to 1.5 GHz		(5)______	+2.0 dB	±0.122 dB
Negative Level Flatness, >10 MHz to 1.5 GHz	–2.0 dB	(6)______		±0.122 dB
Positive Level Flatness, >1.5 GHz		(7)______	+2.0 dB	±0.172 dB
Negative Level Flatness, >1.5 GHz	–2.0 dB	(8)______		±0.172 dB
47. Tracking Generator Harmonic Spurious Outputs *(Option 1DN only)*				
2^{nd} Harmonic, <20 kHz		(1)______	–15 dBc	±2.6 dB
2^{nd} Harmonic, ≥ 20 kHz		(2)______	–25 dBc	±2.6 dB
3^{rd} Harmonic, <20 kHz		(3)______	–15 dBc	±2.6 dB
3^{rd} Harmonic, ≥ 20 kHz		(4)______	–25 dBc	±2.6 dB

Table 3-6 HP E4403B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4403B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
49. Tracking Generator Non-Harmonic Spurious Outputs *(Option 1DN only)*				
Highest Non-Harmonic Spurious Output Amplitude, 9 kHz to 2 GHz		(1)________	–27 dBc	±2.67 dB
Highest Non-Harmonic Spurious Output Amplitude, 2 GHz to 3 GHz		(2)________	–23 dBc	±3.12 dB
50. Tracking Generator LO Feedthrough Amplitude *(Option 1DN only)*				
9 kHz to 2.9 GHz		(1)________	–16 dBm	±1.94 dB
2.9 GHz to 3.0 GHz		(2)________	–16 dBm	±2.49 dB

HP E4404B Performance Verification Test Record

Only the tests for HP E4404B are included in this test record, therefore not all test numbers are included.

Table 3-7 HP E4404B Performance Verification Test Record

Hewlett-Packard Company	
Address: ______________________	Report No. ______________
______________________	Date ______________
______________________	
Model HP E4404B	
Serial No. ____________	Ambient temperature ______ °C
Options ____________	Power mains line frequency ______ Hz (nominal)
Firmware Revision ________	Relative humidity ______ %
Customer ______________________	Tested by ______________________

Test Equipment Used:

Description	**Model No.**	**Trace No.**	**Cal Due Date**
Synthesized Signal Generator	________	________	________
Synthesized Sweeper #1	________	________	________
Synthesized Sweeper #2	________	________	________
Function Generator	________	________	________
Power Meter, Dual-Channel	________	________	________
RF Power Sensor #1	________	________	________
RF Power Sensor #2	________	________	________
Microwave Power Sensor	________	________	________
Low-Power Power Sensor	________	________	________
Digital Multimeter	________	________	________
Universal Counter	________	________	________
Frequency Standard	________	________	________
Power Splitter	________	________	________

Table 3-7 HP E4404B Performance Verification Test Record

50 Ω Termination	________	________	________
1 dB Step Attenuator	________	________	________
10 dB Step Attenuator	________	________	________
6 dB Fixed Attenuator	________	________	________
20 dB Fixed Attenuator *(Option 1DS only)*	________	________	________
Oscilloscope *(Option 1D6 only)*	________	________	________
Microwave Spectrum Analyzer *(Option 1DN only)*	________	________	________
Notes/comments:	________________		

Table 3-8 HP E4404B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4404B **Report No.** ________

Serial No. ________ **Date** ________

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
1. 10 MHz Reference Accuracy (*Non-Option 1D5 only*)				
Settability	–5.0 Hz	(1)______	+5.0 Hz	±293.3 μHz
2. 10 MHz Precision Frequency Reference Output Accuracy (*Option 1D5 only*)				
5 Minute Warm-Up Error	–0.1 ppm	(1)______	+0.1 ppm	±0.000072 ppm
15 Minute Warm-Up Error	–0.01 ppm	(2)______	+0.01 ppm	±0.000070 ppm
4. Frequency Readout Accuracy and Marker Count Accuracy				
Frequency Readout Accuracy				
Center Freq Span				

Table 3-8 HP E4404B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4404B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
1500 MHz 20 MHz	1499.784990 MHz	(1)______	1500.215010 MHz	±0 Hz
1500 MHz 10 MHz	1499.884990 MHz	(2)______	1500.115010 MHz	±0 Hz
1500 MHz 1 MHz	1499.988490 MHz	(3)______	1500.011510 MHz	±0 Hz
4000 MHz 20 MHz	3999.784990 MHz	(4)______	4000.215010 MHz	±0 Hz
4000 MHz 10 MHz	3999.884990 MHz	(5)______	4000.115010 MHz	±0 Hz
4000 MHz 1 MHz	3999.988490 MHz	(6)______	4000.011510 MHz	±0 Hz
Marker Count Accuracy				
Center Freq Span				
1500 MHz 10 MHz	1499.999999 MHz	(16)______	1500.000001 MHz	±0 Hz
1500 MHz 1 MHz	1499.999999 MHz	(17)______	1500.000001 MHz	±0 Hz
4000 MHz 10 MHz	3999.999999 MHz	(18)______	4000.000001 MHz	±0 Hz
4000 MHz 1 MHz	3999.999999 MHz	(19)______	4000.000001 MHz	±0 Hz
6. Frequency Span Readout Accuracy				
Span Start Freq				
3000 MHz 0 Hz	2370 MHz	(1)______	2430 MHz	±6.12 MHz
100 MHz 10 MHz	79 MHz	(2)______	81 MHz	±204 kHz
100 kHz 10 MHz	79 kHz	(3)______	81 kHz	±204 Hz
100 MHz 800 MHz	79 MHz	(4)______	81 MHz	±204 kHz
100 kHz 800 MHz	79 kHz	(5)______	81 kHz	±204 Hz

Table 3-8 HP E4404B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4404B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
100 MHz 1400 MHz	79 MHz	(6)_______	81 MHz	±204 kHz
100 kHz 1499 MHz	79 kHz	(7)_______	81 kHz	±204 Hz
7. Noise Sidebands				
Offset from 1 GHz signal				
10 kHz		(1)_______	–90 dBc/Hz	±1.154 dB
20 kHz		(2)_______	–98 dBc/Hz	±1.154 dB
30 kHz		(3)_______	–100 dBc/Hz	±1.154 dB
100 kHz		(4)_______	–112 dBc/Hz	±1.154 dB
8. System Related Sidebands				
Offset from 500 MHz signal				
30 kHz to 230 kHz		(1)_______	–65 dBc	±1.154 dB
–30 kHz to –230 kHz		(2)_______	–65 dBc	±1.154 dB
9. Residual FM				
1 kHz Res BW, *(Non-Option 1D5)*		(1)_______	150 Hz	±9.24 Hz
1 kHz Res BW, *(Option 1D5)*		(1)_______	100 Hz	±9.24 Hz
10 Hz Res BW *(Options 1DR and 1D5 only)*		(2)_______	2 Hz	±0.274 Hz
10. Sweep Time Accuracy				
Sweep Time				
5 ms	–1.0%	(1)_______	+1.0%	±0.28%
20 ms	–1.0%	(2)_______	+1.0%	±0.28%
100 ms	–1.0%	(3)_______	+1.0%	±0.28%
1 s	–1.0%	(4)_______	+1.0%	±0.28%

Table 3-8 HP E4404B Performance Verification Test Record

Hewlett-Packard Company	
Model HP E4404B	**Report No. ________**
Serial No. ________	**Date ________**

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
10 s	–1.0%	(5)______	+1.0%	±0.28%
1 ms (*Option AYX only*)	–1.0%	(6)______	+1.0%	±0.28%
500 us (*Option AYX only*)	–1.0%	(7)______	+1.0%	±0.28%
100 us (*Option AYX only*)	–1.0%	(8)______	+1.0%	±0.28%
11. Display Scale Fidelity				
Cumulative Log Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–0.34 dB	(1)______	+0.34 dB	±0.064 dB
–8	–0.38 dB	(2)______	+0.38 dB	±0.064 dB
–12	–0.42 dB	(3)______	+0.42 dB	±0.064 dB
–16	–0.46 dB	(4)______	+0.46 dB	±0.064 dB
–20	–0.50 dB	(5)______	+0.50 dB	±0.063 dB
–24	–0.54 dB	(6)______	+0.54 dB	±0.064 dB
–28	–0.58 dB	(7)______	+0.58 dB	±0.064 dB
–32	–0.62 dB	(8)______	+0.62 dB	±0.064 dB
–36	–0.66 dB	(9)______	+0.66 dB	±0.064 dB
–40	–0.70 dB	(10)______	+0.70 dB	±0.063 dB
–44	–0.74 dB	(11)______	+0.74 dB	±0.064 dB
–48	–0.78 dB	(12)______	+0.78 dB	±0.064 dB
–52	–0.82 dB	(13)______	+0.82 dB	±0.089 dB
–56	–0.86 dB	(14)______	+0.86 dB	±0.089 dB
–60	–0.90 dB	(15)______	+0.90 dB	±0.088 dB
–64	–0.94 dB	(16)______	+0.94 dB	±0.089 dB
–68	–0.98 dB	(17)______	+0.98 dB	±0.089 dB
–72	–1.02 dB	(18)______	+1.02 dB	±0.089 dB

Table 3-8 HP E4404B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4404B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–76	–1.06 dB	(19)______	+1.06 dB	±0.089 dB
–80	–1.10 dB	(20)______	+1.10 dB	±0.088 dB
–84	–1.14 dB	(21)______	+1.14 dB	±0.089 dB
Incremental Log Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–0.4 dB	(22)______	+0.4 dB	±0.064 dB
–8	–0.4 dB	(23)______	+0.4 dB	±0.064 dB
–12	–0.4 dB	(24)______	+0.4 dB	±0.064 dB
–16	–0.4 dB	(25)______	+0.4 dB	±0.064 dB
–20	–0.4 dB	(26)______	+0.4 dB	±0.063 dB
–24	–0.4 dB	(27)______	+0.4 dB	±0.064 dB
–28	–0.4 dB	(28)______	+0.4 dB	±0.064 dB
–32	–0.4 dB	(29)______	+0.4 dB	±0.064 dB
–36	–0.4 dB	(30)______	+0.4 dB	±0.064 dB
–40	–0.4 dB	(31)______	+0.4 dB	±0.063 dB
–44	–0.4 dB	(32)______	+0.4 dB	±0.064 dB
–48	–0.4 dB	(33)______	+0.4 dB	±0.064 dB
–52	–0.4 dB	(34)______	+0.4 dB	±0.089 dB
–56	–0.4 dB	(35)______	+0.4 dB	±0.089 dB
–60	–0.4 dB	(36)______	+0.4 dB	±0.088 dB
–64	–0.4 dB	(37)______	+0.4 dB	±0.089 dB
–68	–0.4 dB	(38)______	+0.4 dB	±0.089 dB
–72	–0.4 dB	(39)______	+0.4 dB	±0.089 dB
–76	–0.4 dB	(40)______	+0.4 dB	±0.089 dB
–80	–0.4 dB	(41)______	+0.4 dB	±0.088 dB

Table 3-8 HP E4404B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4404B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
Cumulative Log Fidelity, Res BW ≤ 300 Hz *(Option 1DR only)*				
dB from Ref Level				
–4	–0.34 dB	(43)_______	+0.34 dB	±0.064 dB
–8	–0.38 dB	(44)_______	+0.38 dB	±0.064 dB
–12	–0.42 dB	(45)_______	+0.42 dB	±0.064 dB
–16	–0.46 dB	(46)_______	+0.46 dB	±0.064 dB
–20	–0.50 dB	(47)_______	+0.50 dB	±0.063 dB
–24	–0.54 dB	(48)_______	+0.54 dB	±0.064 dB
–28	–0.58 dB	(49)_______	+0.58 dB	±0.064 dB
–32	–0.62 dB	(50)_______	+0.62 dB	±0.064 dB
–36	–0.66 dB	(51)_______	+0.66 dB	±0.064 dB
–40	–0.70 dB	(52)_______	+0.70 dB	±0.063 dB
–44	–0.74 dB	(53)_______	+0.74 dB	±0.064 dB
–48	–0.78 dB	(54)_______	+0.78 dB	±0.064 dB
–52	–0.82 dB	(55)_______	+0.82 dB	±0.089 dB
–56	–0.86 dB	(56)_______	+0.86 dB	±0.089 dB
–60	–0.90 dB	(57)_______	+0.90 dB	±0.088 dB
–64	–0.94 dB	(58)_______	+0.94 dB	±0.089 dB
–68	–0.98 dB	(59)_______	+0.98 dB	±0.089 dB
–72	–1.02 dB	(60)_______	+1.02 dB	±0.089 dB
–76	–1.06 dB	(61)_______	+1.06 dB	±0.089 dB
–80	–1.10 dB	(62)_______	+1.10 dB	±0.088 dB
–84	–1.14 dB	(63)_______	+1.14 dB	±0.089 dB
–88	–1.18 dB	(64)_______	+1.18 dB	±0.089 dB

Table 3-8 HP E4404B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4404B		**Report No. __________**		
Serial No. __________		**Date __________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–92	–1.22 dB	(65)_______	+1.22 dB	±0.089 dB
–96	–1.26 dB	(66)_______	+1.26 dB	±0.088 dB
–98	–1.28 dB	(67)_______	+1.28 dB	±0.089 dB
Incremental Log Fidelity, Res BW ≤ 300 Hz *(Option 1DR only)*				
dB from Ref Level				
–4	–0.4 dB	(68)_______	+0.4 dB	±0.064 dB
–8	–0.4 dB	(69)_______	+0.4 dB	±0.064 dB
–12	–0.4 dB	(70)_______	+0.4 dB	±0.064 dB
–16	–0.4 dB	(71)_______	+0.4 dB	±0.064 dB
–20	–0.4 dB	(72)_______	+0.4 dB	±0.063 dB
–24	–0.4 dB	(73)_______	+0.4 dB	±0.064 dB
–28	–0.4 dB	(74)_______	+0.4 dB	±0.064 dB
–32	–0.4 dB	(75)_______	+0.4 dB	±0.064 dB
–36	–0.4 dB	(76)_______	+0.4 dB	±0.064 dB
–40	–0.4 dB	(77)_______	+0.4 dB	±0.063 dB
–44	–0.4 dB	(78)_______	+0.4 dB	±0.064 dB
–48	–0.4 dB	(79)_______	+0.4 dB	±0.064 dB
–52	–0.4 dB	(80)_______	+0.4 dB	±0.089 dB
–56	–0.4 dB	(81)_______	+0.4 dB	±0.089 dB
–60	–0.4 dB	(82)_______	+0.4 dB	±0.088 dB
–64	–0.4 dB	(83)_______	+0.4 dB	±0.089 dB
–68	–0.4 dB	(84)_______	+0.4 dB	±0.089 dB
–72	–0.4 dB	(85)_______	+0.4 dB	±0.089 dB
–76	–0.4 dB	(86)_______	+0.4 dB	±0.089 dB

Table 3-8 HP E4404B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4404B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–80	–0.4 dB	(87)________	+0.4 dB	±0.088 dB
Linear Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–2.0%	(89)________	+2.0%	±0.064 %
–8	–2.0%	(90)________	+2.0%	±0.064 %
–12	–2.0%	(91)________	+2.0%	±0.064 %
–16	–2.0%	(92)________	+2.0%	±0.064 %
–20	–2.0%	(93)________	+2.0%	±0.063 %
Linear Fidelity, Res BW ≤ 300 Hz *(Option 1DR only)*				
dB from Ref Level				
–4	–2.0%	(94)________	+2.0%	±0.064 %
–8	–2.0%	(95)________	+2.0%	±0.064 %
–12	–2.0%	(96)________	+2.0%	±0.064 %
–16	–2.0%	(97)________	+2.0%	±0.064 %
–20	–2.0%	(98)________	+2.0%	±0.063 %
Zero Span, Res BW≤ 300 Hz *(Option 1DR only)*				
dB from Ref Level				
–4	–0.36 dB	(99)________	+0.36 dB	±0.064 dB
–8	–0.42 dB	(100)________	+0.42 dB	±0.064 dB
–12	–0.48 dB	(101)________	+0.48 dB	±0.064 dB
–16	–0.54 dB	(102)________	+0.54 dB	±0.064 dB
–20	–0.60 dB	(103)________	+0.60 dB	±0.063 dB
–24	–0.66 dB	(104)________	+0.66 dB	±0.064 dB

Table 3-8 HP E4404B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4404B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–28	–0.72 dB	(105)______	+0.72 dB	±0.064 dB
–32	–0.78 dB	(106)______	+0.78 dB	±0.064 dB
–36	–0.84 dB	(107)______	+0.84 dB	±0.064 dB
–40	–0.90 dB	(108)______	+0.90 dB	±0.063 dB
–44	–0.96 dB	(109)______	+0.96 dB	±0.064 dB
–48	–1.02 dB	(110)______	+1.02 dB	±0.064 dB
–52	–1.08 dB	(111)______	+1.08 dB	±0.089 dB
–56	–1.14 dB	(112)______	+1.14 dB	±0.089 dB
–60	–1.20 dB	(113)______	+1.20 dB	±0.088 dB
–64	–1.5 dB	(114)______	+1.5 dB	±0.089 dB
–68	–1.5 dB	(115)______	+1.5 dB	±0.089 dB
–70	–1.5 dB	(116)______	+1.5 dB	±0.089 dB
12. Input Attenuation Switching Uncertainty				
Input Attenuation Setting				
0 dB	–0.3 dB	(1)______	+0.3 dB	±0.108 dB
5 dB	–0.3 dB	(2)______	+0.3 dB	±0.107 dB
15 dB	–0.3 dB	(3)______	+0.3 dB	±0.107 dB
20 dB	–0.3 dB	(4)______	+0.3 dB	±0.089 dB
25 dB	–0.35 dB	(5)______	+0.35 dB	±0.089 dB
30 dB	–0.40 dB	(6)______	+0.40 dB	±0.089 dB
35 dB	–0.45 dB	(7)______	+0.45 dB	±0.089 dB
40 dB	–0.50 dB	(8)______	+0.50 dB	±0.089 dB
45 dB	–0.55 dB	(9)______	+0.55 dB	±0.089 dB
50 dB	–0.60 dB	(10)______	+0.60 dB	±0.089 dB
55 dB	–0.65 dB	(11)______	+0.65 dB	±0.089 dB

Table 3-8 HP E4404B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4404B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
60 dB	–0.70 dB	(12)______	+0.70 dB	±0.089 dB
65 dB	–0.75 dB	(13)______	+0.75 dB	±0.089 dB
14. Reference Level Accuracy				
Log, Res BW ≥ 1 kHz				
Reference Level				
–10	–0.3 dB	(1)______	+0.3 dB	±0.144 dB
0	–0.3 dB	(2)______	+0.3 dB	±0.144 dB
–30	–0.3 dB	(3)______	+0.3 dB	±0.144 dB
–40	–0.3 dB	(4)______	+0.3 dB	±0.144 dB
–50	–0.5 dB	(5)______	+0.5 dB	±0.156 dB
–60	–0.5 dB	(6)______	+0.5 dB	±0.156 dB
–70	–0.5 dB	(7)______	+0.5 dB	±0.156 dB
–80	–0.7 dB	(8)______	+0.7 dB	±0.156 dB
Linear, Res BW ≥ 1 kHz				
Reference Level				
–10	–0.3 dB	(9)______	+0.3 dB	±0.144 dB
0	–0.3 dB	(10)______	+0.3 dB	±0.144 dB
–30	–0.3 dB	(11)______	+0.3 dB	±0.144 dB
–40	–0.3 dB	(12)______	+0.3 dB	±0.144 dB
–50	–0.5 dB	(13)______	+0.5 dB	±0.156 dB
–60	–0.5 dB	(14)______	+0.5 dB	±0.156 dB
–70	–0.5 dB	(15)______	+0.5 dB	±0.156 dB
–80	–0.7 dB	(16)______	+0.7 dB	±0.156 dB

Table 3-8 HP E4404B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4404B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
Log, Res BW ≤ 300 Hz *(Option 1DR only)*				
Reference Level				
–10	–0.3 dB	(17)______	+0.3 dB	±0.144 dB
0	–0.3 dB	(18)______	+0.3 dB	±0.144 dB
–30	–0.3 dB	(19)______	+0.3 dB	±0.144 dB
–40	–0.3 dB	(20)______	+0.3 dB	±0.144 dB
–50	–0.5 dB	(21)______	+0.5 dB	±0.156 dB
–60	–0.5 dB	(22)______	+0.5 dB	±0.156 dB
–70	–0.5 dB	(23)______	+0.5 dB	±0.156 dB
–80	–0.7 dB	(24)______	+0.7 dB	±0.156 dB
Linear, Res BW ≤ 300 Hz *(Option 1DR only)*				
Reference Level				
–10	–0.3 dB	(25)______	+0.3 dB	±0.144 dB
0	–0.3 dB	(26)______	+0.3 dB	±0.144 dB
–30	–0.3 dB	(27)______	+0.3 dB	±0.144 dB
–40	–0.3 dB	(28)______	+0.3 dB	±0.144 dB
–50	–0.5 dB	(29)______	+0.5 dB	±0.156 dB
–60	–0.5 dB	(30)______	+0.5 dB	±0.156 dB
–70	–0.5 dB	(31)______	+0.5 dB	±0.156 dB
–80	–0.7 dB	(32)______	+0.7 dB	±0.156 dB

Table 3-8 HP E4404B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4404B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
15. Resolution Bandwidth Switching Uncertainty				
Resolution Bandwidth				
3 kHz	–0.3 dB	(1)_______	+0.3 dB	±0.064 dB
9 kHz	–0.3 dB	(2)_______	+0.3 dB	±0.064 dB
10 kHz	–0.3 dB	(3)_______	+0.3 dB	±0.064 dB
30 kHz	–0.3 dB	(4)_______	+0.3 dB	±0.064 dB
100 kHz	–0.3 dB	(5)_______	+0.3 dB	±0.064 dB
120 kHz	–0.3 dB	(6)_______	+0.3 dB	±0.064 dB
300 kHz	–0.3 dB	(7)_______	+0.3 dB	±0.064 dB
1 MHz	–0.3 dB	(8)_______	+0.3 dB	±0.064 dB
3 MHz	–0.3 dB	(9)_______	+0.3 dB	±0.064 dB
5 MHz	–0.6 dB	(10)_______	+0.6 dB	±0.083 dB
300 Hz *(Option 1DR only)*	–0.3 dB	(11)_______	+0.3 dB	±0.064 dB
200 Hz *(Option 1DR only)*	–0.3 dB	(12)_______	+0.3 dB	±0.064 dB
100 Hz *(Option 1DR only)*	–0.3 dB	(13)_______	+0.3 dB	±0.064 dB
30 Hz *(Option 1DR only)*	–0.3 dB	(14)_______	+0.3 dB	±0.064 dB
10 Hz *(Option 1DR only)*	–0.3 dB	(15)_______	+0.3 dB	±0.064 dB
17. Absolute Amplitude Accuracy (Reference Settings)				
Log, Preamp Off	–0.34 dB	(1)_______	+0.34 dB	±0.148 dB
Lin, Preamp Off	–0.34 dB	(2)_______	+0.34 dB	±0.148 dB
Log, Preamp On	–0.5 dB	(3)_______	+0.5 dB	±0.148 dB
Lin, Preamp On	–0.5 dB	(4)_______	+0.5 dB	±0.148 dB

Table 3-8 HP E4404B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4404B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
19. Overall Absolute Amplitude Accuracy				
0 dBm Reference Level				
0 dBm input	–0.54 dB	(1)_______	+0.54 dB	±0.08 dB
–10 dBm input	–0.54 dB	(2)_______	+0.54 dB	±0.081 dB
–20 dBm input	–0.54 dB	(3)_______	+0.54 dB	±0.082 dB
–30 dBm input	–0.54 dB	(4)_______	+0.54 dB	±0.083 dB
–40 dBm input	–0.54 dB	(5)_______	+0.54 dB	±0.084 dB
–50 dBm input	–0.54 dB	(6)_______	+0.54 dB	±0.086 dB
–20 dBm Reference Level				
–20 dBm input	–0.54 dB	(7)_______	+0.54 dB	±0.082 dB
–30 dBm input	–0.54 dB	(8)_______	+0.54 dB	±0.083 dB
–40 dBm input	–0.54 dB	(9)_______	+0.54 dB	±0.084 dB
–50 dBm input	–0.54 dB	(10)_______	+0.54 dB	±0.086 dB
–40 dBm Reference Level				
–40 dBm input	–0.54 dB	(11)_______	+0.54 dB	±0.084 dB
–50 dBm input	–0.54 dB	(12)_______	+0.54 dB	±0.086 dB
–50 dBm Reference Level				
–50 dBm input	–0.54 dB	(13)_______	+0.54 dB	±0.086 dB
20. Resolution Bandwidth Accuracy				
Resolution Bandwidth				
5 MHz	3.5 MHz	(1)_______	6.5 MHz	±38.2 kHz
3 MHz	2.55 MHz	(2)_______	3.45 MHz	±22.9 kHz
1 MHz	0.85 MHz	(3)_______	1.15 MHz	±7.64 kHz
300 kHz	255 kHz	(4)_______	345 kHz	±2.29 kHz

Table 3-8 HP E4404B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4404B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
100 kHz	85 kHz	(5)________	115 kHz	±764 Hz
30 kHz	25.5 kHz	(6)________	34.5 kHz	±229 Hz
10 kHz	8.5 kHz	(7)________	11.5 kHz	±76.4 Hz
3 kHz	2.55 kHz	(8)________	3.45 kHz	±22.9 Hz
1 kHz	850 Hz	(9)________	1.15 kHz	±7.64 Hz
120 kHz	102 kHz	(10)________	138 kHz	±154 Hz
9 kHz	7.65 kHz	(11)________	10.35kHz	±11.5 Hz
23. Frequency Response	Note: Enter data in the appropriate section below depending upon the ambient temperature at which the test was performed.			
20 to 30 °C:				
Band 0, 9 kHz to 3 GHz				
Maximum Response		(1)________	+0.5 dB	±0.245 dB
Minimum Response	–0.5 dB	(2)________		±0.245 dB
Peak-to-Peak Response		(3)________	1.0 dB	±0.245 dB
Band 1, 3 GHz to 6.7 GHz				
Maximum Response		(4)________	+1.5 dB	±0.355 dB
Minimum Response	–1.5 dB	(5)________		±0.355 dB
Peak-to-Peak Response		(6)________	2.6 dB	±0.355 dB
0 to 55 °C:				
Band 0, 9 kHz to 3 GHz				
Maximum Response		(1)________	+1.0 dB	±0.245 dB
Minimum Response	–1.0 dB	(2)________		±0.245 dB
Peak-to-Peak Response		(3)________	2.0 dB	±0.245 dB
Band 1, 3 GHz to 6.7 GHz				
Maximum Response		(4)________	+2.5 dB	±0.355 dB
Minimum Response	–2.5 dB	(5)________		±0.355 dB

Table 3-8 HP E4404B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4404B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
Peak-to-Peak Response		(6)______	3.0 dB	±0.355 dB
26. Frequency Response (Preamp On) *(Option 1DS only)*				
Maximum Response		(1)______	+2.0 dB	±0.343 dB
Minimum Response	–2.0 dB	(2)______		±0.343 dB
Peak-to-Peak Response		(3)______	4.0 dB	±0.343 dB
28. Other Input Related Spurious Responses				
Center Freq Input Freq				
2.0 GHz 2042.8 MHz		(1)______	–65 dBc	±1.14 dB
2.0 GHz 2642.8 MHz		(2)______	–65 dBc	±1.14 dB
2.0 GHz 1820.8 MHz		(3)______	–65 dBc	±1.14 dB
2.0 GHz 278.5 MHz		(4)______	–65 dBc	±1.14 dB
2.0 GHz 5600.0 MHz		(5)______	–80 dBc	±1.14 dB
2.0 GHz 6242.8 MHz		(6)______	–80 dBc	±1.14 dB
4.0 GHz 4042.8 MHz		(7)______	–65 dBc	±1.14 dB
4.0 GHz 4642.8 MHz		(8)______	–65 dBc	±1.14 dB
4.0 GHz 3742.9 MHz		(9)______	–65 dBc	±1.14 dB
4.0 GHz 2242.8 MHz		(10)______	–80 dBc	±1.14 dB
31. Spurious Responses				
300 MHz TOI, 1 kHz RBW	+11 dBm	(1)______		±0.49 dB
300 MHz TOI, 30 Hz RBW *(Option 1DR only)*	+11 dBm	(2)______		±0.49 dB
5 GHz TOI	+11 dBm	(3)______		±0.589 dB
8 GHz TOI	+7.5 dBm	(4)______		±0.589 dB
300 MHz SHI	+35 dBm	(5)______		±0.90 dB

Table 3-8 HP E4404B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4404B		**Report No.** ________		
Serial No. ________		**Date** ________		

Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
900 MHz SHI	+45 dBm	(6)______		±0.90 dB
1.55 GHz SHI	+75 dBm	(7)______		±0.90 dB
3.1 GHz SHI	+90 dBm	(8)______		±0.90 dB
33. Gain Compression				
Test Frequency				
53 MHz		(1)______	1.0 dB	±0.127 dB
50.004 MHz *(Option 1DR only)*		(2)______	1.0 dB	±0.127 dB
1403 MHz		(3)______	1.0 dB	±0.127 dB
2503 MHz		(4)______	1.0 dB	±0.144 dB
4403 MHz		(5)______	1.0 dB	±0.201 dB
36. Displayed Average Noise Level	Note: Enter results with preamp on in the appropriate section based upon the ambient temperature when the test was performed.			
1 kHz RBW, Preamp Off:				
10 MHz to 1 GHz		(1)______	–116 dBm	±1.82 dB
1 GHz to 2 GHz		(2)______	–115 dBm	±1.82 dB
2 GHz to 3 GHz		(3)______	–112 dBm	±1.82 dB
3 GHz to 6 GHz		(4)______	–112 dBm	±1.82 dB
6 GHz to 6.7 GHz		(5)______	–110 dBm	±1.82 dB
1kHz RBW, Preamp On, 0 to 55 °C:				
10 MHz to 1 GHz		(6)______	–131 dBm	±1.82 dB
1 GHz to 2 GHz		(7)______	–129 dBm	±1.82 dB
2 GHz to 3 GHz		(8)______	–127 dBm	±1.82 dB
10 Hz RBW, Preamp Off:				
10 MHz to 1 GHz		(9)______	–135 dBm	±1.82 dB

Table 3-8 HP E4404B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4404B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
1 GHz to 2 GHz		(10)_______	–134 dBm	±1.82 dB
2 GHz to 3 GHz		(11)_______	–131 dBm	±1.82 dB
3 GHz to 6 GHz		(12)_______	–131 dBm	±1.82 dB
6 GHz to 6.7 GHz		(13)_______	–129 dBm	±1.82 dB
10 Hz RBW, Preamp On, 0 to 55 °C:				
10 MHz to 1 GHz		(14)_______	–149 dBm	±1.82 dB
1 GHz to 2 GHz		(15)_______	–147 dBm	±1.82 dB
2 GHz to 3 GHz		(16)_______	–145 dBm	±1.82 dB
1 kHz RBW, Preamp On, 20 to 30 °C:				
10 MHz to 1 GHz		(17)_______	–132 dBm	±1.82 dB
1 GHz to 2 GHz		(18)_______	–131 dBm	±1.82 dB
2 GHz to 3 GHz		(19)_______	–130 dBm	±1.82 dB
10 Hz RBW, Preamp On, 20 to 30 °C:				
10 MHz to 1 GHz		(20)_______	–150 dBm	±1.82 dB
1 GHz to 2 GHz		(21)_______	–149 dBm	±1.82 dB
2 GHz to 3 GHz		(22)_______	–148 dBm	±1.82 dB
38. Residual Responses				
150 kHz to 6.7 GHz		(1)_______	–90 dBm	±0.93 dB

Table 3-8 HP E4404B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4404B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
39. Fast Time Domain Amplitude Accuracy *(Option AYX only)*				
Amplitude Error	–0.3 %	(1)_______	+0.3 %	±0.029 %
41. Tracking Generator Absolute Amplitude and Vernier Accuracy				
Absolute Amplitude Accuracy	–0.75 dB	(1)_______	+0.75 dB	±0.087 dB
Vernier Accuracy, –2 dB	–0.4 dB	(2)_______	+0.4 dB	±0.11 dB
Vernier Accuracy, –3 dB	–0.5 dB	(3)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –5 dB	–0.5 dB	(4)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –6 dB	–0.5 dB	(5)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –7 dB	–0.5 dB	(6)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –8 dB	–0.5 dB	(7)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –9 dB	–0.5 dB	(8)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –10 dB	–0.5 dB	(9)_______	+0.5 dB	±0.16 dB
43. Tracking Generator Level Flatness				
Positive Level Flatness, <1 MHz		(1)_______	+3.0 dB	±0.255 dB
Negative Level Flatness, <1 MHz	–3.0 dB	(2)_______		±0.255 dB
Positive Level Flatness, 1 MHz to 10 MHz		(3)_______	+3.0 dB	±0.145 dB
Negative Level Flatness, 1 MHz to 10 MHz	–3.0 dB	(4)_______		±0.145 dB
Positive Level Flatness, >10 MHz to 1.5 GHz		(5)_______	+2.0 dB	±0.122 dB

Table 3-8 HP E4404B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4404B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
Negative Level Flatness, >10 MHz to 1.5 GHz	–2.0 dB	(6)_______		±0.122 dB
Positive Level Flatness, >1.5 GHz		(7)_______	+2.0 dB	±0.172 dB
Negative Level Flatness, >1.5 GHz	–2.0 dB	(8)_______		±0.172 dB
45. Tracking Generator Harmonic Spurious Outputs *(Option 1DN only)*				
2nd Harmonic, <20 kHz		(1)_______	–15 dBc	±2.6 dB
2nd Harmonic, ≥ 20 kHz		(2)_______	–25 dBc	±2.6 dB
3rd Harmonic, <20 kHz		(3)_______	–15 dBc	±2.6 dB
3rd Harmonic, ≥ 20 kHz		(4)_______	–25 dBc	±2.6 dB
47. Tracking Generator Non-Harmonic Spurious Outputs *(Option 1DN only)*				
Highest Non-Harmonic Spurious Output Amplitude, 9 kHz to 2 GHz		(1)_______	–27 dBc	±2.67 dB
Highest Non-Harmonic Spurious Output Amplitude, 2 GHz to 3 GHz		(2)_______	–23 dBc	±3.12 dB
48. Tracking Generator LO Feedthrough Amplitude *(Option 1DN only)*				
9 kHz to 2.9 GHz		(1)_______	–16 dBm	±1.94 dB
2.9 GHz to 3.0 GHz		(2)_______	–16 dBm	±2.49 dB

Table 3-8 HP E4404B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4404B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
49. Gate Delay Accuracy and Gate Length Accuracy *(Option 1D6 only)*				
Minimum Gate Delay	499.9 ns	(1)______	1.5001 µs	±475 ps
Maximum Gate Delay	499.9 ns	(2)______	1.5001 µs	±475 ps
1 us Gate Length	499.9 ns	(3)______	1.5001 µs	±450 ps
65 ms Gate Length	64.993 ms	(4)______	65.007 ms	±561 ns
50. Gate Mode Amplitude Error *(Option 1D6 only)*				
Amplitude Error	–0.2 dB	(1)______	+0.2 dB	±0.023 dB

HP E4405B Performance Verification Test Record

Only the tests for HP E4405B are included in this test record, therefore not all test numbers are included.

Table 3-9 HP E4405B Performance Verification Test Record

Hewlett-Packard Company

Address: ______________________ Report No. ______________

______________________ Date ______________

____

Model HP E4405B

Serial No. ____________ Ambient temperature ______ °C

Options ____________ Power mains line frequency ______ Hz (nominal)

Firmware Revision ________ Relative humidity ______ %

Customer ______________________ Tested by ______________________

Test Equipment Used:

Description	**Model No.**	**Trace No.**	**Cal Due Date**
Synthesized Signal Generator	________	________	________
Synthesized Sweeper #1	________	________	________
Synthesized Sweeper #2	________	________	________
Function Generator	________	________	________
Power Meter, Dual-Channel	________	________	________
RF Power Sensor #1	________	________	________
RF Power Sensor #2	________	________	________
Microwave Power Sensor	________	________	________
Low-Power Power Sensor	________	________	________
Digital Multimeter	________	________	________
Universal Counter	________	________	________
Frequency Standard	________	________	________
Power Splitter	________	________	________

Table 3-9 HP E4405B Performance Verification Test Record

50 Ω Termination	________	________	________
1 dB Step Attenuator	________	________	________
10 dB Step Attenuator	________	________	________
6 dB Fixed Attenuator	________	________	________
20 dB Fixed Attenuator *(Option 1DS only)*	________	________	________
Oscilloscope *(Option 1D6 only)*	________	________	________
Microwave Spectrum Analyzer *(Option 1DN only)*	________	________	________
Notes/comments:	________________		

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4405B **Report No.** ________

Serial No. ________ **Date** ________

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
1. 10 MHz Reference Output Accuracy (*Non-Option 1D5 only*)				
Settability	–5.0 Hz	(1)______	+5.0 Hz	±293.3 μHz
2. 10 MHz Precision Frequency Reference Accuracy (*Option 1D5 only*)				
5 Minute Warm-Up Error	–0.1 ppm	(1)______	+0.1 ppm	±0.000072 ppm
15 Minute Warm-Up Error	–0.01 ppm	(2)______	+0.01 ppm	±0.000070 ppm

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4405B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
4. Frequency Readout Accuracy and Marker Count Accuracy	Note: TR Entries 10 through 15 do not apply to the HP E4405B.			
Frequency Readout Accuracy				
Center Freq Span				
1500 MHz 20 MHz	1499.784990 MHz	(1)_______	1500.215010 MHz	0 Hz
1500 MHz 10 MHz	1499.884990 MHz	(2)_______	1500.115010 MHz	0 Hz
1500 MHz 1 MHz	1499.988490 MHz	(3)_______	1500.011510 MHz	0 Hz
4000 MHz 20 MHz	3999.784990 MHz	(4)_______	4000.215010 MHz	0 Hz
4000 MHz 10 MHz	3999.884990 MHz	(5)_______	4000.115010 MHz	0 Hz
4000 MHz 1 MHz	3999.988490 MHz	(6)_______	4000.011510 MHz	0 Hz
9000 MHz 20 MHz	8999.784990 MHz	(7)_______	9000.215010 MHz	0 Hz
9000 MHz 10 MHz	8999.884990 MHz	(8)_______	9000.115010 MHz	0 Hz
9000 MHz 1 MHz	8999.988490 MHz	(9)_______	9000.011510 MHz	0 Hz
Marker Count Accuracy	Note: Enter results in the appropriate section below based upon the firmware revision of the analyzer.			
Firmware Revision Prior to A.03.00				
Center Freq Span				
1500 MHz 10 MHz	1499.999998 MHz	(16)_______	1500.000002 MHz	±0 Hz

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4405B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
1500 MHz 1 MHz	1499.999998 MHz	(17)______	1500.000002 MHz	±0 Hz
4000 MHz 10 MHz	3999.999998 MHz	(18)______	4000.000002 MHz	±0 Hz
4000 MHz 1 MHz	3999.999998 MHz	(19)______	4000.000002 MHz	±0 Hz
9000 MHz 10 MHz	8999.999997 MHz	(20)______	9000.000003 MHz	±0 Hz
9000 MHz 1 MHz	8999.999997 MHz	(21)______	9000.000003 MHz	±0 Hz
Marker Count Accuracy				
Firmware Revision A.03.00 or later				
Center Freq Span				
1500 MHz 10 MHz	1499.999999 MHz	(16)______	1500.000001 MHz	±0 Hz
1500 MHz 1 MHz	1499.999999 MHz	(17)______	1500.000001 MHz	±0 Hz
4000 MHz 10 MHz	3999.999999 MHz	(18)______	4000.000001 MHz	±0 Hz
4000 MHz 1 MHz	3999.999999 MHz	(19)______	4000.000001 MHz	±0 Hz
9000 MHz 10 MHz	8999.999999 MHz	(20)______	9000.000001 MHz	±0 Hz
9000 MHz 1 MHz	8999.999999 MHz	(21)______	9000.000001 MHz	±0 Hz

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4405B		**Report No. __________**		
Serial No. __________		**Date __________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
6. Frequency Span Readout Accuracy				
Span Start Freq				
3000 MHz 0 Hz	2370 MHz	(1)_______	2430 MHz	±6.12 MHz
100 MHz 10 MHz	79 MHz	(2)_______	81 MHz	±204 kHz
100 kHz 10 MHz	79 kHz	(3)_______	81 kHz	±204 Hz
100 MHz 800 MHz	79 MHz	(4)_______	81 MHz	±204 kHz
100 kHz 800 MHz	79 kHz	(5)_______	81 kHz	±204 Hz
100 MHz 1400 MHz	79 MHz	(6)_______	81 MHz	±204 kHz
100 kHz 1499 MHz	79 kHz	(7)_______	81 kHz	±204 Hz
7. Noise Sidebands				
Offset from 1 GHz signal				
10 kHz		(1)_______	–90 dBc/Hz	±1.154 dB
20 kHz		(2)_______	–98 dBc/Hz	±1.154 dB
30 kHz		(3)_______	–100 dBc/Hz	±1.154 dB
100 kHz		(4)_______	–112 dBc/Hz	±1.154 dB
8. System Related Sidebands				
Offset from 500 MHz signal				
30 kHz to 230 kHz		(1)_______	–65 dBc	±1.154 dB
–30 kHz to –230 kHz		(2)_______	–65 dBc	±1.154 dB

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4405B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
9. Residual FM				
1 kHz Res BW (*Non-Option 1D5*)		(1)________	150 Hz	±9.24 Hz
1 kHz Res BW (*Option 1D5*)		(1)________	100 Hz	±9.24 Hz
10 Hz Res BW (*Options 1DR and 1D5 only*)		(2)________	2 Hz	±0.274 Hz
10. Sweep Time Accuracy				
Sweep Time				
5 ms	–1.0%	(1)________	+1.0%	±0.28%
20 ms	–1.0%	(2)________	+1.0%	±0.28%
100 ms	–1.0%	(3)________	+1.0%	±0.28%
1 s	–1.0%	(4)________	+1.0%	±0.28%
10 s	–1.0%	(5)________	+1.0%	±0.28%
1 ms (*Option AYX only*)	–1.0%	(6)________	+1.0%	±0.28%
500 μs (*Option AYX only*)	–1.0%	(7)________	+1.0%	±0.28%
100 μs (*Option AYX only*)	–1.0%	(8)________	+1.0%	±0.28%
11. Display Scale Fidelity				
Cumulative Log Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–0.34 dB	(1)________	+0.34 dB	±0.064 dB
–8	–0.38 dB	(2)________	+0.38 dB	±0.064 dB
–12	–0.42 dB	(3)________	+0.42 dB	±0.064 dB
–16	–0.46 dB	(4)________	+0.46 dB	±0.064 dB
–20	–0.50 dB	(5)________	+0.50 dB	±0.063 dB

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4405B **Report No.** __________

Serial No. __________ **Date** __________

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
–24	–0.54 dB	(6)_______	+0.54 dB	±0.064 dB
–28	–0.58 dB	(7)_______	+0.58 dB	±0.064 dB
–32	–0.62 dB	(8)_______	+0.62 dB	±0.064 dB
–36	–0.66 dB	(9)_______	+0.66 dB	±0.064 dB
–40	–0.70 dB	(10)_______	+0.70 dB	±0.063 dB
–44	–0.74 dB	(11)_______	+0.74 dB	±0.064 dB
–48	–0.78 dB	(12)_______	+0.78 dB	±0.064 dB
–52	–0.82 dB	(13)_______	+0.82 dB	±0.089 dB
–56	–0.86 dB	(14)_______	+0.86 dB	±0.089 dB
–60	–0.90 dB	(15)_______	+0.90 dB	±0.088 dB
–64	–0.94 dB	(16)_______	+0.94 dB	±0.089 dB
–68	–0.98 dB	(17)_______	+0.98 dB	±0.089 dB
–72	–1.02 dB	(18)_______	+1.02 dB	±0.089 dB
–76	–1.06 dB	(19)_______	+1.06 dB	±0.089 dB
–80	–1.10 dB	(20)_______	+1.10 dB	±0.088 dB
–84	–1.14 dB	(21)_______	+1.14 dB	±0.089 dB
Incremental Log Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–0.4 dB	(22)_______	+0.4 dB	±0.064 dB
–8	–0.4 dB	(23)_______	+0.4 dB	±0.064 dB
–12	–0.4 dB	(24)_______	+0.4 dB	±0.064 dB
–16	–0.4 dB	(25)_______	+0.4 dB	±0.064 dB
–20	–0.4 dB	(26)_______	+0.4 dB	±0.063 dB
–24	–0.4 dB	(27)_______	+0.4 dB	±0.064 dB
–28	–0.4 dB	(28)_______	+0.4 dB	±0.064 dB

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4405B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–32	–0.4 dB	(29)_______	+0.4 dB	±0.064 dB
–36	–0.4 dB	(30)_______	+0.4 dB	±0.064 dB
–40	–0.4 dB	(31)_______	+0.4 dB	±0.063 dB
–44	–0.4 dB	(32)_______	+0.4 dB	±0.064 dB
–48	–0.4 dB	(33)_______	+0.4 dB	±0.064 dB
–52	–0.4 dB	(34)_______	+0.4 dB	±0.089 dB
–56	–0.4 dB	(35)_______	+0.4 dB	±0.089 dB
–60	–0.4 dB	(36)_______	+0.4 dB	±0.088 dB
–64	–0.4 dB	(37)_______	+0.4 dB	±0.089 dB
–68	–0.4 dB	(38)_______	+0.4 dB	±0.089 dB
–72	–0.4 dB	(39)_______	+0.4 dB	±0.089 dB
–76	–0.4 dB	(40)_______	+0.4 dB	±0.089 dB
–80	–0.4 dB	(41)_______	+0.4 dB	±0.088 dB
Cumulative Log Fidelity, Res BW ≤ 300 Hz *(Option 1DR only)*				
dB from Ref Level				
–4	–0.34 dB	(43)_______	+0.34 dB	±0.064 dB
–8	–0.38 dB	(44)_______	+0.38 dB	±0.064 dB
–12	–0.42 dB	(45)_______	+0.42 dB	±0.064 dB
–16	–0.46 dB	(46)_______	+0.46 dB	±0.064 dB
–20	–0.50 dB	(47)_______	+0.50 dB	±0.063 dB
–24	–0.54 dB	(48)_______	+0.54 dB	±0.064 dB
–28	–0.58 dB	(49)_______	+0.58 dB	±0.064 dB
–32	–0.62 dB	(50)_______	+0.62 dB	±0.064 dB
–36	–0.66 dB	(51)_______	+0.66 dB	±0.064 dB

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4405B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–40	–0.70 dB	(52)______	+0.70 dB	±0.063 dB
–44	–0.74 dB	(53)______	+0.74 dB	±0.064 dB
–48	–0.78 dB	(54)______	+0.78 dB	±0.064 dB
–52	–0.82 dB	(55)______	+0.82 dB	±0.089 dB
–56	–0.86 dB	(56)______	+0.86 dB	±0.089 dB
–60	–0.90 dB	(57)______	+0.90 dB	±0.088 dB
–64	–0.94 dB	(58)______	+0.94 dB	±0.089 dB
–68	–0.98 dB	(59)______	+0.98 dB	±0.089 dB
–72	–1.02 dB	(60)______	+1.02 dB	±0.089 dB
–76	–1.06 dB	(61)______	+1.06 dB	±0.089 dB
–80	–1.10 dB	(62)______	+1.10 dB	±0.088 dB
–84	–1.14 dB	(63)______	+1.14 dB	±0.089 dB
–88	–1.18 dB	(64)______	+1.18 dB	±0.089 dB
–92	–1.22 dB	(65)______	+1.22 dB	±0.089 dB
–96	–1.26 dB	(66)______	+1.26 dB	±0.088 dB
–98	–1.28 dB	(67)______	+1.28 dB	±0.089 dB
Incremental Log Fidelity, Res BW ≤ 300 Hz *(Option 1DR only)*				
dB from Ref Level				
–4	–0.4 dB	(68)______	+0.4 dB	±0.064 dB
–8	–0.4 dB	(69)______	+0.4 dB	±0.064 dB
–12	–0.4 dB	(70)______	+0.4 dB	±0.064 dB
–16	–0.4 dB	(71)______	+0.4 dB	±0.064 dB
–20	–0.4 dB	(72)______	+0.4 dB	±0.063 dB
–24	–0.4 dB	(73)______	+0.4 dB	±0.064 dB

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4405B		Report No. _________		
Serial No. _________		Date _________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–28	–0.4 dB	(74)_______	+0.4 dB	±0.064 dB
–32	–0.4 dB	(75)_______	+0.4 dB	±0.064 dB
–36	–0.4 dB	(76)_______	+0.4 dB	±0.064 dB
–40	–0.4 dB	(77)_______	+0.4 dB	±0.063 dB
–44	–0.4 dB	(78)_______	+0.4 dB	±0.064 dB
–48	–0.4 dB	(79)_______	+0.4 dB	±0.064 dB
–52	–0.4 dB	(80)_______	+0.4 dB	±0.089 dB
–56	–0.4 dB	(81)_______	+0.4 dB	±0.089 dB
–60	–0.4 dB	(82)_______	+0.4 dB	±0.088 dB
–64	–0.4 dB	(83)_______	+0.4 dB	±0.089 dB
–68	–0.4 dB	(84)_______	+0.4 dB	±0.089 dB
–72	–0.4 dB	(85)_______	+0.4 dB	±0.089 dB
–76	–0.4 dB	(86)_______	+0.4 dB	±0.089 dB
–80	–0.4 dB	(87)_______	+0.4 dB	±0.088 dB
Linear Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–2.0%	(89)_______	+2.0%	±0.064 %
–8	–2.0%	(90)_______	+2.0%	±0.064 %
–12	–2.0%	(91)_______	+2.0%	±0.064 %
–16	–2.0%	(92)_______	+2.0%	±0.064 %
–20	–2.0%	(93)_______	+2.0%	±0.063 %
Linear Fidelity, Res BW ≤ 300 Hz *(Option 1DR only)*				
dB from Ref Level				
–4	–2.0%	(94)_______	+2.0%	±0.064 %

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4405B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–8	–2.0%	(95)_______	+2.0%	±0.064 %
–12	–2.0%	(96)_______	+2.0%	±0.064 %
–16	–2.0%	(97)_______	+2.0%	±0.064 %
–20	–2.0%	(98)_______	+2.0%	±0.063 %
Zero Span, Res BW≤ 300 Hz *(Option 1DR only)*				
dB from Ref Level				
–4	–0.36 dB	(99)_______	+0.36 dB	±0.064 dB
–8	–0.42 dB	(100)_______	+0.42 dB	±0.064 dB
–12	–0.48 dB	(101)_______	+0.48 dB	±0.064 dB
–16	–0.54 dB	(102)_______	+0.54 dB	±0.064 dB
–20	–0.60 dB	(103)_______	+0.60 dB	±0.063 dB
–24	–0.66 dB	(104)_______	+0.66 dB	±0.064 dB
–28	–0.72 dB	(105)_______	+0.72 dB	±0.064 dB
–32	–0.78 dB	(106)_______	+0.78 dB	±0.064 dB
–36	–0.84 dB	(107)_______	+0.84 dB	±0.064 dB
–40	–0.90 dB	(108)_______	+0.90 dB	±0.063 dB
–44	–0.96 dB	(109)_______	+0.96 dB	±0.064 dB
–48	–1.02 dB	(110)_______	+1.02 dB	±0.064 dB
–52	–1.08 dB	(111)_______	+1.08 dB	±0.089 dB
–56	–1.14 dB	(112)_______	+1.14 dB	±0.089 dB
–60	–1.20 dB	(113)_______	+1.20 dB	±0.088 dB
–64	–1.5 dB	(114)_______	+1.5 dB	±0.089 dB
–68	–1.5 dB	(115)_______	+1.5 dB	±0.089 dB
–70	–1.5 dB	(116)_______	+1.5 dB	±0.089 dB

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4405B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
12. Input Attenuation Switching Uncertainty				
Input Attenuation Setting				
0 dB	–0.3 dB	(1)_______	+0.3 dB	±0.108 dB
5 dB	–0.3 dB	(2)_______	+0.3 dB	±0.107 dB
15 dB	–0.3 dB	(3)_______	+0.3 dB	±0.107 dB
20 dB	–0.3 dB	(4)_______	+0.3 dB	±0.089 dB
25 dB	–0.35 dB	(5)_______	+0.35 dB	±0.089 dB
30 dB	–0.40 dB	(6)_______	+0.40 dB	±0.089 dB
35 dB	–0.45 dB	(7)_______	+0.45 dB	±0.089 dB
40 dB	–0.50 dB	(8)_______	+0.50 dB	±0.089 dB
45 dB	–0.55 dB	(9)_______	+0.55 dB	±0.089 dB
50 dB	–0.60 dB	(10)_______	+0.60 dB	±0.089 dB
55 dB	–0.65 dB	(11)_______	+0.65 dB	±0.089 dB
60 dB	–0.70 dB	(12)_______	+0.70 dB	±0.089 dB
65 dB	–0.75 dB	(13)_______	+0.75 dB	±0.089 dB
14. Reference Level Accuracy				
Log, Res BW ≥ 1 kHz				
Reference Level				
–10	–0.3 dB	(1)_______	+0.3 dB	±0.144 dB
0	–0.3 dB	(2)_______	+0.3 dB	±0.144 dB
–30	–0.3 dB	(3)_______	+0.3 dB	±0.144 dB
–40	–0.3 dB	(4)_______	+0.3 dB	±0.144 dB
–50	–0.5 dB	(5)_______	+0.5 dB	±0.156 dB
–60	–0.5 dB	(6)_______	+0.5 dB	±0.156 dB

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4405B **Report No.** ________

Serial No. ________ **Date** ________

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
–70	–0.5 dB	(7)_______	+0.5 dB	±0.156 dB
–80	–0.7 dB	(8)_______	+0.7 dB	±0.156 dB
Linear, Res BW ≥ 1 kHz				
Reference Level				
–10	–0.3 dB	(9)_______	+0.3 dB	±0.144 dB
0	–0.3 dB	(10)_______	+0.3 dB	±0.144 dB
–30	–0.3 dB	(11)_______	+0.3 dB	±0.144 dB
–40	–0.3 dB	(12)_______	+0.3 dB	±0.144 dB
–50	–0.5 dB	(13)_______	+0.5 dB	±0.156 dB
–60	–0.5 dB	(14)_______	+0.5 dB	±0.156 dB
–70	–0.5 dB	(15)_______	+0.5 dB	±0.156 dB
–80	–0.7 dB	(16)_______	+0.7 dB	±0.156 dB
Log, Res BW ≤ 300 Hz *(Option 1DR only)*				
Reference Level				
–10	–0.3 dB	(17)_______	+0.3 dB	±0.144 dB
0	–0.3 dB	(18)_______	+0.3 dB	±0.144 dB
–30	–0.3 dB	(19)_______	+0.3 dB	±0.144 dB
–40	–0.3 dB	(20)_______	+0.3 dB	±0.144 dB
–50	–0.5 dB	(21)_______	+0.5 dB	±0.156 dB
–60	–0.5 dB	(22)_______	+0.5 dB	±0.156 dB
–70	–0.5 dB	(23)_______	+0.5 dB	±0.156 dB
–80	–0.7 dB	(24)_______	+0.7 dB	±0.156 dB

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4405B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
Linear, Res BW ≤ 300 Hz *(Option 1DR only)*				
Reference Level				
–10	–0.3 dB	(25)_______	+0.3 dB	±0.144 dB
0	–0.3 dB	(26)_______	+0.3 dB	±0.144 dB
–30	–0.3 dB	(27)_______	+0.3 dB	±0.144 dB
–40	–0.3 dB	(28)_______	+0.3 dB	±0.144 dB
–50	–0.5 dB	(29)_______	+0.5 dB	±0.156 dB
–60	–0.5 dB	(30)_______	+0.5 dB	±0.156 dB
–70	–0.5 dB	(31)_______	+0.5 dB	±0.156 dB
–80	–0.7 dB	(32)_______	+0.7 dB	±0.156 dB
15. Resolution Bandwidth Switching Uncertainty				
Resolution Bandwidth				
3 kHz	–0.3 dB	(1)_______	+0.3 dB	±0.064 dB
9 kHz	–0.3 dB	(2)_______	+0.3 dB	±0.064 dB
10 kHz	–0.3 dB	(3)_______	+0.3 dB	±0.064 dB
30 kHz	–0.3 dB	(4)_______	+0.3 dB	±0.064 dB
100 kHz	–0.3 dB	(5)_______	+0.3 dB	±0.064 dB
120 kHz	–0.3 dB	(6)_______	+0.3 dB	±0.064 dB
300 kHz	–0.3 dB	(7)_______	+0.3 dB	±0.064 dB
1 MHz	–0.3 dB	(8)_______	+0.3 dB	±0.064 dB
3 MHz	–0.3 dB	(9)_______	+0.3 dB	±0.064 dB
5 MHz	–0.6 dB	(10)_______	+0.6 dB	±0.083 dB
300 Hz *(Option 1DR only)*	–0.3 dB	(11)_______	+0.3 dB	±0.064 dB
200 Hz *(Option 1DR only)*	–0.3 dB	(12)_______	+0.3 dB	±0.064 dB

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4405B		**Report No. __________**		
Serial No. __________		**Date __________**		

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
100 Hz *(Option 1DR only)*	–0.3 dB	(13)_______	+0.3 dB	±0.064 dB
30 Hz *(Option 1DR only)*	–0.3 dB	(14)_______	+0.3 dB	±0.064 dB
10 Hz *(Option 1DR only)*	–0.3 dB	(15)_______	+0.3 dB	±0.064 dB
17. Absolute Amplitude Accuracy (Reference Settings)				
Log, Preamp Off	–0.34 dB	(1)_______	+0.34 dB	±0.148 dB
Lin, Preamp Off	–0.34 dB	(2)_______	+0.34 dB	±0.148 dB
Log, Preamp On	–0.5 dB	(3)_______	+0.5 dB	±0.148 dB
Lin, Preamp On	–0.5 dB	(4)_______	+0.5 dB	±0.148 dB
19. Overall Absolute Amplitude Accuracy				
0 dBm Reference Level				
0 dBm input	–0.54 dB	(1)_______	+0.54 dB	±0.08 dB
–10 dBm input	–0.54 dB	(2)_______	+0.54 dB	±0.081 dB
–20 dBm input	–0.54 dB	(3)_______	+0.54 dB	±0.082 dB
–30 dBm input	–0.54 dB	(4)_______	+0.54 dB	±0.083 dB
–40 dBm input	–0.54 dB	(5)_______	+0.54 dB	±0.084 dB
–50 dBm input	–0.54 dB	(6)_______	+0.54 dB	±0.086 dB
–20 dBm Reference Level				
–20 dBm input	–0.54 dB	(7)_______	+0.54 dB	±0.082 dB
–30 dBm input	–0.54 dB	(8)_______	+0.54 dB	±0.083 dB
–40 dBm input	–0.54 dB	(9)_______	+0.54 dB	±0.084 dB
–50 dBm input	–0.54 dB	(10)_______	+0.54 dB	±0.086 dB
–40 dBm Reference Level				
–40 dBm input	–0.54 dB	(11)_______	+0.54 dB	±0.084 dB

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4405B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–50 dBm input	–0.54 dB	(12)______	+0.54 dB	±0.086 dB
–50 dBm Reference Level				
–50 dBm input	–0.54 dB	(13)______	+0.54 dB	±0.086 dB
20. Resolution Bandwidth Accuracy				
Resolution Bandwidth				
5 MHz	3.5 MHz	(1)______	6.5 MHz	±38.2 kHz
3 MHz	2.55 MHz	(2)______	3.45 MHz	±22.9 kHz
1 MHz	0.85 MHz	(3)______	1.15 MHz	±7.64 kHz
300 kHz	255 kHz	(4)______	345 kHz	±2.29 kHz
100 kHz	85 kHz	(5)______	115 kHz	±764 Hz
30 kHz	25.5 kHz	(6)______	34.5 kHz	±229 Hz
10 kHz	8.5 kHz	(7)______	11.5 kHz	±76.4 Hz
3 kHz	2.55 kHz	(8)______	3.45 kHz	±22.9 Hz
1 kHz	850 Hz	(9)______	1.15 kHz	±7.64 Hz
120 kHz	102 kHz	(10)______	138 kHz	±154 Hz
9 kHz	7.65 kHz	(11)______	10.35 kHz	±11.5 Hz
23. Frequency Response	Note: Enter data in the appropriate section below depending upon the ambient temperature at which the test was performed.			
20 to 30 °C:				
Band 0, 9 kHz to 3 GHz				
Maximum Response		(1)______	+0.5 dB	±0.245 dB
Minimum Response	–0.5 dB	(2)______		±0.245 dB
Peak-to-Peak Response		(3)______	1.0 dB	±0.245 dB
Band 1, 3 GHz to 6.7 GHz				
Maximum Response		(4)______	+1.5 dB	±0.355 dB

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4405B		**Report No. __________**		
Serial No. __________		**Date __________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
Minimum Response	–1.5 dB	(5)_______		±0.355 dB
Peak-to-Peak Response		(6)_______	2.6 dB	±0.355 dB
Band 2, 6.7 GHz to 13.2 GHz				
Maximum Response		(7)_______	+2.0 dB	±0.429 dB
Minimum Response	–2.0 dB	(8)_______		±0.429 dB
Peak-to-Peak Response		(9)_______	3.6 dB	±0.429 dB
0 to 55 °C:				
Band 0, 9 kHz to 3 GHz				
Maximum Response		(1)_______	+1.0 dB	±0.245 dB
Minimum Response	–1.0 dB	(2)_______		±0.245 dB
Peak-to-Peak Response		(3)_______	2.0 dB	±0.245 dB
Band 1, 3 GHz to 6.7 GHz				
Maximum Response		(4)_______	+2.5 dB	±0.355 dB
Minimum Response	–2.5 dB	(5)_______		±0.355 dB
Peak-to-Peak Response		(6)_______	3.0 dB	±0.355 dB
Band 2, 6.7 GHz to 13.2 GHz				
Maximum Response		(7)_______	+3.0 dB	±0.429 dB
Minimum Response	–3.0 dB	(8)_______		±0.429 dB
Peak-to-Peak Response		(9)_______	4.0 dB	±0.429 dB
26. Frequency Response (Preamp On) *(Option 1DS only)*				
Maximum Response		(1)_______	+2.0 dB	±0.343 dB
Minimum Response	–2.0 dB	(2)_______		±0.343 dB
Peak-to-Peak Response		(3)_______	4.0 dB	±0.343 dB

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4405B		Report No. ______		
Serial No. ______		Date ______		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
28. Other Input Related Spurious Responses				
Center Freq Input Freq				
2.0 GHz 2042.8 MHz		(1)______	–65 dBc	±1.14 dB
2.0 GHz 2642.8 MHz		(2)______	–65 dBc	±1.14 dB
2.0 GHz 1820.8 MHz		(3)______	–65 dBc	±1.14 dB
2.0 GHz 278.5 MHz		(4)______	–65 dBc	±1.14 dB
2.0 GHz 5600.0 MHz		(5)______	–80 dBc	±1.14 dB
2.0 GHz 6242.8 MHz		(6)______	–80 dBc	±1.14 dB
4.0 GHz 4042.8 MHz		(7)______	–65 dBc	±1.14 dB
4.0 GHz 4642.8 MHz		(8)______	–65 dBc	±1.14 dB
4.0 GHz 3742.9 MHz		(9)______	–65 dBc	±1.14 dB
4.0 GHz 2242.8 MHz		(10)______	–80 dBc	±1.14 dB
9.0 GHz 9042.8 MHz		(11)______	–65 dBc	±1.14 dB
9.0 GHz 9642.8 MHz		(12)______	–65 dBc	±1.14 dB
9.0 GHz 9342.8 MHz		(13)______	–65 dBc	±1.14 dB
9.0 GHz 4982.1 MHz		(14)______	–80 dBc	±1.14 dB
31. Spurious Responses				
300 MHz TOI, 1 kHz RBW	+11 dBm	(1)______		±0.49 dB
300 MHz TOI, 30 Hz RBW (*Option 1DR only)*	+11 dBm	(2)______		±0.49 dB
5 GHz TOI	+11 dBm	(3)______		±0.589 dB
8 GHz TOI	+7.5 dBm	(4)______		±0.589 dB
300 MHz SHI	+35 dBm	(5)______		±0.90 dB
900 MHz SHI	+45 dBm	(6)______		±0.90 dB

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4405B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
1.55 GHz SHI	+75 dBm	(7)______		±0.90 dB
3.1 GHz SHI	+90 dBm	(8)______		±0.90 dB
33. Gain Compression				
Test Frequency				
53 MHz		(1)______	1.0 dB	±0.127 dB
50.004 MHz *(Option 1DR only)*		(2)______	1.0 dB	±0.127 dB
1403 MHz		(3)______	1.0 dB	±0.127 dB
2503 MHz		(4)______	1.0 dB	±0.144 dB
4403 MHz		(5)______	1.0 dB	±0.201 dB
7603 MHz		(6)______	1.0 dB	±0.201 dB
36. Displayed Average Noise Level	Note: Enter results with preamp on in the appropriate section based upon the ambient temperature when the test was performed.			
1 kHz RBW, Preamp Off:				
10 MHz to 1 GHz		(1)______	–116 dBm	±1.82 dB
1 GHz to 2 GHz		(2)______	–115 dBm	±1.82 dB
2 GHz to 3 GHz		(3)______	–112 dBm	±1.82 dB
3 GHz to 6 GHz		(4)______	–112 dBm	±1.82 dB
6 GHz to 12 GHz		(5)______	–110 dBm	±1.82 dB
12 GHz to 13.2 GHz		(6)______	–107 dBm	±1.82 dB
1 kHz RBW, Preamp On, 0 to 55 °C:				
10 MHz to 1 GHz		(7)______	–131 dBm	±1.82 dB
1 GHz to 2 GHz		(8)______	–129 dBm	±1.82 dB
2 GHz to 3 GHz		(9)______	–127 dBm	±1.82 dB
10 Hz RBW, Preamp Off:				

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4405B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
10 MHz to 1 GHz		(10)______	–135 dBm	±1.82 dB
1 GHz to 2 GHz		(11)______	–134 dBm	±1.82 dB
2 GHz to 3 GHz		(12)______	–131 dBm	±1.82 dB
3 GHz to 6 GHz		(13)______	–131 dBm	±1.82 dB
6 GHz to 12 GHz		(14)______	–129 dBm	±1.82 dB
12 GHz to 13.2 GHz		(15)______	–126 dBm	±1.82 dB
10 Hz RBW, Preamp On, 0 to 55 °C:				
10 MHz to 1 GHz		(16)______	–149 dBm	±1.82 dB
1 GHz to 2 GHz		(17)______	–147 dBm	±1.82 dB
2 GHz to 3 GHz		(18)______	–145 dBm	±1.82 dB
1 kHz RBW, Preamp On, 20 to 30 °C:				
10 MHz to 1 GHz		(19)______	–132 dBm	±1.82 dB
1 GHz to 2 GHz		(20)______	–131 dBm	±1.82 dB
2 GHz to 3 GHz		(21)______	–130 dBm	±1.82 dB
10 Hz RBW, Preamp On, 20 to 30 °C:				
10 MHz to 1 GHz		(22)______	–150 dBm	±1.82 dB
1 GHz to 2 GHz		(23)______	–149 dBm	±1.82 dB
2 GHz to 3 GHz		(24)______	–148 dBm	±1.82 dB
38. Residual Responses				
150 kHz to 6.7 GHz		(1)______	–90 dBm	±0.93 dB
39. Fast Time Domain Amplitude Accuracy *(Option AYX only)*				
Amplitude Error	–0.3 %	(1)______	+0.3 %	±0.029 %

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4405B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
41. Tracking Generator Absolute Amplitude and Vernier Accuracy				
Absolute Amplitude Accuracy	–0.75 dB	(1)_______	+0.75 dB	±0.087 dB
Vernier Accuracy, –2 dB	–0.4 dB	(2)_______	+0.4 dB	±0.11 dB
Vernier Accuracy, –3 dB	–0.5 dB	(3)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –5 dB	–0.5 dB	(4)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –6 dB	–0.5 dB	(5)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –7 dB	–0.5 dB	(6)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –8 dB	–0.5 dB	(7)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –9 dB	–0.5 dB	(8)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –10 dB	–0.5 dB	(9)_______	+0.5 dB	±0.16 dB
43. Tracking Generator Level Flatness				
Positive Level Flatness, <1 MHz		(1)_______	+3.0 dB	±0.255 dB
Negative Level Flatness, <1 MHz	–3.0 dB	(2)_______		±0.255 dB
Positive Level Flatness, 1 MHz to 10 MHz		(3)_______	+3.0 dB	±0.145 dB
Negative Level Flatness, 1 MHz to 10 MHz	–3.0 dB	(4)_______		±0.145 dB
Positive Level Flatness, >10 MHz to 1.5 GHz		(5)_______	+2.0 dB	±0.122 dB
Negative Level Flatness, >10 MHz to 1.5 GHz	–2.0 dB	(6)_______		±0.122 dB
Positive Level Flatness, >1.5 GHz		(7)_______	+2.0 dB	±0.172 dB

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4405B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
Negative Level Flatness, >1.5 GHz	−2.0 dB	(8)______		±0.172 dB
45. Tracking Generator Harmonic Spurious Outputs *(Option 1DN only)*				
2^{nd} Harmonic, <20 kHz		(1)______	−15 dBc	±2.6 dB
2^{nd} Harmonic, ≥ 20 kHz		(2)______	−25 dBc	±2.6 dB
3^{rd} Harmonic, <20 kHz		(3)______	−15 dBc	±2.6 dB
3^{rd} Harmonic, ≥ 20 kHz		(4)______	−25 dBc	±2.6 dB
47. Tracking Generator Non-Harmonic Spurious Outputs *(Option 1DN only)*				
Highest Non-Harmonic Spurious Output Amplitude, 9 kHz to 2 GHz		(1)______	−27 dBc	±2.67 dB
Highest Non-Harmonic Spurious Output Amplitude, 2 GHz to 3 GHz		(2)______	−23 dBc	±3.12 dB
48. Tracking Generator LO Feedthrough Amplitude *(Option 1DN only)*				
9 kHz to 2.9 GHz		(1)______	−16 dBm	±1.94 dB
2.9 GHz to 3.0 GHz		(2)______	−16 dBm	±2.49 dB
49. Gate Delay Accuracy and Gate Length Accuracy *(Option 1D6 only)*				
Minimum Gate Delay	499.9 ns	(1)______	1.5001µs	±475 ps
Maximum Gate Delay	499.9 ns	(2)______	1.5001µs	±475 ps

Table 3-10 HP E4405B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4405B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
1 μs Gate Length	499.9 ns	(3)________	1.5001μs	±450 ps
65 ms Gate Length	64.993 ms	(4)________	65.007 ms	±561 ns
50. Gate Mode Amplitude Error *(Option 1D6 only)*				
Amplitude Error	–0.2 dB	(1)________	+0.2 dB	±0.023 dB

HP E4407B Performance Verification Test Record

Only the tests for HP E4407B are included in this test record, therefore not all test numbers are included.

Table 3-11 HP E4407B Performance Verification Test Record

Hewlett-Packard Company

Address: ____________________	Report No. ______________
____________________	Date ______________
____________________	
Model HP E4407B	
Serial No. ______________	Ambient temperature _______ °C
Options ______________	Power mains line frequency ______ Hz (nominal)
Firmware Revision __________	Relative humidity _______ %
Customer ____________________	Tested by ____________________

Test Equipment Used:

Description	Model No.	Trace No.	Cal Due Date
Synthesized Signal Generator	________	________	________
Synthesized Sweeper #1	________	________	________
Synthesized Sweeper #2	________	________	________
Function Generator	________	________	________
Power Meter, Dual-Channel	________	________	________
RF Power Sensor #1	________	________	________
RF Power Sensor #2	________	________	________
Microwave Power Sensor	________	________	________
Low-Power Power Sensor	________	________	________
Digital Multimeter	________	________	________
Universal Counter	________	________	________
Frequency Standard	________	________	________
Power Splitter	________	________	________

Table 3-11 HP E4407B Performance Verification Test Record

50 Ω Termination	______	______	______
1 dB Step Attenuator	______	______	______
10 dB Step Attenuator	______	______	______
6 dB Fixed Attenuator	______	______	______
20 dB Fixed Attenuator *(Option 1DS only)*	______	______	______
Oscilloscope *(Option 1D6 only)*	______	______	______
Microwave Spectrum Analyzer *(Option 1DN only)*	______	______	______
Notes/comments:	______		

Table 3-12 HP E4407B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4407B **Report No.** ______

Serial No. ______ **Date** ______

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
1. 10 MHz Reference Output Accuracy (*Non-Option 1D5 only*)				
Settability	–5.0 Hz	(1)______	+5.0 Hz	±293.3 μHz
2. 10 MHz Precision Frequency Reference Output Accuracy (*Option 1D5 only*)				
5 Minute Warm-Up Error	–0.1 ppm	(1)______	+0.1 ppm	±0.000072 ppm
15 Minute Warm-Up Error	–0.01 ppm	(2)______	+0.01 ppm	±0.000070 ppm
4. Frequency Readout and Marker Frequency Accuracy				
Frequency Readout Accuracy				
Center Freq Span				

Table 3-12 HP E4407B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4407B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
1500 MHz 20 MHz	1499.784990 MHz	(1)________	1500.215010 MHz	±0 Hz
1500 MHz 10 MHz	1499.884990 MHz	(2)________	1500.115010 MHz	±0 Hz
1500 MHz 1 MHz	1499.988490 MHz	(3)________	1500.011510 MHz	±0 Hz
4000 MHz 20 MHz	3999.784990 MHz	(4)________	4000.215010 MHz	±0 Hz
4000 MHz 10 MHz	3999.884990 MHz	(5)________	4000.115010 MHz	±0 Hz
4000 MHz 1 MHz	3999.988490 MHz	(6)________	4000.011510 MHz	±0 Hz
9000 MHz 20 MHz	8999.784990 MHz	(7)________	9000.215010 MHz	±0 Hz
9000 MHz 10 MHz	8999.884990 MHz	(8)________	9000.115010 MHz	±0 Hz
9000 MHz 1 MHz	8999.988490 MHz	(9)________	9000.011510 MHz	±0 Hz
16000 MHz 20 MHz	15999.784990 MHz	(10)________	16000.215010 MHz	±0 Hz
16000 MHz 10 MHz	15999.884990 MHz	(11)________	16000.115010 MHz	±0 Hz
16000 MHz 1 MHz	15999.988490 MHz	(12)________	16000.011510 MHz	±0 Hz
21000 MHz 20 MHz	20999.784990 MHz	(13)________	21000.215010 MHz	±0 Hz
21000 MHz 10 MHz	20999.884990 MHz	(14)________	21000.115010 MHz	±0 Hz
21000 MHz 1 MHz	20999.988490 MHz	(15)________	21000.011510 MHz	±0 Hz

Table 3-12 HP E4407B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4407B **Report No.** ________

Serial No. ________ **Date** ________

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
Marker Count Accuracy	Note: Enter results in the appropriate section below based upon the firmware revision of the analyzer.			
Firmware Revision Prior to A.03.00				
Center Freq Span				
1500 MHz 10 MHz	1499.999998 MHz	(16)______	1500.000002 MHz	±0 Hz
1500 MHz 1 MHz	1499.999998 MHz	(17)______	1500.000002 MHz	±0 Hz
4000 MHz 10 MHz	3999.999998 MHz	(18)______	4000.000002 MHz	±0 Hz
4000 MHz 1 MHz	3999.999998 MHz	(19)______	4000.000002 MHz	±0 Hz
9000 MHz 10 MHz	8999.999997 MHz	(20)______	9000.000003 MHz	±0 Hz
9000 MHz 1 MHz	8999.999997 MHz	(21)______	9000.000003 MHz	±0 Hz
16000 MHz 10 MHz	15999.999995 MHz	(22)______	16000.000005 MHz	±0 Hz
16000 MHz 1 MHz	20999.999995 MHz	(23)______	21000.000005 MHz	±0 Hz
21000 MHz 10 MHz	20999.999995 MHz	(24)______	21000.000005 MHz	±0 Hz
21000 MHz 1 MHz	20999.999995 MHz	(25)______	21000.000005 MHz	±0 Hz
Firmware Revision A.03.00 or later				
Center Freq Span				
1500 MHz 10 MHz	1499.999999 MHz	(16)______	1500.000001 MHz	±0 Hz

Table 3-12 HP E4407B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4407B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
1500 MHz 1 MHz	1499.999999 MHz	(17)________	1500.000001 MHz	±0 Hz
4000 MHz 10 MHz	3999.999999 MHz	(18)________	4000.000001 MHz	±0 Hz
4000 MHz 1 MHz	3999.999999 MHz	(19)________	4000.000001 MHz	±0 Hz
9000 MHz 10 MHz	8999.999999 MHz	(20)________	9000.000001 MHz	±0 Hz
9000 MHz 1 MHz	8999.999999 MHz	(21)________	9000.000001 MHz	±0 Hz
16000 MHz 10 MHz	15999.999999 MHz	(22)________	16000.000001 MHz	±0 Hz
16000 MHz 1 MHz	20999.999999 MHz	(23)________	21000.000001 MHz	±0 Hz
21000 MHz 10 MHz	20999.999999 MHz	(24)________	21000.000001 MHz	±0 Hz
21000 MHz 1 MHz	20999.999999 MHz	(25)________	21000.000001 MHz	±0 Hz
6. Frequency Span Accuracy				
Span Start Freq				
3000 MHz 0 Hz	2370 MHz	(1)________	2430 MHz	±6.12 MHz
100 MHz 10 MHz	79 MHz	(2)________	81 MHz	±204 kHz
100 kHz 10 MHz	79 kHz	(3)________	81 kHz	±204 Hz
100 MHz 800 MHz	79 MHz	(4)________	81 MHz	±204 kHz
100 kHz 800 MHz	79 kHz	(5)________	81 kHz	±204 Hz
100 MHz 1400 MHz	79 MHz	(6)________	81 MHz	±204 kHz
100 kHz 1499 MHz	79 kHz	(7)________	81 kHz	±204 Hz

Table 3-12 HP E4407B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4407B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
7. Noise Sidebands				
Offset from 1 GHz signal				
10 kHz		(1)______	–90 dBc/Hz	±1.154 dB
20 kHz		(2)______	–98 dBc/Hz	±1.154 dB
30 kHz		(3)______	–100 dBc/Hz	±1.154 dB
100 kHz		(4)______	–112 dBc/Hz	±1.154 dB
8. System-Related Sidebands				
Offset from 500 MHz signal				
30 kHz to 230 kHz		(1)______	–65 dBc	±1.154 dB
–30 kHz to –230 kHz		(2)______	–65 dBc	±1.154 dB
9. Residual FM				
1 kHz Res BW, (*Non-Option 1D5*)		(1)______	150 Hz	±9.24 Hz
1 kHz Res BW, (*Option 1D5*)		(1)______	100 Hz	±9.24 Hz
10 Hz Res BW (*Options 1DR and 1D5 only*)		(2)______	2 Hz	±0.274 Hz
10. Sweep Time Accuracy				
Sweep Time				
5 ms	–1.0%	(1)______	±1.0%	±0.28%
20 ms	–1.0%	(2)______	±1.0%	±0.28%
100 ms	–1.0%	(3)______	±1.0%	±0.28%
1 s	–1.0%	(4)______	±1.0%	±0.28%
10 s	–1.0%	(5)______	±1.0%	±0.28%
1 ms (*Option AYX only*)	–1.0%	(6)______	±1.0%	±0.28%

Table 3-12 HP E4407B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4407B		**Report No. ________**		
Serial No. ________		**Date ________**		

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
500 µs (*Option AYX only*)	–1.0%	(7)_______	±1.0%	±0.28%
100 µs (*Option AYX only*)	–1.0%	(8)_______	±1.0%	±0.28%
11. Display Scale Fidelity				
Cumulative Log Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–0.34 dB	(1)_______	+0.34 dB	±0.064 dB
–8	–0.38 dB	(2)_______	+0.38 dB	±0.064 dB
–12	–0.42 dB	(3)_______	+0.42 dB	±0.064 dB
–16	–0.46 dB	(4)_______	+0.46 dB	±0.064 dB
–20	–0.50 dB	(5)_______	+0.50 dB	±0.063 dB
–24	–0.54 dB	(6)_______	+0.54 dB	±0.064 dB
–28	–0.58 dB	(7)_______	+0.58 dB	±0.064 dB
–32	–0.62 dB	(8)_______	+0.62 dB	±0.064 dB
–36	–0.66 dB	(9)_______	+0.66 dB	±0.064 dB
–40	–0.70 dB	(10)_______	+0.70 dB	±0.063 dB
–44	–0.74 dB	(11)_______	+0.74 dB	±0.064 dB
–48	–0.78 dB	(12)_______	+0.78 dB	±0.064 dB
–52	–0.82 dB	(13)_______	+0.82 dB	±0.089 dB
–56	–0.86 dB	(14)_______	+0.86 dB	±0.089 dB
–60	–0.90 dB	(15)_______	+0.90 dB	±0.088 dB
–64	–0.94 dB	(16)_______	+0.94 dB	±0.089 dB
–68	–0.98 dB	(17)_______	+0.98 dB	±0.089 dB
–72	–1.02 dB	(18)_______	+1.02 dB	±0.089 dB
–76	–1.06 dB	(19)_______	+1.06 dB	±0.089 dB
–80	–1.10 dB	(20)_______	+1.10 dB	±0.088 dB

Table 3-12 HP E4407B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4407B **Report No. __________**

Serial No. __________ **Date __________**

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
–84	–1.14 dB	(21)_______	+1.14 dB	±0.089 dB
Incremental Log Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–0.4 dB	(22)_______	+0.4 dB	±0.064 dB
–8	–0.4 dB	(23)_______	+0.4 dB	±0.064 dB
–12	–0.4 dB	(24)_______	+0.4 dB	±0.064 dB
–16	–0.4 dB	(25)_______	+0.4 dB	±0.064 dB
–20	–0.4 dB	(26)_______	+0.4 dB	±0.063 dB
–24	–0.4 dB	(27)_______	+0.4 dB	±0.064 dB
–28	–0.4 dB	(28)_______	+0.4 dB	±0.064 dB
–32	–0.4 dB	(29)_______	+0.4 dB	±0.064 dB
–36	–0.4 dB	(30)_______	+0.4 dB	±0.064 dB
–40	–0.4 dB	(31)_______	+0.4 dB	±0.063 dB
–44	–0.4 dB	(32)_______	+0.4 dB	±0.064 dB
–48	–0.4 dB	(33)_______	+0.4 dB	±0.064 dB
–52	–0.4 dB	(34)_______	+0.4 dB	±0.089 dB
–56	–0.4 dB	(35)_______	+0.4 dB	±0.089 dB
–60	–0.4 dB	(36)_______	+0.4 dB	±0.088 dB
–64	–0.4 dB	(37)_______	+0.4 dB	±0.089 dB
–68	–0.4 dB	(38)_______	+0.4 dB	±0.089 dB
–72	–0.4 dB	(39)_______	+0.4 dB	±0.089 dB
–76	–0.4 dB	(40)_______	+0.4 dB	±0.089 dB
–80	–0.4 dB	(41)_______	+0.4 dB	±0.088 dB

Table 3-12 HP E4407B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4407B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
Cumulative Log Fidelity, Res BW ≤ 300 Hz *(Option 1DR only)*				
dB from Ref Level				
–4	–0.34 dB	(43)________	+0.34 dB	±0.064 dB
–8	–0.38 dB	(44)________	+0.38 dB	±0.064 dB
–12	–0.42 dB	(45)________	+0.42 dB	±0.064 dB
–16	–0.46 dB	(46)________	+0.46 dB	±0.064 dB
–20	–0.50 dB	(47)________	+0.50 dB	±0.063 dB
–24	–0.54 dB	(48)________	+0.54 dB	±0.064 dB
–28	–0.58 dB	(49)________	+0.58 dB	±0.064 dB
–32	–0.62 dB	(50)________	+0.62 dB	±0.064 dB
–36	–0.66 dB	(51)________	+0.66 dB	±0.064 dB
–40	–0.70 dB	(52)________	+0.70 dB	±0.063 dB
–44	–0.74 dB	(53)________	+0.74 dB	±0.064 dB
–48	–0.78 dB	(54)________	+0.78 dB	±0.064 dB
–52	–0.82 dB	(55)________	+0.82 dB	±0.089 dB
–56	–0.86 dB	(56)________	+0.86 dB	±0.089 dB
–60	–0.90 dB	(57)________	+0.90 dB	±0.088 dB
–64	–0.94 dB	(58)________	+0.94 dB	±0.089 dB
–68	–0.98 dB	(59)________	+0.98 dB	±0.089 dB
–72	–1.02 dB	(60)________	+1.02 dB	±0.089 dB
–76	–1.06 dB	(61)________	+1.06 dB	±0.089 dB
–80	–1.10 dB	(62)________	+1.10 dB	±0.088 dB
–84	–1.14 dB	(63)________	+1.14 dB	±0.089 dB
–88	–1.18 dB	(64)________	+1.18 dB	±0.089 dB

Table 3-12 HP E4407B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4407B **Report No. ________**

Serial No. ________ **Date ________**

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
−92	−1.22 dB	(65)_______	+1.22 dB	±0.089 dB
−96	−1.26 dB	(66)_______	+1.26 dB	±0.088 dB
−98	−1.28 dB	(67)_______	+1.28 dB	±0.089 dB
Incremental Log Fidelity, Res BW ≤ 300 Hz *(Option 1DR only)*				
dB from Ref Level				
−4	−0.4 dB	(68)_______	+0.4 dB	±0.064 dB
−8	−0.4 dB	(69)_______	+0.4 dB	±0.064 dB
−12	−0.4 dB	(70)_______	+0.4 dB	±0.064 dB
−16	−0.4 dB	(71)_______	+0.4 dB	±0.064 dB
−20	−0.4 dB	(72)_______	+0.4 dB	±0.063 dB
−24	−0.4 dB	(73)_______	+0.4 dB	±0.064 dB
−28	−0.4 dB	(74)_______	+0.4 dB	±0.064 dB
−32	−0.4 dB	(75)_______	+0.4 dB	±0.064 dB
−36	−0.4 dB	(76)_______	+0.4 dB	±0.064 dB
−40	−0.4 dB	(77)_______	+0.4 dB	±0.063 dB
−44	−0.4 dB	(78)_______	+0.4 dB	±0.064 dB
−48	−0.4 dB	(79)_______	+0.4 dB	±0.064 dB
−52	−0.4 dB	(80)_______	+0.4 dB	±0.089 dB
−56	−0.4 dB	(81)_______	+0.4 dB	±0.089 dB
−60	−0.4 dB	(82)_______	+0.4 dB	±0.088 dB
−64	−0.4 dB	(83)_______	+0.4 dB	±0.089 dB
−68	−0.4 dB	(84)_______	+0.4 dB	±0.089 dB
−72	−0.4 dB	(85)_______	+0.4 dB	±0.089 dB
−76	−0.4 dB	(86)_______	+0.4 dB	±0.089 dB

Table 3-12 HP E4407B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4407B		Report No. ______		
Serial No. ______		Date ______		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–80	–0.4 dB	(87)___	+0.4 dB	±0.088 dB
Linear Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–2.0%	(89)_______	+2.0%	±0.064 %
–8	–2.0%	(90)_______	+2.0%	±0.064 %
–12	–2.0%	(91)_______	+2.0%	±0.064 %
–16	–2.0%	(92)_______	+2.0%	±0.064 %
–20	–2.0%	(93)_______	+2.0%	±0.063 %
Linear Fidelity, Res BW ≤ 300 Hz *(Option 1DR only)*				
dB from Ref Level				
–4	–2.0%	(94)_______	+2.0%	±0.064 %
–8	–2.0%	(95)_______	+2.0%	±0.064 %
–12	–2.0%	(96)_______	+2.0%	±0.064 %
–16	–2.0%	(97)_______	+2.0%	±0.064 %
–20	–2.0%	(98)_______	+2.0%	±0.063 %
Zero Span, Res BW≤ 300 Hz *(Option 1DR only)*				
dB from Ref Level				
–4	–0.36 dB	(99)_______	+0.36 dB	±0.064 dB
–8	–0.42 dB	(100)_______	+0.42 dB	±0.064 dB
–12	–0.48 dB	(101)_______	+0.48 dB	±0.064 dB
–16	–0.54 dB	(102)_______	+0.54 dB	±0.064 dB
–20	–0.60 dB	(103)_______	+0.60 dB	±0.063 dB
–24	–0.66 dB	(104)_______	+0.66 dB	±0.064 dB

Table 3-12 HP E4407B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4407B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–28	–0.72 dB	(105)_______	+0.72 dB	±0.064 dB
–32	–0.78 dB	(106)_______	+0.78 dB	±0.064 dB
–36	–0.84 dB	(107)_______	+0.84 dB	±0.064 dB
–40	–0.90 dB	(108)_______	+0.90 dB	±0.063 dB
–44	–0.96 dB	(109)_______	+0.96 dB	±0.064 dB
–48	–1.02 dB	(110)_______	+1.02 dB	±0.064 dB
–52	–1.08 dB	(111)_______	+1.08 dB	±0.089 dB
–56	–1.14 dB	(112)_______	+1.14 dB	±0.089 dB
–60	–1.20 dB	(113)_______	+1.20 dB	±0.088 dB
–64	–1.5 dB	(114)_______	+1.5 dB	±0.089 dB
–68	–1.5 dB	(115)_______	+1.5 dB	±0.089 dB
–70	–1.5 dB	(116)_______	+1.5 dB	±0.089 dB
12. Input Attenuation Switching Uncertainty				
Input Attenuation Setting				
0 dB	–0.3 dB	(1)_______	+0.3 dB	±0.108 dB
5 dB	–0.3 dB	(2)_______	+0.3 dB	±0.107 dB
15 dB	–0.3 dB	(3)_______	+0.3 dB	±0.107 dB
20 dB	–0.3 dB	(4)_______	+0.3 dB	±0.089 dB
25 dB	–0.35 dB	(5)_______	+0.35 dB	±0.089 dB
30 dB	–0.40 dB	(6)_______	+0.40 dB	±0.089 dB
35 dB	–0.45 dB	(7)_______	+0.45 dB	±0.089 dB
40 dB	–0.50 dB	(8)_______	+0.50 dB	±0.089 dB
45 dB	–0.55 dB	(9)_______	+0.55 dB	±0.089 dB
50 dB	–0.60 dB	(10)_______	+0.60 dB	±0.089 dB
55 dB	–0.65 dB	(11)_______	+0.65 dB	±0.089 dB

Table 3-12 HP E4407B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4407B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
60 dB	–0.70 dB	(12)______	+0.70 dB	±0.089 dB
65 dB	–0.75 dB	(13)______	+0.75 dB	±0.089 dB
14. Reference Level Accuracy				
Log, Res BW ≥ 1 kHz				
Reference Level				
–10	–0.3 dB	(1)______	+0.3 dB	±0.144 dB
0	–0.3 dB	(2)______	+0.3 dB	±0.144 dB
–30	–0.3 dB	(3)______	+0.3 dB	±0.144 dB
–40	–0.3 dB	(4)______	+0.3 dB	±0.144 dB
–50	–0.5 dB	(5)______	+0.5 dB	±0.156 dB
–60	–0.5 dB	(6)______	+0.5 dB	±0.156 dB
–70	–0.5 dB	(7)______	+0.5 dB	±0.156 dB
–80	–0.7 dB	(8)______	+0.7 dB	±0.156 dB
Linear, Res BW ≥ 1 kHz				
Reference Level				
–10	–0.3 dB	(9)______	+0.3 dB	±0.144 dB
0	–0.3 dB	(10)______	+0.3 dB	±0.144 dB
–30	–0.3 dB	(11)______	+0.3 dB	±0.144 dB
–40	–0.3 dB	(12)______	+0.3 dB	±0.144 dB
–50	–0.5 dB	(13)______	+0.5 dB	±0.156 dB
–60	–0.5 dB	(14)______	+0.5 dB	±0.156 dB
–70	–0.5 dB	(15)______	+0.5 dB	±0.156 dB
–80	–0.7 dB	(16)______	+0.7 dB	±0.156 dB

Table 3-12 **HP E4407B Performance Verification Test Record**

Hewlett-Packard Company				
Model HP E4407B		**Report No. __________**		
Serial No. __________		**Date __________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
Log, Res BW ≤ 300 Hz *(Option 1DR only)*				
Reference Level				
–10	–0.3 dB	(17)_______	+0.3 dB	±0.144 dB
0	–0.3 dB	(18)_______	+0.3 dB	±0.144 dB
–30	–0.3 dB	(19)_______	+0.3 dB	±0.144 dB
–40	–0.3 dB	(20)_______	+0.3 dB	±0.144 dB
–50	–0.5 dB	(21)_______	+0.5 dB	±0.156 dB
–60	–0.5 dB	(22)_______	+0.5 dB	±0.156 dB
–70	–0.5 dB	(23)_______	+0.5 dB	±0.156 dB
–80	–0.7 dB	(24)_______	+0.7 dB	±0.156 dB
Linear, Res BW ≤ 300 Hz *(Option 1DR only)*				
Reference Level				
–10	–0.3 dB	(25)_______	+0.3 dB	±0.144 dB
0	–0.3 dB	(26)_______	+0.3 dB	±0.144 dB
–30	–0.3 dB	(27)_______	+0.3 dB	±0.144 dB
–40	–0.3 dB	(28)_______	+0.3 dB	±0.144 dB
–50	–0.5 dB	(29)_______	+0.5 dB	±0.156 dB
–60	–0.5 dB	(30)_______	+0.5 dB	±0.156 dB
–70	–0.5 dB	(31)_______	+0.5 dB	±0.156 dB
–80	–0.7 dB	(32)_______	+0.7 dB	±0.156 dB
15. Resolution Bandwidth Switching Uncertainty				
Resolution Bandwidth				
3 kHz	–0.3 dB	(1)_______	+0.3 dB	±0.064 dB
9 kHz	–0.3 dB	(2)_______	+0.3 dB	±0.064 dB

Table 3-12 HP E4407B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4407B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
10 kHz	–0.3 dB	(3)_______	+0.3 dB	±0.064 dB
30 kHz	–0.3 dB	(4)_______	+0.3 dB	±0.064 dB
100 kHz	–0.3 dB	(5)_______	+0.3 dB	±0.064 dB
120 kHz	–0.3 dB	(6)_______	+0.3 dB	±0.064 dB
300 kHz	–0.3 dB	(7)_______	+0.3 dB	±0.064 dB
1 MHz	–0.3 dB	(8)_______	+0.3 dB	±0.064 dB
3 MHz	–0.3 dB	(9)_______	+0.3 dB	±0.064 dB
5 MHz	–0.6 dB	(10)_______	+0.6 dB	±0.083 dB
300 Hz *(Option 1DR only)*	–0.3 dB	(11)_______	+0.3 dB	±0.064 dB
200 Hz *(Option 1DR only)*	–0.3 dB	(12)_______	+0.3 dB	±0.064 dB
100 Hz *(Option 1DR only)*	–0.3 dB	(13)_______	+0.3 dB	±0.064 dB
30 Hz *(Option 1DR only)*	–0.3 dB	(14)_______	+0.3 dB	±0.064 dB
10 Hz *(Option 1DR only)*	–0.3 dB	(15)_______	+0.3 dB	±0.064 dB
17. Absolute Amplitude Accuracy (Reference Settings)				
Log, Preamp Off	–0.34 dB	(1)_______	+0.34 dB	±0.148 dB
Lin, Preamp Off	–0.34 dB	(2)_______	+0.34 dB	±0.148 dB
Log, Preamp On	–0.5 dB	(3)_______	+0.5 dB	±0.148 dB
Lin, Preamp On	–0.5 dB	(4)_______	+0.5 dB	±0.148 dB
19. Overall Absolute Amplitude Accuracy				
0 dBm Reference Level				
0 dBm input	–0.54 dB	(1)_______	+0.54 dB	±0.08 dB
–10 dBm input	–0.54 dB	(2)_______	+0.54 dB	±0.081 dB
–20 dBm input	–0.54 dB	(3)_______	+0.54 dB	±0.082 dB

Table 3-12 HP E4407B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4407B		**Report No. __________**		
Serial No. __________		**Date __________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–30 dBm input	–0.54 dB	(4)_______	+0.54 dB	±0.083 dB
–40 dBm input	–0.54 dB	(5)_______	+0.54 dB	±0.084 dB
–50 dBm input	–0.54 dB	(6)_______	+0.54 dB	±0.086 dB
–20 dBm Reference Level				
–20 dBm input	–0.54 dB	(7)_______	+0.54 dB	±0.082 dB
–30 dBm input	–0.54 dB	(8)_______	+0.54 dB	±0.083 dB
–40 dBm input	–0.54 dB	(9)_______	+0.54 dB	±0.084 dB
–50 dBm input	–0.54 dB	(10)_______	+0.54 dB	±0.086 dB
–40 dBm Reference Level				
–40 dBm input	–0.54 dB	(11)_______	+0.54 dB	±0.084 dB
–50 dBm input	–0.54 dB	(12)_______	+0.54 dB	±0.086 dB
–50 dBm Reference Level				
–50 dBm input	–0.54 dB	(13)_______	+0.54 dB	±0.086 dB
20. Resolution Bandwidth Accuracy				
Resolution Bandwidth				
5 MHz	3.5 MHz	(1)_______	6.5 MHz	±38.2 kHz
3 MHz	2.55 MHz	(2)_______	3.45 MHz	±22.9 kHz
1 MHz	0.85 MHz	(3)_______	1.15 MHz	±7.64 kHz
300 kHz	255 kHz	(4)_______	345 kHz	±2.29 kHz
100 kHz	85 kHz	(5)_______	115 kHz	±764 Hz
30 kHz	25.5 kHz	(6)_______	34.5 kHz	±229 Hz
10 kHz	8.5 kHz	(7)_______	11.5 kHz	±76.4 Hz
3 kHz	2.55 kHz	(8)_______	3.45 kHz	±22.9 Hz
1 kHz	850 Hz	(9)_______	1.15 kHz	±7.64 Hz
120 kHz	102 kHz	(10)_______	138 kHz	±154 Hz

Table 3-12 HP E4407B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4407B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
9 kHz	7.65 kHz	(11)______	10.35kHz	±11.5 Hz
23. Frequency Response	Note: Enter data in the appropriate section below depending upon the ambient temperature at which the test was performed.			
20 to 30 °C:				
Band 0, 9 kHz to 3 GHz				
Maximum Response		(1)______	+0.5 dB	±0.245 dB
Minimum Response	–0.5 dB	(2)______		±0.245 dB
Peak-to-Peak Response		(3)______	1.0 dB	±0.245 dB
Band 1, 3 GHz to 6.7 GHz				
Maximum Response		(4)______	+1.5 dB	±0.355 dB
Minimum Response	–1.5 dB	(5)______		±0.355 dB
Peak-to-Peak Response		(6)______	2.6 dB	±0.355 dB
Band 2, 6.7 GHz to 13.2 GHz				
Maximum Response		(7)______	+2.0 dB	±0.429 dB
Minimum Response	–2.0 dB	(8)______		±0.429 dB
Peak-to-Peak Response		(9)______	3.6 dB	±0.429 dB
Band 3, 13.2 GHz to 25 GHz				
Maximum Response		(10)______	+2.0 dB	±0.425 dB
Minimum Response	–2.0 dB	(11)______		±0.425 dB
Peak-to-Peak Response		(12)______	3.6 dB	±0.425 dB
Band 4, 25 GHz to 26.5 GHz				
Maximum Response		(13)______	+2.0 dB	±0.428 dB
Minimum Response	–2.0 dB	(14)______		±0.428 dB
Peak-to-Peak Response		(15)______	3.6 dB	±0.428 dB

Table 3-12 HP E4407B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4407B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
0 to 55 °C:				
Band 0, 9 kHz to 3 GHz				
Maximum Response		(1)_______	+1.0 dB	±0.245 dB
Minimum Response	–1.0 dB	(2)_______		±0.245 dB
Peak-to-Peak Response		(3)_______	2.0 dB	±0.245 dB
Band 1, 3 GHz to 6.7 GHz				
Maximum Response		(4)_______	+2.5 dB	±0.355 dB
Minimum Response	–2.5 dB	(5)_______		±0.355 dB
Peak-to-Peak Response		(6)_______	3.0 dB	±0.355 dB
Band 2, 6.7 GHz to 13.2 GHz				
Maximum Response		(7)_______	+3.0 dB	±0.429 dB
Minimum Response	–3.0 dB	(8)_______		±0.429 dB
Peak-to-Peak Response		(9)_______	4.0 dB	±0.429 dB
Band 3, 13.2 GHz to 25 GHz				
Maximum Response		(10)_______	+3.0 dB	±0.425 dB
Minimum Response	–3.0 dB	(11)_______		±0.425 dB
Peak-to-Peak Response		(12)_______	4.0 dB	±0.425 dB
Band 4, 25 GHz to 26.5 GHz				
Maximum Response		(13)_______	+3.0 dB	±0.428 dB
Minimum Response	–3.0 dB	(14)_______		±0.428 dB
Peak-to-Peak Response		(15)_______	4.0 dB	±0.428 dB

Table 3-12 HP E4407B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4407B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
26. Frequency Response (Preamp On) *(Option 1DS only)*				
Maximum Response		(1)______	+2.0 dB	±0.343 dB
Minimum Response	–2.0 dB	(2)______		±0.343 dB
Peak-to-Peak Response		(3)______	4.0 dB	±0.343 dB
28. Other Input-Related Spurious Responses				
Center Freq Input Freq				
2.0 GHz 2042.8 MHz		(1)______	–65 dBc	±1.14 dB
2.0 GHz 2642.8 MHz		(2)______	–65 dBc	±1.14 dB
2.0 GHz 1820.8 MHz		(3)______	–65 dBc	±1.14 dB
2.0 GHz 278.5 MHz		(4)______	–65 dBc	±1.14 dB
2.0 GHz 5600.0 MHz		(5)______	–80 dBc	±1.14 dB
2.0 GHz 6242.8 MHz		(6)______	–80 dBc	±1.14 dB
4.0 GHz 4042.8 MHz		(7)______	–65 dBc	±1.14 dB
4.0 GHz 4642.8 MHz		(8)______	–65 dBc	±1.14 dB
4.0 GHz 3742.9 MHz		(9)______	–65 dBc	±1.14 dB
4.0 GHz 2242.8 MHz		(10)______	–80 dBc	±1.14 dB
9.0 GHz 9042.8 MHz		(11)______	–65 dBc	±1.14 dB
9.0 GHz 9642.8 MHz		(12)______	–65 dBc	±1.14 dB
9.0 GHz 9342.8 MHz		(13)______	–65 dBc	±1.14 dB
9.0 GHz 4982.1 MHz		(14)______	–80 dBc	±1.14 dB
15.0 GHz 15042.8 MHz		(15)______	–65 dBc	±1.14 dB
15.0 GHz 15642.8 MHz		(16)______	–65 dBc	±1.14 dB
15.0 GHz 18830.35 MHz		(17)______	–65 dBc	±1.14 dB

Table 3-12 **HP E4407B Performance Verification Test Record**

Hewlett-Packard Company				
Model HP E4407B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
15.0 GHz 4151.75 MHz		(18)______	–80 dBc	±1.14 dB
21.0 GHz 21042.8 MHz		(19)______	–65 dBc	±1.14 dB
21.0 GHz 21642.8 MHz		(20)______	–65 dBc	±1.14 dB
21.0 GHz 21342.8 MHz		(21)______	–65 dBc	±1.14 dB
21.0 GHz 5008.95 MHz		(22)______	–80 dBc	±1.14 dB
31. Spurious Responses				
300 MHz TOI, 1 kHz RBW	+11 dBm	(1)______		±0.49 dB
300 MHz TOI, 30 Hz RBW *(Option 1DR only)*	+11 dBm	(2)______		±0.49 dB
5 GHz TOI	+11 dBm	(3)______		±0.589 dB
8 GHz TOI	+7.5 dBm	(4)______		±0.589 dB
300 MHz SHI	+35 dBm	(5)______		±0.90 dB
900 MHz SHI	+45 dBm	(6)______		±0.90 dB
1.55 GHz SHI	+75 dBm	(7)______		±0.90 dB
3.1 GHz SHI	+90 dBm	(8)______		±0.90 dB
33. Gain Compression				
Test Frequency				
53 MHz		(1)______	1.0 dB	±0.127 dB
50.004 MHz *(Option 1DR only)*		(2)______	1.0 dB	±0.127 dB
1403 MHz		(3)______	1.0 dB	±0.127 dB
2503 MHz		(4)______	1.0 dB	±0.144 dB
4403 MHz		(5)______	1.0 dB	±0.201 dB
7603 MHz		(6)______	1.0 dB	±0.201 dB
14003 MHz		(7)______	1.0 dB	±0.201 dB

Table 3-12 **HP E4407B Performance Verification Test Record**

Hewlett-Packard Company				
Model HP E4407B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
37. Displayed Average Noise Level	Note: Enter results with preamp on in the appropriate section based upon the ambient temperature when the test was performed.			
1 kHz RBW, Preamp Off:				
10 MHz to 1 GHz		(1)________	–116 dBm	±1.82 dB
1 GHz to 2 GHz		(2)________	–115 dBm	±1.82 dB
2 GHz to 3 GHz		(3)________	–112 dBm	±1.82 dB
3 GHz to 6 GHz		(4)________	–112 dBm	±1.82 dB
6 GHz to 12 GHz		(5)________	–110 dBm	±1.82 dB
12 GHz to 22 GHz		(6)________	–107 dBm	±1.82 dB
22 GHz to 26.5 GHz		(7)________	–101 dBm	±1.82 dB
1kHz RBW, Preamp On, 0 to 55 °C:				
10 MHz to 1 GHz		(8)________	–131 dBm	±1.82 dB
1 GHz to 2 GHz		(9)________	–129 dBm	±1.82 dB
2 GHz to 3 GHz		(10)________	–127 dBm	±1.82 dB
10 Hz RBW, Preamp Off:				
10 MHz to 1 GHz		(11)________	–135 dBm	±1.82 dB
1 GHz to 2 GHz		(12)________	–134 dBm	±1.82 dB
2 GHz to 3 GHz		(13)________	–131 dBm	±1.82 dB
3 GHz to 6 GHz		(14)________	–131 dBm	±1.82 dB
6 GHz to 12 GHz		(15)________	–129 dBm	±1.82 dB
12 GHz to 22 GHz		(16)________	–126 dBm	±1.82 dB
22 GHz to 26.5 GHz		(17)________	–120 dBm	±1.82 dB
10 Hz RBW, Preamp On, 0 to 55 °C:				
10 MHz to 1 GHz		(18)________	–149 dBm	±1.82 dB

Table 3-12 HP E4407B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4407B		**Report No. __________**		
Serial No. __________		**Date __________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
1 GHz to 2 GHz		(19)_______	–147 dBm	±1.82 dB
2 GHz to 3 GHz		(20)_______	–145 dBm	±1.82 dB
1kHz RBW, Preamp On, 20 to 30 °C:				
10 MHz to 1 GHz		(21)_______	–132 dBm	±1.82 dB
1 GHz to 2 GHz		(22)_______	–131 dBm	±1.82 dB
2 GHz to 3 GHz		(23)_______	–130 dBm	±1.82 dB
10 Hz RBW, Preamp On, 20 to 30 °C:				
10 MHz to 1 GHz		(24)_______	–150 dBm	±1.82 dB
1 GHz to 2 GHz		(25)_______	–149 dBm	±1.82 dB
2 GHz to 3 GHz		(26)_______	–148 dBm	±1.82 dB
38. Residual Responses				
150 kHz to 6.7 GHz		(1)_______	–90 dBm	±0.93 dB
39. Fast Time Domain Amplitude Accuracy *(Option AYX only)*				
Amplitude Error	–0.3 %	(1)_______	+0.3 %	±0.029 %
41. Tracking Generator Absolute Amplitude and Vernier Accuracy				
Absolute Amplitude Accuracy	–0.75 dB	(1)_______	+0.75 dB	±0.087 dB
Vernier Accuracy, –2 dB	–0.4 dB	(2)_______	+0.4 dB	±0.11 dB
Vernier Accuracy, –3 dB	–0.5 dB	(3)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –5 dB	–0.5 dB	(4)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –6 dB	–0.5 dB	(5)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –7 dB	–0.5 dB	(6)_______	+0.5 dB	±0.16 dB

Table 3-12 HP E4407B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4407B **Report No.** ________

Serial No. ________ **Date** ________

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
Vernier Accuracy, –8 dB	–0.5 dB	(7)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –9 dB	–0.5 dB	(8)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –10 dB	–0.5 dB	(9)_______	+0.5 dB	±0.16 dB
43. Tracking Generator Output Level Flatness				
Positive Level Flatness, <1 MHz		(1)_______	+3.0 dB	±0.255 dB
Negative Level Flatness, <1 MHz	–3.0 dB	(2)_______		±0.255 dB
Positive Level Flatness, 1 MHz to 10 MHz		(3)_______	+3.0 dB	±0.145 dB
Negative Level Flatness, 1 MHz to 10 MHz	–3.0 dB	(4)_______		±0.145 dB
Positive Level Flatness, >10 MHz to 1.5 GHz		(5)_______	+2.0 dB	±0.122 dB
Negative Level Flatness, >10 MHz to 1.5 GHz	–2.0 dB	(6)_______		±0.122 dB
Positive Level Flatness, >1.5 GHz		(7)_______	+2.0 dB	±0.172 dB
Negative Level Flatness, >1.5 GHz	–2.0 dB	(8)_______		±0.172 dB
45. Tracking Generator Harmonic Spurious Outputs *(Option 1DN only)*				
2^{nd} Harmonic, <20 kHz		(1)_______	–15 dBc	±2.6 dB
2^{nd} Harmonic, ≥ 20 kHz		(2)_______	–25 dBc	±2.6 dB
3^{rd} Harmonic, <20 kHz		(3)_______	–15 dBc	±2.6 dB
3^{rd} Harmonic, ≥ 20 kHz		(4)_______	–25 dBc	±2.6 dB

Table 3-12 HP E4407B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4407B **Report No.** ________

Serial No. ________ **Date** ________

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
47. Tracking Generator Non-Harmonic Spurious Outputs *(Option 1DN only)*				
Highest Non-Harmonic Spurious Output Amplitude, 9 kHz to 2 GHz		(1)______	–27 dBc	±2.67 dB
Highest Non-Harmonic Spurious Output Amplitude, 2 GHz to 3 GHz		(2)______	–23 dBc	±3.12 dB
48. Tracking Generator LO Feedthrough Amplitude *(Option 1DN only)*				
9 kHz to 2.9 GHz		(1)______	–16 dBm	±1.94 dB
2.9 GHz to 3.0 GHz		(2)______	–16 dBm	±2.49 dB
49. Gate Delay and Gate Length Accuracy *(Option 1D6 only)*				
Minimum Gate Delay	499.9 ns	(1)______	1.5001µs	±475 ps
Maximum Gate Delay	499.9 ns	(2)______	1.5001µs	±475 ps
1 µs Gate Length	499.9 ns	(3)______	1.5001µs	±450 ps
65 ms Gate Length	64.993ms	(4)______	65.007ms	±561 ns
50. Gate Mode Amplitude Error *(Option 1D6 only)*				
Amplitude Error	–0.2 dB	(1)______	+0.2 dB	±0.023 dB
51. First LO Output Amplitude Accuracy *(Option AYZ only)* 20 to 30 °C	Note: Enter data in the appropriate section based upon the ambient temperature at which the test was performed.			
First LO Frequency				
2.9 GHz	+15.5 dBm	(1)______	+17.0 dBm	±0.357 dB

Table 3-12 HP E4407B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4407B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
3.1 GHz	+15.5 dBm	(2)______	+17.0 dBm	±0.357 dB
3.3 GHz	+15.5 dBm	(3)______	+17.0 dBm	±0.357 dB
3.5 GHz	+15.5 dBm	(4)______	+17.0 dBm	±0.357 dB
3.7 GHz	+15.5 dBm	(5)______	+17.0 dBm	±0.357 dB
3.9 GHz	+15.5 dBm	(6)______	+17.0 dBm	±0.357 dB
4.1 GHz	+15.5 dBm	(7)______	+17.0 dBm	±0.357 dB
4.3 GHz	+15.5 dBm	(8)______	+17.0 dBm	±0.357 dB
4.5 GHz	+15.5 dBm	(9)______	+17.0 dBm	±0.357 dB
4.7 GHz	+15.5 dBm	(10)______	+17.0 dBm	±0.357 dB
4.9 GHz	+15.5 dBm	(11)______	+17.0 dBm	±0.357 dB
5.1 GHz	+15.5 dBm	(12)______	+17.0 dBm	±0.357 dB
5.3 GHz	+15.5 dBm	(13)______	+17.0 dBm	±0.357 dB
5.5 GHz	+15.5 dBm	(14)______	+17.0 dBm	±0.357 dB
5.7 GHz	+15.5 dBm	(15)______	+17.0 dBm	±0.357 dB
5.9 GHz	+15.5 dBm	(16)______	+17.0 dBm	±0.357 dB
6.1 GHz	+15.5 dBm	(17)______	+17.0 dBm	±0.357 dB
6.3 GHz	+13.0 dBm	(18)______	+17.5 dBm	±0.357 dB
6.5 GHz	+13.0 dBm	(19)______	+17.5 dBm	±0.357 dB
6.7 GHz	+13.0 dBm	(20)______	+17.5 dBm	±0.357 dB
6.9 GHz	+13.0 dBm	(21)______	+17.5 dBm	±0.357 dB
7.1 GHz	+13.0 dBm	(22)______	+17.5 dBm	±0.357 dB
0 to 55 ° C First LO Frequency				
2.9 GHz	+15.0 dBm	(1)______	+17.5 dBm	±0.357 dB
3.1 GHz	+15.0 dBm	(2)______	+17.5 dBm	±0.357 dB
3.3 GHz	+15.0 dBm	(3)______	+17.5 dBm	±0.357 dB

Table 3-12 **HP E4407B Performance Verification Test Record**

Hewlett-Packard Company				
Model HP E4407B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
3.5 GHz	+15.0 dBm	(4)______	+17.5 dBm	±0.357 dB
3.7 GHz	+15.0 dBm	(5)______	+17.5 dBm	±0.357 dB
3.9 GHz	+15.0 dBm	(6)______	+17.5 dBm	±0.357 dB
4.1 GHz	+15.0 dBm	(7)______	+17.5 dBm	±0.357 dB
4.3 GHz	+15.0 dBm	(8)______	+17.5 dBm	±0.357 dB
4.5 GHz	+15.0 dBm	(9)______	+17.5 dBm	±0.357 dB
4.7 GHz	+15.0 dBm	(10)______	+17.5 dBm	±0.357 dB
4.9 GHz	+15.0 dBm	(11)______	+17.5 dBm	±0.357 dB
5.1 GHz	+15.0 dBm	(12)______	+17.5 dBm	±0.357 dB
5.3 GHz	+15.0 dBm	(13)______	+17.5 dBm	±0.357 dB
5.5 GHz	+15.0 dBm	(14)______	+17.5 dBm	±0.357 dB
5.7 GHz	+15.0 dBm	(15)______	+17.5 dBm	±0.357 dB
5.9 GHz	+15.0 dBm	(16)______	+17.5 dBm	±0.357 dB
6.1 GHz	+15.0 dBm	(17)______	+17.5 dBm	±0.357 dB
6.3 GHz	+13.0 dBm	(18)______	+17.5 dBm	±0.357 dB
6.5 GHz	+13.0 dBm	(19)______	+17.5 dBm	±0.357 dB
6.7 GHz	+13.0 dBm	(20)______	+17.5 dBm	±0.357 dB
6.9 GHz	+13.0 dBm	(21)______	+17.5 dBm	±0.357 dB
7.1 GHz	+13.0 dBm	(22)______	+17.5 dBm	±0.357 dB
52. IF Input Accuracy, *(Option AYZ only)*	Note: Enter data in the appropriate section below depending upon the ambient temperature at which the test was performed.			
20 to 30 °C:				
IF Input Accuracy	–1.0 dB	(1)______	+1.0 dBm	±0.23 dB
0 to 50 °C:				
IF Input Accuracy	–1.5 dB	(1)______	+1.5 dBm	±0.23 dB

Report

The tables in "Test Procedure" are essentially the Report.

HP E4408B Performance Verification Test Record

Only the tests for HP E4408B are included in this test record, therefore not all test numbers a re included.

Table 3-13 HP E4408B Performance Verification Test Record

Hewlett-Packard Company	
Address: ______________________	Report No. ______________
______________________	Date ______________
______________________	
Model HP E4408B	
Serial No. ____________	Ambient temperature ______ °C
Options ____________	Power mains line frequency ______ Hz (nominal)
Firmware Revision ________	Relative humidity ______ %
Customer ______________________	Tested by ______________________

Test Equipment Used:

Description	Model No.	Trace No.	Cal Due Date
Synthesized Signal Generator	________	________	________
Synthesized Sweeper #1	________	________	________
Synthesized Sweeper #2	________	________	________
Function Generator	________	________	________
Power Meter, Dual-Channel	________	________	________
RF Power Sensor #1	________	________	________
RF Power Sensor #2	________	________	________
Microwave Power Sensor	________	________	________
Low-Power Power Sensor	________	________	________
Digital Multimeter	________	________	________
Universal Counter	________	________	________
Frequency Standard	________	________	________
Power Splitter	________	________	________
50 Ω Termination	________	________	________

Table 3-13 HP E4408B Performance Verification Test Record

1 dB Step Attenuator	________	________	________
10 dB Step Attenuator	________	________	________
6 dB Fixed Attenuator	________	________	________
Microwave Spectrum Analyzer *(Option 1DN only)*	________	________	________
Notes/comments:	________		

Table 3-14 HP E4408B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4408B **Report No.** ________

Serial No. ________ **Date** ________

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
1. 10 MHz Reference Output Accuracy				
Settability	–5.0 Hz	(1)________	+5.0 Hz	±293.3 μHz
4. Frequency Readout Accuracy and Marker Count Accuracy				
Frequency Readout Accuracy				
Center Freq / Span				
1500 MHz / 20 MHz	1499.784990 MHz	(1)________	1500.215010 MHz	±0 Hz
1500 MHz / 10 MHz	1499.884990 MHz	(2)________	1500.115010 MHz	±0 Hz
1500 MHz / 1 MHz	1499.988490 MHz	(3)________	1500.011510 MHz	±0 Hz
4000 MHz / 20 MHz	3999.784990 MHz	(4)________	4000.215010 MHz	±0 Hz
4000 MHz / 10 MHz	3999.884990 MHz	(5)________	4000.115010 MHz	±0 Hz
4000 MHz / 1 MHz	3999.988490 MHz	(6)________	4000.011510 MHz	±0 Hz

Table 3-14 HP E4408B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4408B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
9000 MHz 20 MHz	8999.784990 MHz	(7)_______	9000.215010 MHz	±0 Hz
9000 MHz 10 MHz	8999.884990 MHz	(8)_______	9000.115010 MHz	±0 Hz
9000 MHz 1 MHz	8999.988490 MHz	(9)_______	9000.011510 MHz	±0 Hz
16000 MHz 20 MHz	15999.784990 MHz	(10)_______	16000.215010 MHz	±0 Hz
16000 MHz 10 MHz	15999.884990 MHz	(11)_______	16000.115010 MHz	±0 Hz
16000 MHz 1 MHz	15999.988490 MHz	(12)_______	16000.011510 MHz	±0 Hz
21000 MHz 20 MHz	20999.784990 MHz	(13)_______	21000.215010 MHz	±0 Hz
21000 MHz 10 MHz	20999.884990 MHz	(14)_______	21000.115010 MHz	±0 Hz
21000 MHz 1 MHz	20999.988490 MHz	(15)_______	21000.011510 MHz	±0 Hz
Marker Count Accuracy	Note: Enter results in the appropriate section below based upon the firmware revision of the analyzer.			
Firmware Revision Prior to A.03.00				
Center Freq Span				
1500 MHz 10 MHz	1499.999998 MHz	(16)_______	1500.000002 MHz	±0 Hz
1500 MHz 1 MHz	1499.999998 MHz	(17)_______	1500.000002 MHz	±0 Hz
4000 MHz 10 MHz	3999.999998 MHz	(18)_______	4000.000002 MHz	±0 Hz
4000 MHz 1 MHz	3999.999998 MHz	(19)_______	4000.000002 MHz	±0 Hz

Table 3-14 HP E4408B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4408B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
9000 MHz 10 MHz	8999.999997 MHz	(20)_______	9000.000003 MHz	±0 Hz
9000 MHz 1 MHz	8999.999997 MHz	(21)_______	9000.000003 MHz	±0 Hz
16000 MHz 10 MHz	15999.999995 MHz	(22)_______	16000.000005 MHz	±0 Hz
16000 MHz 1 MHz	20999.999995 MHz	(23)_______	21000.000005 MHz	±0 Hz
21000 MHz 10 MHz	20999.999995 MHz	(24)_______	21000.000005 MHz	±0 Hz
21000 MHz 1 MHz	20999.999995 MHz	(25)_______	21000.000005 MHz	±0 Hz
Firmware Revision A.03.00 or later				
Center Freq Span				
1500 MHz 10 MHz	1499.999999 MHz	(16)_______	1500.000001 MHz	±0 Hz
1500 MHz 1 MHz	1499.999999 MHz	(17)_______	1500.000001 MHz	±0 Hz
4000 MHz 10 MHz	3999.999999 MHz	(18)_______	4000.000001 MHz	±0 Hz
4000 MHz 1 MHz	3999.999999 MHz	(19)_______	4000.000001 MHz	±0 Hz
9000 MHz 10 MHz	8999.999999 MHz	(20)_______	9000.000001 MHz	±0 Hz
9000 MHz 1 MHz	8999.999999 MHz	(21)_______	9000.000001 MHz	±0 Hz
16000 MHz 10 MHz	15999.999999 MHz	(22)_______	16000.000001 MHz	±0 Hz
16000 MHz 1 MHz	20999.999999 MHz	(23)_______	21000.000001 MHz	±0 Hz

Table 3-14 HP E4408B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4408B **Report No. ________**

Serial No. ________ **Date ________**

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
21000 MHz 10 MHz	20999.999999 MHz	(24)______	21000.000001 MHz	±0 Hz
21000 MHz 1 MHz	20999.999999 MHz	(25)______	21000.000001 MHz	±0 Hz
6. Frequency Span Readout Accuracy				
Span Start Freq				
3000 MHz 0 Hz	2370 MHz	(1)______	2430 MHz	±6.12 MHz
100 MHz 10 MHz	79 MHz	(2)______	81 MHz	±204 kHz
100 kHz 10 MHz	79 kHz	(3)______	81 kHz	±204 Hz
100 MHz 800 MHz	79 MHz	(4)______	81 MHz	±204 kHz
100 kHz 800 MHz	79 kHz	(5)______	81 kHz	±204 Hz
100 MHz 1400 MHz	79 MHz	(6)______	81 MHz	±204 kHz
100 kHz 1499 MHz	79 kHz	(7)______	81 kHz	±204 Hz
7. Noise Sidebands				
Offset from 1 GHz signal				
10 kHz		(1)______	–90 dBc/Hz	±1.154 dB
20 kHz		(2)______	–98 dBc/Hz	±1.154 dB
30 kHz		(3)______	–100 dBc/Hz	±1.154 dB
100 kHz		(4)______	–112 dBc/Hz	±1.154 dB
8. System Related Sidebands				
Offset from 500 MHz signal				
30 kHz to 230 kHz		(1)______	–65 dBc	±1.154 dB
–30 kHz to –230 kHz		(2)______	–65 dBc	±1.154 dB

Table 3-14 HP E4408B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4408B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
9. Residual FM				
1 kHz Res BW		(1)_______	150 Hz	±9.24 Hz
10. Sweep Time Accuracy				
Sweep Time				
5 ms	–1.0%	(1)_______	±1.0%	±0.28%
20 ms	–1.0%	(2)_______	±1.0%	±0.28%
100 ms	–1.0%	(3)_______	±1.0%	±0.28%
1 s	–1.0%	(4)_______	±1.0%	±0.28%
10 s	–1.0%	(5)_______	±1.0%	±0.28%
11. Display Scale Fidelity				
Cumulative Log Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–0.34 dB	(1)_______	+0.34 dB	±0.064 dB
–8	–0.38 dB	(2)_______	+0.38 dB	±0.064 dB
–12	–0.42 dB	(3)_______	+0.42 dB	±0.064 dB
–16	–0.46 dB	(4)_______	+0.46 dB	±0.064 dB
–20	–0.50 dB	(5)_______	+0.50 dB	±0.063 dB
–24	–0.54 dB	(6)_______	+0.54 dB	±0.064 dB
–28	–0.58 dB	(7)_______	+0.58 dB	±0.064 dB
–32	–0.62 dB	(8)_______	+0.62 dB	±0.064 dB
–36	–0.66 dB	(9)_______	+0.66 dB	±0.064 dB
–40	–0.70 dB	(10)_______	+0.70 dB	±0.063 dB
–44	–0.74 dB	(11)_______	+0.74 dB	±0.064 dB
–48	–0.78 dB	(12)_______	+0.78 dB	±0.064 dB
–52	–0.82 dB	(13)_______	+0.82 dB	±0.089 dB

Table 3-14 HP E4408B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4408B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–56	–0.86 dB	(14)________	+0.86 dB	±0.089 dB
–60	–0.90 dB	(15)________	+0.90 dB	±0.088 dB
–64	–0.94 dB	(16)________	+0.94 dB	±0.089 dB
–68	–0.98 dB	(17)________	+0.98 dB	±0.089 dB
–72	–1.02 dB	(18)________	+1.02 dB	±0.089 dB
–76	–1.06 dB	(19)________	+1.06 dB	±0.089 dB
–80	–1.10 dB	(20)________	+1.10 dB	±0.088 dB
–84	–1.14 dB	(21)________	+1.14 dB	±0.089 dB
Incremental Log Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–0.4 dB	(22)________	+0.4 dB	±0.064 dB
–8	–0.4 dB	(23)________	+0.4 dB	±0.064 dB
–12	–0.4 dB	(24)________	+0.4 dB	±0.064 dB
–16	–0.4 dB	(25)________	+0.4 dB	±0.064 dB
–20	–0.4 dB	(26)________	+0.4 dB	±0.063 dB
–24	–0.4 dB	(27)________	+0.4 dB	±0.064 dB
–28	–0.4 dB	(28)________	+0.4 dB	±0.064 dB
–32	–0.4 dB	(29)________	+0.4 dB	±0.064 dB
–36	–0.4 dB	(30)________	+0.4 dB	±0.064 dB
–40	–0.4 dB	(31)________	+0.4 dB	±0.063 dB
–44	–0.4 dB	(32)________	+0.4 dB	±0.064 dB
–48	–0.4 dB	(33)________	+0.4 dB	±0.064 dB
–52	–0.4 dB	(34)________	+0.4 dB	±0.089 dB
–56	–0.4 dB	(35)________	+0.4 dB	±0.089 dB
–60	–0.4 dB	(36)________	+0.4 dB	±0.088 dB

Table 3-14 **HP E4408B Performance Verification Test Record**

Hewlett-Packard Company				
Model HP E4408B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–64	–0.4 dB	(37)______	+0.4 dB	±0.089 dB
–68	–0.4 dB	(38)______	+0.4 dB	±0.089 dB
–72	–0.4 dB	(39)______	+0.4 dB	±0.089 dB
–76	–0.4 dB	(40)______	+0.4 dB	±0.089 dB
–80	–0.4 dB	(41)______	+0.4 dB	±0.088 dB
Linear Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–2.0%	(89)______	+2.0%	±0.064 %
–8	–2.0%	(90)______	+2.0%	±0.064 %
–12	–2.0%	(91)______	+2.0%	±0.064 %
–16	–2.0%	(92)______	+2.0%	±0.064 %
–20	–2.0%	(93)______	+2.0%	±0.063 %
12. **Input Attenuation Switching Uncertainty**				
Input Attenuation Setting				
0 dB	–0.3 dB	(1)______	+0.3 dB	±0.108 dB
5 dB	–0.3 dB	(2)______	+0.3 dB	±0.107 dB
15 dB	–0.3 dB	(3)______	+0.3 dB	±0.107 dB
20 dB	–0.3 dB	(4)______	+0.3 dB	±0.089 dB
25 dB	–0.35 dB	(5)______	+0.35 dB	±0.089 dB
30 dB	–0.40 dB	(6)______	+0.40 dB	±0.089 dB
35 dB	–0.45 dB	(7)______	+0.45 dB	±0.089 dB
40 dB	–0.50 dB	(8)______	+0.50 dB	±0.089 dB
45 dB	–0.55 dB	(9)______	+0.55 dB	±0.089 dB
50 dB	–0.60 dB	(10)______	+0.60 dB	±0.089 dB

Table 3-14 HP E4408B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4408B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
55 dB	–0.65 dB	(11)______	+0.65 dB	±0.089 dB
60 dB	–0.70 dB	(12)______	+0.70 dB	±0.089 dB
65 dB	–0.75 dB	(13)______	+0.75 dB	±0.089 dB
14. Reference Level Accuracy				
Log				
Reference Level				
–10	–0.3 dB	(1)______	+0.3 dB	±0.144 dB
0	–0.3 dB	(2)______	+0.3 dB	±0.144 dB
–30	–0.3 dB	(3)______	+0.3 dB	±0.144 dB
–40	–0.3 dB	(4)______	+0.3 dB	±0.144 dB
–50	–0.5 dB	(5)______	+0.5 dB	±0.156 dB
–60	–0.5 dB	(6)______	+0.5 dB	±0.156 dB
–70	–0.5 dB	(7)______	+0.5 dB	±0.156 dB
–80	–0.7 dB	(8)______	+0.7 dB	±0.156 dB
Linear				
Reference Level				
–10	–0.3 dB	(9)______	+0.3 dB	±0.144 dB
0	–0.3 dB	(10)______	+0.3 dB	±0.144 dB
–30	–0.3 dB	(11)______	+0.3 dB	±0.144 dB
–40	–0.3 dB	(12)______	+0.3 dB	±0.144 dB
–50	–0.5 dB	(13)______	+0.5 dB	±0.156 dB
–60	–0.5 dB	(14)______	+0.5 dB	±0.156 dB
–70	–0.5 dB	(15)______	+0.5 dB	±0.156 dB

Table 3-14 HP E4408B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4408B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–80	–0.7 dB	(16)________	+0.7 dB	±0.156 dB
15. Resolution Bandwidth Switching Uncertainty				
Resolution Bandwidth				
3 kHz	–0.3 dB	(1)________	+0.3 dB	±0.064 dB
9 kHz	–0.3 dB	(2)________	+0.3 dB	±0.064 dB
10 kHz	–0.3 dB	(3)________	+0.3 dB	±0.064 dB
30 kHz	–0.3 dB	(4)________	+0.3 dB	±0.064 dB
100 kHz	–0.3 dB	(5)________	+0.3 dB	±0.064 dB
120 kHz	–0.3 dB	(6)________	+0.3 dB	±0.064 dB
300 kHz	–0.3 dB	(7)________	+0.3 dB	±0.064 dB
1 MHz	–0.3 dB	(8)________	+0.3 dB	±0.064 dB
3 MHz	–0.3 dB	(9)________	+0.3 dB	±0.064 dB
5 MHz	–0.6 dB	(10)________	+0.6 dB	±0.083 dB
17. Absolute Amplitude Accuracy (Reference Settings)				
Log, Preamp Off	–0.4 dB	(1)________	+0.4 dB	±0.148 dB
Lin, Preamp Off	–0.4 dB	(2)________	+0.4 dB	±0.148 dB
19. Overall Absolute Amplitude Accuracy				
0 dBm Reference Level				
0 dBm input	–0.6 dB	(1)________	+0.6 dB	±0.08 dB
–10 dBm input	–0.6 dB	(2)________	+0.6 dB	±0.081 dB
–20 dBm input	–0.6 dB	(3)________	+0.6 dB	±0.082 dB
–30 dBm input	–0.6 dB	(4)________	+0.6 dB	±0.083 dB
–40 dBm input	–0.6 dB	(5)________	+0.6 dB	±0.084 dB

Table 3-14 HP E4408B Performance Verification Test Record

Hewlett-Packard Company	
Model HP E4408B	**Report No.** __________
Serial No. __________	**Date** __________

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
–50 dBm input	–0.6 dB	(6)_______	+0.6 dB	±0.086 dB
–20 dBm Reference Level				
–20 dBm input	–0.6 dB	(7)_______	+0.6 dB	±0.082 dB
–30 dBm input	–0.6 dB	(8)_______	+0.6 dB	±0.083 dB
–40 dBm input	–0.6 dB	(9)_______	+0.6 dB	±0.084 dB
–50 dBm input	–0.6 dB	(10)_______	+0.6 dB	±0.086 dB
–40 dBm Reference Level				
–40 dBm input	–0.6 dB	(11)_______	+0.6 dB	±0.084 dB
–50 dBm input	–0.6 dB	(12)_______	+0.6 dB	±0.086 dB
–50 dBm Reference Level				
–50 dBm input	–0.6 dB	(13)_______	+0.6 dB	±0.086 dB
20. Resolution Bandwidth Accuracy				
Resolution Bandwidth				
5 MHz	3.5 MHz	(1)_______	6.5 MHz	±38.2 kHz
3 MHz	2.55 MHz	(2)_______	3.45 MHz	±22.9 kHz
1 MHz	0.85 MHz	(3)_______	1.15 MHz	±7.64 kHz
300 kHz	255 kHz	(4)_______	345 kHz	±2.29 kHz
100 kHz	85 kHz	(5)_______	115 kHz	±764 Hz
30 kHz	25.5 kHz	(6)_______	34.5 kHz	±229 Hz
10 kHz	8.5 kHz	(7)_______	11.5 kHz	±76.4 Hz
3 kHz	2.55 kHz	(8)_______	3.45 kHz	±22.9 Hz
1 kHz	850 Hz	(9)_______	1.15 kHz	±7.64 Hz
120 kHz	102 kHz	(10)_______	138 kHz	±154 Hz
9 kHz	7.65 kHz	(11)_______	10.35kHz	±11.5 Hz

Table 3-14 **HP E4408B Performance Verification Test Record**

Hewlett-Packard Company				
Model HP E4408B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
24. Frequency Response	Note: Enter data in the appropriate section below depending upon the ambient temperature at which the test was performed.			
20 to 30 °C:				
Band 0, 9 kHz to 3 GHz				
Maximum Response		(1)________	+0.5 dB	±0.245 dB
Minimum Response	–0.5 dB	(2)________		±0.245 dB
Peak-to-Peak Response		(3)________	1.0 dB	±0.245 dB
Band 1, 3 GHz to 6.7 GHz				
Maximum Response		(4)________	+1.5 dB	±0.355 dB
Minimum Response	–1.5 dB	(5)________		±0.355 dB
Peak-to-Peak Response		(6)________	2.6 dB	±0.355 dB
Band 2, 6.7 GHz to 13.2 GHz				
Maximum Response		(7)________	+2.0 dB	±0.429 dB
Minimum Response	–2.0 dB	(8)________		±0.429 dB
Peak-to-Peak Response		(9)________	3.6 dB	±0.429 dB
Band 3, 13.2 GHz to 25 GHz				
Maximum Response		(10)________	+2.0 dB	±0.425 dB
Minimum Response	–2.0 dB	(11)________		±0.425 dB
Peak-to-Peak Response		(12)________	3.6 dB	±0.425 dB
Band 4, 25 GHz to 26.5 GHz				
Maximum Response		(13)________	+2.0 dB	±0.428 dB
Minimum Response	–2.0 dB	(14)________		±0.428 dB
Peak-to-Peak Response		(15)________	3.6 dB	±0.428 dB
0 to 55 °C:				

Table 3-14 HP E4408B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4408B		**Report No.** ________		
Serial No. ________		**Date** ________		

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
Band 0, 9 kHz to 3 GHz				
Maximum Response		(1)______	+1.0 dB	±0.245 dB
Minimum Response	–1.0 dB	(2)______		±0.245 dB
Peak-to-Peak Response		(3)______	2.0 dB	±0.245 dB
Band 1, 3 GHz to 6.7 GHz				
Maximum Response		(4)______	+2.5 dB	±0.355 dB
Minimum Response	–2.5 dB	(5)______		±0.355 dB
Peak-to-Peak Response		(6)______	3.0 dB	±0.355 dB
Band 2, 6.7 GHz to 13.2 GHz				
Maximum Response		(7)______	+3.0 dB	±0.429 dB
Minimum Response	–3.0 dB	(8)______		±0.429 dB
Peak-to-Peak Response		(9)______	4.0 dB	±0.429 dB
Band 3, 13.2 GHz to 25 GHz				
Maximum Response		(10)______	+3.0 dB	±0.425 dB
Minimum Response	–3.0 dB	(11)______		±0.425 dB
Peak-to-Peak Response		(12)______	4.0 dB	±0.425 dB
Band 4, 25 GHz to 26.5 GHz				
Maximum Response		(13)______	+3.0 dB	±0.428 dB
Minimum Response	–3.0 dB	(14)______		±0.428 dB
Peak-to-Peak Response		(15)______	4.0 dB	±0.428 dB

Table 3-14 HP E4408B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4408B		**Report No. __________**		
Serial No. __________		**Date __________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
28. Other Input Related Spurious Responses				
Center Freq Input Freq				
2.0 GHz 2042.8 MHz		(1)_______	–65 dBc	±1.14 dB
2.0 GHz 2642.8 MHz		(2)_______	–65 dBc	±1.14 dB
2.0 GHz 1820.8 MHz		(3)_______	–65 dBc	±1.14 dB
2.0 GHz 278.5 MHz		(4)_______	–65 dBc	±1.14 dB
2.0 GHz 5600.0 MHz		(5)_______	–80 dBc	±1.14 dB
2.0 GHz 6242.8 MHz		(6)_______	–80 dBc	±1.14 dB
4.0 GHz 4042.8 MHz		(7)_______	–65 dBc	±1.14 dB
4.0 GHz 4642.8 MHz		(8)_______	–65 dBc	±1.14 dB
4.0 GHz 3742.9 MHz		(9)_______	–65 dBc	±1.14 dB
4.0 GHz 2242.8 MHz		(10)_______	–80 dBc	±1.14 dB
9.0 GHz 9042.8 MHz		(11)_______	–65 dBc	±1.14 dB
9.0 GHz 9642.8 MHz		(12)_______	–65 dBc	±1.14 dB
9.0 GHz 9342.8 MHz		(13)_______	–65 dBc	±1.14 dB
9.0 GHz 4982.1 MHz		(14)_______	–80 dBc	±1.14 dB
15.0 GHz 15042.8 MHz		(15)_______	–65 dBc	±1.14 dB
15.0 GHz 15642.8 MHz		(16)_______	–65 dBc	±1.14 dB
15.0 GHz 18830.35 MHz		(17)_______	–65 dBc	±1.14 dB
15.0 GHz 4151.75 MHz		(18)_______	–80 dBc	±1.14 dB
21.0 GHz 21042.8 MHz		(19)_______	–65 dBc	±1.14 dB
21.0 GHz 21642.8 MHz		(20)_______	–65 dBc	±1.14 dB
21.0 GHz 21342.8 MHz		(21)_______	–65 dBc	±1.14 dB
21.0 GHz 5008.95 MHz		(22)_______	–80 dBc	±1.14 dB

Table 3-14 HP E4408B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4408B		**Report No. __________**		
Serial No. __________		**Date __________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
32. Spurious Responses	Note: TR Entry 2 does not apply to the HP E4408B.			
300 MHz TOI	+7.5 dBm	(1)_______		±0.49 dB
5 GHz TOI	+7.5 dBm	(3)_______		±0.589 dB
8 GHz TOI	+5 dBm	(4)_______		±0.589 dB
300 MHz SHI	+30 dBm	(5)_______		±0.90 dB
900 MHz SHI	+40 dBm	(6)_______		±0.90 dB
1.55 GHz SHI	+70 dBm	(7)_______		±0.90 dB
3.1 GHz SHI	+85 dBm	(8)_______		±0.90 dB
33. Gain Compression	Note: TR Entry 2 does not apply to the HP E4408B.			
Test Frequency				
53 MHz		(1)_______	1.0 dB	±0.127 dB
1403 MHz		(3)_______	1.0 dB	±0.127 dB
2503 MHz		(4)_______	1.0 dB	±0.144 dB
4403 MHz		(5)_______	1.0 dB	±0.201 dB
7603 MHz		(6)_______	1.0 dB	±0.201 dB
14003 MHz		(7)_______	1.0 dB	±0.201 dB
37. Displayed Average Noise Level				
10 MHz to 1 GHz		(1)_______	–116 dBm	±1.82 dB
1 GHz to 2 GHz		(2)_______	–115 dBm	±1.82 dB
2 GHz to 3 GHz		(3)_______	–112 dBm	±1.82 dB
3 GHz to 6 GHz		(4)_______	–112 dBm	±1.82 dB
6 GHz to 12 GHz		(5)_______	–110 dBm	±1.82 dB
12 GHz to 22 GHz		(6)_______	–107 dBm	±1.82 dB
22 GHz to 26.5 GHz		(7)_______	–101 dBm	±1.82 dB

Table 3-14 **HP E4408B Performance Verification Test Record**

Hewlett-Packard Company				
Model HP E4408B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
38. Residual Responses				
150 kHz to 6.7 GHz		(1)_______	–90 dBm	±0.93 dB
41. Tracking Generator Absolute Amplitude and Vernier Accuracy				
Absolute Amplitude Accuracy	–0.75 dB	(1)_______	+0.75 dB	±0.087 dB
Vernier Accuracy, –2 dB	–0.4 dB	(2)_______	+0.4 dB	±0.11 dB
Vernier Accuracy, –3 dB	–0.5 dB	(3)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –5 dB	–0.5 dB	(4)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –6 dB	–0.5 dB	(5)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –7 dB	–0.5 dB	(6)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –8 dB	–0.5 dB	(7)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –9 dB	–0.5 dB	(8)_______	+0.5 dB	±0.16 dB
Vernier Accuracy, –10 dB	–0.5 dB	(9)_______	+0.5 dB	±0.16 dB
43. Tracking Generator Level Flatness				
Positive Level Flatness, <1 MHz		(1)_______	+3.0 dB	±0.255 dB
Negative Level Flatness, <1 MHz	–3.0 dB	(2)_______		±0.255 dB
Positive Level Flatness, 1 MHz to 10 MHz		(3)_______	+3.0 dB	±0.145 dB
Negative Level Flatness, 1 MHz to 10 MHz	–3.0 dB	(4)_______		±0.145 dB
Positive Level Flatness, >10 MHz to 1.5 GHz		(5)_______	+2.0 dB	±0.122 dB
Negative Level Flatness, >10 MHz to 1.5 GHz	–2.0 dB	(6)_______		±0.122 dB

Table 3-14 HP E4408B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4408B		**Report No.** ________		
Serial No. ________		**Date** ________		

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
Positive Level Flatness, >1.5 GHz		(7)______	+2.0 dB	±0.172 dB
Negative Level Flatness, >1.5 GHz	−2.0 dB	(8)______		±0.172 dB
45. Tracking Generator Harmonic Spurious Outputs *(Option 1DN only)*				
2nd Harmonic, <20 kHz		(1)______	−15 dBc	±2.6 dB
2nd Harmonic, ≥ 20 kHz		(2)______	−25 dBc	±2.6 dB
3rd Harmonic, <20 kHz		(3)______	−15 dBc	±2.6 dB
3rd Harmonic, ≥ 20 kHz		(4)______	−25 dBc	±2.6 dB
47. Tracking Generator Non-Harmonic Spurious Outputs *(Option 1DN only)*				
Highest Non-Harmonic Spurious Output Amplitude, 9 kHz to 2 GHz		(1)______	−27 dBc	±2.67 dB
Highest Non-Harmonic Spurious Output Amplitude, 2 GHz to 3 GHz		(2)______	−23 dBc	±3.12 dB
48. Tracking Generator LO Feedthrough Amplitude *(Option 1DN only)*				
9 kHz to 2.9 GHz		(1)______	−16 dBm	±1.94 dB
2.9 GHz to 3.0 GHz		(2)______	−16 dBm	±2.49 dB

HP E4411B Performance Verification Test Record

Only the tests for HP E4411B are included in this test record, therefore not all test numbers are included.

Table 3-15 HP E4411B Performance Verification Test Record

Hewlett-Packard Company			
Address: ____________		Report No. ____________	
____________		Date ____________	
____________			
Model HP E4411B			
Serial No. ____________		Ambient temperature ______ °C	
Options ____________		Power mains line frequency ______ Hz (nominal)	
Firmware Revision ____________		Relative humidity ______ %	
Customer ____________		Tested by ____________	
Test Equipment Used:			
Description	**Model No.**	**Trace No.**	**Cal Due Date**
Synthesized Signal Generator	______	______	______
Synthesized Sweeper	______	______	______
Function Generator	______	______	______
Power Meter, Dual-Channel	______	______	______
RF Power Sensor #1	______	______	______
RF Power Sensor #2 *(Non-Option 1DP only)*	______	______	______
Low-Power Power Sensor	______	______	______
75Ω Power Sensor *(Option 1DP only)*	______	______	______
Digital Multimeter	______	______	______
Universal Counter	______	______	______
Frequency Standard	______	______	______
Power Splitter	______	______	______

Table 3-15 HP E4411B Performance Verification Test Record

50Ω Termination	________	________	________
Minimum Loss Pad *(Option 1DP only)*	________	________	________
1 dB Step Attenuator	________	________	________
10 dB Step Attenuator	________	________	________
6 dB Fixed Attenuator	________	________	________
20 dB Fixed Attenuator *(Option 1DS only)*			
Oscilloscope *(Option 1D6 only)*			
Notes/comments:	________________		

Table 3-16 HP E4411B Performance Verification Test Record

Hewlett-Packard Company

Model HP E4411B **Report No. ________**

Serial No. ________ **Date ________**

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
1. 10 MHz Reference Output Accuracy				
Settability	–5.0 Hz	(1)_______	+5.0 Hz	±293.3 μHz
3. Frequency Readout Accuracy and Marker Count Accuracy				
Frequency Readout Accuracy				
Center Freq / Span				
1490 MHz / 20 MHz	1489.784990 MHz	(1)_______	1490.215010 MHz	±0 Hz
1490 MHz / 10 MHz	1489.884990 MHz	(2)_______	1490.115010 MHz	±0 Hz
1490 MHz / 1 MHz	1489.988490 MHz	(3)_______	1490.011510 MHz	±0 Hz
Marker Count Accuracy				

Table 3-16 HP E4411B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4411B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
Center Freq Span				
1490 MHz 10 MHz	1489.999998 MHz	(4)_______	1490.000002 MHz	±0 Hz
1490 MHz 1 MHz	1489.999998 MHz	(5)_______	1490.000002 MHz	±0 Hz
5. Frequency Span Readout Accuracy				
Span Start Freq				
1500 MHz 0 Hz	1185 MHz	(1)_______	1215 MHz	±3.06 MHz
100 MHz 10 MHz	79 MHz	(2)_______	81 MHz	±204 kHz
100 kHz 10 MHz	79 kHz	(3)_______	81 kHz	±204 Hz
100 MHz 800 MHz	79 MHz	(4)_______	81 MHz	±204 kHz
100 kHz 800 MHz	79 kHz	(5)_______	81 kHz	±204 Hz
100 MHz 1400 MHz	79 MHz	(6)_______	81 MHz	±204 kHz
100 kHz 1499 MHz	79 kHz	(7)_______	81 kHz	±204 Hz
7. Noise Sidebands				
Offset from 1 GHz signal				
10 kHz		(1)_______	–90 dBc/Hz	±1.154 dB
20 kHz		(2)_______	–100 dBc/Hz	±1.154 dB
30 kHz		(3)_______	–102 dBc/Hz	±1.154 dB
100 kHz		(4)_______	–112 dBc/Hz	±1.154 dB
8. System Related Sidebands				
Offset from 500 MHz signal				
30 kHz to 230 kHz		(1)_______	–65 dBc	±1.154 dB
–30 kHz to –230 kHz		(2)_______	–65 dBc	±1.154 dB

Table 3-16 HP E4411B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4411B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
9. Residual FM				
1 kHz Res BW		(1)______	150 Hz	±9.24 Hz
10. Sweep Time Accuracy				
Sweep Time				
5 ms	–1.0%	(1)______	+1.0%	±0.28%
20 ms	–1.0%	(2)______	+1.0%	±0.28%
100 ms	–1.0%	(3)______	+1.0%	±0.28%
1 s	–1.0%	(4)______	+1.0%	±0.28%
10 s	–1.0%	(5)______	+1.0%	±0.28%
11. Display Scale Fidelity				
Cumulative Log Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–0.34 dB	(1)______	+0.34 dB	±0.064 dB
–8	–0.38 dB	(2)______	+0.38 dB	±0.064 dB
–12	–0.42 dB	(3)______	+0.42 dB	±0.064 dB
–16	–0.46 dB	(4)______	+0.46 dB	±0.064 dB
–20	–0.50 dB	(5)______	+0.50 dB	±0.063 dB
–24	–0.54 dB	(6)______	+0.54 dB	±0.064 dB
–28	–0.58 dB	(7)______	+0.58 dB	±0.064 dB
–32	–0.62 dB	(8)______	+0.62 dB	±0.064 dB
–36	–0.66 dB	(9)______	+0.66 dB	±0.064 dB
–40	–0.70 dB	(10)______	+0.70 dB	±0.063 dB
–44	–0.74 dB	(11)______	+0.74 dB	±0.064 dB
–48	–0.78 dB	(12)______	+0.78 dB	±0.064 dB
–52	–0.82 dB	(13)______	+0.82 dB	±0.089 dB

Table 3-16 HP E4411B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4411B		Report No. ________		
Serial No. ________		Date ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–56	–0.86 dB	(14)________	+0.86 dB	±0.089 dB
–60	–0.90 dB	(15)________	+0.90 dB	±0.088 dB
–64	–0.94 dB	(16)________	+0.94 dB	±0.089 dB
–68	–0.98 dB	(17)________	+0.98 dB	±0.089 dB
–72	–1.02 dB	(18)________	+1.02 dB	±0.089 dB
–76	–1.06 dB	(19)________	+1.06 dB	±0.089 dB
–80	–1.10 dB	(20)________	+1.10 dB	±0.088 dB
–84	–1.14 dB	(21)________	+1.14 dB	±0.089 dB
Incremental Log Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–0.4 dB	(22)________	+0.4 dB	±0.064 dB
–8	–0.4 dB	(23)________	+0.4 dB	±0.064 dB
–12	–0.4 dB	(24)________	+0.4 dB	±0.064 dB
–16	–0.4 dB	(25)________	+0.4 dB	±0.064 dB
–20	–0.4 dB	(26)________	+0.4 dB	±0.063 dB
–24	–0.4 dB	(27)________	+0.4 dB	±0.064 dB
–28	–0.4 dB	(28)________	+0.4 dB	±0.064 dB
–32	–0.4 dB	(29)________	+0.4 dB	±0.064 dB
–36	–0.4 dB	(30)________	+0.4 dB	±0.064 dB
–40	–0.4 dB	(31)________	+0.4 dB	±0.063 dB
–44	–0.4 dB	(32)________	+0.4 dB	±0.064 dB
–48	–0.4 dB	(33)________	+0.4 dB	±0.064 dB
–52	–0.4 dB	(34)________	+0.4 dB	±0.089 dB
–56	–0.4 dB	(35)________	+0.4 dB	±0.089 dB
–60	–0.4 dB	(36)________	+0.4 dB	±0.088 dB

Table 3-16 HP E4411B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4411B		**Report No. ________**		
Serial No. ________		**Date ________**		

Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–64	–0.4 dB	(37)______	+0.4 dB	±0.089 dB
–68	–0.4 dB	(38)______	+0.4 dB	±0.089 dB
–72	–0.4 dB	(39)______	+0.4 dB	±0.089 dB
–76	–0.4 dB	(40)______	+0.4 dB	±0.089 dB
–80	–0.4 dB	(41)___	+0.4 dB	±0.088 dB
Linear Fidelity, Res BW ≥ 1 kHz				
dB from Ref Level				
–4	–2.0%	(89)______	+2.0%	±0.064 %
–8	–2.0%	(90)______	+2.0%	±0.064 %
–12	–2.0%	(91)______	+2.0%	±0.064 %
–16	–2.0%	(92)______	+2.0%	±0.064 %
–20	–2.0%	(93)______	+2.0%	±0.063 %
12. Input Attenuation Switching Uncertainty				
Input Attenuation Setting				
0 dB	–0.3 dB	(1)______	+0.3 dB	±0.108 dB
5 dB	–0.3 dB	(2)______	+0.3 dB	±0.107 dB
15 dB	–0.3 dB	(3)______	+0.3 dB	±0.107 dB
20 dB	–0.3 dB	(4)______	+0.3 dB	±0.089 dB
25 dB	–0.35 dB	(5)______	+0.35 dB	±0.089 dB
30 dB	–0.40 dB	(6)______	+0.40 dB	±0.089 dB
35 dB	–0.45 dB	(7)______	+0.45 dB	±0.089 dB
40 dB	–0.50 dB	(8)______	+0.50 dB	±0.089 dB
45 dB	–0.55 dB	(9)______	+0.55 dB	±0.089 dB
50 dB	–0.60 dB	(10)______	+0.60 dB	±0.089 dB

Table 3-16 HP E4411B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4411B		**Report No. ________**		
Serial No. ________		**Date ________**		

Test Description	Minimum	Results Measured	Maximum	Measurement Uncertainty
55 dB	–0.65 dB	(11)______	+0.65 dB	±0.089 dB
60 dB	–0.70 dB	(12)______	+0.70 dB	±0.089 dB
13. Reference Level Accuracy				
Log				
Reference Level				
50 Ω (dBm) 75 Ω (dBmV)				
–15 +33.75	–0.3 dB	(1)______	+0.3 dB	±0.144 dB
–5 +43.75	–0.3 dB	(2)______	+0.3 dB	±0.144 dB
–35 +13.75	–0.3 dB	(3)______	+0.3 dB	±0.144 dB
–45 +3.75	–0.3 dB	(4)______	+0.3 dB	±0.144 dB
–55 –6.25	–0.5 dB	(5)______	+0.5 dB	±0.156 dB
–65 –16.25	–0.5 dB	(6)______	+0.5 dB	±0.156 dB
–75 –26.25	–0.7 dB	(7)______	+0.7 dB	±0.156 dB
Linear				
Reference Level				
50Ω (dBm) 75Ω (dBmV)				
–15 +33.75	–0.3 dB	(8)______	+0.3 dB	±0.144 dB
–5 +43.75	–0.3 dB	(9)______	+0.3 dB	±0.144 dB
–35 +13.75	–0.3 dB	(10)______	+0.3 dB	±0.144 dB
–45 +3.75	–0.3 dB	(11)______	+0.3 dB	±0.144 dB
–55 –6.25	–0.5 dB	(12)______	+0.5 dB	±0.156 dB
–65 –16.25	–0.5 dB	(13)______	+0.5 dB	±0.156 dB
–75 –26.25	–0.7 dB	(14)______	+0.7 dB	±0.156 dB

Table 3-16 HP E4411B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4411B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
15. Resolution Bandwidth Switching Uncertainty				
Resolution Bandwidth				
3 kHz	–0.3 dB	(1)______	+0.3 dB	±0.064 dB
9 kHz	–0.3 dB	(2)______	+0.3 dB	±0.064 dB
10 kHz	–0.3 dB	(3)______	+0.3 dB	±0.064 dB
30 kHz	–0.3 dB	(4)______	+0.3 dB	±0.064 dB
100 kHz	–0.3 dB	(5)______	+0.3 dB	±0.064 dB
120 kHz	–0.3 dB	(6)______	+0.3 dB	±0.064 dB
300 kHz	–0.3 dB	(7)______	+0.3 dB	±0.064 dB
1 MHz	–0.3 dB	(8)______	+0.3 dB	±0.064 dB
3 MHz	–0.3 dB	(9)______	+0.3 dB	±0.064 dB
5 MHz	–0.6 dB	(10)______	+0.6 dB	±0.083 dB
16. Absolute Amplitude Accuracy (Reference Settings)				
Log, Preamp Off	–0.4 dB	(1)______	+0.4 dB	±0.148 dB
Lin, Preamp Off	–0.4 dB	(2)______	+0.4 dB	±0.148 dB
18. Overall Absolute Amplitude Accuracy				
0 dBm Reference Level				
0 dBm input	–0.6 dB	(1)______	+0.6 dB	±0.08 dB
–10 dBm input	–0.6 dB	(2)______	+0.6 dB	±0.081 dB
–20 dBm input	–0.6 dB	(3)______	+0.6 dB	±0.082 dB
–30 dBm input	–0.6 dB	(4)______	+0.6 dB	±0.083 dB
–40 dBm input	–0.6 dB	(5)______	+0.6 dB	±0.084 dB
–50 dBm input	–0.6 dB	(6)______	+0.6 dB	±0.086 dB

Table 3-16 HP E4411B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4411B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
–20 dBm Reference Level				
–20 dBm input	–0.6 dB	(7)______	+0.6 dB	±0.082 dB
–30 dBm input	–0.6 dB	(8)______	+0.6 dB	±0.083 dB
–40 dBm input	–0.6 dB	(9)______	+0.6 dB	±0.084 dB
–50 dBm input	–0.6 dB	(10)______	+0.6 dB	±0.086 dB
–40 dBm Reference Level				
–40 dBm input	–0.6 dB	(11)______	+0.6 dB	±0.084 dB
–50 dBm input	–0.6 dB	(12)______	+0.6 dB	±0.086 dB
–50 dBm Reference Level				
–50 dBm input	–0.6 dB	(13)______	+0.6 dB	±0.086 dB
20. Resolution Bandwidth Accuracy				
Resolution Bandwidth				
5 MHz	3.5 MHz	(1)______	6.5 MHz	±38.2 kHz
3 MHz	2.55 MHz	(2)______	3.45 MHz	±22.9 kHz
1 MHz	0.85 MHz	(3)______	1.15 MHz	±7.64 kHz
300 kHz	255 kHz	(4)______	345 kHz	±2.29 kHz
100 kHz	85 kHz	(5)______	115 kHz	±764 Hz
30 kHz	25.5 kHz	(6)______	34.5 kHz	±229 Hz
10 kHz	8.5 kHz	(7)______	11.5 kHz	±76.4 Hz
3 kHz	2.55 kHz	(8)______	3.45 kHz	±22.9 Hz
1 kHz	850 Hz	(9)______	1.15 kHz	±7.64 Hz
120 kHz	102 kHz	(10)______	138 kHz	±154 Hz
9 kHz	7.65 kHz	(11)______	10.35 kHz	±11.5 Hz

Table 3-16 HP E4411B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4411B		**Report No. __________**		
Serial No. __________		**Date __________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
21. Frequency Response	Note: Enter data in the appropriate section below depending upon the input impedance of the analyzer and the ambient temperature at which the test was performed.			
50 Ω, 20 to 30 °C:				
Maximum Response		(1)_______	+0.5 dB	±0.245 dB
Minimum Response	–0.5 dB	(2)_______		±0.245 dB
Peak-to-Peak Response		(3)_______	1.0 dB	±0.245 dB
50 Ω, 0 to 55 °C:				
Maximum Response		(1)_______	+1.0 dB	±0.245 dB
Minimum Response	–1.0 dB	(2)_______		±0.245 dB
Peak-to-Peak Response		(3)_______	2.0 dB	±0.245 dB
75 Ω, 20 to 30 °C:				
Maximum Response		(1)_______	+0.5 dB	±0.189 dB
Minimum Response	–0.5 dB	(2)_______		±0.189 dB
Peak-to-Peak Response		(3)_______	1.0 dB	±0.189 dB
75 Ω, 0 to 55 °C:				
Maximum Response		(1)_______	+1.0 dB	±0.189 dB
Minimum Response	–1.0 dB	(2)_______		±0.189 dB
Peak-to-Peak Response		(3)_______	2.0 dB	±0.189 dB
27. Other Input Related Spurious Responses				
Input Frequency				
542.8 MHz		(1)_______	–65 dBc	±1.08 dB
510.7 MHz		(2)_______	–65 dBc	±1.08 dB
1310.7 MHz		(3)_______	–45 dBc	±1.08 dB

Table 3-16 HP E4411B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4411B		**Report No. ________**		
Serial No. ________		**Date ________**		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
29. Spurious Responses	Note: Enter the results in the appropriate lines below based upon the input impedance of the analyzer. TR Entry 2 does not apply to HP E4411B.			
50 MHz TOI, 50 Ω	+7.5 dBm	(1)______		±0.489 dB
50 MHz TOI, 75 Ω	+56.25 dBmV	(1)______		±0.481 dB
40 MHz SHI, 50 Ω	+35 dBm	(3)______		±1.11 dB
40 MHz SHI, 75 Ω	+83.75 dBmV	(3)______		±1.11 dB
32. Gain Compression	Note: TR Entry 2 does not apply to HP E4411B.			
Test Frequency				
53 MHz		(1)______	1.0 dB	±0.127 dB
1403 MHz		(3)______	1.0 dB	±0.127 dB
34. Displayed Average Noise Level	Note: Enter data in the appropriate section below depending upon the input impedance of the analyzer.			
50 Ω:				
400 kHz		(1)______	–115 dBm	±1.82 dB
1 MHz to 10 MHz		(2)______	–115 dBm	±1.82 dB
10 MHz to 500 MHz		(3)______	–119 dBm	±1.82 dB
500 MHz to 1 GHz		(4)______	–117 dBm	±1.82 dB
1 GHz to 1.5 GHz		(5)______	–113 dBm	±1.82 dB
75 Ω:				
1 MHz to 10 MHz		(21)______	–63 dBmV	±1.82 dB
10 MHz to 500 MHz		(22)______	–65 dBmV	±1.82 dB
500 MHz to 1 GHz		(23)______	–60 dBmV	±1.82 dB
1 GHz to 1.5 GHz		(24)______	–53 dBmV	±1.82 dB

Table 3-16 **HP E4411B Performance Verification Test Record**

Hewlett-Packard Company				
Model HP E4411B		**Report No.** ________		
Serial No. ________		**Date** ________		
Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
38. Residual Responses	Note: Enter data in the appropriate section below depending upon the input impedance of the analyzer.			
50 Ω, 150 kHz to 1.5 GHz		(1)________	–90 dBm	±0.90 dB
75 Ω, 1 MHz to 1.5 GHz		(1)________	–36 dBmV	±0.90 dB
40. Tracking Generator Absolute Amplitude and Vernier Accuracy	Note: Enter data in the appropriate section below depending upon the input impedance of the analyzer.			
50 Ω *(Option 1DN)*				
Absolute Amplitude Accuracy	–0.5 dB	(1)________	+0.5 dB	±0.14 dB
Positive Vernier Accuracy		(2)________	+0.75 dB	±0.19 dB
Negative Vernier Accuracy	–0.75 dB	(3)________		±0.19 dB
Power Sweep Accuracy		(4)________	1.5 dB	±0.19 dB
75 Ω *(Option 1DQ)*				
Absolute Amplitude Accuracy	–1.5 dB	(1)________	+1.5 dB	±0.14 dB
Positive Vernier Accuracy		(2)________	+0.9 dB	±0.19 dB
Negative Vernier Accuracy	–0.9 dB	(3)________		±0.19 dB
Power Sweep Accuracy		(4)________	1.8 dB	±0.19 dB
42. Tracking Generator Level Flatness	Note: Enter data in the appropriate section below depending upon the input impedance of the analyzer.			
50Ω *(Option 1DN)*				
Positive Level Flatness, <1 MHz		(1)________	+2.0 dB	±0.588 dB
Negative Level Flatness, <1 MHz	–2.0 dB	(2)________		±0.588 dB
Positive Level Flatness, 1 MHz to 10 MHz		(3)________	+2.0 dB	±0.281 dB

Table 3-16 HP E4411B Performance Verification Test Record

Hewlett-Packard Company				
Model HP E4411B		**Report No.** ________		
Serial No. ________		**Date** ________		

Test Description	**Minimum**	**Results Measured**	**Maximum**	**Measurement Uncertainty**
Negative Level Flatness, 1 MHz to 10 MHz	–2.0 dB	(4)________		±0.281 dB
Positive Level Flatness, >10 MHz		(5)________	+1.5 dB	±0.202 dB
Negative Level Flatness, >10 MHz	–1.5 dB	(6)________		±0.202 dB
75 Ω *(Option 1DQ)*				
Positive Level Flatness, 1 MHz to 10 MHz		(3)________	+2.5 dB	±0.314 dB
Negative Level Flatness, 1 MHz to 10 MHz	–2.5 dB	(4)________		±0.314 dB
Positive Level Flatness, >10 MHz		(5)________	+2.0 dB	±0.314 dB
Negative Level Flatness, >10 MHz	–2.0 dB	(6)________		±0.314 dB
44. Tracking Generator Harmonic Spurious Outputs *(Option 1DN or Option 1DQ only)*				
2^{nd} Harmonic, <20 MHz		(1)________	–20 dBc	±2.6 dB
2^{nd} Harmonic, ≥ 20 MHz		(2)________	–25 dBc	±2.6 dB
3^{rd} Harmonic, <20 MHz		(3)________	–20 dBc	±2.6 dB
3^{rd} Harmonic, ≥20 MHz		(4)________	–25 dBc	±2.6 dB
46. Tracking Generator Non-Harmonic Spurious Outputs *(Option 1DN or Option 1DQ only)*				
Highest Non-Harmonic Spurious Output Amplitude		(1)________	–35 dBc	±2.67 dB

4 HP E4401B Specifications and Characteristics

About This Chapter

This chapter contains specifications and characteristics for the HP E4401B spectrum analyzer. The distinction between specifications and characteristics is described as follows.

- Specifications describe the performance of parameters covered by the product warranty. (The temperature range is 0 °C to 55 °C, unless otherwise noted.)
- Characteristics describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- Typical performance describes additional product performance information that is not covered by the product warranty. It is performance beyond an indicated specification, that most units will exhibit.
- Nominal values indicate the expected, but not warranted, value of a parameter.

The following conditions must be met for the analyzer to meet its specifications.

- ❑ The analyzer is within the one year calibration cycle.
- ❑ If **Auto Align All** is selected:
  - — After 2 hours of storage within the operating temperature range.
  - — 5 minutes after the analyzer is turned on with sweep times less than 4 seconds.
- ❑ If **Auto Align Off** is selected:
  - — When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes,
  - — After the analyzer is turned on for a minimum of 90 minutes, and **Align Now All** has been run.
  - — When **Align Now All** is run:
    - Every hour
    - If the ambient temperature changes more than 3 °C
    - If the 10 MHz reference changes
- ❑ If **Auto Align All but RF** is selected:
  - — When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.

— After the analyzer is turned on for a minimum of 90 minutes, and **Align Now RF** has been run.

— When **Align Now RF** is run:

- Every hour
- If the ambient temperature changes more than 3 °C

Frequency

	Specifications	Supplemental Information
Frequency Range		
50 Ω	9 kHz to 1.5 GHz	
50 Ω, Preamp On *(Option 1DS)*	100 kHz to 1.5 GHz	
75 Ω *(Option 1DP)*	1 MHz to 1.5 GHz	
75 Ω, Preamp On *(Option 1DS, 1DP)*	1 MHz to 1.5 GHz	

	Specifications	Supplemental Information
Frequency Reference		
Aging Rate	$\pm 2 \times 10^{-6}$/year	$\pm 1.0 \times 10^{-7}$/day, characteristic
Settability	$\pm 5 \times 10^{-7}$	
Temperature Stability	$\pm 5 \times 10^{-6}$	

	Specifications	Supplemental Information
High Stability Frequency Reference *(Option 1D5)*		
Aging Rate	$\pm 1 \times 10^{-7}$/year	$\pm 5 \times 10^{-10}$/day, 7-day average after being powered on for 7 days, characteristic
Settability	$\pm 1 \times 10^{-8}$	
Temperature Stability		
20 to 30 °C	$\pm 1 \times 10^{-8}$	
0 to 55 °C	$\pm 5 \times 10^{-8}$	
Warm-Up (Internal frequency reference selected)		
After 5 minutes		$< \pm 1 \times 10^{-7}$ of final frequency,[a] characteristic
After 15 minutes		$< \pm 1 \times 10^{-8}$ of final frequency,[a] characteristic

a. Final frequency is defined as frequency 60 minutes after power-on with analyzer set to internal frequency reference.

	Specifications	Supplemental Information
Frequency Readout Accuracy		
(Start, Stop, Center, Marker)	±(frequency indication × frequency reference error[a] + span accuracy + 15% of RBW + 10 Hz)	

a. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).

	Specifications	Supplemental Information
Marker Frequency Counter		
Resolution	Selectable from 1 Hz to 100 kHz	
Accuracy[a]	±(marker frequency × frequency reference error[b] + counter resolution)	For RBW ≥ 1 kHz

a. Marker level to displayed noise level > 25 dB, RBW/ Span ≥ 0.002, frequency offset = 0 Hz.
b. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).

	Specifications	Supplemental Information
Frequency Span		
Range	0 Hz (zero span), 100 Hz to 1.5 GHz	
Resolution	2 Hz	
Accuracy	±1% of span	

	Specifications	Supplemental Information
Sweep Time		
Range	5 ms to 2000 s	50 ms is the minimum sweep time with the tracking generator in operation *(Option 1DN or 1DQ)*
(Option AYX)	20 µs to 2000 s	For Span = 0 Hz, RBW ≥ 1 kHz
Accuracy		
Span = 0 Hz 5 ms to 2000 s	±1%	
20 µs to < 5ms *(Option AYX)*	±1%	
Sweep Trigger[a][b]	Free Run, Single, Line, Video, External, Delayed, Gate *(Option 1D6)*, TV *(Option B7B)*	
Delayed Trigger[a][c]		
Range	1 µs to 400 s	
Resolution	[(delay in seconds)/65000] rounded up to nearest µs	
Accuracy	±(500 ns +(0.01% of delay))	

a. Gate cannot be used simultaneously with delayed or TV trigger.
b. Auto align is suspended in video, external, gate, and delayed trigger modes while waiting for a trigger event to occur.
c. Delayed trigger is available with line, external, and TV trigger (Option B7B).

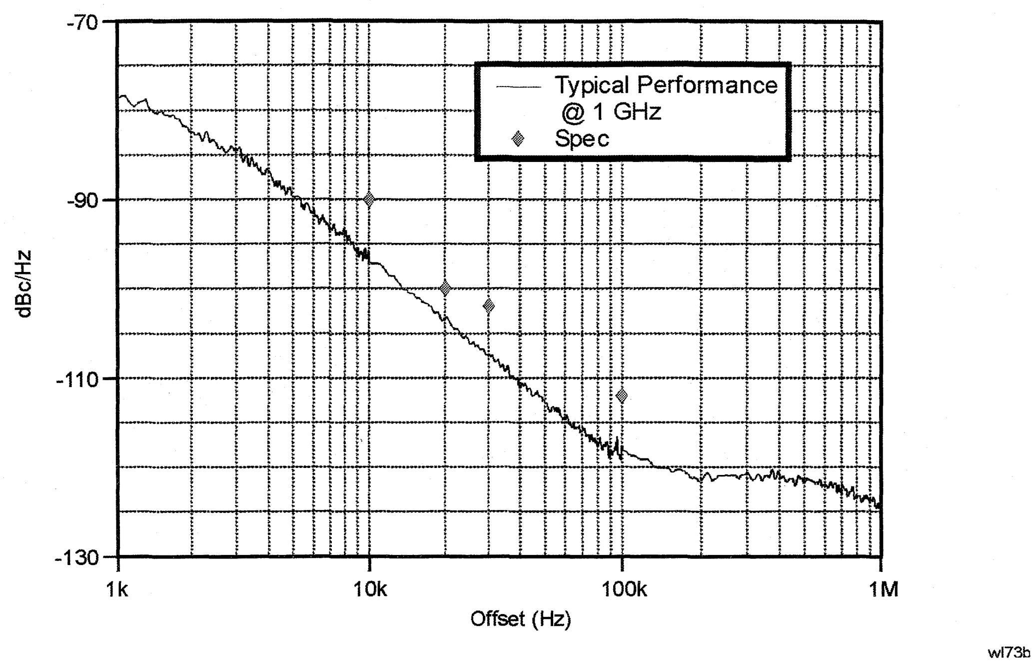
	Specifications	Supplemental Information
Resolution Bandwidth (RBW)		
Range		
–3 dB bandwidth	1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz	
–6 dB bandwidth (EMI)	9 kHz and 120 kHz	
(Option 1DR)		Only available in spans ≤ 5 MHz, sweep times ≥ 5 ms, and not usable with tracking generator in operation (*Option 1DN or Option 1DQ*)
–3 dB bandwidth	Adds 10, 30, 100, 300 Hz	
–6 dB bandwidth (EMI)	Add 200 Hz	

	Specifications	Supplemental Information
Accuracy		
1 kHz to 3 MHz RBW	±15%	
5 MHz RBW	±30%	
10 Hz to 300 Hz RBW *(Option 1DR)*	±10%	
Shape		
1 kHz to 5 MHz RBW		Synchronously tuned four poles, approximately Gaussian shape
10 Hz to 300 Hz RBW *(Option 1DR)*		Digital, approximately Gaussian shape
Selectivity (60 dB/3 dB bandwidth ratio)		
1 kHz to 5 MHz RBW		<15:1, characteristic
10 Hz to 300 Hz RBW *(Option 1DR)*		<5:1, characteristic

	Specifications	Supplemental Information
Video Bandwidth (VBW) (–3 dB)		
Range	30 Hz to 1 MHz in 1-3-10 sequence	3 MHz, characteristic
(Option 1DR)	Adds 1, 3, 10 Hz for RBW's <1 kHz	
Accuracy		±30%, characteristic
Shape		Post detection, single pole low-pass filter used to average displayed noise Video bandwidths below 30 Hz are digital bandwidths with anti-aliasing filtering.

	Specifications	Supplemental Information
Stability		
Noise Sidebands, offset from CW signal with 1 kHz RBW, 30 Hz VBW and sample detector		
≥10 kHz	≤ –90 dBc/Hz	
≥20 kHz	≤ –100 dBc/Hz	
≥30 kHz	≤ –102 dBc/Hz	
≥100 kHz	≤ –112 dBc/Hz	
Residual FM		
1 kHz RBW, 1 kHz VBW	≤150 Hz p–p in 100 ms	
(Option 1D5)	≤100 Hz p–p in 100 ms	
10 Hz RBW, 10 Hz VBW *(Option 1DR and 1D5)*	≤2 Hz p–p in 20 ms	
10 Hz RBW, 10 Hz VBW *(Option 1DR)*		≤10 Hz p–p in 20 ms, characteristic
System-Related Sidebands, offset from CW signal		
≥30 kHz	≤ –65 dBc	
Line-Related Sidebands, offset from CW signal *(Option 1DR)*		
<300 Hz		≤ –50 dBc, characteristic
>300 Hz to 30 kHz		≤ –55 dBc, characteristic

Noise Sidebands Normalized to 1 Hz Versus Offset From Carrier



Amplitude

Amplitude specifications do not apply for the negative peak detector mode.

	Specifications	Supplemental Information
Measurement Range	Displayed Average Noise Level to Maximum Safe Input Level	
Input Attenuator Range	0 to 60 dB, in 5 dB steps	

	Specifications	Supplemental Information
Maximum Safe Input Level		
Input attenuator setting ≥15 dB		Signals > +33 dBm (2 W) nominal may trigger input protection, which disconnects the input path. (75 Ω: signals > +79 dBmV (1 W))
Average Continuous Power or Peak Pulse Power		
50 Ω	+30 dBm (1 W)	
75 Ω *(Option 1DP)*	+75 dBmV (0.4 W)	
dc	100 Vdc	dc transients may momentarily trigger input protection
Input attenuator setting <15 dB		Signals > +6 dBm (4 mW) nominal may trigger input protection, which automatically increases input attenuation to 15 dB. (75 Ω: signals > +61 dBmV (15 mW))
Average Continuous Power or Peak Pulse Power		
50 Ω	+3 dBm (2 mW)	
75 Ω *(Option 1DP)*	+59 dBmV (10 mW)	
dc	100 Vdc	dc transients may trigger input protection

	Specifications	Supplemental Information
1 dB Gain Compression		
Total power at input mixer [ab]		
50 MHz to 1.5 GHz		
50 Ω	0 dBm	
75 Ω *(Option 1DP)*	+46.75 dBmV	
Preamp On *(Option 1DS)*		
Total power at the preamp[c]		
50 Ω		–20 dBm, characteristic
75 Ω		26.75 dBmV, characteristic

a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
b. For resolution bandwidths 1 kHz to 30 kHz, the maximum input signal amplitude must be ≤ reference level +10 dB. *(Option 1DP: For resolution bandwidths 1 kHz to 30 kHz, the maximum input signal amplitude must be ≤ reference level +5 dB).*
c. Total power at the preamp = total power at the input (dBm).

	Specifications		Supplemental Information
Displayed Average Noise Level			
(Input terminated, 0 dB attenuation, sample detector, Reference Level = –70 dBm) (75 Ω: Reference Level = –21.24 dBmV)			
50 Ω	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW *(Option 1DR)*	
400 kHz to 10 MHz	≤ –115 dBm	≤ –134 dBm	
10 MHz to 500 MHz	≤ –119 dBm	≤ –138 dBm	
500 MHz to 1.0 GHz	≤ –117 dBm	≤ –136 dBm	
1.0 GHz to 1.5 GHz	≤ –113 dBm	≤ –132 dBm	

	Specifications		Supplemental Information
50 Ω, Preamp On *(Option 1DS)*	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW *(Option 1DR)*	
400 kHz to 10 MHz	≤ −131 dBm	≤ −149 dBm	
10 MHz to 500 MHz	≤ −135 dBm	≤ −153 dBm	
500 MHz to 1.0 GHz	≤ −133 dBm	≤ −151 dBm	
1.0 GHz to 1.5 GHz	≤ −129 dBm	≤ −147 dBm	
75 Ω, *(Option 1DP)*	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW *(Option 1DR)*	
1 MHz to 10 MHz	≤ −63 dBmV	≤ −82 dBmV	
10 MHz to 500 MHz	≤ −65 dBmV	≤ −84 dBmV	
500 MHz to 1.0 GHz	≤ −60 dBmV	≤ −79 dBmV	
1.0 GHz to 1.5 GHz	≤ −53 dBmV	≤ −72 dBmV	
75 Ω, Preamp On *(Option 1DP and 1DS)*	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW *(Option 1DR)*	
1 MHz to 10 MHz	≤ −80 dBmV	≤ −98 dBmV	
10 MHz to 500 MHz	≤ −81 dBmV	≤ −99 dBmV	
500 MHz to 1.0 GHz	≤ −76 dBmV	≤ −94 dBmV	
1.0 GHz to 1.5 GHz	≤ −69 dBmV	≤ −87 dBmV	

	Specifications	Supplemental Information
Display Range		
Log Scale	Ten divisions displayed; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps	
RBW ≥ 1 kHz	Calibrated 0 to –85 dB from Reference Level	
RBW ≤ 300 Hz *(Option 1DR)*	Calibrated 0 to –120 dB[a] from Reference Level	
Linear Scale	Ten divisions	
Scale Units	dBm, dBmV, dBμV, V,W and Hz (Option BAA)	

a. 0 to –70 dB range when span = 0 Hz, or when auto ranging is off: (:DISPlay:WINDow:TRACe:Y[:SCALe]:LOG:RANGe:AUTO OFF).

	Specifications	Supplemental Information
Marker Readout Resolution		
Log scale		
RBW ≥ 1 kHz		
0 to –85 dB from ref level	0.04 dB	
RBW ≤ 300 Hz		
0 to –120 dB from ref level	0.04 dB	
Linear scale	0.01% of Reference Level	
Fast Sweep Times for Zero Span		
20 μs to <5 ms *(Option AYX)*		
Log		
0 to –85 dB from ref level	0.3 dB	
Linear	0.3% of Reference Level for linear scale	

	Specifications	Supplemental Information
Frequency Response		
50 Ω, Absolute[a]/Relative		
9 kHz to 1.5 GHz		
10 dB attenuation		
20 to 30 °C	±0.5 dB	
0 to 55 °C	±1.0 dB	
0 dB, 5 dB, 15 to 60 dB attenuation		±1.0 dB, characteristic
50 Ω, Absolute[a]/Relative Preamp On *(Option 1DS)*		
100 kHz to 1.5 GHz		
0 dB attenuation		
20 to 30 °C	±1.0 dB	
0 to 55 °C	±1.5 dB	
5 dB to 20 dB attenuation		±1.5 dB, characteristic
75 Ω, Absolute[a]/Relative *(Option 1DP)*		
1 MHz to 1.5 GHz		
10 dB attenuation		
20 to 30 °C	±0.5 dB	
0 to 55 °C	±1.0 dB	
0, 5, 15 to 50 dB attenuation		±1.0 dB, characteristic
55 to 60 dB attenuation		
1 MHz to 1 GHz		±1.0 dB, characteristic
1 GHz to 1.5 GHz		±1.25 dB, characteristic
75 Ω, Absolute[a]/Relative Preamp On *(Option 1DS and 1DP)*		
1 MHz to 1.5 GHz		
0 dB attenuation		
20 to 30 °C	±1.5 dB	
0 to 55 °C	±2.0 dB	

	Specifications	Supplemental Information
5 dB to 20 dB attenuation		±2.0 dB, characteristic

a. Absolute flatness values are referenced to the amplitude at 50 MHz.

	Specifications	Supplemental Information
Input Attenuation Switching Uncertainty at 50 MHz		
Attenuator Setting		
0 dB to 5 dB	±0.3 dB	
10 dB	Reference	
15 dB	±0.3 dB	
20 to 60 dB	±(0.1 dB + 0.01 × Attenuator Setting)	

	Specifications	Supplemental Information
Preamp *(Option 1DS)*		
Gain		+20 dB, nominal[a]
Noise figure		4 dB, characteristic

a. Amplifier is before the input attenuator.

	Specifications	Supplemental Information
Absolute Amplitude Accuracy		
At reference settings [a]	±0.34 dB	
Preamp On[b] *(Option 1DS)*	±0.5 dB	
Overall Amplitude Accuracy[c]		
20 to 30 °C	± (0.54 dB + Absolute Frequency Response)	

a. Settings are: reference level −25 dBm; (75 Ω reference level +28.75 dBmV); input attenuation 10 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, sample detector, signal at reference level.

b. Settings are: reference level −30 dBm; (75 Ω reference level +18.75 dBmV); input attenuation 0 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, signal at reference level.

c. For reference level 0 to −50 dBm; input attenuation 10 dB; RBW 1 kHz; VBW 1 kHz; scale log, log range 0 to 50 dB from reference level; sweep time coupled; signal input 0 to −50 dBm; span ≤20 kHz.

	Specifications	Supplemental Information
RF Input VSWR (at tuned frequency)		
Attenuator setting		
50 Ω		
0 to 5 dB attenuation		1.55:1, characteristic
10 to 60 dB attenuation		1.35:1, characteristic
75 Ω		
1 MHz to 1.1 GHz		
0 to 5 dB attenuation		1.55:1, characteristic
10 to 60 dB attenuation		1.35:1, characteristic
1.1 GHz to 1.5 GHz		
0 to 60 dB attenuation		2.0:1, characteristic
Input protection is tripped		Open input, characteristic
Amptd Ref is On		Open input, characteristic
Auto Align All is selected		Open input momentarily during retrace, characteristic

	Specifications	Supplemental Information
Auto Alignment[a]		
Sweep-to-sweep variation		±0.1 dB, characteristic

a. Set **Auto Align** to **Off** and use **Align Now, All** to eliminate this variation.

	Specifications	Supplemental Information
Resolution Bandwidth Switching Uncertainty (at Reference Level)		
1 kHz RBW	Reference	
3 kHz to 3 MHz RBW	±0.3 dB	
5 MHz RBW	±0.6 dB	
10 Hz to 300 Hz RBW *(Option 1DR)*	±0.3 dB	

	Specifications	Supplemental Information
Reference Level		
Range	Adjustable over Amplitude Measurement Range	
Resolution		
Log Scale	±0.1 dB	
Linear Scale	±0.12% of Reference Level	
50 Ω, Accuracy (at a fixed frequency, a fixed attenuator, and referenced to –35 dBm (–10 dBm, Preamp On *(Option 1DS)*)		
Reference Level (dBm) – input attenuator setting (dB) + preamp gain (dB)		
–10 dBm to > –60 dBm	±0.3 dB	
–60 dBm to > –85 dBm	±0.5 dB	
–85 dBm to –90 dBm	±0.7 dB	
75 Ω *(Option 1DP)*, Accuracy (at a fixed frequency, a fixed attenuator, and referenced to 18.75 dBmV (38.75 dBmV, Preamp On *(Option 1DS)*))		

	Specifications	Supplemental Information
Reference Level (dBmV) – input attenuator setting (dB) + preamp gain (dB)		
38.75 dBmV to > –11.25 dBmV	±0.3 dB	
–11.25 dBmV to > –26.25 dBmV	±0.5 dB	
–26.25 dBmV to –41.25 dBmV	±0.7 dB	

	Specifications	Supplemental Information
Display Scale Switching Uncertainty		
Switching between Linear and Log	±0.15 dB at Reference Level	
Log Scale Switching	No error	

	Specifications	Supplemental Information
Display Scale Fidelity		
Log Maximum Cumulative		
0 to –85 dB from Reference Level	±(0.3 dB + 0.01 × dB from Reference Level)	
RBW ≤ 300 Hz *(Option 1DR)*		
Span > 0 Hz		
0 to –98 dB from Reference Level	±(0.3 dB + 0.01 × dB from Reference Level)	
–98 to –120 dB from Reference Level		±2.0 dB, characteristic
Span = 0 Hz[a]		
0 to –60 dB from Reference Level	±(0.3 dB + 0.015 × dB from Reference Level)	
–60 to –70 dB from Reference Level	±1.5 dB	
Log Incremental Accuracy		
0 to –80 dB[b] from reference level	±0.4 dB/4 dB	
Linear Accuracy	±2% of Reference Level	

a. or when auto ranging is off: (:DISPlay:WINDow:TRACe:Y[:SCALe]:LOG:RANGe:AUTO OFF)
b. 0 to –50 dB for RBWs ≤ 300 Hz and span = 0 Hz, or when auto ranging is off.

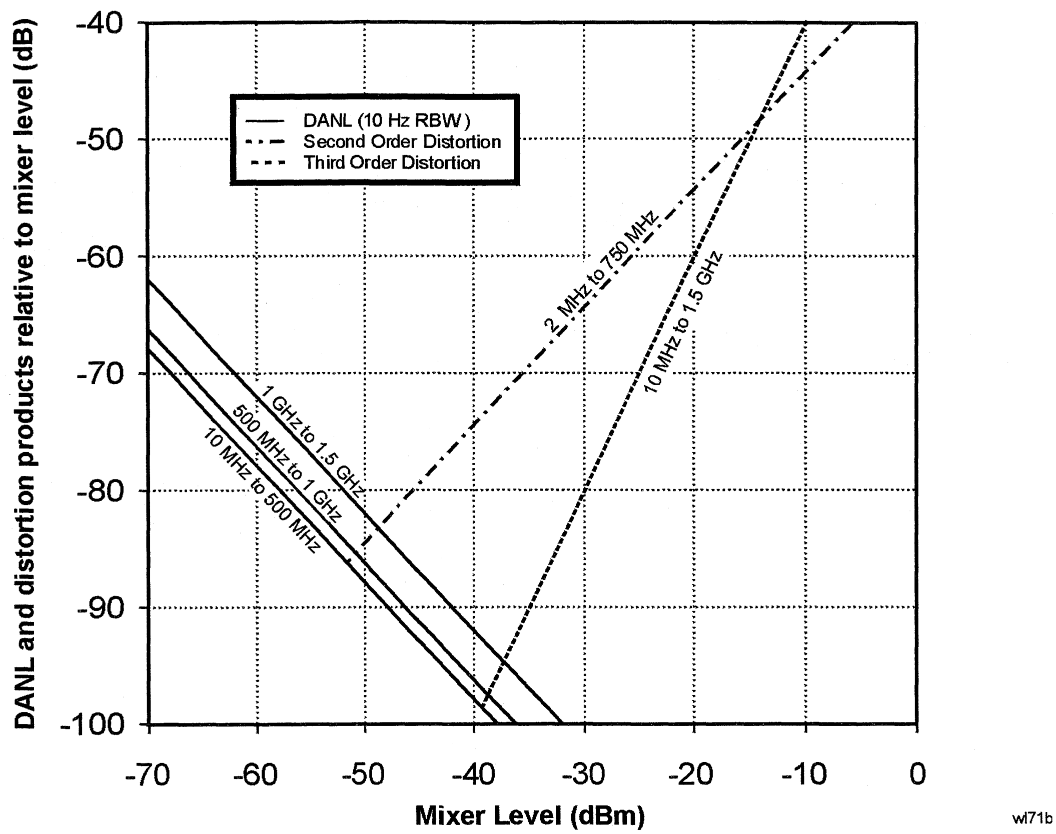
	Specifications	Supplemental Information
Spurious Responses		
50 Ω		
Second Harmonic Distortion		
Input Signal		
2 MHz to 750 MHz	< –75 dBc for –40 dBm signal at input mixer.[a]	+35 dBm SHI (second harmonic intercept)
Preamp On *(Option 1DS)* 2 MHz to 750 MHz		0 dBm SHI, characteristic
Third Order Intermodulation Distortion		
2 MHz to 10 MHz		+5 dBm TOI (third order intercept), characteristic
10 MHz to 1.5 GHz	< –80 dBc for two –30 dBm signals at input mixer[a] and >50 kHz separation.	+10 dBm TOI +15 dBm TOI, typical, 20 to 30 °C
Preamp On *(Option 1DS),* 10 MHz to 1.5 GHz		–16 dBm TOI, characteristic
Other Input Related Spurious		
30 kHz ≤ offset ≤1200 MHz	< –65 dBc for –20 dBm signals at input mixer[a] ≤1.5 GHz.	
Offset >1200 MHz	< –45 dBc for –20 dBm signal at input mixer[a] ≤1.5 GHz.	
Noise Floor Degradation		
Input frequency = 1210.7 MHz ± RBW		< –62 dBc for –45 dBm signal at input mixer[a]

a. Mixer Power Level (dBm) = Input Power (dBm) – Input Attenuation (dB).

	Specifications	Supplemental Information
Spurious Responses		
75 Ω, *(Option 1DP)*		
Second Harmonic Distortion Input signal		
2 MHz to 750 MHz	< –75 dBc for +8.75 dBmV signal at input mixer.[a]	
Preamp On *(Option 1DS),* 2 MHz to 750 MHz		< –40 dBc for with 0 dB input attenuation, characteristic
Third Order Intermodulation Distortion		
10 MHz to 1.5 GHz	< –80 dBc for two +18.75 dBmV signals at input mixer[a] and >50 kHz separation.	
Preamp On *(Option 1DS),* 10 MHz to 1.5 GHz		< –28 dBc for two +18.75 dBmV signals at the Input with 0 dB input attenuation and > 50 kHz separation, characteristic
Other Input Related Spurious		
30 kHz ≤ offset ≤1200 MHz	< –65 dBc for +28.75 dBmV signal at input mixer[a] ≤1.5 GHz.	
Offset >1200 MHz	< –45 dBc, for +28.75 dBmV signal at input mixer[a] ≤1.5 GHz.	
Noise Floor Degradation		
Input frequency = 1210.7 MHz ± RBW		< –62 dBc, for +3.75 dBmV signal at input mixer[a]

a. Mixer Power Level (dBm) = Input Power (dBm) – Input Attenuation (dB)

Specified Dynamic Range



	Specifications	Supplemental Information
Residual Responses (Input terminated and 0 dB attenuation)		
50 Ω		
150 kHz to 1.5 GHz	< –90 dBm	
75 Ω, *(Option 1DP)*		
1 MHz to 1.5 GHz	< –36 dBmV	

Options

Time Gated Spectrum Analysis (Option 1D6)

	Specifications	Supplemental Information
Gate Delay		
Range	1 μs to 400 s	
Accuracy	±(500 ns + (0.01% × (maximum of gate delay or length)))	From gate trigger input to positive edge of gate output
Gate Length		
Range	1 μs to 400 s	
Accuracy	±(500 ns + (0.01% × (maximum of gate delay or length)))	From positive edge to negative edge of gate output
Resolution	[(maximum of gate delay or length in seconds)/65000] rounded up to nearest μs	Dependent on the greater of gate delay or gate length
Additional Amplitude Error[a]		
Log Scale	±0.2 dB	
Linear Scale	±0.1 % of reference level	

a. While in gate mode.

Tracking Generator (Option 1DN or 1DQ)

	Specifications	Supplemental Information
Warm-Up	5 minutes	

	Specifications	Supplemental Information
Output Frequency Range		
50 Ω *(Option 1DN)*	9 kHz to 1.5 GHz	
75 Ω *(Option 1DQ)*	1 MHz to 1.5 GHz	

	Specifications	Supplemental Information
Minimum Resolution BW	1 kHz	Not usable with resolution bandwidths ≤300 Hz *(Option 1DR)*

	Specifications	Supplemental Information
Output Power Level		
Range		
50 Ω *(Option 1DN)*		
0 to 55 °C	0 to –70 dBm	
20 to 30 °C	2 to –70 dBm	
75 Ω *(Option 1DQ)*	+42.75 to –27.25 dBmV	
Resolution	0.1 dB	
Absolute Accuracy (at 50 MHz with coupled source attenuator)		
50 Ω *(Option 1DN)* referenced to 0 dBm	± 0.5 dB	
75 Ω *(Option 1DQ)* referenced to +42.75 dBmV	± 1.5 dB	
Vernier		
Range	10 dB	
Accuracy (with coupled source attenuator)		
50 Ω *(Option 1DN)* referenced to 0 dBm	±0.75 dB, for 0 to –10 dBm	
75 Ω *(Option 1DQ)* referenced to 42.75 dBmV	±0.9 dB, for +42.75 to +32.75 dBmV	
Output Attenuator Range	0 to 60 dB in 10 dB steps	

	Specifications	Supplemental Information
Maximum Safe Reverse Level		dc transients may trigger output protection
50 Ω *(Option 1DN)*[a]		+20 dBm (0.1 W), 100 Vdc, characteristic
75 Ω *(Option 1DQ)*[a]		+69 dBmV (0.1 W), 100 Vdc, characteristic

a. dc transients may trigger reverse power protection.

	Specifications	Supplemental Information
Output Power Sweep		
Range		
50 Ω *(Option 1DN)*	(–15 dBm to 0 dBm) – (Source Attenuator Setting)	
75 Ω *(Option 1DQ)*	(+27.75 dBm to +42.75 dBmV) – (Source Attenuator Setting)	
Resolution	0.1 dB	
Accuracy (zero span)		
50 Ω *(Option 1DN)*	<1.5 dB peak-to-peak	
75 Ω *(Option 1DQ)*	<1.8 dB peak-to-peak	

	Specifications	Supplemental Information
Output Flatness		
Referenced to 50 MHz, 0 dB attenuator		
50 Ω *(Option 1DN)*		
9 kHz to 10 MHz	±2 dB	
10 MHz to 1.5 GHz	±1.5 dB	
75 Ω *(Option 1DQ)*		
1 MHz to 10 MHz	±2.5 dB	
10 MHz to 1.5 GHz	±2 dB	

	Specifications	Supplemental Information
Spurious Outputs		
50 Ω *(Option 1DN)* (0 dBm output), 75 Ω *(Option 1DQ)* (+42.75 dBmV output)		
Harmonic Spurs		
9 kHz to 20 MHz	< −20 dBc	
20 MHz to 1.5 GHz	< −25 dBc	
Non-harmonic Spurs	< −35 dBc	

	Specifications	Supplemental Information
Dynamic Range	Maximum Output Power Level – Displayed Average Noise Level	

	Specifications	Supplemental Information
Output Tracking		
Drift		No error
Swept Tracking Error		No error for coupled sweep times

	Specifications	Supplemental Information
RF Power-Off Residuals		
50 Ω *(Option 1DN)* 100 kHz to 1.5 GHz		< −120 dBm, characteristic
75 Ω *(Option 1DQ)* 1 MHz to 1.5 GHz		< −65 dBmV, characteristic

	Specifications	Supplemental Information
Output Attenuator Repeatability		±0.2 dB, characteristic

	Specifications	Supplemental Information
Output VSWR		
50 Ω *(Option 1DN)*		<2.5:1, characteristic
75 Ω *(Option 1DQ)*		<2.0:1, characteristic

	Specifications	Supplemental Information
Output Attenuator Accuracy		
0 dB	Reference	
10 dB		±0.6 dB, characteristic
20 dB		±0.9 dB, characteristic
30 dB		±1.2 dB, characteristic
40 dB		±1.5 dB, characteristic
50 dB		±1.8 dB, characteristic
60 dB		±2.1 dB, characteristic

Tracking Generator Output Accuracy 50 Ω (Option 1DN)
Relative Accuracy (Referred to 0 dBm) = Output Attenuator Accuracy + Vernier Accuracy + Output Flatness
Absolute Accuracy = Relative Accuracy (Referred to 0 dBm) + Absolute Accuracy at 50 MHz

Tracking Generator Output Accuracy 75 Ω (Option 1DQ)
Relative Accuracy (Referred to +42.75 dBmV) = Output Attenuator Accuracy + Vernier Accuracy + Output Flatness
Absolute Accuracy = Relative Accuracy (Referred to +42.75 dBmV) + Absolute Accuracy at 50 MHz

FM Demodulation (Option BAA)

The FM demodulation characteristics will be met after an **Align Now, FM Demod** has been run.

	Specifications	Supplemental Information
Input Level		≥ (–60 dBm + attenuator setting – preamp gain), characteristic
Signal Level		0 to –30 dB below reference level, characteristic
FM Deviation		
Range		10 kHz to 1 MHz
Resolution		Provides 1 Hz display annotation resolution
FM Deviation Range		
10 kHz to 40 kHz		12 Hz, characteristic
>40 kHz to 200 kHz		60 Hz, characteristic
>200 kHz to 1 MHz		300 Hz, characteristic
Accuracy[a] FM Rate < FM BW/100, VBW ≥(30 × FM Rate), RBW > the maximum of (30 × FM deviation) or (30 × FM Rate)		< (2% of FM deviation range + 2 × Resolution), characteristic
Offset Error[a]		5% of FM Deviation Range + 300 Hz, characteristic
FM Bandwidth *(–3 dB)*		
FM Deviation Range		
10 kHz to 40 kHz		7.5 × FM deviation range, characteristic
>40 kHz to 200 kHz		1.3 × FM deviation range, characteristic
>200 kHz to 1 MHz		0.3 × FM deviation range, characteristic

a. In time domain sweeps (span = 0 Hz).

TV Trigger and Picture On Screen (Option B7B)

	Specifications	Supplemental Information
TV Trigger and Picture On Screen		TV Trigger initiates a sweep of the analyzer after the sync pulse of a selected line of a TV video field. Picture On Screen displays the TV picture on the analyzer display.
Amplitude Requirements		
TV Source: SA		Top 50% of linear display, characteristic
TV Source: EXT VIDEO IN		500 mVp–p to 2 Vp–p, characteristic
Compatible Standards	NTSC–M, NTSC–Japan, PAL–M, PAL–B,D,G,H,I, PAL–N, PAL–N Combination, SECAM-L	
Field Selection	Entire frame, even, odd	
Sync Polarity	Positive or negative	
TV Trigger		
Line Selection	1 to 525, or 1 to 625, standard dependent	

General

	Specifications	Supplemental Information
Temperature Range		
Operating	0 to 55 °C	Floppy disk 10 to 40 °C
Storage	–40 to +75 °C	

	Specifications	Supplemental Information
Audible Noise (ISO 7779)		
Sound Pressure at 25 °C		<40 dBa, (<4.6 Bels power)

	Specifications	Supplemental Information
Military Specification	Has been type tested to the environmental specifications of MIL-PRF-28800F class 3.	

	Specifications	Supplemental Information
EMI Compatibility	Conducted and radiated emission is in compliance with CISPR Pub. 11/1990 Group 1 Class A.	

	Specifications	Supplemental Information
Immunity Testing		
Radiated Immunity		Testing was done at 3 V/m according to IEC 801-3/1984. When the analyzer tuned frequency is identical to the immunity test signal frequency there may be signals of up to –60 dBm displayed on the screen.
Electrostatic Discharge		Air discharges of up to 8 kV were applied according to IEC 801-2/1991. Discharges to center pins of any of the connectors may cause damage to the associated circuitry.

	Specifications	Supplemental Information
Power Requirements		Uses CUKonverter® topology in the power supply.
ac Operation		
Voltage, frequency	90 to 132 V rms, 47 to 440 Hz 195 to 250 V rms, 47 to 66 Hz	
Power Consumption, On	<300 W	
Power Consumption, Standby	<5 W	
dc Operation		
Voltage	12 to 20 Vdc	
Power Consumption	<200 W	

	Specifications	Supplemental Information
Measurement Speed		
Local Measurement and Display Update rate[a]		≥ 28/s, characteristic
Remote Measurement and HP-IB Transfer Rate[b] *(Option A4H)*		≥ 19/s, characteristic

a. Auto align off, 5 ms sweep time, fixed center frequency.
b. Auto align off, 5 ms sweep time, fixed center frequency, 401 point trace, display off (DISPlay:ENABle off), and 32-bit integer data format (FORMat:DATA INT,32).

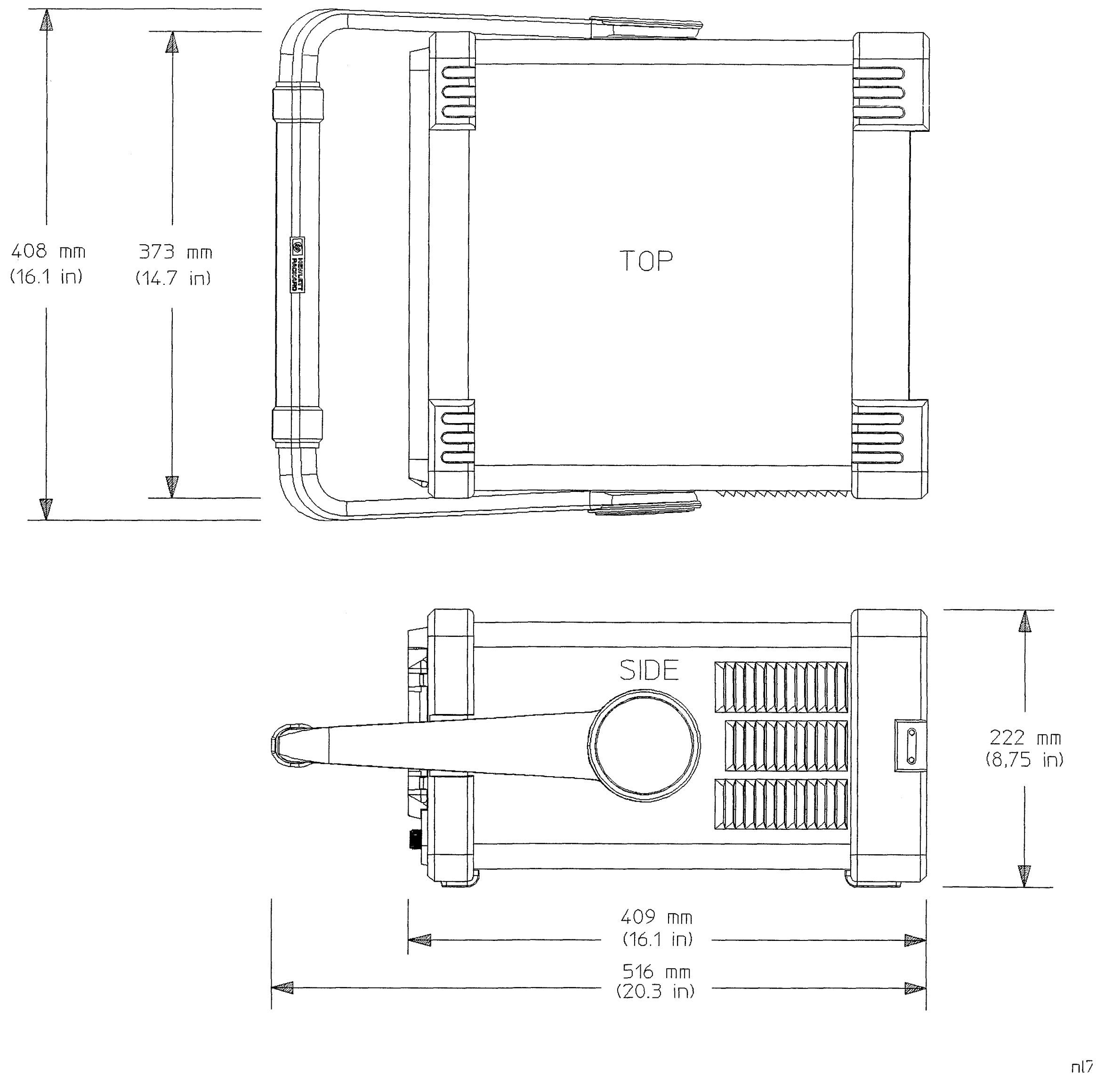
	Specifications	Supplemental Information
Data Storage		
Internal		200 Traces or States
External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS® compatible floppy disk		200 Traces or States

	Specifications	Supplemental Information
Downloadable Program Memory		2 MB available memory
(Option B72)		10 MB available memory

	Specifications	Supplemental Information
Demod Tune Listen		
AM		Internal speaker, front-panel earphone jack and front-panel volume control.
FM *(Option BAA)*		
(Option A4J, AYX, or BAA)		An uncalibrated demodulated signal is available on the AUX VIDEO OUT or EXT VIDEO OUT connectors at the rear panel.

	Specifications	Supplemental Information
Weight (without options)		
Net		12.6 kg (27.7 lb), characteristic
Shipping		27.3 kg (60 lb), characteristic

Dimensions


408 mm
(16.1 in)
373 mm
(14.7 in)
TOP
SIDE
222 mm
(8.75 in)
409 mm
(16.1 in)
516 mm
(20.3 in)
nl7

Inputs and Outputs

Internal

	Specifications	Supplemental Information
Amptd Ref[a]		Amplitude reference
Frequency		50 MHz
Frequency Accuracy		Frequency reference error[b]
50 Ω Amplitude		–25 dBm[c], nominal
75 Ω Amplitude *(Option 1DP)*		+28.75 dBmV[c], nominal

a. Turn the amplitude reference signal on/off by pressing the keys: **Input/Output**, **Amptd Ref**.
b. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).
c. The internal amplitude reference actual power is stored internally.

Front Panel

	Specifications	Supplemental Information
INPUT 50 Ω		
Connector	Type-N female	
Impedance		50 Ω, nominal
INPUT 75 Ω *(Option 1DP)*		
Connector	BNC female	
Impedance		75 Ω, nominal

	Specifications	Supplemental Information
RF OUT 50 Ω, *(Option 1DN)*		
Connector	Type-N female	
Impedance		50 Ω, nominal
RF OUT 75 Ω, *(Option 1DQ)*		
Connector	BNC female	
Impedance		75 Ω, nominal

	Specifications	Supplemental Information
PROBE POWER		
Voltage/Current		+15 Vdc, ±7% at 150 mA max., characteristic −12.6 Vdc ±10% at 150 mA max., characteristic

	Specifications	Supplemental Information
EXT KEYBOARD		Feature not implemented.
Connector	6-pin mini-DIN	

	Specifications	Supplemental Information
Speaker		Front panel knob controls volume

	Specifications	Supplemental Information
Headphone		Front panel knob controls volume
Connector	3.5 mm (1/8 inch) miniature audio jack	
Power Output		0.2 W into 4 Ω, characteristic

Rear Panel

	Specifications	Supplemental Information
10 MHz REF OUT		
Connector	BNC female	
Impedance		50 Ω, nominal
Output Amplitude		>0 dBm, characteristic

	Specifications	Supplemental Information
10 MHz REF IN		
Connector	BNC female	Note: Analyzer noise sidebands and spurious response performance may be affected by the quality of the external reference used.
Impedance		50 Ω, nominal
Input Amplitude Range		–15 to +10 dBm, characteristic
Frequency		10 MHz, nominal

	Specifications	Supplemental Information
GATE TRIG/EXT TRIG IN		
Connector	BNC female	
External Trigger Input		
Trigger Level		Selectable positive or negative edge initiates sweep in EXT TRIG mode (5 V TTL)
Gate Trigger Input *(Option 1D6)*		
Minimum Pulse Width		>30 ns (5 V TTL)

	Specifications	Supplemental Information
GATE/HI SWP OUT		
Connector	BNC female	
High Sweep Output		
Level		High = sweep; Low = retrace (5 V TTL)
Gate Output *(Option 1D6)*		
Level		High = gate on; Low = gate off (5 V TTL)

	Specifications	Supplemental Information
VGA OUTPUT		
Connector	VGA compatible, 15-pin mini D-SUB	
Format		VGA (31.5 kHz horizontal, 60 Hz vertical sync rates, non-interlaced) Analog RGB
Resolution	640 × 480	

	Specifications	Supplemental Information
AUX IF OUT *(Option A4J or AYX)*		RBW ≥ 1 kHz
Connector	BNC female	
Frequency		21.4 MHz, nominal
Amplitude Range (for signal at reference level and for reference levels – input attenuation + preamp gain of –10 to –70 dBm)		–10 dBm (uncorrected), characteristic
Impedance		50 Ω, nominal

	Specifications	Supplemental Information
AUX VIDEO OUT *(Option A4J or AYX)*		RBW ≥ 1 kHz
Connector	BNC female	
Amplitude Range (into >10 kΩ)		0 to 1 V (uncorrected), characteristic

	Specifications	Supplemental Information
HI SWP IN *(Option A4J or AYX)*		
Connector	BNC female	
Input		Open collector, low stops sweep (5 V TTL)

	Specifications	Supplemental Information
HI SWP OUT *(Option A4J or AYX)*		
Connector	BNC female	
Output		High = sweep, Low = retrace (5 V TTL)

	Specifications	Supplemental Information
SWP OUT *(Option A4J or AYX)*		
Connector	BNC female	
Amplitude		0 to +10 V ramp, characteristic

	Specifications	Supplemental Information
HP-IB Interface *(Option A4H)*		
Connector	IEEE-488 bus connector	
HP-IB Codes		SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3 and C28

	Specifications	Supplemental Information
Serial Interface *(Option 1AX)*		
Connector	9-pin D-SUB male	RS-232

	Specifications	Supplemental Information
Parallel Interface *(Option A4H or 1AX)*		Printer port only
Connector	25-pin D-SUB female	

	Specifications	Supplemental Information
EXT VIDEO IN/TV TRIG OUT[a] *(Option B7B or BAA)*		EXT VIDEO IN is the Baseband composite video input for TV trigger and picture on screen. TV TRIG OUT is the TV trigger output.
Connector	BNC Female (75 Ω)	
Impedance		75 Ω, characteristic.
(Option BAA without Option B7B)		Feature not implemented.
(Option BAA with Option B7B)		
External Video Input Video Amplitude		1 Vp–p, nominal, characteristic
TV Trigger Output		Positive edge indicates start of selected TV line after sync. pulse.
Amplitude		TTL (0 V and 3.4 V with 75 Ω series resistance), characteristic

a. This connector is labelled EXT VIDEO IN on older spectrum analyzers and EXT VIDEO IN/TV TRIG OUT on newer spectrum analyzers.

	Specifications	Supplemental Information
EXT VIDEO OUT *(Option B7B or BAA)*		Baseband video output RBW ≥ 1 kHz
Connector	BNC Female (75 Ω)	
Impedance		75 Ω, characteristic.
Amplitude *(Option BAA without Option B7B)*		0 to 1 V (uncorrected), characteristic
Amplitude *(Option BAA with Option B7B)*		
TV Source: SA		0 to 1 V (uncorrected), characteristic
TV Source and EXT VIDEO IN		Same as level at EXT VIDEO IN/TV TRIG OUT, characteristic

Regulatory Information

CAUTION

This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 1010 and 664 respectively.

NOTE

This product has been designed and tested in accordance with IEC Publication 1010, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

CE

The CE mark is a registered trademark of the European Community (if accompanied by a year, it is the year when the design was proven).

The CSA mark is the Canadian Standards Association safety mark.

ISM 1-A

This is a symbol of an Industrial Scientific and Medical Group 1 Class A product. (CISPR 11, Clause 4)

Declaration of Conformity

DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name: Hewlett-Packard Co.

Manufacturer's Address: 1400 Fountaingrove Parkway
Santa Rosa, CA 95403-1799
USA

Declares that the products

Product Name: Spectrum Analyzer

Model Number: HP E4401B, HP E4402B, HP E4403B,
HP E4404B, HP E4405B, HP E4407B,
HP E4408B, HP E4411B

Product Options: This declaration covers all options of the above products.

Conform to the following Product specifications:

Safety: IEC 61010-1:1990 / EN 61010-1:1993
CAN/CSA-C22.2 No. 1010.1-92

EMC: CISPR 11:1990/EN 55011:1991 Group 1, Class A
IEC 801-2:1984/EN 50082-1:1992 4 kV CD, 8 kV AD
IEC 801-3:1984/EN 50082-1:1992 3 V/m, 27-500 MHz
IEC 801-4:1988/EN 50082-1:1992 0.5 kV sig. lines, 1 kV power lines

Supplementary Information:

The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.

Santa Rosa, CA, USA 7 Jan. 1999

Greg Pfeiffer/Quality Engineering Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH Department HQ-TRE, Herreneberger Strasse 130, D71034 Boblingen, Germany (FAX +49-7031-14-3143)

5 HP E4402B Specifications and Characteristics

About This Chapter

This chapter contains specifications and characteristics for the HP E4402B spectrum analyzer. The distinction between specifications and characteristics is described as follows.

- Specifications describe the performance of parameters covered by the product warranty. (The temperature range is 0 °C to 55 °C, unless otherwise noted.)
- Characteristics describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- Typical performance describes additional product performance information that is not covered by the product warranty. It is performance beyond an indicated specification, that most units will exhibit.
- Nominal values indicate the expected, but not warranted, value of a parameter.

The following conditions must be met for the analyzer to meet its specifications.

- ❑ The analyzer is within the one year calibration cycle.
- ❑ If **Auto Align All** is selected:
  - — After 2 hours of storage within the operating temperature range.
  - — 5 minutes after the analyzer is turned on with sweep times less than 4 seconds.
  - — After the front-panel amplitude reference is connected to the INPUT, and **Align Now RF** has been run, after the analyzer is turned on. And, once every 24 hours, or if ambient temperature changes more than 30 °C[1].
- ❑ If **Auto Align Off** is selected:
  - — When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes,
  - — After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now All** has been run.
  - — When **Align Now All** is run:
    - Every hour

1. 10 °C if Option 1DS is active.

    - If the ambient temperature changes more than 3 °C
    - If the 10 MHz reference changes
  - When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):
    - Every 24 hours
    - If the ambient temperature changes more than 30 °C[1]
- ❑ If **Auto Align All but RF** is selected:
  - When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.
  - After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now RF** has been run.
  - When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):
    - Every hour
    - If the ambient temperature changes more than 3 °C

1. 10 °C if Option 1DS is active.

Frequency

	Specifications	Supplemental Information
Frequency Range		
	9 kHz to 3 GHz	
Preamp On *(Option 1DS)*	1 MHz to 3 GHz	

	Specifications	Supplemental Information
Frequency Reference		
Aging Rate	$\pm 2 \times 10^{-6}$/year	$\pm 1.0 \times 10^{-7}$/day, characteristic
Settability	$\pm 5 \times 10^{-7}$	
Temperature Stability	$\pm 5 \times 10^{-6}$	

	Specifications	Supplemental Information
High Stability Frequency Reference *(Option 1D5)*		
Aging Rate	$\pm 1 \times 10^{-7}$/year	$\pm 5 \times 10^{-10}$/day, 7-day average after being powered on for 7 days, characteristic
Settability	$\pm 1 \times 10^{-8}$	
Temperature Stability		
20 to 30 °C	$\pm 1 \times 10^{-8}$	
0 to 55 °C	$\pm 5 \times 10^{-8}$	
Warm-Up (Internal frequency reference selected)		
After 5 minutes		$< \pm 1 \times 10^{-7}$ of final frequency,[a] characteristic
After 15 minutes		$< \pm 1 \times 10^{-8}$ of final frequency,[a] characteristic

a. Final frequency is defined as frequency 60 minutes after power-on with analyzer set to internal frequency reference.

	Specifications	Supplemental Information
Frequency Readout Accuracy		
(Start, Stop, Center, Marker)	±(frequency indication × frequency reference error[a] + span accuracy + 15% of RBW + 10 Hz)	

a. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).

	Specifications	Supplemental Information
Marker Frequency Counter		
Resolution	Selectable from 1 Hz to 100 kHz	
Accuracy[a]	±(marker frequency × frequency reference error[b] + counter resolution)	For RBW ≥ 1 kHz

a. Marker level to displayed noise level > 25 dB, RBW/ Span ≥ 0.002, frequency offset = 0 Hz.
b. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).

	Specifications	Supplemental Information
Frequency Span		
Range	0 Hz (zero span), 100 Hz to 3 GHz	
Resolution	2 Hz	
Accuracy	±1% of span	

	Specifications	Supplemental Information
Sweep Time		
Range	5 ms to 2000 s	50 ms is the minimum sweep time with the tracking generator in operation *(Option 1DN)*
(Option AYX)	20 μs to 2000 s	For Span = 0 Hz, RBW ≥ 1 kHz
Accuracy		
Span = 0 Hz 5 ms to 2000 s	±1%	
20 μs to < 5ms *(Option AYX)*	±1%	
Sweep Trigger[a][b]	Free Run, Single, Line, Video, External, Delayed, Gate *(Option 1D6)*, TV *(Option B7B)*	
Delayed Trigger[a][c]		
Range	1 μs to 400 s	
Resolution	[(delay in seconds)/65000] rounded up to nearest μs	
Accuracy	±(500 ns +(0.01% of delay))	

a. Gate cannot be used simultaneously with delayed or TV trigger.
b. Auto align is suspended in video, external, gate, and delayed trigger modes while waiting for a trigger event to occur.
c. Delayed trigger is available with line, external, and TV trigger (Option B7B).

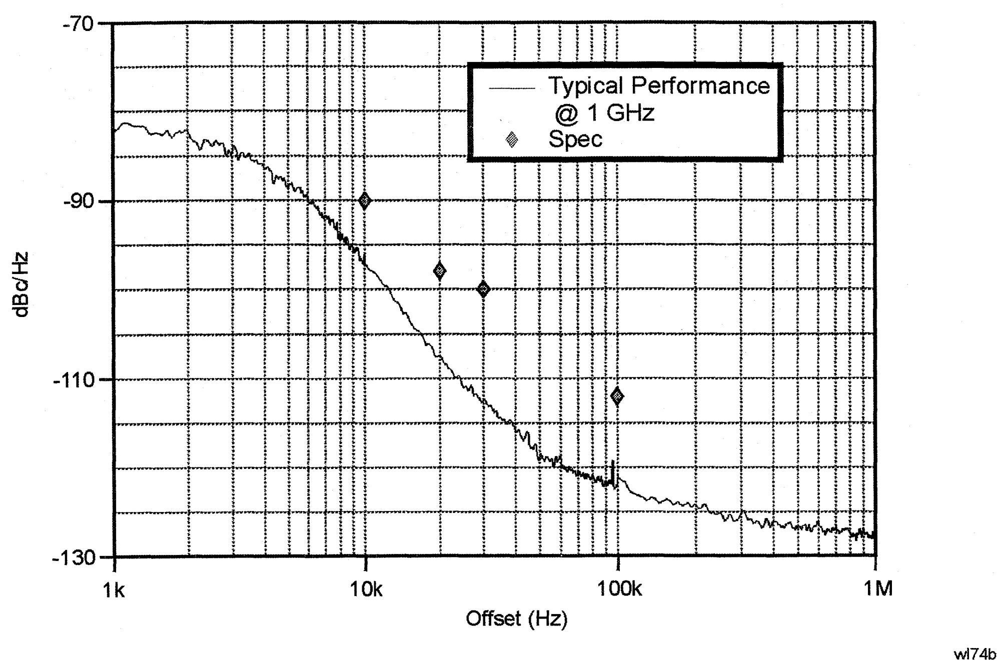
	Specifications	Supplemental Information
Resolution Bandwidth (RBW)		
Range		
–3 dB bandwidth	1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz	
–6 dB bandwidth (EMI)	9 kHz and 120 kHz	
(Option 1DR)		Only available in spans ≤ 5 MHz, sweep times ≥ 5 ms, and not usable with tracking generator in operation (*Option 1DN*)
–3 dB bandwidth	Adds 10, 30, 100, 300 Hz	
–6 dB bandwidth (EMI)	Add 200 Hz	

	Specifications	Supplemental Information
Accuracy		
1 kHz to 3 MHz RBW	±15%	
5 MHz RBW	±30%	
10 Hz to 300 Hz RBW *(Option 1DR)*	±10%	
Shape		
1 kHz to 5 MHz RBW		Synchronously tuned four poles, approximately Gaussian shape
10 Hz to 300 Hz RBW *(Option 1DR)*		Digital, approximately Gaussian shape
Selectivity (60 dB/3 dB bandwidth ratio)		
1 kHz to 5 MHz RBW		<15:1, characteristic
10 Hz to 300 Hz RBW *(Option 1DR)*		<5:1, characteristic

	Specifications	Supplemental Information
Video Bandwidth (VBW) (–3 dB)		
Range	30 Hz to 1 MHz in 1-3-10 sequence	3 MHz, characteristic
(Option 1DR)	Adds 1, 3, 10 Hz for RBW's <1 kHz	
Accuracy		±30%, characteristic
Shape		Post detection, single pole low-pass filter used to average displayed noise Video bandwidths below 30 Hz are digital bandwidths with anti-aliasing filtering.

	Specifications	Supplemental Information
Stability		
Noise Sidebands, offset from CW signal with 1 kHz RBW, 30 Hz VBW and sample detector		
≥10 kHz	≤ –90 dBc/Hz	
≥20 kHz	≤ –98 dBc/Hz	
≥30 kHz	≤ –100 dBc/Hz	
≥100 kHz	≤ –112 dBc/Hz	
Residual FM		
1 kHz RBW, 1 kHz VBW	≤150 Hz p–p in 100 ms	
(Option 1D5)	≤100 Hz p–p in 100 ms	
10 Hz RBW, 10 Hz VBW *(Option 1DR and 1D5)*	≤2 Hz p–p in 20 ms	
10 Hz RBW, 10 Hz VBW *(Option 1DR)*		≤10 Hz p–p in 20 ms, characteristic
System-Related Sidebands, offset from CW signal		
≥30 kHz	≤ –65 dBc	
Line-Related Sidebands, offset from CW signal *(Option 1DR)*		
<300 Hz		≤ –50 dBc, characteristic
>300 Hz to 30 kHz		≤ –55 dBc, characteristic

Noise Sidebands Normalized to 1 Hz Versus Offset From Carrier



Amplitude

Amplitude specifications do not apply for the negative peak detector mode.

	Specifications	Supplemental Information
Measurement Range	Displayed Average Noise Level to Maximum Safe Input Level	
Input Attenuator Range	0 to 65 dB, in 5 dB steps	

	Specifications	Supplemental Information
Maximum Safe Input Level		
Average Continuous Power	+30 dBm (1 W)	
Input attenuator setting ≥5 dB		
Peak Pulse Power for <10 μsec pulse width, <1% duty cycle, and input attenuation ≥30 dB	+50 dBm (100 W)	
dc	100 Vdc	

	Specifications	Supplemental Information
1 dB Gain Compression		
Total power at input mixer [a][b]		
50 MHz to 3.0 GHz	0 dBm	
Preamp On *(Option 1DS)* Total power at the preamp[c]		–20 dBm, characteristic

a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
b. For resolution bandwidths 1 kHz to 30 kHz, the maximum input signal amplitude must be ≤ reference level +10 dB.
c. Total power at the preamp (dBm) = total power at the input (dBm) – input attenuation (dB).

	Specifications		Supplemental Information	
Displayed Average Noise Level (Input terminated, 0 dB attenuation, sample detector, Reference Level = –70 dBm)				
	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW *(Option 1DR)*	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW *(Option 1DR)*
1 MHz to 10 MHz			≤ –117 dBm, characteristic	≤ –136 dBm, characteristic
10 MHz to 1.0 GHz	≤ –117 dBm	≤ –136 dBm		
1.0 GHz to 2.0 GHz	≤ –116 dBm	≤ –135 dBm		
2.0 GHz to 3.0 GHz	≤ –114 dBm	≤ –133 dBm		
Preamp On *(Option 1DS)*	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW *(Option 1DR)*	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW *(Option 1DR)*
0 to 55 °C				
1 MHz to 10 MHz			≤ –132 dBm, characteristic	≤ –150 dBm, characteristic
10 MHz to 1.0 GHz	≤ –132 dBm	≤ –150 dBm		
1.0 GHz to 2.0 GHz	≤ –131 dBm	≤ –149 dBm		
2.0 GHz to 3.0 GHz	≤ –129 dBm	≤ –147 dBm		
20 to 30 °C				
10 MHz to 1.0 GHz	≤ –133 dBm	≤ –151 dBm		
1.0 GHz to 2.0 GHz	≤ –133 dBm	≤ –151 dBm		
2.0 GHz to 3.0 GHz	≤ –132 dBm	≤ –150 dBm		

	Specifications	Supplemental Information
Display Range		
Log Scale	Ten divisions displayed; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps	
RBW ≥ 1 kHz	Calibrated 0 to –85 dB from Reference Level	
RBW ≤ 300 Hz *(Option 1DR)*	Calibrated 0 to –120 dB[a] from Reference Level	
Linear Scale	Ten divisions	
Scale Units	dBm, dBmV, dBµV, V,W and Hz (Option BAA)	

a. 0 to –70 dB range when span = 0 Hz, or when auto ranging is off: (:DISPlay:WINDow:TRACe:Y[:SCALe]:LOG:RANGe:AUTO OFF).

	Specifications	Supplemental Information
Marker Readout Resolution		
Log scale		
RBW ≥ 1 kHz		
0 to –85 dB from ref level	0.04 dB	
RBW ≤ 300 Hz		
0 to –120 dB from ref level	0.04 dB	
Linear scale	0.01% of Reference Level	
Fast Sweep Times for Zero Span		
20 µs to <5 ms *(Option AYX)*		
Log		
0 to –85 dB from ref level	0.3 dB	
Linear	0.3% of Reference Level for linear scale	

	Specifications	Supplemental Information
Frequency Response		
50 Ω, Absolute[a]/Relative		
9 kHz to 3.0 GHz		
10 dB attenuation		
20 to 30 °C	±0.5 dB	
0 to 55 °C	±1.0 dB	
50 Ω, Absolute[a]/Relative Preamp On *(Option 1DS)*		
1 MHz to 3.0 GHz		
0 dB attenuation	±2.0 dB	

a. Absolute flatness values are referenced to the amplitude at 50 MHz.

	Specifications	Supplemental Information
Input Attenuation Switching Uncertainty at 50 MHz		
Attenuator Setting		
0 dB to 5 dB	±0.3 dB	
10 dB	Reference	
15 dB	±0.3 dB	
20 to 65 dB attenuation	±(0.1 dB + 0.01 × Attenuator Setting)	

	Specifications	Supplemental Information
Preamp *(Option 1DS)*		
Gain		+20 dB, nominal[a]
Noise figure		5 dB, characteristic

a. Amplifier is between the input attenuator and the input mixer.

Attenuation Accuracy Relative to the 10 dB Attenuator Setting, Characteristic	
	Frequency Range
Attenuation, dB	**dc–3.0 GHz, (± dB)**
0	0.3
5	0.3
10 (Reference)	Reference
15	0.4
20	0.4
25	0.5
30	0.5
35	0.6
40	0.6
45	0.7
50	0.7
55	0.9
60	0.9
65	1.0

	Specifications	Supplemental Information
Absolute Amplitude Accuracy		
At reference settings [a]	±0.34 dB	
Preamp On[b] *(Option 1DS)*	±0.5 dB	
Overall Amplitude Accuracy[c]		
20 to 30 °C	± (0.54 dB + Absolute Frequency Response)	

a. Settings are: reference level –20 dBm; input attenuation 10 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, sample detector, signal at reference level.

b. Settings are: reference level –30 dBm; input attenuation 0 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, signal at reference level.

c. For reference level 0 to –50 dBm; input attenuation 10 dB; RBW 1 kHz; VBW 1 kHz; scale log, log range 0 to 50 dB from reference level; sweep time coupled; signal input 0 to –50 dBm; span ≤20 kHz.

	Specifications	Supplemental Information
RF Input VSWR (at tuned frequency)		
Attenuator setting 0 dB		
100 kHz to 3 GHz		3.0:1, characteristic
Attenuator setting 5 dB		
100 kHz to 3 GHz		1.6:1, characteristic
Attenuator setting 10 to 65 dB		
9 kHz to 100 kHz		2.0:1, characteristic
100 kHz to 3 GHz		1.4:1, characteristic

	Specifications	Supplemental Information
Auto Alignment[a]		
Sweep-to-sweep variation		±0.1 dB, characteristic

a. Set **Auto Align** to **Off** and use **Align Now, All** to eliminate this variation.

	Specifications	Supplemental Information
Resolution Bandwidth Switching Uncertainty (at Reference Level)		
1 kHz RBW	Reference	
3 kHz to 3 MHz RBW	±0.3 dB	
5 MHz RBW	±0.6 dB	
10 Hz to 300 Hz RBW *(Option 1DR)*	±0.3 dB	

	Specifications	Supplemental Information
Reference Level		
Range	Adjustable over Amplitude Measurement Range	
Resolution		
Log Scale	±0.1 dB	
Linear Scale	±0.12% of Reference Level	
Accuracy (at a fixed frequency, a fixed attenuator, and referenced to –30 dBm (–10 dBm, Preamp On *(Option 1DS)*))		
Reference Level (dBm) – input attenuator setting (dB) + preamp gain (dB)		
–10 dBm to > –60 dBm	±0.3 dB	
–60 dBm to > –85 dBm	±0.5 dB	
–85 dBm to –90 dBm	±0.7 dB	

	Specifications	Supplemental Information
Display Scale Switching Uncertainty		
Switching between Linear and Log	±0.15 dB at Reference Level	
Log Scale Switching	No error	

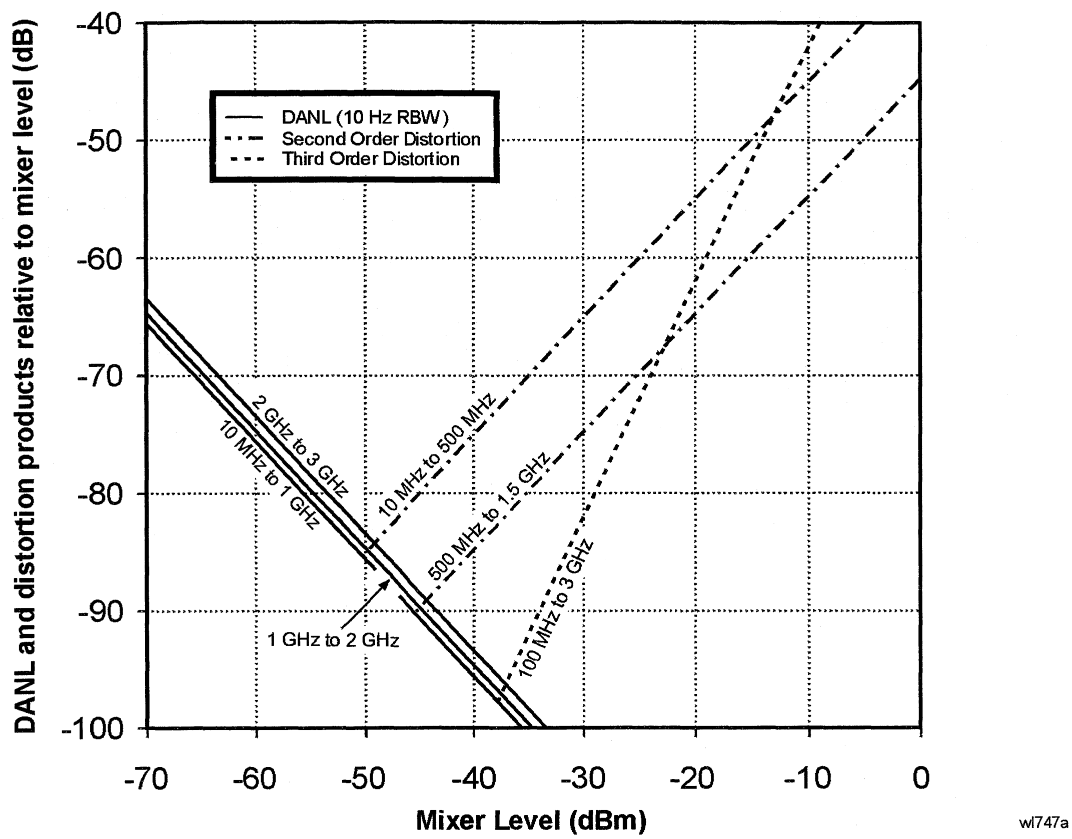
	Specifications	Supplemental Information
Display Scale Fidelity		
Log Maximum Cumulative		
0 to –85 dB from Reference Level	±(0.3 dB + 0.01 × dB from Reference Level)	
RBW ≤ 300 Hz *(Option 1DR)*		
Span > 0 Hz		
0 to –98 dB from Reference Level	±(0.3 dB + 0.01 × dB from Reference Level)	
–98 to –120 dB from Reference Level		±2.0 dB, characteristic
Span = 0 Hz[a]		
0 to –60 dB from Reference Level	±(0.3 dB + 0.015 × dB from Reference Level)	
–60 to –70 dB from Reference Level	±1.5 dB	
Log Incremental Accuracy		
0 to –80 dB[b] from reference level	±0.4 dB/4 dB	
Linear Accuracy	±2% of Reference Level	

a. or when auto ranging is off: (:DISPlay:WINDow:TRACe:Y[:SCALe]:LOG:RANGe:AUTO OFF)
b. 0 to –50 dB for RBWs ≤ 300 Hz and span = 0 Hz, or when auto ranging is off.

	Specifications	Supplemental Information
Spurious Responses		
Second Harmonic Distortion		
Input Signal		
10 MHz to 500 MHz	< –65 dBc for –30 dBm signal at input mixer[a]	+35 dBm SHI (second harmonic intercept)
500 MHz to 1.5 GHz	< –75 dBc for –30 dBm signal at input mixer[a]	+45 dBm SHI
Preamp On *(Option 1DS)* 10 MHz to 1.5 GHz		–5 dBm SHI, characteristic
Third Order Intermodulation Distortion		
10 MHz to 100 MHz		+7 dBm TOI (third order intercept), characteristic
100 MHz to 3 GHz	< –82 dBc for two –30 dBm signals at input mixer[a] and >50 kHz separation	+11 dBm TOI +16 dBm TOI, typical, 20 to 30 °C
Preamp On *(Option 1DS)* 10 MHz to 3 GHz,		–16 dBm TOI, characteristic
Other Input Related Spurious		
>30 kHz offset	< –65 dBc for –20 dBm signal at input mixer[a]	

a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).

Specified Dynamic Range



	Specifications	Supplemental Information
Residual Responses (Input terminated and 0 dB attenuation)		
150 kHz to 3 GHz	< –90 dBm	

Options

Time Gated Spectrum Analysis (Option 1D6)

	Specifications	Supplemental Information
Gate Delay		
Range	1 μs to 400 s	
Accuracy	±(500 ns + (0.01% × (maximum of gate delay or length)))	From gate trigger input to positive edge of gate output
Gate Length		
Range	1 μs to 400 s	
Accuracy	±(500 ns + (0.01% × (maximum of gate delay or length)))	From positive edge to negative edge of gate output
Resolution	[(maximum of gate delay or length in seconds)/65000] rounded up to nearest μs	Dependent on the greater of gate delay or gate length
Additional Amplitude Error[a]		
Log Scale	±0.2 dB	
Linear Scale	±0.1 % of reference level	

a. While in gate mode.

Tracking Generator (Option 1DN)

The spectrum analyzer tracking generator combination will meet its specification after a cable (8120-5148) and adapter are connected between RF OUT and INPUT and **Align Now**, **TG** has been run.

	Specifications	Supplemental Information
Warm-Up	5 minutes	

	Specifications	Supplemental Information
Output Frequency Range	9 kHz to 3.0 GHz	

	Specifications	Supplemental Information
Minimum Resolution BW	1 kHz	Not usable with resolution bandwidths ≤300 Hz *(Option 1DR)*

	Specifications	Supplemental Information
Output Power Level		
Range	–2 to –66 dBm	
Resolution	0.1 dB	
Absolute Accuracy (at 50 MHz with coupled source attenuator, referenced to –20 dBm)	± 0.75 dB	
Vernier		
Range	8 dB	
Accuracy (with coupled source attenuator, 50 MHz, –20 dBm)		
Incremental	±0.2 dB/dB	
Cumulative	±0.5 dB, total	
Output Attenuator Range	0 to 56 dB in 8 dB steps	

	Specifications	Supplemental Information
Maximum Safe Reverse Level		+30 dBm (1 W), +30 Vdc, characteristic

	Specifications	Supplemental Information
Output Power Sweep		
Range	(–10 dBm to –2 dBm) – (Source Attenuator Setting)	
Resolution	0.1 dB	
Accuracy (zero span)	<1 dB peak-to-peak	

	Specifications	Supplemental Information
Output Flatness		
Referenced to 50 MHz, –20 dBm		
9 kHz to 10 MHz	±3 dB	
10 MHz to 3 GHz	±2 dB	

	Specifications	Supplemental Information
Spurious Outputs		
(–2 dBm output)		
Harmonic Spurs		
TG Output 9 kHz to 20 kHz	≤ –15 dBc	
TG Output 20 kHz to 3 GHz	≤ –25 dBc	
Non-harmonic Spurs		
TG Output 9 kHz to 2 GHz	≤ –27 dBc	
TG Output 2 GHz to 3 GHz	≤ –23 dBc	
LO Feedthrough		
LO Frequency 3.921409 to 6.9214 GHz	≤ –16 dBm	

	Specifications	Supplemental Information
Dynamic Range	Maximum Output Power Level – Displayed Average Noise Level	

	Specifications	Supplemental Information
Output Tracking		
Drift		1.5 kHz/5 minute, characteristic
Swept Tracking Error		Usable in 1 kHz RBW after 5 minutes of warm-up

	Specifications	Supplemental Information
RF Power-Off Residuals		
9 kHz to 3 GHz		< –120 dBm, characteristic

	Specifications	Supplemental Information
Output Attenuator Repeatability		
9 kHz to 300 MHz		±0.1 dB, characteristic
300 MHz to 2.0 GHz		±0.2 dB, characteristic
2.0 GHz to 3 GHz		±0.3 dB, characteristic

	Specifications	Supplemental Information
Output VSWR		
0 dB attenuation		<2.0:1, characteristic
≥ 8 dB attenuation		<1.5:1, characteristic

	Specifications	Supplemental Information
Output Attenuator Accuracy		
0 dB		±0.5 dB, characteristic
8 dB		±0.5 dB, characteristic
16 dB	Reference	
24 dB		±0.5 dB, characteristic
32 dB		±0.6 dB, characteristic
40 dB		±0.8 dB, characteristic
48 dB		±1.0 dB, characteristic
56 dB		±1.1 dB, characteristic

Tracking Generator Output Accuracy
Relative Accuracy (Referred to –20 dBm) = Output Attenuator Accuracy + Vernier Accuracy + Output Flatness
Absolute Accuracy = Relative Accuracy (Referred to –20 dBm) + Absolute Accuracy at 50 MHz

	Specifications	Supplemental Information
Output Power Level		
Range	–2 to –66 dBm	
Resolution	0.1 dB	
Absolute Accuracy (at 50 MHz with coupled source attenuator, referenced to –20 dBm)	± 0.75 dB	
Vernier		
Range	8 dB	
Accuracy (with coupled source attenuator, 50 MHz, –20 dBm)		
Incremental	±0.2 dB/dB	
Cumulative	±0.5 dB, total	
Output Attenuator Range	0 to 56 dB in 8 dB steps	

FM Demodulation (Option BAA)

The FM demodulation characteristics will be met after an **Align Now, FM Demod** has been run.

	Specifications	Supplemental Information
Input Level		≥ (–60 dBm + attenuator setting – preamp gain), characteristic
Signal Level		0 to –30 dB below reference level, characteristic
FM Deviation		
Range		10 kHz to 1 MHz
Resolution		Provides 1 Hz display annotation resolution
FM Deviation Range		
10 kHz to 40 kHz		12 Hz, characteristic
>40 kHz to 200 kHz		60 Hz, characteristic
>200 kHz to 1 MHz		300 Hz, characteristic
Accuracy[a] FM Rate < FM BW/100, VBW ≥(30 × FM Rate), RBW > the maximum of (30 × FM deviation) or (30 × FM Rate)		< (2% of FM deviation range + 2 × Resolution), characteristic
Offset Error[a]		5% of FM Deviation Range + 300 Hz, characteristic
FM Bandwidth *(–3 dB)*		
FM Deviation Range		
10 kHz to 40 kHz		7.5 × FM deviation range, characteristic
>40 kHz to 200 kHz		1.3 × FM deviation range, characteristic
>200 kHz to 1 MHz		0.3 × FM deviation range, characteristic

a. In time domain sweeps (span = 0 Hz).

TV Trigger and Picture On Screen (Option B7B)

	Specifications	Supplemental Information
TV Trigger and Picture On Screen		TV Trigger initiates a sweep of the analyzer after the sync pulse of a selected line of a TV video field. Picture On Screen displays the TV picture on the analyzer display.
Amplitude Requirements		
TV Source: SA		Top 50% of linear display, characteristic
TV Source: EXT VIDEO IN		500 mVp–p to 2 Vp–p, characteristic
Compatible Standards	NTSC–M, NTSC–Japan, PAL–M, PAL–B,D,G,H,I, PAL–N, PAL–N Combination, SECAM-L	
Field Selection	Entire frame, even, odd	
Sync Polarity	Positive or negative	
TV Trigger		
Line Selection	1 to 525, or 1 to 625, standard dependent	

General

	Specifications	Supplemental Information
Temperature Range		
Operating	0 to 55 °C	Floppy disk 10 to 40 °C
Storage	–40 to +75 °C	

	Specifications	Supplemental Information
Audible Noise (ISO 7779)		
Sound Pressure at 25 °C		<40 dBa, (<4.6 Bels power)

	Specifications	Supplemental Information
Military Specification	Has been type tested to the environmental specifications of MIL-PRF-28800F class 3.	

	Specifications	Supplemental Information
EMI Compatibility	Conducted and radiated emission is in compliance with CISPR Pub. 11/1990 Group 1 Class A.	

	Specifications	Supplemental Information
Immunity Testing		
Radiated Immunity		Testing was done at 3 V/m according to IEC 801-3/1984. When the analyzer tuned frequency is identical to the immunity test signal frequency there may be signals of up to –60 dBm displayed on the screen.
Electrostatic Discharge		Air discharges of up to 8 kV were applied according to IEC 801-2/1991. Discharges to center pins of any of the connectors may cause damage to the associated circuitry.

	Specifications	Supplemental Information
Power Requirements		Uses CUKonverter® topology in the power supply.
ac Operation		
Voltage, frequency	90 to 132 V rms, 47 to 440 Hz 195 to 250 V rms, 47 to 66 Hz	
Power Consumption, On	<300 W	
Power Consumption, Standby	<5 W	
dc Operation		
Voltage	12 to 20 Vdc	
Power Consumption	<200 W	

	Specifications	Supplemental Information
Measurement Speed		
Local Measurement and Display Update rate[a]		≥ 28/s, characteristic
Remote Measurement and HP-IB Transfer Rate[b] *(Option A4H)*		≥ 19/s, characteristic

a. Auto align off, 5 ms sweep time, fixed center frequency.
b. Auto align off, 5 ms sweep time, fixed center frequency, 401 point trace, display off (DISPlay:ENABle off), and 32-bit integer data format (FORMat:DATA INT,32).

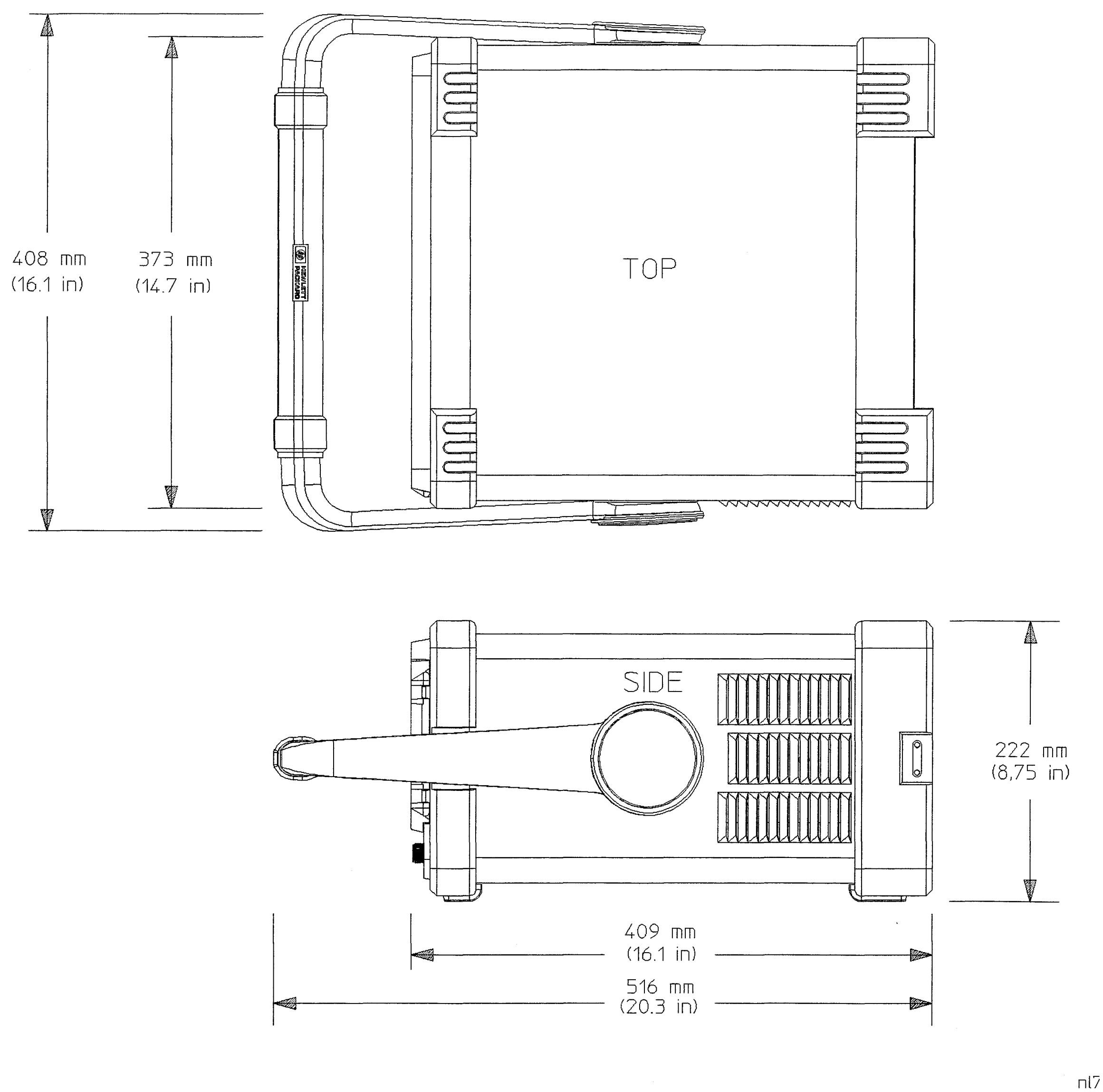
	Specifications	Supplemental Information
Data Storage		
Internal		200 Traces or States
External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS® compatible floppy disk		200 Traces or States

	Specifications	Supplemental Information
Downloadable Program Memory		2 MB available memory
(Option B72)		10 MB available memory

	Specifications	Supplemental Information
Demod Tune Listen		
AM FM *(Option BAA)*		Internal speaker, front-panel earphone jack and front-panel volume control.
(Option A4J, AYX, or BAA)		An uncalibrated demodulated signal is available on the AUX VIDEO OUT or EXT VIDEO OUT connectors at the rear panel.

	Specifications	Supplemental Information
Weight (without options)		
Net		14.9 kg (32.9 lb), characteristic
Shipping		29.5 kg (65 lb), characteristic

Dimensions


408 mm
(16.1 in)
373 mm
(14.7 in)
TOP
SIDE
222 mm
(8.75 in)
409 mm
(16.1 in)
516 mm
(20.3 in)
nl7

Inputs and Outputs

Front Panel

	Specifications	Supplemental Information
INPUT 50 Ω		
Connector	Type-N female	
Impedance		50 Ω, nominal

	Specifications	Supplemental Information
RF OUT 50 Ω, *(Option 1DN)*		
Connector	Type-N female	
Impedance		50 Ω, nominal

	Specifications	Supplemental Information
AMPTD REF OUT[a]		Amplitude Reference
Connector	BNC Female	
Impedance		50 Ω, nominal
Frequency		50 MHz
Frequency Accuracy		Frequency reference error[b]
50 Ω Amplitude[c]		–20 dBm, nominal

a. Turn the amplitude reference on/off by pressing the keys: **Input, Amptd Ref Out**.
b. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).
c. The internal amplitude reference actual power is stored internally.

	Specifications	Supplemental Information
PROBE POWER		
Voltage/Current		+15 Vdc, ±7% at 150 mA max., characteristic –12.6 Vdc ±10% at 150 mA max., characteristic

	Specifications	Supplemental Information
EXT KEYBOARD		Feature not implemented.
Connector	6-pin mini-DIN	

	Specifications	Supplemental Information
Speaker		Front panel knob controls volume

	Specifications	Supplemental Information
Headphone		Front panel knob controls volume
Connector	3.5 mm (1/8 inch) miniature audio jack	
Power Output		0.2 W into 4 Ω, characteristic

Rear Panel

	Specifications	Supplemental Information
10 MHz REF OUT		
Connector	BNC female	
Impedance		50 Ω, nominal
Output Amplitude		>0 dBm, characteristic

	Specifications	Supplemental Information
10 MHz REF IN		
Connector	BNC female	Note: Analyzer noise sidebands and spurious response performance may be affected by the quality of the external reference used.
Impedance		50 Ω, nominal
Input Amplitude Range		–15 to +10 dBm, characteristic
Frequency		10 MHz, nominal

	Specifications	Supplemental Information
GATE TRIG/EXT TRIG IN		
Connector	BNC female	
External Trigger Input		
Trigger Level		Selectable positive or negative edge initiates sweep in EXT TRIG mode (5 V TTL)
Gate Trigger Input *(Option 1D6)*		
Minimum Pulse Width		>30 ns (5 V TTL)

	Specifications	Supplemental Information
GATE/HI SWP OUT		
Connector	BNC female	
High Sweep Output		
Level		High = sweep; Low = retrace (5 V TTL)
Gate Output *(Option 1D6)*		
Level		High = gate on; Low = gate off (5 V TTL)

	Specifications	Supplemental Information
VGA OUTPUT		
Connector	VGA compatible, 15-pin mini D-SUB	
Format		VGA (31.5 kHz horizontal, 60 Hz vertical sync rates, non-interlaced) Analog RGB
Resolution	640 × 480	

	Specifications	Supplemental Information
AUX IF OUT *(Option A4J or AYX)*		RBW ≥ 1 kHz
Connector	BNC female	
Frequency		21.4 MHz, nominal
Amplitude Range (for signal at reference level and for reference levels – input attenuation + preamp gain of –10 to –70 dBm)		–10 dBm (uncorrected), characteristic
Impedance		50 Ω, nominal

	Specifications	Supplemental Information
AUX VIDEO OUT *(Option A4J or AYX)*		RBW ≥ 1 kHz
Connector	BNC female	
Amplitude Range (into >10 kΩ)		0 to 1 V (uncorrected), characteristic

	Specifications	Supplemental Information
HI SWP IN *(Option A4J or AYX)*		
Connector	BNC female	
Input		Open collector, low stops sweep (5 V TTL)

	Specifications	Supplemental Information
HI SWP OUT *(Option A4J or AYX)*		
Connector	BNC female	
Output		High = sweep, Low = retrace (5 V TTL)

	Specifications	Supplemental Information
SWP OUT *(Option A4J or AYX)*		
Connector	BNC female	
Amplitude		0 to +10 V ramp, characteristic

	Specifications	Supplemental Information
HP-IB Interface *(Option A4H)*		
Connector	IEEE-488 bus connector	
HP-IB Codes		SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3 and C28

	Specifications	Supplemental Information
Serial Interface *(Option 1AX)*		
Connector	9-pin D-SUB male	RS-232

	Specifications	Supplemental Information
Parallel Interface *(Option A4H or 1AX)*		Printer port only
Connector	25-pin D-SUB female	

	Specifications	Supplemental Information
EXT VIDEO IN/TV TRIG OUT[a] *(Option B7B or BAA)*		EXT VIDEO IN is the Baseband composite video input for TV trigger and picture on screen. TV TRIG OUT is the TV trigger output.
Connector	BNC Female (75 Ω)	
Impedance		75 Ω, characteristic.
(Option BAA without Option B7B)		Feature not implemented.
(Option BAA with Option B7B)		
External Video Input Video Amplitude		1 Vp–p, nominal, characteristic
TV Trigger Output		Positive edge indicates start of selected TV line after sync. pulse.
Amplitude		TTL (0 V and 3.4 V with 75 Ω series resistance), characteristic

a. This connector is labelled EXT VIDEO IN on older spectrum analyzers and EXT VIDEO IN/TV TRIG OUT on newer spectrum analyzers.

	Specifications	Supplemental Information
EXT VIDEO OUT *(Option B7B or BAA)*		Baseband video output RBW ≥ 1 kHz
Connector	BNC Female (75 Ω)	
Impedance		75 Ω, characteristic.
Amplitude *(Option BAA without Option B7B)*		0 to 1 V (uncorrected), characteristic
Amplitude *(Option BAA with Option B7B)*		
TV Source: SA		0 to 1 V (uncorrected), characteristic
TV Source and EXT VIDEO IN		Same as level at EXT VIDEO IN/TV TRIG OUT, characteristic

Regulatory Information

CAUTION This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 1010 and 664 respectively.

NOTE This product has been designed and tested in accordance with IEC Publication 1010, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

The CE mark is a registered trademark of the European Community (if accompanied by a year, it is the year when the design was proven).

The CSA mark is the Canadian Standards Association safety mark.

ISM 1-A This is a symbol of an Industrial Scientific and Medical Group 1 Class A product. (CISPR 11, Clause 4)

Declaration of Conformity

DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name: Hewlett-Packard Co.

Manufacturer's Address: 1400 Fountaingrove Parkway
Santa Rosa, CA 95403-1799
USA

Declares that the products

Product Name: Spectrum Analyzer

Model Number: HP E4401B, HP E4402B, HP E4403B,
HP E4404B, HP E4405B, HP E4407B,
HP E4408B, HP E4411B

Product Options: This declaration covers all options of the above products.

Conform to the following Product specifications:

Safety: IEC 61010-1:1990 / EN 61010-1:1993
CAN/CSA-C22.2 No. 1010.1-92

EMC: CISPR 11:1990/EN 55011:1991 Group 1, Class A
IEC 801-2:1984/EN 50082-1:1992 4 kV CD, 8 kV AD
IEC 801-3:1984/EN 50082-1:1992 3 V/m, 27-500 MHz
IEC 801-4:1988/EN 50082-1:1992 0.5 kV sig. lines, 1 kV power lines

Supplementary Information:

The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.

Santa Rosa, CA, USA 7 Jan. 1999

Greg Pfeiffer/Quality Engineering Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH Department HQ-TRE, Herreneberger Strasse 130, D71034 Boblingen, Germany (FAX +49-7031-14-3143)

6 HP E4403B Specifications and Characteristics

About This Chapter

This chapter contains specifications and characteristics for the HP E4403B spectrum analyzer. The distinction between specifications and characteristics is described as follows.

- Specifications describe the performance of parameters covered by the product warranty. (The temperature range is 0 °C to 55 °C, unless otherwise noted.)
- Characteristics describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- Typical performance describes additional product performance information that is not covered by the product warranty. It is performance beyond an indicated specification, that most units will exhibit.
- Nominal values indicate the expected, but not warranted, value of a parameter.

The following conditions must be met for the analyzer to meet its specifications.

❑ The analyzer is within the one year calibration cycle.

❑ If **Auto Align All** is selected:

- — After 2 hours of storage within the operating temperature range.
- — 5 minutes after the analyzer is turned on with sweep times less than 4 seconds.
- — After the front-panel amplitude reference is connected to the INPUT, and **Align Now RF** has been run, after the analyzer is turned on. And, once every 24 hours, or if ambient temperature changes more than 30 °C.

❑ If **Auto Align Off** is selected:

- — When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes,
- — After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now All** has been run.
- — When **Align Now All** is run:
  - Every hour
  - If the ambient temperature changes more than 3 °C
  - If the 10 MHz reference changes

— When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):

- Every 24 hours
- If the ambient temperature changes more than 30 °C

❑ If **Auto Align All but RF** is selected:

— When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.

— After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now RF** has been run.

— When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):

- Every hour
- If the ambient temperature changes more than 3 °C

Frequency

	Specifications	Supplemental Information
Frequency Range	9 kHz to 3 GHz	

	Specifications	Supplemental Information
Frequency Reference		
Aging Rate	$\pm 2 \times 10^{-6}$/year	$\pm 1.0 \times 10^{-7}$/day, characteristic
Settability	$\pm 5 \times 10^{-7}$	
Temperature Stability	$\pm 5 \times 10^{-6}$	

	Specifications	Supplemental Information
Frequency Readout Accuracy		
(Start, Stop, Center, Marker)	±(frequency indication × frequency reference error[a] + span accuracy + 15% of RBW + 10 Hz)	

a. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).

	Specifications	Supplemental Information
Marker Frequency Counter		
Resolution	Selectable from 1 Hz to 100 kHz	
Accuracy[a]	±(marker frequency × frequency reference error[b] + counter resolution)	

a. Marker level to displayed noise level > 25 dB, RBW/ Span ≥ 0.002, frequency offset = 0 Hz.
b. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).

	Specifications	Supplemental Information
Frequency Span		
Range	0 Hz (zero span), 100 Hz to 3 GHz	
Resolution	2 Hz	
Accuracy	±1% of span	

	Specifications	Supplemental Information
Sweep Time		
Range	5 ms to 2000 s	50 ms is the minimum sweep time with the tracking generator in operation *(Option 1DN)*
Accuracy		
Span = 0 Hz 5 ms to 2000 s	±1%	
Sweep Trigger[a]	Free Run, Single, Line, Video, External, Delayed	
Delayed Trigger[b]		
Range	1 μs to 400 s	
Resolution	[(delay in seconds)/65000] rounded up to nearest μs	
Accuracy	±(500 ns +(0.01% of delay))	

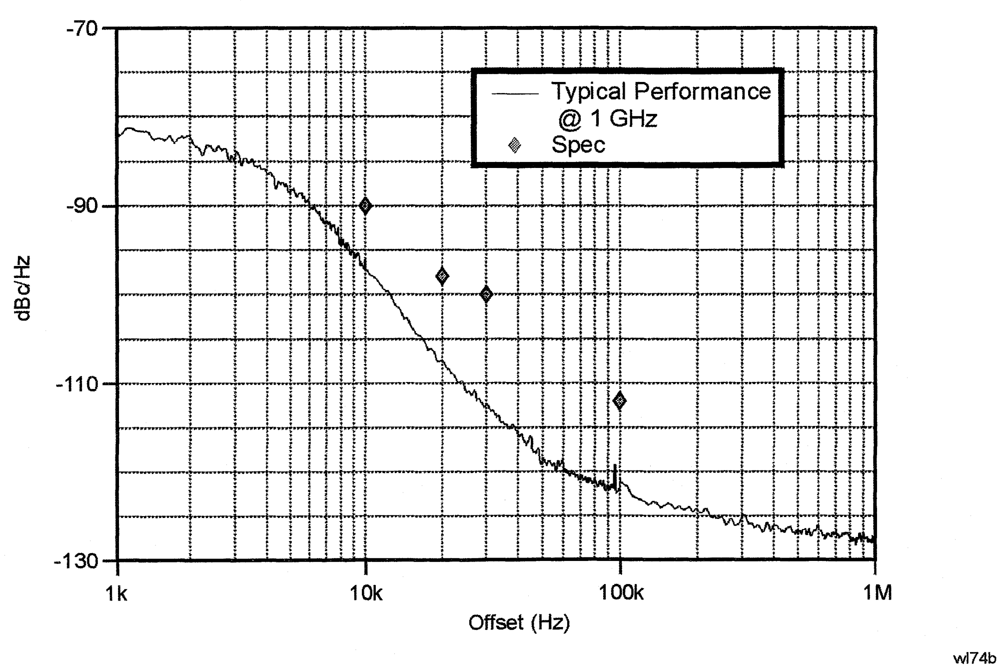
a. Auto align is suspended in video, external, gate, and delayed trigger modes while waiting for a trigger event to occur.
b. Delayed trigger is available with line and external trigger.

	Specifications	Supplemental Information
Resolution Bandwidth (RBW)		
Range		
–3 dB bandwidth	1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz	
–6 dB bandwidth (EMI)	9 kHz and 120 kHz	
Accuracy		
1 kHz to 3 MHz RBW	±15%	
5 MHz RBW	±30%	
Shape		
1 kHz to 5 MHz RBW		Synchronously tuned four poles, approximately Gaussian shape
Selectivity (60 dB/3 dB bandwidth ratio)		
1 kHz to 5 MHz RBW		<15:1, characteristic

	Specifications	Supplemental Information
Video Bandwidth (VBW) (–3 dB)		
Range	30 Hz to 1 MHz in 1-3-10 sequence	3 MHz, characteristic
Accuracy		±30%, characteristic
Shape		Post detection, single pole low-pass filter used to average displayed noise

	Specifications	Supplemental Information
Stability		
Noise Sidebands, offset from CW signal with 1 kHz RBW, 30 Hz VBW and sample detector		
≥10 kHz	≤ –90 dBc/Hz	
≥20 kHz	≤ –98 dBc/Hz	
≥30 kHz	≤ –100 dBc/Hz	
≥100 kHz	≤ –112 dBc/Hz	
Residual FM		
1 kHz RBW, 1 kHz VBW	≤150 Hz p–p in 100 ms	
System-Related Sidebands, offset from CW signal		
≥30 kHz	≤ –65 dBc	

Noise Sidebands Normalized to 1 Hz Versus Offset From Carrier



Amplitude

Amplitude specifications do not apply for the negative peak detector mode.

	Specifications	Supplemental Information
Measurement Range	Displayed Average Noise Level to Maximum Safe Input Level	
Input Attenuator Range	0 to 65 dB, in 5 dB steps	

	Specifications	Supplemental Information
Maximum Safe Input Level		
Average Continuous Power	+30 dBm (1 W)	
Input attenuator setting ≥5 dB		
Peak Pulse Power for <10 µsec pulse width, <1% duty cycle, and input attenuation ≥30 dB	+50 dBm (100 W)	
dc	100 Vdc	

	Specifications	Supplemental Information
1 dB Gain Compression		
Total power at input mixer [a,b]		
50 MHz to 3.0 GHz	0 dBm	

a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
b. For resolution bandwidths 1 kHz to 30 kHz, the maximum input signal amplitude must be ≤ reference level +10 dB.

	Specifications	Supplemental Information
Displayed Average Noise Level (Input terminated, 0 dB attenuation, sample detector, Reference Level = –70 dBm)		
	1 kHz RBW 30 Hz VBW	1 kHz RBW 30 Hz VBW
1 MHz to 10 MHz		≤ –117 dBm, characteristic
10 MHz to 1.0 GHz	≤ –117 dBm	
1.0 GHz to 2.0 GHz	≤ –116 dBm	
2.0 GHz to 3.0 GHz	≤ –114 dBm	

	Specifications	Supplemental Information
Display Range		
Log Scale	Ten divisions displayed; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps Calibrated 0 to –85 dB from Reference Level	
Linear Scale	Ten divisions	
Scale Units	dBm, dBmV, dBμV, V and W	

	Specifications	Supplemental Information
Marker Readout Resolution		
Log scale		
0 to –85 dB from ref level	0.04 dB	
Linear scale	0.01% of Reference Level	

	Specifications	Supplemental Information
Frequency Response		
50 Ω, Absolute[a]/Relative		
9 kHz to 3.0 GHz		
10 dB attenuation		
20 to 30 °C	±0.5 dB	
0 to 55 °C	±1.0 dB	

a. Absolute flatness values are referenced to the amplitude at 50 MHz.

	Specifications	Supplemental Information
Input Attenuation Switching Uncertainty at 50 MHz		
Attenuator Setting		
0 dB to 5 dB	±0.3 dB	
10 dB	Reference	
15 dB	±0.3 dB	
20 to 65 dB	±(0.1 dB + 0.01 × Attenuator Setting)	

Attenuation Accuracy Relative to the 10 dB Attenuator Setting, Characteristic	
	Frequency Range
Attenuation, dB	**dc–3.0 GHz, (± dB)**
0	0.3
5	0.3
10 (Reference)	Reference
15	0.4
20	0.4
25	0.5
30	0.5
35	0.6
40	0.6
45	0.7
50	0.7
55	0.9
60	0.9
65	1.0

	Specifications	Supplemental Information
Absolute Amplitude Accuracy		
At reference settings [a]	±0.4 dB	
Overall Amplitude Accuracy[b]		
20 to 30 °C	± (0.6 dB + Absolute Frequency Response)	

a. Settings are: reference level –20 dBm; input attenuation 10 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, signal at reference level.

b. For reference level 0 to –50 dBm; input attenuation 10 dB; RBW 1 kHz; VBW 1 kHz; scale log, log range 0 to 50 dB from reference level; sweep time coupled; signal input 0 to –50 dBm; span ≤20 kHz.

	Specifications	Supplemental Information
RF Input VSWR (at tuned frequency)		
Attenuator setting 0 dB		
100 kHz to 3 GHz		3.0:1, characteristic
Attenuator setting 5 dB		
100 kHz to 3 GHz		1.6:1, characteristic
Attenuator setting 10 to 65 dB		
9 kHz to 100 kHz		2.0:1, characteristic
100 kHz to 3 GHz		1.4:1, characteristic

	Specifications	Supplemental Information
Auto Alignment[a]		
Sweep-to-sweep variation		±0.1 dB, characteristic

a. Set **Auto Align** to **Off** and use **Align Now, All** to eliminate this variation.

	Specifications	Supplemental Information
Resolution Bandwidth Switching Uncertainty (at Reference Level)		
1 kHz RBW	Reference	
3 kHz to 3 MHz RBW	±0.3 dB	
5 MHz RBW	±0.6 dB	

	Specifications	Supplemental Information
Reference Level		
Range	Adjustable over Amplitude Measurement Range	
Resolution		
Log Scale	±0.1 dB	
Linear Scale	±0.12% of Reference Level	
Accuracy (at a fixed frequency, a fixed attenuator, and referenced to –30 dBm)		
Reference Level (dBm) – input attenuator setting (dB)		
–10 dBm to > –60 dBm	±0.3 dB	
–60 dBm to > –85 dBm	±0.5 dB	
–85 dBm to –90 dBm	±0.7 dB	

	Specifications	Supplemental Information
Display Scale Switching Uncertainty		
Switching between Linear and Log	±0.15 dB at Reference Level	
Log Scale Switching	No error	

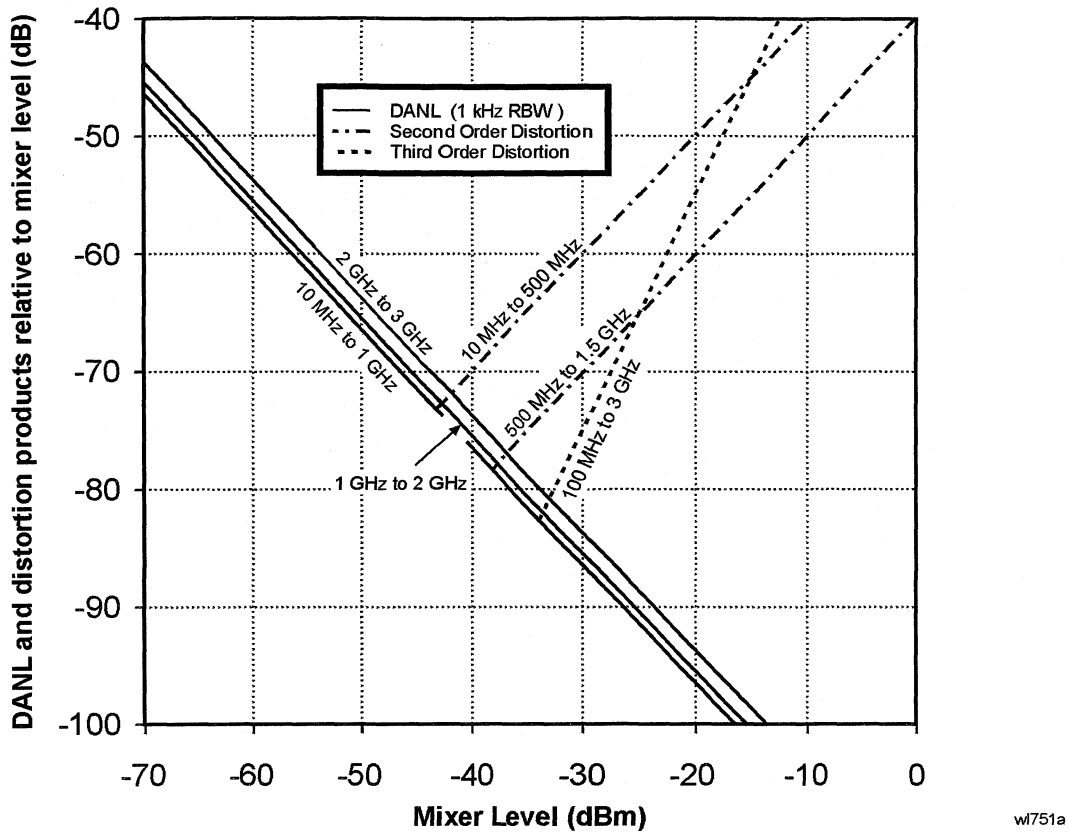
	Specifications	Supplemental Information
Display Scale Fidelity		
Log Maximum Cumulative		
0 to –85 dB from Reference Level	±(0.3 dB + 0.01 × dB from Reference Level)	
Log Incremental Accuracy		
0 to –80 dB[a] from reference level	±0.4 dB/4 dB	
Linear Accuracy	±2% of Reference Level	

a. 0 to –50 dB for RBWs ≤ 300 Hz and span = 0 Hz, or when auto ranging is off.

	Specifications	Supplemental Information
Spurious Responses		
Second Harmonic Distortion		
Input Signal		
10 MHz to 500 MHz	< –60 dBc for –30 dBm signal at input mixer[a]	+30 dBm SHI (second harmonic intercept)
500 MHz to 1.5 GHz	< –70 dBc for –30 dBm signal at input mixer[a]	+40 dBm SHI
Third Order Intermodulation Distortion		
10 MHz to 100 MHz		+5 dBm TOI (third order intercept), characteristic
100 MHz to 3 GHz	< –75 dBc for two –30 dBm signals at input mixer[a] and >50 kHz separation	+7.5 dBm TOI
Other Input Related Spurious		
>30 kHz offset	< –65 dBc for –20 dBm signal at input mixer[a]	

a. Mixer power level (dBm) = input power (dBm – input attentuation (dB)

Specified Dynamic Range



	Specifications	Supplemental Information
Residual Responses (Input terminated and 0 dB attenuation)		
150 kHz to 3 GHz	< –90 dBm	

Options

Tracking Generator (Option 1DN)

The spectrum analyzer tracking generator combination will meet its specification after a cable (8120-5148) and adapter are connected between RF OUT and INPUT and **Align Now**, **TG** has been run.

	Specifications	Supplemental Information
Warm-Up	5 minutes	

	Specifications	Supplemental Information
Output Frequency Range	9 kHz to 3.0 GHz	

	Specifications	Supplemental Information
Output Power Level		
Range	–2 to –66 dBm	
Resolution	0.1 dB	
Absolute Accuracy (at 50 MHz with coupled source attenuator, referenced to –20 dBm)	± 0.75 dB	
Vernier		
Range	8 dB	
Accuracy (with coupled source attenuator, 50 MHz, –20 dBm)		
Incremental	±0.2 dB/dB	
Cumulative	±0.5 dB, total	
Output Attenuator Range	0 to 56 dB in 8 dB steps	

	Specifications	Supplemental Information
Maximum Safe Reverse Level		+30 dBm (1 W), +30 Vdc, characteristic

	Specifications	Supplemental Information
Output Power Sweep		
Range	(–10 dBm to –2 dBm) – (Source Attenuator Setting)	
Resolution	0.1 dB	
Accuracy (zero span)	<1 dB peak-to-peak	

	Specifications	Supplemental Information
Output Flatness		
Referenced to 50 MHz, –20 dBm		
9 kHz to 10 MHz	±3 dB	
10 MHz to 3 GHz	±2 dB	

	Specifications	Supplemental Information
Spurious Outputs		
(–2 dBm output)		
Harmonic Spurs		
TG Output 9 kHz to 20 kHz	≤ –15 dBc	
TG Output 20 kHz to 3 GHz	≤ –25 dBc	
Non-harmonic Spurs		
TG Output 9 kHz to 2 GHz	≤ –27 dBc	
TG Output 2 GHz to 3 GHz	≤ –23 dBc	
LO Feedthrough		
LO Frequency 3.921409 to 6.9214 GHz	≤ –16 dBm	

	Specifications	Supplemental Information
Dynamic Range	Maximum Output Power Level – Displayed Average Noise Level	

	Specifications	Supplemental Information
Output Tracking		
Drift		1.5 kHz/5 minute, characteristic
Swept Tracking Error		Usable in 1 kHz RBW after 5 minutes of warm-up

	Specifications	Supplemental Information
RF Power-Off Residuals		
9 kHz to 3 GHz		< –120 dBm, characteristic

	Specifications	Supplemental Information
Output Attenuator Repeatability		
9 kHz to 300 MHz		±0.1 dB, characteristic
300 MHz to 2.0 GHz		±0.2 dB, characteristic
2.0 GHz to 3 GHz		±0.3 dB, characteristic

	Specifications	Supplemental Information
Output VSWR		
0 dB attenuation		<2.0:1, characteristic
≥ 8 dB attenuation		<1.5:1, characteristic

	Specifications	Supplemental Information
Output Attenuator Accuracy		
0 dB		±0.5 dB, characteristic
8 dB		±0.5 dB, characteristic
16 dB	Reference	
24 dB		±0.5 dB, characteristic
32 dB		±0.6 dB, characteristic
40 dB		±0.8 dB, characteristic
48 dB		±1.0 dB, characteristic
56 dB		±1.1 dB, characteristic

Tracking Generator Output Accuracy
Relative Accuracy (Referred to –20 dBm) = Output Attenuator Accuracy + Vernier Accuracy + Output Flatness
Absolute Accuracy = Relative Accuracy (Referred to –20 dBm) + Absolute Accuracy at 50 MHz

	Specifications	Supplemental Information
Output Power Level		
Range	–2 to –66 dBm	
Resolution	0.1 dB	
Absolute Accuracy (at 50 MHz with coupled source attenuator, referenced to –20 dBm)	± 0.75 dB	
Vernier		
Range	8 dB	
Accuracy (with coupled source attenuator, 50 MHz, –20 dBm)		
Incremental	±0.2 dB/dB	
Cumulative	±0.5 dB, total	
Output Attenuator Range	0 to 56 dB in 8 dB steps	

General

	Specifications	Supplemental Information
Temperature Range		
Operating	0 to 55 °C	Floppy disk 10 to 40 °C
Storage	–40 to +75 °C	

	Specifications	Supplemental Information
Audible Noise (ISO 7779)		
Sound Pressure at 25 °C		<40 dBa, (<4.6 Bels power)

	Specifications	Supplemental Information
Military Specification	Has been type tested to the environmental specifications of MIL-PRF-28800F class 3.	

	Specifications	Supplemental Information
EMI Compatibility	Conducted and radiated emission is in compliance with CISPR Pub. 11/1990 Group 1 Class A.	

	Specifications	Supplemental Information
Immunity Testing		
Radiated Immunity		Testing was done at 3 V/m according to IEC 801-3/1984. When the analyzer tuned frequency is identical to the immunity test signal frequency there may be signals of up to –60 dBm displayed on the screen.
Electrostatic Discharge		Air discharges of up to 8 kV were applied according to IEC 801-2/1991. Discharges to center pins of any of the connectors may cause damage to the associated circuitry.

	Specifications	Supplemental Information
Power Requirements		Uses CUKonverter® topology in the power supply.
ac Operation		
Voltage, frequency	90 to 132 V rms, 47 to 440 Hz 195 to 250 V rms, 47 to 66 Hz	
Power Consumption, On	<300 W	
Power Consumption, Standby	<5 W	
dc Operation		
Voltage	12 to 20 Vdc	
Power Consumption	<200 W	

	Specifications	Supplemental Information
Measurement Speed		
Local Measurement and Display Update rate[a]		≥ 28/s, characteristic
Remote Measurement and HP-IB Transfer Rate[b] *(Option A4H)*		≥ 19/s, characteristic

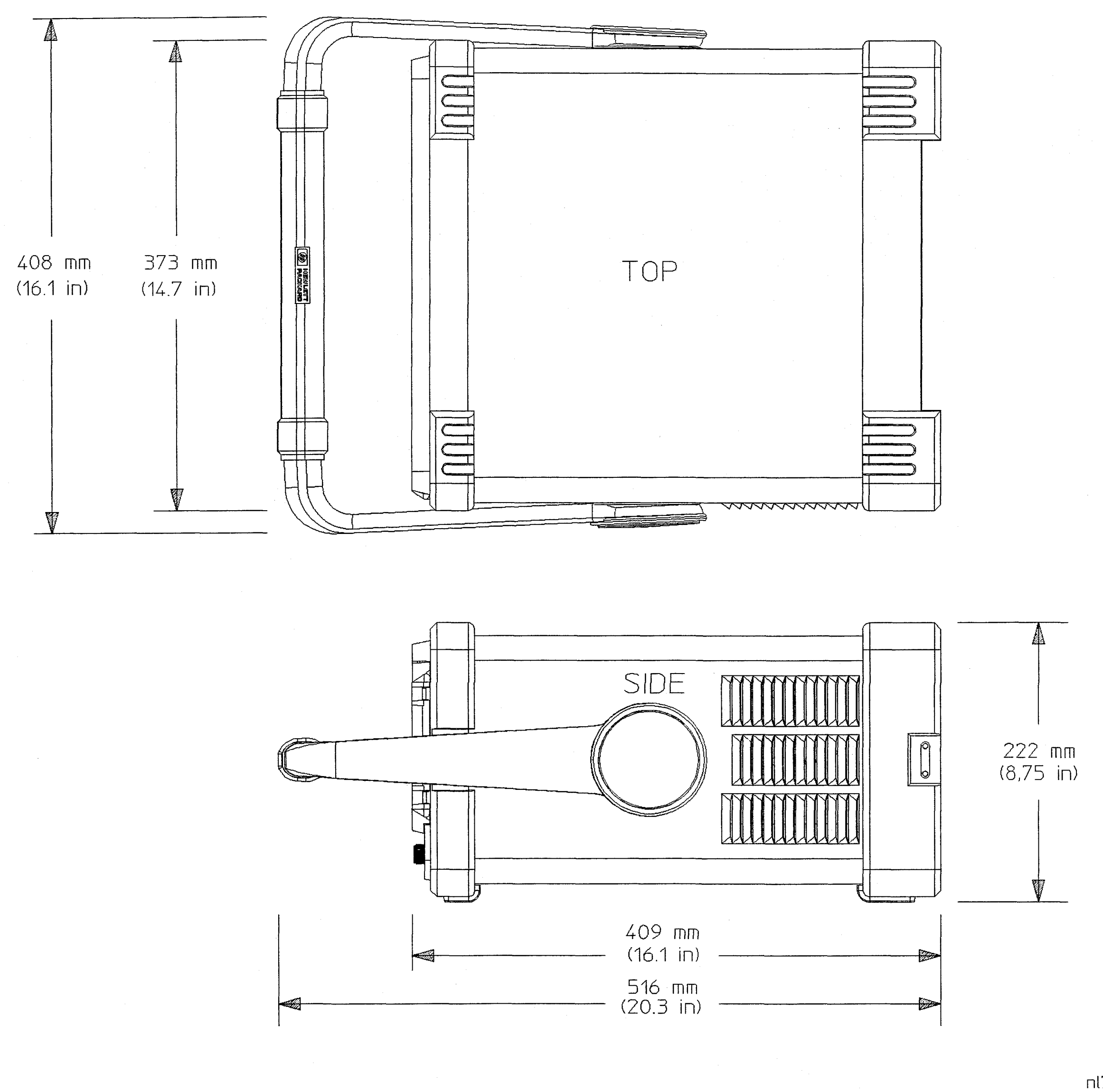
a. Auto align off, 5 ms sweep time, fixed center frequency.
b. Auto align off, 5 ms sweep time, fixed center frequency, 401 point trace, display off (DISPlay:ENABle off), and 32-bit integer data format (FORMat:DATA INT,32).

	Specifications	Supplemental Information
Data Storage		
Internal		200 Traces or States
External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS® compatible floppy disk		200 Traces or States

	Specifications	Supplemental Information
Demod Tune Listen		
AM		Internal speaker, front-panel earphone jack and front-panel volume control.
(Option A4J)		An uncalibrated demodulated signal is available on the AUX VIDEO OUT connector at the rear panel.

	Specifications	Supplemental Information
Weight (without options)		
Net		14.9 kg (32.9 lb), characteristic
Shipping		29.5 kg (65 lb), characteristic

Dimensions


408 mm
(16.1 in)
373 mm
(14.7 in)
TOP
SIDE
222 mm
(8.75 in)
409 mm
(16.1 in)
516 mm
(20.3 in)
nl7

Inputs and Outputs

Front Panel

	Specifications	Supplemental Information
INPUT 50 Ω		
Connector	Type-N female	
Impedance		50 Ω, nominal

	Specifications	Supplemental Information
RF OUT 50 Ω, *(Option 1DN)*		
Connector	Type-N female	
Impedance		50 Ω, nominal

	Specifications	Supplemental Information
AMPTD REF OUT[a]		Amplitude Reference
Connector	BNC Female	
Impedance		50 Ω, nominal
Frequency		50 MHz
Frequency Accuracy		Frequency reference error[b]
50 Ω Amplitude[c]		−20 dBm, nominal

a. Turn the amplitude reference on/off by pressing the keys: **Input**, **Amptd Ref Out**.
b. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).
c. The internal amplitude reference actual power is stored internally.

	Specifications	Supplemental Information
PROBE POWER		
Voltage/Current		+15 Vdc, ±7% at 150 mA max., characteristic −12.6 Vdc ±10% at 150 mA max., characteristic

	Specifications	Supplemental Information
EXT KEYBOARD		Feature not implemented.
Connector	6-pin mini-DIN	

	Specifications	Supplemental Information
Speaker		Front panel knob controls volume

	Specifications	Supplemental Information
Headphone		Front panel knob controls volume
Connector	3.5 mm (1/8 inch) miniature audio jack	
Power Output		0.2 W into 4 Ω, characteristic

Rear Panel

	Specifications	Supplemental Information
10 MHz REF OUT		
Connector	BNC female	
Impedance		50 Ω, nominal
Output Amplitude		>0 dBm, characteristic

	Specifications	Supplemental Information
10 MHz REF IN		
Connector	BNC female	Note: Analyzer noise sidebands and spurious response performance may be affected by the quality of the external reference used.
Impedance		50 Ω, nominal
Input Amplitude Range		–15 to +10 dBm, characteristic
Frequency		10 MHz, nominal

	Specifications	Supplemental Information
GATE TRIG/EXT TRIG IN		
Connector	BNC female	
External Trigger Input		
Trigger Level		Selectable positive or negative edge initiates sweep in EXT TRIG mode (5 V TTL)

	Specifications	Supplemental Information
GATE/HI SWP OUT		
Connector	BNC female	
High Sweep Output		
Level		High = sweep; Low = retrace (5 V TTL)

	Specifications	Supplemental Information
VGA OUTPUT		
Connector	VGA compatible, 15-pin mini D-SUB	
Format		VGA (31.5 kHz horizontal, 60 Hz vertical sync rates, non-interlaced) Analog RGB
Resolution	640 × 480	

	Specifications	Supplemental Information
AUX IF OUT *(Option A4J)*		
Connector	BNC female	
Frequency		21.4 MHz, nominal
Amplitude Range (for signal at reference level and for reference levels – input attenuation of –10 to –70 dBm)		–10 dBm (uncorrected), characteristic
Impedance		50 Ω, nominal

	Specifications	Supplemental Information
AUX VIDEO OUT *(Option A4J)*		
Connector	BNC female	
Amplitude Range (into >10 kΩ)		0 to 1 V (uncorrected), characteristic

	Specifications	Supplemental Information
HI SWP IN *(Option A4J)*		
Connector	BNC female	
Input		Open collector, low stops sweep (5 V TTL)

	Specifications	Supplemental Information
HI SWP OUT *(Option A4J)*		
Connector	BNC female	
Output		High = sweep, Low = retrace (5 V TTL)

	Specifications	Supplemental Information
SWP OUT *(Option A4J)*		
Connector	BNC female	
Amplitude		0 to +10 V ramp, characteristic

	Specifications	Supplemental Information
HP-IB Interface *(Option A4H)*		
Connector	IEEE-488 bus connector	
HP-IB Codes		SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3 and C28

	Specifications	Supplemental Information
Serial Interface *(Option 1AX)*		
Connector	9-pin D-SUB male	RS-232

	Specifications	Supplemental Information
Parallel Interface *(Option A4H or 1AX)*		Printer port only
Connector	25-pin D-SUB female	

Regulatory Information

CAUTION This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 1010 and 664 respectively.

NOTE This product has been designed and tested in accordance with IEC Publication 1010, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

The CE mark is a registered trademark of the European Community (if accompanied by a year, it is the year when the design was proven).

The CSA mark is the Canadian Standards Association safety mark.

ISM 1-A This is a symbol of an Industrial Scientific and Medical Group 1 Class A product. (CISPR 11, Clause 4)

Declaration of Conformity

DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name: Hewlett-Packard Co.

Manufacturer's Address: 1400 Fountaingrove Parkway
Santa Rosa, CA 95403-1799
USA

Declares that the products

Product Name: Spectrum Analyzer

Model Number: HP E4401B, HP E4402B, HP E4403B,
HP E4404B, HP E4405B, HP E4407B,
HP E4408B, HP E4411B

Product Options: This declaration covers all options of the above products.

Conform to the following Product specifications:

Safety: IEC 61010-1:1990 / EN 61010-1:1993
CAN/CSA-C22.2 No. 1010.1-92

EMC: CISPR 11:1990/EN 55011:1991 Group 1, Class A
IEC 801-2:1984/EN 50082-1:1992 4 kV CD, 8 kV AD
IEC 801-3:1984/EN 50082-1:1992 3 V/m, 27-500 MHz
IEC 801-4:1988/EN 50082-1:1992 0.5 kV sig. lines, 1 kV power lines

Supplementary Information:

The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.

Santa Rosa, CA, USA 7 Jan. 1999

Greg Pfeiffer/Quality Engineering Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH Department HQ-TRE, Herreneberger Strasse 130, D71034 Boblingen, Germany (FAX +49-7031-14-3143)

7 HP E4404B Specifications and Characteristics

About This Chapter

This chapter contains specifications and characteristics for the HP E4404B spectrum analyzer. The distinction between specifications and characteristics is described as follows.

- Specifications describe the performance of parameters covered by the product warranty. (The temperature range is 0 °C to 55 °C, unless otherwise noted.)
- Characteristics describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- Typical performance describes additional product performance information that is not covered by the product warranty. It is performance beyond an indicated specification, that most units will exhibit.
- Nominal values indicate the expected, but not warranted, value of a parameter.

The following conditions must be met for the analyzer to meet its specifications.

❑ The analyzer is within the one year calibration cycle.

❑ If **Auto Align All** is selected:

- — After 2 hours of storage within the operating temperature range.
- — 5 minutes after the analyzer is turned on with sweep times less than 4 seconds.
- — After the front-panel amplitude reference is connected to the INPUT, and **Align Now RF** has been run, after the analyzer is turned on. And, once every 24 hours, or if ambient temperature changes more than 30 °C[1].

❑ If **Auto Align Off** is selected:

- — When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes,
- — After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now All** has been run.
- — When **Align Now All** is run:
    - Every hour

1. 10 °C if Option 1DS is active.

- If the ambient temperature changes more than 3 °C
- If the 10 MHz reference changes

— When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):

- Every 24 hours
- If the ambient temperature changes more than 30 °C[1]

❑ If **Auto Align All but RF** is selected:

— When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.

— After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now RF** has been run.

— When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):

- Every hour
- If the ambient temperature changes more than 3 °C

1. 10 °C if Option 1DS is active.

Frequency

	Specifications	Supplemental Information
Frequency Range		
dc Coupled	9 kHz to 6.7 GHz	
ac Coupled	100 kHz to 6.7 GHz	
Band		
0	9 kHz to 3.0 GHz	
1	2.85 GHz to 6.7 GHz	
Preamp On *(Option 1DS)*	1 MHz to 3 GHz	

	Specifications	Supplemental Information
Frequency Reference		
Aging Rate	$\pm 2 \times 10^{-6}$/year	$\pm 1.0 \times 10^{-7}$/day, characteristic
Settability	$\pm 5 \times 10^{-7}$	
Temperature Stability	$\pm 5 \times 10^{-6}$	

	Specifications	Supplemental Information
High Stability Frequency Reference *(Option 1D5)*		
Aging Rate	$\pm1 \times 10^{-7}$/year	$\pm5 \times 10^{-10}$/day, 7-day average after being powered on for 7 days, characteristic
Settability	$\pm1 \times 10^{-8}$	
Temperature Stability		
20 to 30 °C	$\pm1 \times 10^{-8}$	
0 to 55 °C	$\pm5 \times 10^{-8}$	
Warm-Up (Internal frequency reference selected)		
After 5 minutes		$< \pm1\times 10^{-7}$ of final frequency,[a] characteristic
After 15 minutes		$< \pm1\times 10^{-8}$ of final frequency,[a] characteristic

a. Final frequency is defined as frequency 60 minutes after power-on with analyzer set to internal frequency reference.

	Specifications	Supplemental Information
Frequency Readout Accuracy		
(Start, Stop, Center, Marker)	±(frequency indication × frequency reference error[a] + span accuracy + 15% of RBW + 10 Hz)	

a. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).

	Specifications	Supplemental Information
Marker Frequency Counter		
Resolution	Selectable from 1 Hz to 100 kHz	
Accuracy[a]	±(marker frequency × frequency reference error[b] + counter resolution)	For RBW ≥ 1 kHz

a. Marker level to displayed noise level > 25 dB, RBW/ Span ≥ 0.002, frequency offset = 0 Hz.
b. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).

	Specifications	Supplemental Information
Frequency Span		
Range	0 Hz (zero span), 100 Hz to 6.7 GHz	
Resolution	2 Hz	
Accuracy	±1% of span	

	Specifications	Supplemental Information
Sweep Time		
Range	5 ms to 2000 s	50 ms is the minimum sweep time with the tracking generator in operation *(Option 1DN)*
(Option AYX)	20 μs to 2000 s	For Span = 0 Hz, RBW ≥ 1 kHz
Accuracy		
Span = 0 Hz 5 ms to 2000 s	±1%	
20 μs to < 5ms *(Option AYX)*	±1%	
Sweep Trigger[a][b]	Free Run, Single, Line, Video, External, Delayed, Gate *(Option 1D6)*, TV *(Option B7B)*	
Delayed Trigger[a][c]		
Range	1 μs to 400 s	
Resolution	[(delay in seconds)/65000] rounded up to nearest μs	
Accuracy	±(500 ns +(0.01% of delay))	

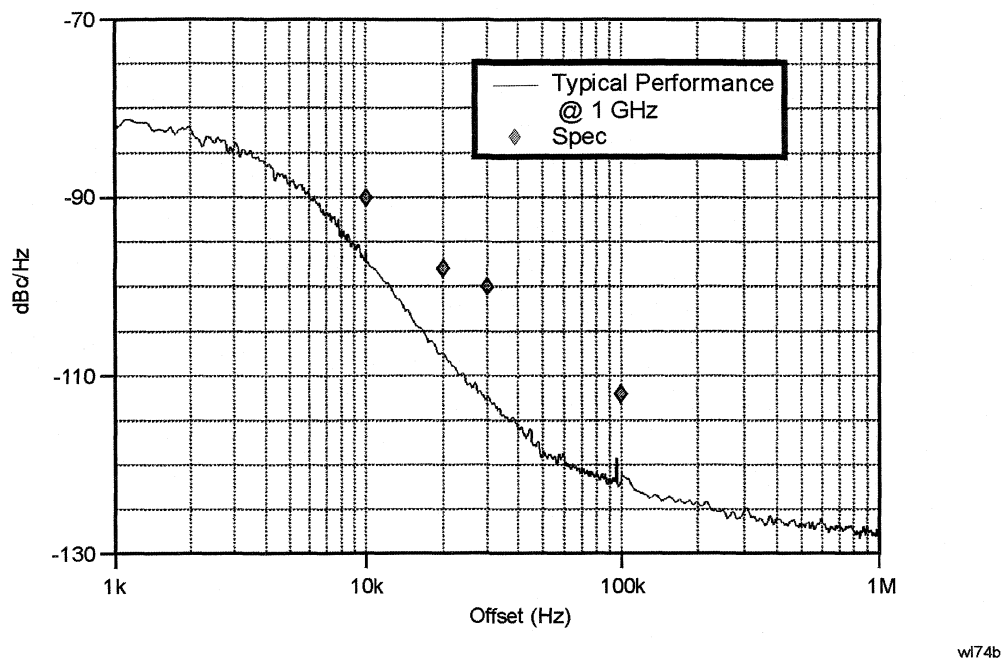
a. Gate cannot be used simultaneously with delayed or TV trigger.
b. Auto align is suspended in video, external, gate, and delayed trigger modes while waiting for a trigger event to occur.
c. Delayed trigger is available with line, external, and TV trigger (Option B7B).

	Specifications	Supplemental Information
Resolution Bandwidth (RBW)		
Range		
–3 dB bandwidth	1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz	
–6 dB bandwidth (EMI)	9 kHz and 120 kHz	
(Option 1DR)		Only available in spans ≤ 5 MHz, sweep times ≥ 5 ms, and not usable with tracking generator in operation (*Option 1DN*)
–3 dB bandwidth	Adds 10, 30, 100, 300 Hz	
–6 dB bandwidth (EMI)	Add 200 Hz	
Accuracy		
1 kHz to 3 MHz RBW	±15%	
5 MHz RBW	±30%	
10 Hz to 300 Hz RBW *(Option 1DR)*	±10%	
Shape		
1 kHz to 5 MHz RBW		Synchronously tuned four poles, approximately Gaussian shape
10 Hz to 300 Hz RBW *(Option 1DR)*		Digital, approximately Gaussian shape
Selectivity (60 dB/3 dB bandwidth ratio)		
1 kHz to 5 MHz RBW		<15:1, characteristic
10 Hz to 300 Hz RBW *(Option 1DR)*		<5:1, characteristic

	Specifications	Supplemental Information
Video Bandwidth (VBW) (–3 dB)		
Range	30 Hz to 1 MHz in 1-3-10 sequence	3 MHz, characteristic
(Option 1DR)	Adds 1, 3, 10 Hz for RBW's <1 kHz	
Accuracy		±30%, characteristic
Shape		Post detection, single pole low-pass filter used to average displayed noise Video bandwidths below 30 Hz are digital bandwidths with anti-aliasing filtering.

	Specifications	Supplemental Information
Stability		
Noise Sidebands, offset from CW signal with 1 kHz RBW, 30 Hz VBW and sample detector		
≥10 kHz	≤ –90 dBc/Hz	
≥20 kHz	≤ –98 dBc/Hz	
≥30 kHz	≤ –100 dBc/Hz	
≥100 kHz	≤ –112 dBc/Hz	
Residual FM		
1 kHz RBW, 1 kHz VBW	≤150 Hz p–p in 100 ms	
(Option 1D5)	≤100 Hz p–p in 100 ms	
10 Hz RBW, 10 Hz VBW *(Option 1DR and 1D5)*	≤2 Hz p–p in 20 ms	
10 Hz RBW, 10 Hz VBW *(Option 1DR)*		≤10 Hz p–p in 20 ms, characteristic
System-Related Sidebands, offset from CW signal		
≥30 kHz	≤ –65 dBc	
Line-Related Sidebands, offset from CW signal *(Option 1DR)*		
<300 Hz		≤ –50 dBc, characteristic
>300 Hz to 30 kHz		≤ –55 dBc, characteristic

Noise Sidebands Normalized to 1 Hz Versus Offset From Carrier



Amplitude

Amplitude specifications do not apply for the negative peak detector mode.

	Specifications	Supplemental Information
Measurement Range	Displayed Average Noise Level to Maximum Safe Input Level	
Input Attenuator Range	0 to 65 dB, in 5 dB steps	

	Specifications	Supplemental Information
Maximum Safe Input Level		
Average Continuous Power	+30 dBm (1 W)	
Input attenuator setting ≥5 dB		
Peak Pulse Power for <10 µsec pulse width, <1% duty cycle, and input attenuation ≥30 dB	+50 dBm (100 W)	
dc		
dc Coupled	0 Vdc	
ac Coupled	50 Vdc	

	Specifications	Supplemental Information
1 dB Gain Compression		
Total power at input mixer [a][b]		
50 MHz to 3.0 GHz	0 dBm	
3.0 GHz to 6.7 GHz	0 dBm	
Preamp On *(Option 1DS)* Total power at the preamp[c]		–20 dBm, characteristic

a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).

b. For resolution bandwidths 1 kHz to 30 kHz, the maximum input signal amplitude must be ≤ reference level +10 dB.

c. Total power at the preamp (dBm) = total power at the input (dBm) – input attenuation (dB).

	Specifications		Supplemental Information	
Displayed Average Noise Level (Input terminated, 0 dB attenuation, sample detector, Reference Level = –70 dBm)				
	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW (*Option 1DR*)	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW (*Option 1DR*)
1 MHz to 10 MHz			≤ –116 dBm, characteristic	≤ –134 dBm, characteristic
10 MHz to 1.0 GHz	≤ –116 dBm	≤ –135 dBm		
1.0 GHz to 2.0 GHz	≤ –115 dBm	≤ –134 dBm		
2.0 GHz to 3.0 GHz	≤ –112 dBm	≤ –131 dBm		
3.0 GHz to 6.0 GHz	≤ –112 dBm	≤ –131 dBm		
6.0 GHz to 6.7 GHz	≤ –110 dBm	≤ –129 dBm		
Preamp On (*Option 1DS*)	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW (*Option 1DR*)	1 kHz RBW 30 Hz VBW	10 kHz RBW 1 Hz VBW (*Option 1DR*)
0 to 55 °C				
1 MHz to 10 MHz			≤ –131 dBm, characteristic	≤ –149 dBm, characteristic
10 MHz to 1.0 GHz	≤ –131 dBm	≤ –149 dBm		
1.0 GHz to 2.0 GHz	≤ –129 dBm	≤ –147 dBm		
2.0 GHz to 3.0 GHz	≤ –127 dBm	≤ –145 dBm		
20 to 30 °C				
10 MHz to 1.0 GHz	≤ –132 dBm	≤ –150 dBm		
1.0 GHz to 2.0 GHz	≤ –131 dBm	≤ –149 dBm		
2.0 GHz to 3.0 GHz	≤ –130 dBm	≤ –148 dBm		

	Specifications	Supplemental Information
Display Range		
Log Scale	Ten divisions displayed; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps	
RBW ≥ 1 kHz	Calibrated 0 to –85 dB from Reference Level	
RBW ≤ 300 Hz *(Option 1DR)*	Calibrated 0 to –120 dB[a] from Reference Level	
Linear Scale	Ten divisions	
Scale Units	dBm, dBmV, dBμV, V,W and Hz (Option BAA)	

a. 0 to –70 dB range when span = 0 Hz, or when auto ranging is off: (:DISPlay:WINDow:TRACe:Y[:SCALe]:LOG:RANGe:AUTO OFF).

	Specifications	Supplemental Information
Marker Readout Resolution		
Log scale		
RBW ≥ 1 kHz		
0 to –85 dB from ref level	0.04 dB	
RBW ≤ 300 Hz		
0 to –120 dB from ref level	0.04 dB	
Linear scale	0.01% of Reference Level	
Fast Sweep Times for Zero Span		
20 μs to <5 ms *(Option AYX)*		
Log		
0 to –85 dB from ref level	0.3 dB	
Linear	0.3% of Reference Level for linear scale	

	Specifications	Supplemental Information
Frequency Response		
50 Ω, Absolute[a]/Relative		
10 dB attenuation	9 kHz to 3.0 GHz (dc coupled)	100 kHz to 3.0 GHz (ac coupled)
20 to 30 °C	±0.5 dB	±0.5 dB, characteristic
0 to 55 °C	±1.0 dB	±1.0 dB, characteristic
50 Ω, Absolute[a]/Relative Preamp On *(Option 1DS)*		
1 MHz to 3.0 GHz	(dc coupled)	(ac coupled)
0 dB attenuation	±2.0 dB	±2.0 dB
Preselector centered for frequency >3.0 GHz		
3.0 GHz to 6.7 GHz	(dc coupled)	(ac coupled)
10 dB attenuation		
Absolute[a]		
20 to 30 °C	±1.5 dB	±1.5 dB, characteristic
0 to 55 °C	±2.5 dB	±2.5 dB, characteristic
Relative		
20 to 30 °C	±1.3 dB	±1.3 dB, characteristic
0 to 55 °C	±1.5 dB	±1.5 dB, characteristic

a. Absolute flatness values are referenced to the amplitude at 50 MHz.

	Specifications	Supplemental Information
Input Attenuation Switching Uncertainty at 50 MHz		
Attenuator Setting		
0 dB to 5 dB	±0.3 dB	
10 dB	Reference	
15 dB	±0.3 dB	
20 to 65 dB	±(0.1 dB + 0.01 × Attenuator Setting)	

	Specifications	Supplemental Information
Preamp *(Option 1DS)*		
Gain		+20 dB, nominal[a]
Noise figure		5 dB, characteristic

a. Amplifier is between the input attenuator and the input mixer.

Attenuation Accuracy Relative to the 10 dB Attenuator Setting, Characteristic		
	Frequency Range	
Attenuation, dB	**dc–3.0 GHz (± dB)**	**3.0–6.7 GHz (± dB)**
0	0.3	0.5
5	0.3	0.5
10 (Reference)	Reference	Reference
15	0.4	0.5
20	0.4	0.5
25	0.5	0.6
30	0.5	0.6
35	0.6	0.7
40	0.6	0.7
45	0.7	1.0
50	0.7	1.0
55	0.9	1.1
60	0.9	1.1
65	1.0	1.6

	Specifications	Supplemental Information
Absolute Amplitude Accuracy		
At reference settings [a]	±0.34 dB	
Preamp On[b] *(Option 1DS)*	±0.5 dB	
Overall Amplitude Accuracy[c]		
20 to 30 °C	± (0.54 dB + Absolute Frequency Response)	

a. Settings are: reference level –20 dBm; input attenuation 10 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, sample detector, signal at reference level.
b. Settings are: reference level –30 dBm; input attenuation 0 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, signal at reference level.
c. For reference level 0 to –50 dBm; input attenuation 10 dB; RBW 1 kHz; VBW 1 kHz; scale log, log range 0 to 50 dB from reference level; sweep time coupled; signal input 0 to –50 dBm; span ≤20 kHz.

	Specifications	Supplemental Information	
RF Input VSWR (at tuned frequency)		characteristic	characteristic
Attenuator setting 0 dB		(dc coupled)	(ac coupled)
9 kHz to 100 kHz		3.0:1	
100 kHz to 6.7 GHz		3.0:1	3.0:1
Attenuator setting 5 dB		(dc coupled)	(ac coupled)
9 kHz to 100 kHz		2.0:1	
100 kHz to 300 kHz		1.4:1	2.3:1
300 kHz to 1.0 MHz		1.4:1	1.6:1
1.0 MHz to 3.0 GHz		1.4:1	1.4:1
3.0 GHz to 6.7 GHz		1.4:1	1.7:1
Attenuator setting 10 to 65 dB		(dc coupled)	(ac coupled)
9 kHz to 100 kHz		2.0:1	
100 kHz to 300 kHz		1.3:1	2.1:1
300 kHz to 1.0 MHz		1.3:1	1.5:1
1.0 MHz to 3.0 GHz		1.3:1	1.3:1
3.0 GHz to 6.7 GHz		1.3:1	1.5:1

	Specifications	Supplemental Information
Auto Alignment[a]		
Sweep-to-sweep variation		±0.1 dB, characteristic

a. Set **Auto Align** to **Off** and use **Align Now, All** to eliminate this variation.

	Specifications	Supplemental Information
Resolution Bandwidth Switching Uncertainty (at Reference Level)		
1 kHz RBW	Reference	
3 kHz to 3 MHz RBW	±0.3 dB	
5 MHz RBW	±0.6 dB	
10 Hz to 300 Hz RBW *(Option 1DR)*	±0.3 dB	

	Specifications	Supplemental Information
Reference Level		
Range	Adjustable over Amplitude Measurement Range	
Resolution		
Log Scale	±0.1 dB	
Linear Scale	±0.12% of Reference Level	
Accuracy (at a fixed frequency, a fixed attenuator, and referenced to –30 dBm (–10 dBm, Preamp On *(Option 1DS)*))		
Reference Level (dBm) – input attenuator setting (dB) + preamp gain (dB)		
–10 dBm to > –60 dBm	±0.3 dB	
–60 dBm to > –85 dBm	±0.5 dB	
–85 dBm to –90 dBm	±0.7 dB	

	Specifications	Supplemental Information
Display Scale Switching Uncertainty		
Switching between Linear and Log	±0.15 dB at Reference Level	
Log Scale Switching	No error	

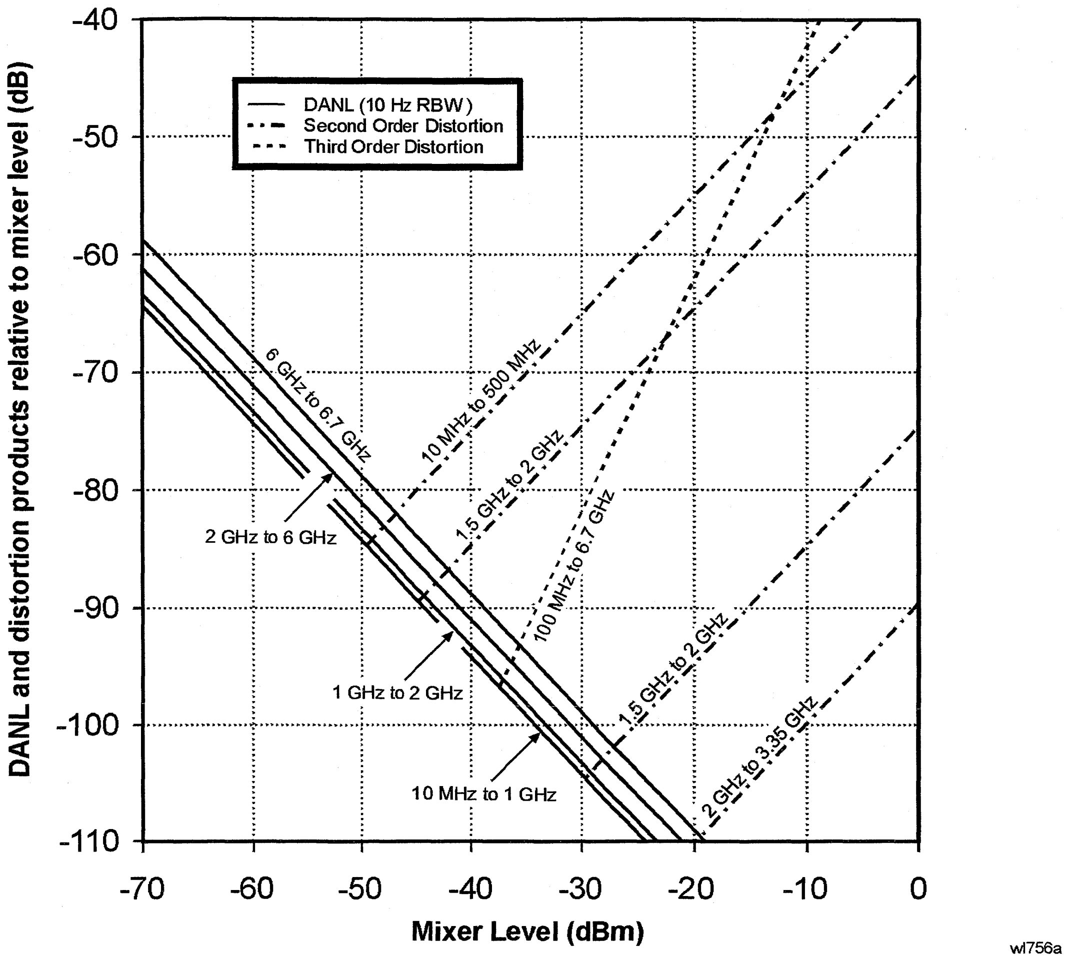
	Specifications	Supplemental Information
Display Scale Fidelity		
Log Maximum Cumulative		
0 to −85 dB from Reference Level	±(0.3 dB + 0.01 × dB from Reference Level)	
RBW ≤ 300 Hz *(Option 1DR)*		
Span > 0 Hz		
0 to −98 dB from Reference Level	±(0.3 dB + 0.01 × dB from Reference Level)	
−98 to −120 dB from Reference Level		±2.0 dB, characteristic
Span = 0 Hz[a]		
0 to −60 dB from Reference Level	±(0.3 dB + 0.015 × dB from Reference Level)	
−60 to −70 dB from Reference Level	±1.5 dB	
Log Incremental Accuracy		
0 to −80 dB[b] from reference level	±0.4 dB/4 dB	
Linear Accuracy	±2% of Reference Level	

a. or when auto ranging is off: (:DISPlay:WINDow:TRACe:Y[:SCALe]:LOG:RANGe:AUTO OFF)
b. 0 to −50 dB for RBWs ≤ 300 Hz and span = 0 Hz, or when auto ranging is off.

	Specifications	Supplemental Information
Spurious Responses		
Second Harmonic Distortion		
Input Signal		
10 MHz to 500 MHz	< –65 dBc for –30 dBm signal at input mixer[a]	+35 dBm SHI (second harmonic intercept)
500 MHz to 1.5 GHz	< –75 dBc for –30 dBm signal at input mixer[a]	+45 dBm SHI
1.5 GHz to 2.0 GHz	< –85 dBc for –10 dBm signal at input mixer[a]	+75 dBm SHI
2.0 GHz to 3.35 GHz	< –100 dBc[b] for –10 dBm signal at input mixer[a]	+90 dBm SHI
Preamp On *(Option 1DS)* 10 MHz to 1.5 GHz		–5 dBm SHI, characteristic
Third Order Intermodulation Distortion		
10 MHz to 100 MHz		+7 dBm TOI (third order intercept), characteristic
100 MHz to 3 GHz	< –82 dBc for two –30 dBm signals at input mixer[a] and >50 kHz separation	+11 dBm TOI +16 dBm TOI, typical, 20 to 30 °C
3.0 GHz to 6.7 GHz	< –82 dBc for two –30 dBm signals at input mixer[a] and >50 kHz separation	+11 dBm TOI +18 dBm TOI, typical, 20 to 30 °C
Preamp On *(Option 1DS)* 10 MHz to 3 GHz,		–16 dBm TOI, characteristic
Other Input Related Spurious		
Inband Responses		
>30 kHz offset	< –65 dBc for –20 dBm signal at input mixer[a]	
Out-of-band Responses	< –80 dBc for –10 dBm signal at input mixer[a]	

a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
b. or signal below displayed average noise level.

Specified Dynamic Range



	Specifications	Supplemental Information
Residual Responses (Input terminated and 0 dB attenuation)		
150 kHz to 6.7 GHz	< –90 dBm	

Options

Time Gated Spectrum Analysis (Option 1D6)

	Specifications	Supplemental Information
Gate Delay		
Range	1 μs to 400 s	
Accuracy	±(500 ns + (0.01% × (maximum of gate delay or length)))	From gate trigger input to positive edge of gate output
Gate Length		
Range	1 μs to 400 s	
Accuracy	±(500 ns + (0.01% × (maximum of gate delay or length)))	From positive edge to negative edge of gate output
Resolution	[(maximum of gate delay or length in seconds)/65000] rounded up to nearest μs	Dependent on the greater of gate delay or gate length
Additional Amplitude Error[a]		
Log Scale	±0.2 dB	
Linear Scale	±0.1 % of reference level	

a. While in gate mode.

Tracking Generator (Option 1DN)

The spectrum analyzer tracking generator combination will meet its specification after a cable (8120-5148) and adapter are connected between RF OUT and INPUT and **Align Now, TG** has been run.

	Specifications	Supplemental Information
Warm-Up	5 minutes	

	Specifications	Supplemental Information
Output Frequency Range	9 kHz to 3.0 GHz	

	Specifications	Supplemental Information
Minimum Resolution BW	1 kHz	Not usable with resolution bandwidths ≤300 Hz *(Option 1DR)*

	Specifications	Supplemental Information
Output Power Level		
Range	–2 to –66 dBm	
Resolution	0.1 dB	
Absolute Accuracy (at 50 MHz with coupled source attenuator, referenced to –20 dBm)	± 0.75 dB	
Vernier		
Range	8 dB	
Accuracy (with coupled source attenuator, 50 MHz, –20 dBm)		
Incremental	±0.2 dB/dB	
Cumulative	±0.5 dB, total	
Output Attenuator Range	0 to 56 dB in 8 dB steps	

	Specifications	Supplemental Information
Maximum Safe Reverse Level		+30 dBm (1 W), +30 Vdc, characteristic

	Specifications	Supplemental Information
Output Power Sweep		
Range	(–10 dBm to –2 dBm) – (Source Attenuator Setting)	
Resolution	0.1 dB	
Accuracy (zero span)	<1 dB peak-to-peak	

	Specifications	Supplemental Information
Output Flatness		
Referenced to 50 MHz, –20 dBm		
9 kHz to 10 MHz	±3 dB	
10 MHz to 3 GHz	±2 dB	

	Specifications	Supplemental Information
Spurious Outputs		
(–2 dBm output)		
Harmonic Spurs		
TG Output 9 kHz to 20 kHz	≤ –15 dBc	
TG Output 20 kHz to 3 GHz	≤ –25 dBc	
Non-harmonic Spurs		
TG Output 9 kHz to 2 GHz	≤ –27 dBc	
TG Output 2 GHz to 3 GHz	≤ –23 dBc	
LO Feedthrough		
LO Frequency 3.921409 to 6.9214 GHz	≤ –16 dBm	

	Specifications	Supplemental Information
Dynamic Range	Maximum Output Power Level – Displayed Average Noise Level	

	Specifications	Supplemental Information
Output Tracking		
Drift		1.5 kHz/5 minute, characteristic
Swept Tracking Error		Usable in 1 kHz RBW after 5 minutes of warm-up

	Specifications	Supplemental Information
RF Power-Off Residuals		
9 kHz to 3 GHz		< –120 dBm, characteristic

	Specifications	Supplemental Information
Output Attenuator Repeatability		
9 kHz to 300 MHz		±0.1 dB, characteristic
300 MHz to 2.0 GHz		±0.2 dB, characteristic
2.0 GHz to 3 GHz		±0.3 dB, characteristic

	Specifications	Supplemental Information
Output VSWR		
0 dB attenuation		<2.0:1, characteristic
≥ 8 dB attenuation		<1.5:1, characteristic

	Specifications	Supplemental Information
Output Attenuator Accuracy		
0 dB		±0.5 dB, characteristic
8 dB		±0.5 dB, characteristic
16 dB	Reference	
24 dB		±0.5 dB, characteristic
32 dB		±0.6 dB, characteristic
40 dB		±0.8 dB, characteristic
48 dB		±1.0 dB, characteristic
56 dB		±1.1 dB, characteristic

Tracking Generator Output Accuracy
Relative Accuracy (Referred to –20 dBm) = Output Attenuator Accuracy + Vernier Accuracy + Output Flatness
Absolute Accuracy = Relative Accuracy (Referred to –20 dBm) + Absolute Accuracy at 50 MHz

	Specifications	Supplemental Information
Output Power Level		
Range	–2 to –66 dBm	
Resolution	0.1 dB	
Absolute Accuracy (at 50 MHz with coupled source attenuator, referenced to –20 dBm)	± 0.75 dB	
Vernier		
Range	8 dB	
Accuracy (with coupled source attenuator, 50 MHz, –20 dBm)		
Incremental	±0.2 dB/dB	
Cumulative	±0.5 dB, total	
Output Attenuator Range	0 to 56 dB in 8 dB steps	

FM Demodulation (Option BAA)

The FM demodulation characteristics will be met after an **Align Now, FM Demod** has been run.

	Specifications	Supplemental Information
Input Level		≥ (–60 dBm + attenuator setting – preamp gain), characteristic
Signal Level		0 to –30 dB below reference level, characteristic
FM Deviation		
Range		10 kHz to 1 MHz
Resolution		Provides 1 Hz display annotation resolution
FM Deviation Range		
10 kHz to 40 kHz		12 Hz, characteristic
>40 kHz to 200 kHz		60 Hz, characteristic
>200 kHz to 1 MHz		300 Hz, characteristic
Accuracy[a] FM Rate < FM BW/100, VBW ≥(30 × FM Rate), RBW > the maximum of (30 × FM deviation) or (30 × FM Rate)		< (2% of FM deviation range + 2 × Resolution), characteristic
Offset Error[a]		5% of FM Deviation Range + 300 Hz, characteristic
FM Bandwidth *(–3 dB)*		
FM Deviation Range		
10 kHz to 40 kHz		7.5 × FM deviation range, characteristic
>40 kHz to 200 kHz		1.3 × FM deviation range, characteristic
>200 kHz to 1 MHz		0.3 × FM deviation range, characteristic

a. In time domain sweeps (span = 0 Hz).

TV Trigger and Picture On Screen (Option B7B)

	Specifications	Supplemental Information
TV Trigger and Picture On Screen		TV Trigger initiates a sweep of the analyzer after the sync pulse of a selected line of a TV video field. Picture On Screen displays the TV picture on the analyzer display.
Amplitude Requirements		
TV Source: SA		Top 50% of linear display, characteristic
TV Source: EXT VIDEO IN		500 mVp–p to 2 Vp–p, characteristic
Compatible Standards	NTSC–M, NTSC–Japan, PAL–M, PAL–B,D,G,H,I, PAL–N, PAL–N Combination, SECAM-L	
Field Selection	Entire frame, even, odd	
Sync Polarity	Positive or negative	
TV Trigger		
Line Selection	1 to 525, or 1 to 625, standard dependent	

General

	Specifications	Supplemental Information
Temperature Range		
Operating	0 to 55 °C	Floppy disk 10 to 40 °C
Storage	–40 to +75 °C	

	Specifications	Supplemental Information
Audible Noise (ISO 7779)		
Sound Pressure at 25 °C		<40 dBa, (<4.6 Bels power)

	Specifications	Supplemental Information
Military Specification	Has been type tested to the environmental specifications of MIL-PRF-28800F class 3.	

	Specifications	Supplemental Information
EMI Compatibility	Conducted and radiated emission is in compliance with CISPR Pub. 11/1990 Group 1 Class A.	

	Specifications	Supplemental Information
Immunity Testing		
Radiated Immunity		Testing was done at 3 V/m according to IEC 801-3/1984. When the analyzer tuned frequency is identical to the immunity test signal frequency there may be signals of up to –60 dBm displayed on the screen.
Electrostatic Discharge		Air discharges of up to 8 kV were applied according to IEC 801-2/1991. Discharges to center pins of any of the connectors may cause damage to the associated circuitry.

	Specifications	Supplemental Information
Power Requirements		Uses CUKonverter® topology in the power supply.
ac Operation		
Voltage, frequency	90 to 132 V rms, 47 to 440 Hz 195 to 250 V rms, 47 to 66 Hz	
Power Consumption, On	<300 W	
Power Consumption, Standby	<5 W	
dc Operation		
Voltage	12 to 20 Vdc	
Power Consumption	<200 W	

	Specifications	Supplemental Information
Measurement Speed		
Local Measurement and Display Update rate[a]		≥ 28/s, characteristic
Remote Measurement and HP-IB Transfer Rate[b] *(Option A4H)*		≥ 19/s, characteristic

a. Auto align off, 5 ms sweep time, fixed center frequency.
b. Auto align off, 5 ms sweep time, fixed center frequency, 401 point trace, display off (DISPlay:ENABle off), and 32-bit integer data format (FORMat:DATA INT,32).

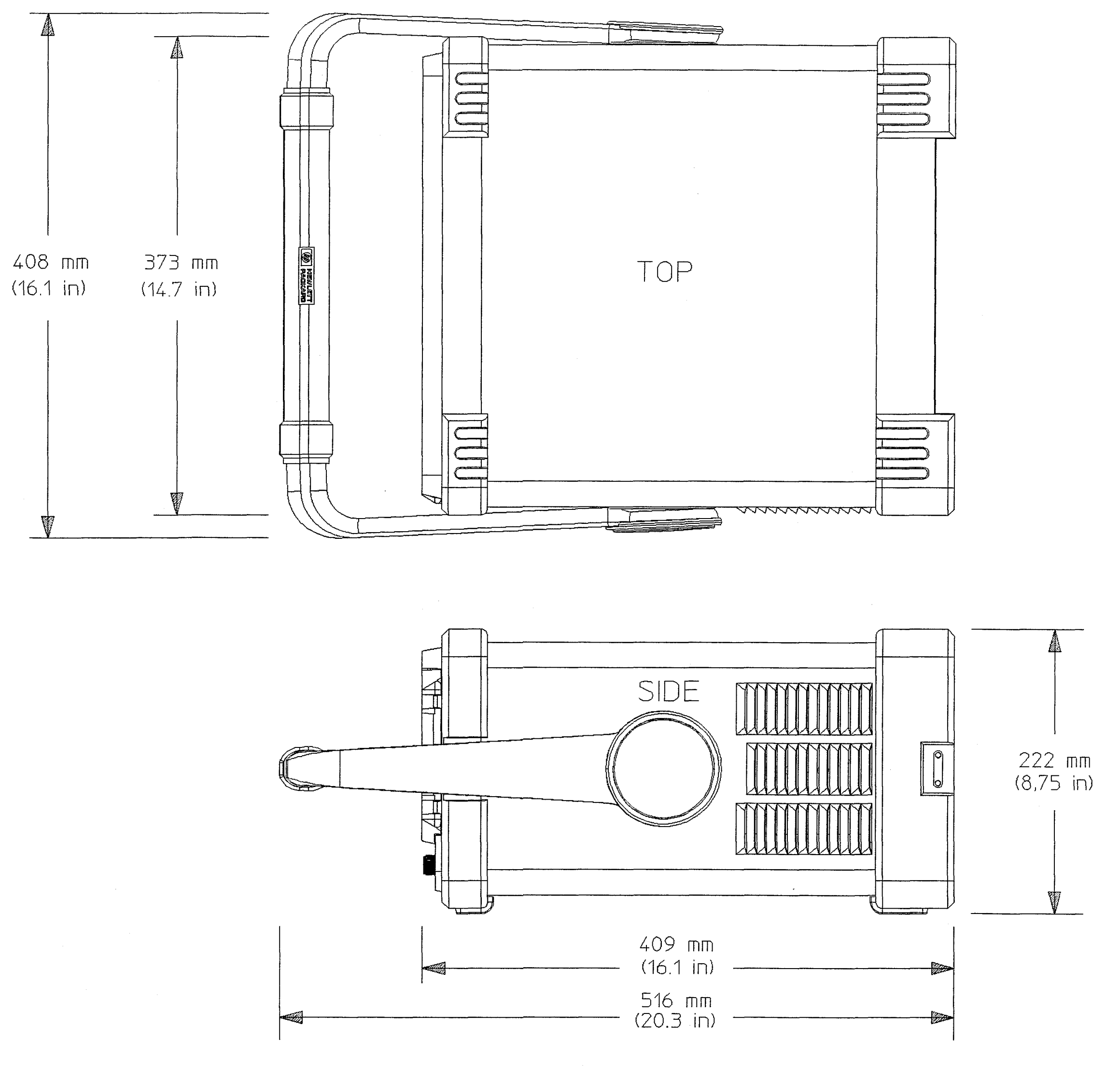
	Specifications	Supplemental Information
Data Storage		
Internal		200 Traces or States
External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS® compatible floppy disk		200 Traces or States

	Specifications	Supplemental Information
Downloadable Program Memory		2 MB available memory
(Option B72)		10 MB available memory

	Specifications	Supplemental Information
Demod Tune Listen		
AM		Internal speaker, front-panel earphone jack and front-panel volume control.
FM *(Option BAA)*		
(Option A4J, AYX, or BAA)		An uncalibrated demodulated signal is available on the AUX VIDEO OUT or EXT VIDEO OUT connectors at the rear panel.

	Specifications	Supplemental Information
Weight (without options)		
Net		16.2 kg (35.6 lb), characteristic
Shipping		31.0 kg (68 lb), characteristic

Dimensions



408 mm
(16.1 in)
373 mm
(14.7 in)
TOP
SIDE
222 mm
(8.75 in)
409 mm
(16.1 in)
516 mm
(20.3 in)
nl7

Inputs and Outputs

Front Panel

	Specifications	Supplemental Information
INPUT 50 Ω		
Connector	Type-N female	
Impedance		50 Ω, nominal

	Specifications	Supplemental Information
RF OUT 50 Ω, *(Option 1DN)*		
Connector	Type-N female	
Impedance		50 Ω, nominal

	Specifications	Supplemental Information
AMPTD REF OUT[a]		Amplitude Reference
Connector	BNC Female	
Impedance		50 Ω, nominal
Frequency		50 MHz
Frequency Accuracy		Frequency reference error[b]
50 Ω Amplitude[c]		–20 dBm, nominal

a. Turn the amplitude reference on/off by pressing the keys: **Input**, **Amptd Ref Out**.
b. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).
c. The internal amplitude reference actual power is stored internally.

	Specifications	Supplemental Information
PROBE POWER		
Voltage/Current		+15 Vdc, ±7% at 150 mA max., characteristic –12.6 Vdc ±10% at 150 mA max., characteristic

	Specifications	Supplemental Information
EXT KEYBOARD		Feature not implemented.
Connector	6-pin mini-DIN	

	Specifications	Supplemental Information
Speaker		Front panel knob controls volume

	Specifications	Supplemental Information
Headphone		Front panel knob controls volume
Connector	3.5 mm (1/8 inch) miniature audio jack	
Power Output		0.2 W into 4 Ω, characteristic

Rear Panel

	Specifications	Supplemental Information
10 MHz REF OUT		
Connector	BNC female	
Impedance		50 Ω, nominal
Output Amplitude		>0 dBm, characteristic

	Specifications	Supplemental Information
10 MHz REF IN		
Connector	BNC female	Note: Analyzer noise sidebands and spurious response performance may be affected by the quality of the external reference used.
Impedance		50 Ω, nominal
Input Amplitude Range		–15 to +10 dBm, characteristic
Frequency		10 MHz, nominal

	Specifications	Supplemental Information
GATE TRIG/EXT TRIG IN		
Connector	BNC female	
External Trigger Input		
Trigger Level		Selectable positive or negative edge initiates sweep in EXT TRIG mode (5 V TTL)
Gate Trigger Input *(Option 1D6)*		
Minimum Pulse Width		>30 ns (5 V TTL)

	Specifications	Supplemental Information
GATE/HI SWP OUT		
Connector	BNC female	
High Sweep Output		
Level		High = sweep; Low = retrace (5 V TTL)
Gate Output *(Option 1D6)*		
Level		High = gate on; Low = gate off (5 V TTL)

	Specifications	Supplemental Information
VGA OUTPUT		
Connector	VGA compatible, 15-pin mini D-SUB	
Format		VGA (31.5 kHz horizontal, 60 Hz vertical sync rates, non-interlaced) Analog RGB
Resolution	640 × 480	

	Specifications	Supplemental Information
AUX IF OUT *(Option A4J or AYX)*		RBW ≥ 1 kHz
Connector	BNC female	
Frequency		21.4 MHz, nominal
Amplitude Range (for signal at reference level and for reference levels – input attenuation + preamp gain of –10 to –70 dBm)		–10 dBm (uncorrected), characteristic
Impedance		50 Ω, nominal

	Specifications	Supplemental Information
AUX VIDEO OUT *(Option A4J or AYX)*		RBW ≥ 1 kHz
Connector	BNC female	
Amplitude Range (into >10 kΩ)		0 to 1 V (uncorrected), characteristic

	Specifications	Supplemental Information
HI SWP IN *(Option A4J or AYX)*		
Connector	BNC female	
Input		Open collector, low stops sweep (5 V TTL)

	Specifications	Supplemental Information
HI SWP OUT *(Option A4J or AYX)*		
Connector	BNC female	
Output		High = sweep, Low = retrace (5 V TTL)

	Specifications	Supplemental Information
SWP OUT *(Option A4J or AYX)*		
Connector	BNC female	
Amplitude		0 to +10 V ramp, characteristic

	Specifications	Supplemental Information
PRESEL TUNE OUTPUT		
Connector	BNC female	
Load Impedance (dc coupled)		> 10 kΩ, nominal
Range		0 to +10 V, characteristic
Sensitivity		0.33 V/GHz of tuned frequency > 3 GHz, characteristic

	Specifications	Supplemental Information
HP-IB Interface *(Option A4H)*		
Connector	IEEE-488 bus connector	
HP-IB Codes		SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3 and C28

	Specifications	Supplemental Information
Serial Interface *(Option 1AX)*		
Connector	9-pin D-SUB male	RS-232

	Specifications	Supplemental Information
Parallel Interface *(Option A4H or 1AX)*		Printer port only
Connector	25-pin D-SUB female	

	Specifications	Supplemental Information
EXT VIDEO IN/TV TRIG OUT[a] *(Option B7B or BAA)*		EXT VIDEO IN is the Baseband composite video input for TV trigger and picture on screen. TV TRIG OUT is the TV trigger output.
Connector	BNC Female (75 Ω)	
Impedance		75 Ω, characteristic.
(Option BAA without Option B7B)		Feature not implemented.
(Option BAA with Option B7B)		
External Video Input Video Amplitude		1 Vp–p, nominal, characteristic
TV Trigger Output		Positive edge indicates start of selected TV line after sync. pulse.
Amplitude		TTL (0 V and 3.4 V with 75 Ω series resistance), characteristic

a. This connector is labelled EXT VIDEO IN on older spectrum analyzers and EXT VIDEO IN/TV TRIG OUT on newer spectrum analyzers.

	Specifications	Supplemental Information
EXT VIDEO OUT *(Option B7B or BAA)*		Baseband video output RBW ≥ 1 kHz
Connector	BNC Female (75 Ω)	
Impedance		75 Ω, characteristic.
Amplitude *(Option BAA without Option B7B)*		0 to 1 V (uncorrected), characteristic
Amplitude *(Option BAA with Option B7B)*		
TV Source: SA		0 to 1 V (uncorrected), characteristic
TV Source and EXT VIDEO IN		Same as level at EXT VIDEO IN/TV TRIG OUT, characteristic

Regulatory Information

CAUTION

This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 1010 and 664 respectively.

NOTE

This product has been designed and tested in accordance with IEC Publication 1010, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

The CE mark is a registered trademark of the European Community (if accompanied by a year, it is the year when the design was proven).

The CSA mark is the Canadian Standards Association safety mark.

ISM 1-A

This is a symbol of an Industrial Scientific and Medical Group 1 Class A product. (CISPR 11, Clause 4)

Declaration of Conformity

DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name: Hewlett-Packard Co.

Manufacturer's Address: 1400 Fountaingrove Parkway
Santa Rosa, CA 95403-1799
USA

Declares that the products

Product Name: Spectrum Analyzer

Model Number: HP E4401B, HP E4402B, HP E4403B,
HP E4404B, HP E4405B, HP E4407B,
HP E4408B, HP E4411B

Product Options: This declaration covers all options of the above products.

Conform to the following Product specifications:

Safety: IEC 61010-1:1990 / EN 61010-1:1993
CAN/CSA-C22.2 No. 1010.1-92

EMC: CISPR 11:1990/EN 55011:1991 Group 1, Class A
IEC 801-2:1984/EN 50082-1:1992 4 kV CD, 8 kV AD
IEC 801-3:1984/EN 50082-1:1992 3 V/m, 27-500 MHz
IEC 801-4:1988/EN 50082-1:1992 0.5 kV sig. lines, 1 kV power lines

Supplementary Information:

The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.

Santa Rosa, CA, USA 7 Jan. 1999

Greg Pfeiffer/Quality Engineering Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH Department HQ-TRE, Herreneberger Strasse 130, D71034 Boblingen, Germany (FAX +49-7031-14-3143)

8 HP E4405B Specifications and Characteristics

About This Chapter

This chapter contains specifications and characteristics for the HP E4405B spectrum analyzer. The distinction between specifications and characteristics is described as follows.

- Specifications describe the performance of parameters covered by the product warranty. (The temperature range is 0 °C to 55 °C, unless otherwise noted.)
- Characteristics describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- Typical performance describes additional product performance information that is not covered by the product warranty. It is performance beyond an indicated specification, that most units will exhibit.
- Nominal values indicate the expected, but not warranted, value of a parameter.

The following conditions must be met for the analyzer to meet its specifications.

❑ The analyzer is within the one year calibration cycle.

❑ If **Auto Align All** is selected:

— After 2 hours of storage within the operating temperature range.

— 5 minutes after the analyzer is turned on with sweep times less than 4 seconds.

— After the front-panel amplitude reference is connected to the INPUT, and **Align Now RF** has been run, after the analyzer is turned on. And, once every 24 hours, or if ambient temperature changes more than 30 °C[1].

❑ If **Auto Align Off** is selected:

— When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes,

— After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now All** has been run.

— When **Align Now All** is run:

  - Every hour

1. 10 °C if Option 1DS is active

    - If the ambient temperature changes more than 3 °C
    - If the 10 MHz reference changes
  - When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):
    - Every 24 hours
    - If the ambient temperature changes more than 30 °C[1]

- ❑ If **Auto Align All but RF** is selected:
  - When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.
  - After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now RF** has been run.
  - When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):
    - Every hour
    - If the ambient temperature changes more than 3 °C

1. 10 °C if Option 1DS is active

Frequency

	Specifications	Supplemental Information
Frequency Range		
dc Coupled	9 kHz to 13.2 GHz	
ac Coupled	100 kHz to 13.2 GHz	
Band		Harmonic Mixing Mode (N[a])
0	9 kHz to 3.0 GHz	1–
1	2.85 GHz to 6.7 GHz	1–
2	6.2 GHz to 13.2 GHz	2–
Preamp On *(Option 1DS)*	1 MHz to 3 GHz	

a. N is the harmonic mixing mode. For negative mixing modes (as indicated by the "–"), the desired 1st LO harmonic is higher than the tuned frequency by the 1st IF (3.9214 for the 9 kHz to 3 GHz band, 321.4 MHz for all other bands). For positive mixing modes, the desired 1st LO harmonic is lower than the tuned frequency by 321.4 MHz.

	Specifications	Supplemental Information
Frequency Reference		
Aging Rate	$\pm 2 \times 10^{-6}$/year	$\pm 1.0 \times 10^{-7}$/day, characteristic
Settability	$\pm 5 \times 10^{-7}$	
Temperature Stability	$\pm 5 \times 10^{-6}$	

	Specifications	Supplemental Information
High Stability Frequency Reference *(Option 1D5)*		
Aging Rate	$\pm 1 \times 10^{-7}$/year	$\pm 5 \times 10^{-10}$/day, 7-day average after being powered on for 7 days, characteristic
Settability	$\pm 1 \times 10^{-8}$	
Temperature Stability		
20 to 30 °C	$\pm 1 \times 10^{-8}$	
0 to 55 °C	$\pm 5 \times 10^{-8}$	
Warm-Up (Internal frequency reference selected)		
After 5 minutes		$< \pm 1 \times 10^{-7}$ of final frequency,[a] characteristic
After 15 minutes		$< \pm 1 \times 10^{-8}$ of final frequency,[a] characteristic

a. Final frequency is defined as frequency 60 minutes after power-on with analyzer set to internal frequency reference.

	Specifications	Supplemental Information
Frequency Readout Accuracy		
(Start, Stop, Center, Marker)	±(frequency indication × frequency reference error[a] + span accuracy + 15% of RBW + 10 Hz + 1 Hz × N[b])	

a. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).
b. N is the harmonic mixing mode.

	Specifications	Supplemental Information
Marker Frequency Counter		
Resolution	Selectable from 1 Hz to 100 kHz	
Accuracy[a]	±(marker frequency × frequency reference error[b] + counter resolution)[c]	For RBW ≥ 1 kHz

a. Marker level to displayed noise level > 25 dB, RBW/ Span ≥ 0.002, frequency offset = 0 Hz.
b. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).
c. For firmware revisions prior to A.03.00, add 1 Hz x N, where N is the harmonic mixing mode.

	Specifications	Supplemental Information
Frequency Span		
Range	0 Hz (zero span), 100 Hz to 13.2 GHz	
Resolution	2 Hz x N[a]	
Accuracy	±1% of span	

a. N is the harmonic mixing mode.

	Specifications	Supplemental Information
Sweep Time		
Range	5 ms to 2000 s	50 ms is the minimum sweep time with the tracking generator in operation *(Option 1DN)*
(Option AYX)	20 μs to 2000 s	For Span = 0 Hz, RBW ≥ 1 kHz
Accuracy		
Span = 0 Hz 5 ms to 2000 s	±1%	
20 μs to < 5ms *(Option AYX)*	±1%	
Sweep Trigger[ab]	Free Run, Single, Line, Video, External, Delayed, Gate *(Option 1D6)*, TV *(Option B7B)*	
Delayed Trigger[ac]		
Range	1 μs to 400 s	
Resolution	[(delay in seconds)/65000] rounded up to nearest μs	
Accuracy	±(500 ns +(0.01% of delay))	

a. Gate cannot be used simultaneously with delayed or TV trigger.

b. Auto align is suspended in video, external, gate, and delayed trigger modes while waiting for a trigger event to occur.

c. Delayed trigger is available with line, external, and TV trigger (Option B7B).

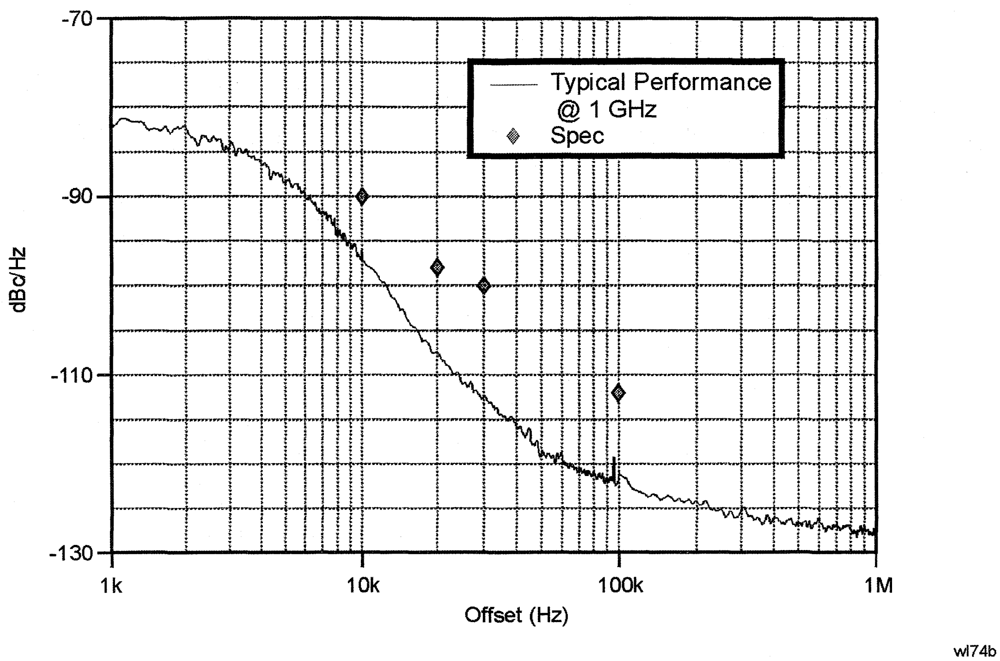
	Specifications	Supplemental Information
Resolution Bandwidth (RBW)		
Range		
–3 dB bandwidth	1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz	
–6 dB bandwidth (EMI)	9 kHz and 120 kHz	
(Option 1DR)		Only available in spans ≤ 5 MHz, sweep times ≥ 5 ms, and not usable with tracking generator in operation (*Option 1DN*)
–3 dB bandwidth	Adds 10, 30, 100, 300 Hz	
–6 dB bandwidth (EMI)	Add 200 Hz	
Accuracy		
1 kHz to 3 MHz RBW	±15%	
5 MHz RBW	±30%	
10 Hz to 300 Hz RBW *(Option 1DR)*	±10%	
Shape		
1 kHz to 5 MHz RBW		Synchronously tuned four poles, approximately Gaussian shape
10 Hz to 300 Hz RBW *(Option 1DR)*		Digital, approximately Gaussian shape
Selectivity (60 dB/3 dB bandwidth ratio)		
1 kHz to 5 MHz RBW		<15:1, characteristic
10 Hz to 300 Hz RBW *(Option 1DR)*		<5:1, characteristic

	Specifications	Supplemental Information
Video Bandwidth (VBW) (–3 dB)		
Range	30 Hz to 1 MHz in 1-3-10 sequence	3 MHz, characteristic
(Option 1DR)	Adds 1, 3, 10 Hz for RBW's <1 kHz	
Accuracy		±30%, characteristic
Shape		Post detection, single pole low-pass filter used to average displayed noise Video bandwidths below 30 Hz are digital bandwidths with anti-aliasing filtering.

	Specifications	Supplemental Information
Stability		
Noise Sidebands, offset from CW signal with 1 kHz RBW, 30 Hz VBW and sample detector		
≥10 kHz	≤ −90 dBc/Hz[a]	
≥20 kHz	≤ −98 dBc/Hz[a]	
≥30 kHz	≤ −100 dBc/Hz[a]	
≥100 kHz	≤ −112 dBc/Hz[a]	
Residual FM		
1 kHz RBW, 1 kHz VBW	≤150 Hz × N p–p in 100 ms	
(Option 1D5)	≤100 Hz × N p–p in 100 ms	
10 Hz RBW, 10 Hz VBW *(Option 1DR and 1D5)*	≤2 Hz × N p–p in 20 ms	
10 Hz RBW, 10 Hz VBW *(Option 1DR)*		≤10 Hz × N p–p in 20 ms, characteristic
System-Related Sidebands, offset from CW signal		
≥30 kHz	≤ −65 dBc[a]	
Line-Related Sidebands, offset from CW signal *(Option 1DR)*		
<300 Hz		≤ −50 dBc[a], characteristic
>300 Hz to 30 kHz		≤ −55 dBc[a], characteristic

a. Add 20 Log(N) for frequencies > 3 GHz

Noise Sidebands Normalized to 1 Hz Versus Offset From Carrier



Amplitude

Amplitude specifications do not apply for the negative peak detector mode.

	Specifications	Supplemental Information
Measurement Range	Displayed Average Noise Level to Maximum Safe Input Level	
Input Attenuator Range	0 to 65 dB, in 5 dB steps	

	Specifications	Supplemental Information
Maximum Safe Input Level		
Average Continuous Power	+30 dBm (1 W)	
Input attenuator setting ≥5 dB		
Peak Pulse Power for <10 μsec pulse width, <1% duty cycle, and input attenuation ≥30 dB	+50 dBm (100 W)	
dc		
dc Coupled	0 Vdc	
ac Coupled	50 Vdc	

	Specifications	Supplemental Information
1 dB Gain Compression		
Total power at input mixer [a][b]		
50 MHz to 3.0 GHz	0 dBm	
3.0 GHz to 6.7 GHz	0 dBm	
6.7 GHz to 13.2 GHz	–3 dBm	
Preamp On *(Option 1DS)*		
Total power at the preamp[c]		–20 dBm, characteristic

a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
b. For resolution bandwidths 1 kHz to 30 kHz, the maximum input signal amplitude must be ≤ reference level +10 dB.
c. Total power at the preamp (dBm) = total power at the input (dBm) – input attenuation (dB).

	Specifications		Supplemental Information	
Displayed Average Noise Level				
(Input terminated, 0 dB attenuation, sample detector, Reference Level = –70 dBm)				
	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW *(Option 1DR)*	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW *(Option 1DR)*
1 MHz to 10 MHz			≤ –116 dBm, characteristic	≤ –134 dBm, characteristic
10 MHz to 1.0 GHz	≤ –116 dBm	≤ –135 dBm		
1.0 GHz to 2.0 GHz	≤ –115 dBm	≤ –134 dBm		
2.0 GHz to 3.0 GHz	≤ –112 dBm	≤ –131 dBm		
3.0 GHz to 6.0 GHz	≤ –112 dBm	≤ –131 dBm		
6.0 GHz to 12 GHz	≤ –110 dBm	≤ –129 dBm		
12 GHz to 13.2 GHz	≤ –107 dBm	≤ –126 dBm		
Preamp On *(Option 1DS)*	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW *(Option 1DR)*	1 kHz RBW 30 Hz VBW	10 kHz RBW 1 Hz VBW *(Option 1DR)*
0 to 55 °C				
1 MHz to 10 MHz			≤ –131 dBm, characteristic	≤ –149 dBm, characteristic
10 MHz to 1.0 GHz	≤ –131 dBm	≤ –149 dBm		
1.0 GHz to 2.0 GHz	≤ –129 dBm	≤ –147 dBm		
2.0 GHz to 3.0 GHz	≤ –127 dBm	≤ –145 dBm		
20 to 30 °C				
10 MHz to 1.0 GHz	≤ –132 dBm	≤ –150 dBm		
1.0 GHz to 2.0 GHz	≤ –131 dBm	≤ –149 dBm		
2.0 GHz to 3.0 GHz	≤ –130 dBm	≤ –148 dBm		

	Specifications	Supplemental Information
Display Range		
Log Scale	Ten divisions displayed; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps	
RBW ≥ 1 kHz	Calibrated 0 to –85 dB from Reference Level	
RBW ≤ 300 Hz *(Option 1DR)*	Calibrated 0 to –120 dB[a] from Reference Level	
Linear Scale	Ten divisions	
Scale Units	dBm, dBmV, dBμV, V,W and Hz (Option BAA)	

a. 0 to –70 dB range when span = 0 Hz, or when auto ranging is off: (:DISPlay:WINDow:TRACe:Y[:SCALe]:LOG:RANGe:AUTO OFF).

	Specifications	Supplemental Information
Marker Readout Resolution		
Log scale		
RBW ≥ 1 kHz		
0 to –85 dB from ref level	0.04 dB	
RBW ≤ 300 Hz		
0 to –120 dB from ref level	0.04 dB	
Linear scale	0.01% of Reference Level	
Fast Sweep Times for Zero Span		
20 μs to <5 ms *(Option AYX)*		
Log		
0 to –85 dB from ref level	0.3 dB	
Linear	0.3% of Reference Level for linear scale	

	Specifications	Supplemental Information
Frequency Response		
50 Ω, Absolute[a]/Relative		
10 dB attenuation	9 kHz to 3.0 GHz (dc coupled)	100 kHz to 3.0 GHz (ac coupled)
20 to 30 °C	±0.5 dB	±0.5 dB, characteristic
0 to 55 °C	±1.0 dB	±1.0 dB, characteristic
50 Ω, Absolute[a]/Relative Preamp On *(Option 1DS)*		
1 MHz to 3.0 GHz	(dc coupled)	(ac coupled)
0 dB attenuation	±2.0 dB	±2.0 dB
Preselector centered for frequency >3.0 GHz		
3.0 GHz to 6.7 GHz	(dc coupled)	(ac coupled)
10 dB attenuation		
Absolute[a]		
20 to 30 °C	±1.5 dB	±1.5 dB, characteristic
0 to 55 °C	±2.5 dB	±2.5 dB, characteristic
Relative		
20 to 30 °C	±1.3 dB	±1.3 dB, characteristic
0 to 55 °C	±1.5 dB	±1.5 dB, characteristic
6.7 GHz to 13.2 GHz	(dc coupled)	(ac coupled)
10 dB attenuation		
Absolute[a]		
20 to 30 °C	±2.0 dB	±2.0 dB, characteristic
0 to 55 °C	±3.0 dB	±3.0 dB, characteristic
Relative		
20 to 30 °C	±1.8 dB	±1.8 dB, characteristic
0 to 55 °C	±2.0 dB	±2.0 dB, characteristic

a. Absolute flatness values are referenced to the amplitude at 50 MHz.

	Specifications	Supplemental Information
Input Attenuation Switching Uncertainty at 50 MHz		
Attenuator Setting		
0 dB to 5 dB	±0.3 dB	
10 dB	Reference	
15 dB	±0.3 dB	
20 to 65 dB	±(0.1 dB + 0.01 × Attenuator Setting)	

	Specifications	Supplemental Information
Preamp *(Option 1DS)*		
Gain		+20 dB, nominal[a]
Noise figure		5 dB, characteristic

a. Amplifier is between the input attenuator and the input mixer.

Attenuation Accuracy Relative to the 10 dB Attenuator Setting, Characteristic		
	Frequency Range	
Attenuation, dB	**dc–3.0 GHz (± dB)**	**3.0–13.2GHz (± dB)**
0	0.3	0.5
5	0.3	0.5
10 (Reference)	Reference	Reference
15	0.4	0.5
20	0.4	0.5
25	0.5	0.6
30	0.5	0.6
35	0.6	0.7
40	0.6	0.7
45	0.7	1.0
50	0.7	1.0
55	0.9	1.1
60	0.9	1.1
65	1.0	1.6

	Specifications	Supplemental Information
Absolute Amplitude Accuracy		
At reference settings [a]	±0.34 dB	
Preamp On[b] *(Option 1DS)*	±0.5 dB	
Overall Amplitude Accuracy[c]		
20 to 30 °C	± (0.54 dB + Absolute Frequency Response)	

a. Settings are: reference level –20 dBm; input attenuation 10 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, sample detector, signal at reference level.
b. Settings are: reference level –30 dBm; input attenuation 0 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, signal at reference level.
c. For reference level 0 to –50 dBm; input attenuation 10 dB; RBW 1 kHz; VBW 1 kHz; scale log, log range 0 to 50 dB from reference level; sweep time coupled; signal input 0 to –50 dBm; span ≤20 kHz.

	Specifications	Supplemental Information	
RF Input VSWR (at tuned frequency)		characteristic	characteristic
Attenuator setting 0 dB		(dc coupled)	(ac coupled)
9 kHz to 100 kHz		3.0:1	
100 kHz to 13.2 GHz		3.0:1	3.0:1
Attenuator setting 5 dB		(dc coupled)	(ac coupled)
9 kHz to 100 kHz		2.0:1	
100 kHz to 300 kHz		1.4:1	2.3:1
300 kHz to 1.0 MHz		1.4:1	1.6:1
1.0 MHz to 3.0 GHz		1.4:1	1.4:1
3.0 GHz to 6.7 GHz		1.4:1	1.7:1
6.7 GHz to 13.2 GHz		1.7:1	1.9:1
Attenuator setting 10 to 65 dB		(dc coupled)	(ac coupled)
9 kHz to 100 kHz		2.0:1	
100 kHz to 300 kHz		1.3:1	2.1:1
300 kHz to 1.0 MHz		1.3:1	1.5:1
1.0 MHz to 3.0 GHz		1.3:1	1.3:1
3.0 GHz to 6.7 GHz		1.3:1	1.5:1
6.7 GHz to 13.2 GHz		1.5:1	1.7:1

	Specifications	Supplemental Information
Auto Alignment[a]		
Sweep-to-sweep variation		±0.1 dB, characteristic

a. Set **Auto Align** to **Off** and use **Align Now, All** to eliminate this variation.

	Specifications	Supplemental Information
Resolution Bandwidth Switching Uncertainty (at Reference Level)		
1 kHz RBW	Reference	
3 kHz to 3 MHz RBW	±0.3 dB	
5 MHz RBW	±0.6 dB	
10 Hz to 300 Hz RBW *(Option 1DR)*	±0.3 dB	

	Specifications	Supplemental Information
Reference Level		
Range	Adjustable over Amplitude Measurement Range	
Resolution		
Log Scale	±0.1 dB	
Linear Scale	±0.12% of Reference Level	
Accuracy (at a fixed frequency, a fixed attenuator, and referenced to –30 dBm (–10 dBm, Preamp On *(Option 1DS)*))		
Reference Level (dBm) – input attenuator setting (dB) + preamp gain (dB)		
–10 dBm to > –60 dBm	±0.3 dB	
–60 dBm to > –85 dBm	±0.5 dB	
–85 dBm to –90 dBm	±0.7 dB	

	Specifications	Supplemental Information
Display Scale Switching Uncertainty		
Switching between Linear and Log	±0.15 dB at Reference Level	
Log Scale Switching	No error	

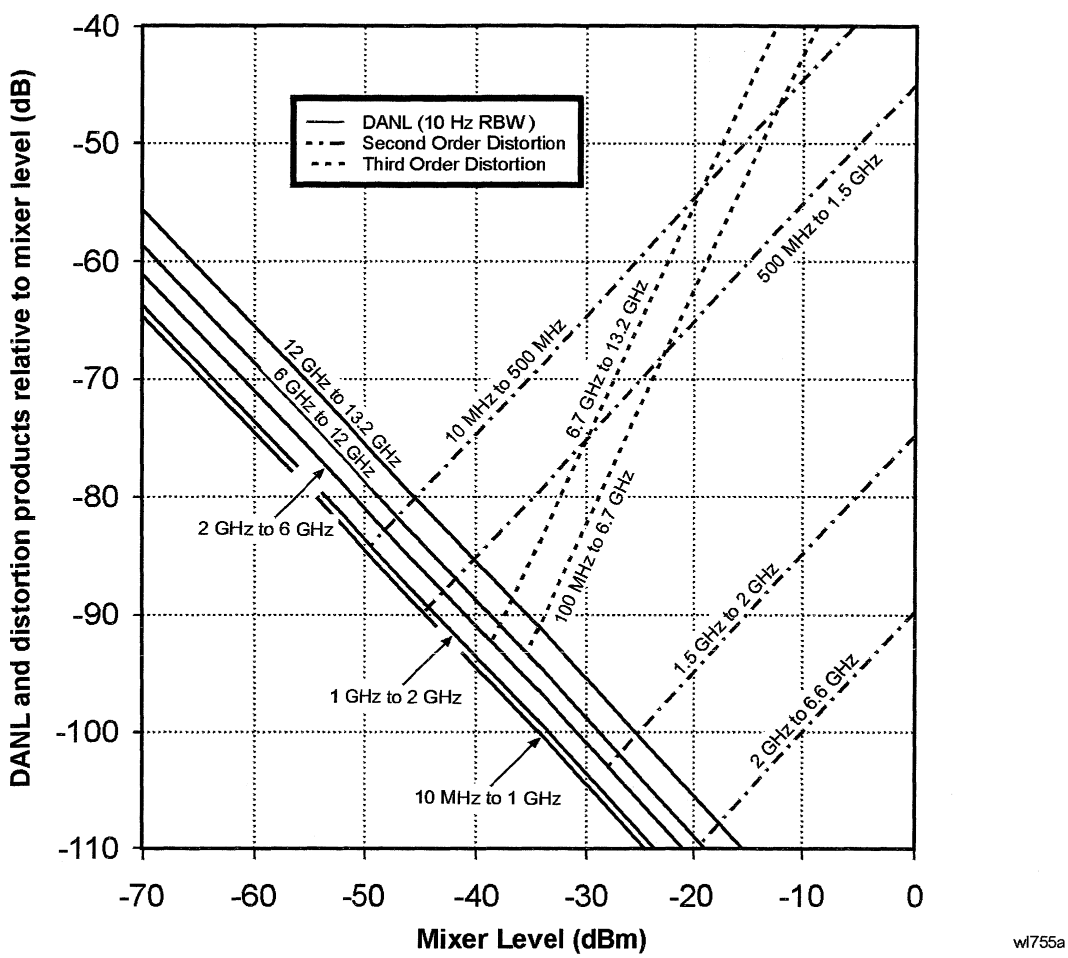
	Specifications	Supplemental Information
Display Scale Fidelity		
Log Maximum Cumulative		
0 to –85 dB from Reference Level	±(0.3 dB + 0.01 × dB from Reference Level)	
RBW ≤ 300 Hz *(Option 1DR)*		
Span > 0 Hz		
0 to –98 dB from Reference Level	±(0.3 dB + 0.01 × dB from Reference Level)	
–98 to –120 dB from Reference Level		±2.0 dB, characteristic
Span = 0 Hz[a]		
0 to –60 dB from Reference Level	±(0.3 dB + 0.015 × dB from Reference Level)	
–60 to –70 dB from Reference Level	±1.5 dB	
Log Incremental Accuracy		
0 to –80 dB[b] from reference level	±0.4 dB/4 dB	
Linear Accuracy	±2% of Reference Level	

a. or when auto ranging is off: (:DISPlay:WINDow:TRACe:Y[:SCALe]:LOG:RANGe:AUTO OFF)
b. 0 to –50 dB for RBWs ≤ 300 Hz and span = 0 Hz, or when auto ranging is off.

	Specifications	Supplemental Information
Spurious Responses		
Second Harmonic Distortion		
Input Signal		
10 MHz to 500 MHz	< –65 dBc for –30 dBm signal at input mixer[a]	+35 dBm SHI (second harmonic intercept)
500 MHz to 1.5 GHz	< –75 dBc for –30 dBm signal at input mixer[a]	+45 dBm SHI
1.5 GHz to 2.0 GHz	< –85 dBc for –10 dBm signal at input mixer[a]	+75 dBm SHI
2.0 GHz to 3.35 GHz	< –100 dBc[b] for –10 dBm signal at input mixer[a]	+90 dBm SHI
3.35 GHz to 6.6 GHz	< –100 dBc[b] for –10 dBm signal at input mixer[a]	+90 dBm SHI
Preamp On *(Option 1DS)* 10 MHz to 1.5 GHz		–5 dBm SHI, characteristic
Third Order Intermodulation Distortion		
10 MHz to 100 MHz		+7 dBm TOI (third order intercept), characteristic
100 MHz to 3 GHz	< –82 dBc for two –30 dBm signals at input mixer[a] and >50 kHz separation	+11 dBm TOI +16 dBm TOI, typical, 20 to 30 °C
3.0 GHz to 6.7 GHz	< –82 dBc for two –30 dBm signals at input mixer[a] and >50 kHz separation	+11 dBm TOI +18 dBm TOI, typical, 20 to 30 °C
6.7 GHz to 13.2 GHz	< –75 dBc for two –30 dBm signals at input mixer[a] and >50 kHz separation	+7.5 dBm TOI +12 dBm TOI, typical, 20 to 30 °C
Preamp On *(Option 1DS)* 10 MHz to 3 GHz,		–16 dBm TOI, characteristic
Other Input Related Spurious		
Inband Responses		
>30 kHz offset	< –65 dBc for –20 dBm signal at input mixer[a]	
Out-of-band Responses	< –80 dBc for –10 dBm signal at input mixer[a]	

a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
b. or signal below displayed average noise level.

Specified Dynamic Range



	Specifications	Supplemental Information
Residual Responses (Input terminated and 0 dB attenuation)		
150 kHz to 6.7 GHz	< –90 dBm	

Options

Time Gated Spectrum Analysis (Option 1D6)

	Specifications	Supplemental Information
Gate Delay		
Range	1 μs to 400 s	
Accuracy	±(500 ns + (0.01% × (maximum of gate delay or length)))	From gate trigger input to positive edge of gate output
Gate Length		
Range	1 μs to 400 s	
Accuracy	±(500 ns + (0.01% × (maximum of gate delay or length)))	From positive edge to negative edge of gate output
Resolution	[(maximum of gate delay or length in seconds)/65000] rounded up to nearest μs	Dependent on the greater of gate delay or gate length
Additional Amplitude Error[a]		
Log Scale	±0.2 dB	
Linear Scale	±0.1 % of reference level	

a. While in gate mode.

Tracking Generator (Option 1DN)

The spectrum analyzer tracking generator combination will meet its specification after a cable (8120-5148) and adapter are connected between RF OUT and INPUT and **Align Now, TG** has been run.

	Specifications	Supplemental Information
Warm-Up	5 minutes	

	Specifications	Supplemental Information
Output Frequency Range	9 kHz to 3.0 GHz	

	Specifications	Supplemental Information
Minimum Resolution BW	1 kHz	Not usable with resolution bandwidths ≤300 Hz *(Option 1DR)*

	Specifications	Supplemental Information
Output Power Level		
Range	–2 to –66 dBm	
Resolution	0.1 dB	
Absolute Accuracy (at 50 MHz with coupled source attenuator, referenced to –20 dBm)	± 0.75 dB	
Vernier		
Range	8 dB	
Accuracy (with coupled source attenuator, 50 MHz, –20 dBm)		
Incremental	±0.2 dB/dB	
Cumulative	±0.5 dB, total	
Output Attenuator Range	0 to 56 dB in 8 dB steps	

	Specifications	Supplemental Information
Maximum Safe Reverse Level		+30 dBm (1 W), +30 Vdc, characteristic

	Specifications	Supplemental Information
Output Power Sweep		
Range	(–10 dBm to –2 dBm) – (Source Attenuator Setting)	
Resolution	0.1 dB	
Accuracy (zero span)	<1 dB peak-to-peak	

	Specifications	Supplemental Information
Output Flatness		
Referenced to 50 MHz, –20 dBm		
9 kHz to 10 MHz	±3 dB	
10 MHz to 3 GHz	±2 dB	

	Specifications	Supplemental Information
Spurious Outputs		
(–2 dBm output)		
Harmonic Spurs		
TG Output 9 kHz to 20 kHz	≤ –15 dBc	
TG Output 20 kHz to 3 GHz	≤ –25 dBc	
Non-harmonic Spurs		
TG Output 9 kHz to 2 GHz	≤ –27 dBc	
TG Output 2 GHz to 3 GHz	≤ –23 dBc	
LO Feedthrough		
LO Frequency 3.921409 to 6.9214 GHz	≤ –16 dBm	

	Specifications	Supplemental Information
Dynamic Range	Maximum Output Power Level – Displayed Average Noise Level	

	Specifications	Supplemental Information
Output Tracking		
Drift		1.5 kHz/5 minute, characteristic
Swept Tracking Error		Usable in 1 kHz RBW after 5 minutes of warm-up

	Specifications	Supplemental Information
RF Power-Off Residuals		
9 kHz to 3 GHz		< –120 dBm, characteristic

	Specifications	Supplemental Information
Output Attenuator Repeatability		
9 kHz to 300 MHz		±0.1 dB, characteristic
300 MHz to 2.0 GHz		±0.2 dB, characteristic
2.0 GHz to 3 GHz		±0.3 dB, characteristic

	Specifications	Supplemental Information
Output VSWR		
0 dB attenuation		<2.0:1, characteristic
≥ 8 dB attenuation		<1.5:1, characteristic

	Specifications	Supplemental Information
Output Attenuator Accuracy		
0 dB		±0.5 dB, characteristic
8 dB		±0.5 dB, characteristic
16 dB	Reference	
24 dB		±0.5 dB, characteristic
32 dB		±0.6 dB, characteristic
40 dB		±0.8 dB, characteristic
48 dB		±1.0 dB, characteristic
56 dB		±1.1 dB, characteristic

Tracking Generator Output Accuracy
Relative Accuracy (Referred to –20 dBm) = Output Attenuator Accuracy + Vernier Accuracy + Output Flatness
Absolute Accuracy = Relative Accuracy (Referred to –20 dBm) + Absolute Accuracy at 50 MHz

	Specifications	Supplemental Information
Output Power Level		
Range	–2 to –66 dBm	
Resolution	0.1 dB	
Absolute Accuracy (at 50 MHz with coupled source attenuator, referenced to –20 dBm)	± 0.75 dB	
Vernier		
Range	8 dB	
Accuracy (with coupled source attenuator, 50 MHz, –20 dBm)		
Incremental	±0.2 dB/dB	
Cumulative	±0.5 dB, total	
Output Attenuator Range	0 to 56 dB in 8 dB steps	

FM Demodulation (Option BAA)

The FM demodulation characteristics will be met after an **Align Now, FM Demod** has been run.

	Specifications	Supplemental Information
Input Level		≥ (–60 dBm + attenuator setting – preamp gain), characteristic
Signal Level		0 to –30 dB below reference level, characteristic
FM Deviation		
Range		10 kHz to 1 MHz
Resolution		Provides 1 Hz display annotation resolution
FM Deviation Range		
10 kHz to 40 kHz		12 Hz, characteristic
>40 kHz to 200 kHz		60 Hz, characteristic
>200 kHz to 1 MHz		300 Hz, characteristic
Accuracy[a] FM Rate < FM BW/100, VBW ≥(30 × FM Rate), RBW > the maximum of (30 × FM deviation) or (30 × FM Rate)		< (2% of FM deviation range + 2 × Resolution), characteristic
Offset Error[a]		5% of FM Deviation Range + 300 Hz, characteristic
FM Bandwidth *(–3 dB)*		
FM Deviation Range		
10 kHz to 40 kHz		7.5 × FM deviation range, characteristic
>40 kHz to 200 kHz		1.3 × FM deviation range, characteristic
>200 kHz to 1 MHz		0.3 × FM deviation range, characteristic

a. In time domain sweeps (span = 0 Hz).

TV Trigger and Picture On Screen (Option B7B)

	Specifications	Supplemental Information
TV Trigger and Picture On Screen		TV Trigger initiates a sweep of the analyzer after the sync pulse of a selected line of a TV video field. Picture On Screen displays the TV picture on the analyzer display.
Amplitude Requirements		
TV Source: SA		Top 50% of linear display, characteristic
TV Source: EXT VIDEO IN		500 mVp–p to 2 Vp–p, characteristic
Compatible Standards	NTSC–M, NTSC–Japan, PAL–M, PAL–B,D,G,H,I, PAL–N, PAL–N Combination, SECAM-L	
Field Selection	Entire frame, even, odd	
Sync Polarity	Positive or negative	
TV Trigger Line Selection		
	1 to 525, or 1 to 625, standard dependent	

General

	Specifications	Supplemental Information
Temperature Range		
Operating	0 to 55 °C	Floppy disk 10 to 40 °C
Storage	–40 to +75 °C	

	Specifications	Supplemental Information
Audible Noise (ISO 7779)		
Sound Pressure at 25 °C		<40 dBa, (<4.6 Bels power)

	Specifications	Supplemental Information
Military Specification	Has been type tested to the environmental specifications of MIL-PRF-28800F class 3.	

	Specifications	Supplemental Information
EMI Compatibility	Conducted and radiated emission is in compliance with CISPR Pub. 11/1990 Group 1 Class A.	

	Specifications	Supplemental Information
Immunity Testing		
Radiated Immunity		Testing was done at 3 V/m according to IEC 801-3/1984. When the analyzer tuned frequency is identical to the immunity test signal frequency there may be signals of up to –60 dBm displayed on the screen.
Electrostatic Discharge		Air discharges of up to 8 kV were applied according to IEC 801-2/1991. Discharges to center pins of any of the connectors may cause damage to the associated circuitry.

	Specifications	Supplemental Information
Power Requirements		Uses CUKonverter® topology in the power supply.
ac Operation		
Voltage, frequency	90 to 132 V rms, 47 to 440 Hz	
	195 to 250 V rms, 47 to 66 Hz	
Power Consumption, On	<300 W	
Power Consumption, Standby	<5 W	
dc Operation		
Voltage	12 to 20 Vdc	
Power Consumption	<200 W	

	Specifications	Supplemental Information
Measurement Speed		
Local Measurement and Display Update rate[a]		≥ 28/s, characteristic
Remote Measurement and HP-IB Transfer Rate[b] *(Option A4H)*		≥ 19/s, characteristic

a. Auto align off, 5 ms sweep time, fixed center frequency.
b. Auto align off, 5 ms sweep time, fixed center frequency, 401 point trace, display off (DISPlay:ENABle off), and 32-bit integer data format (FORMat:DATA INT,32).

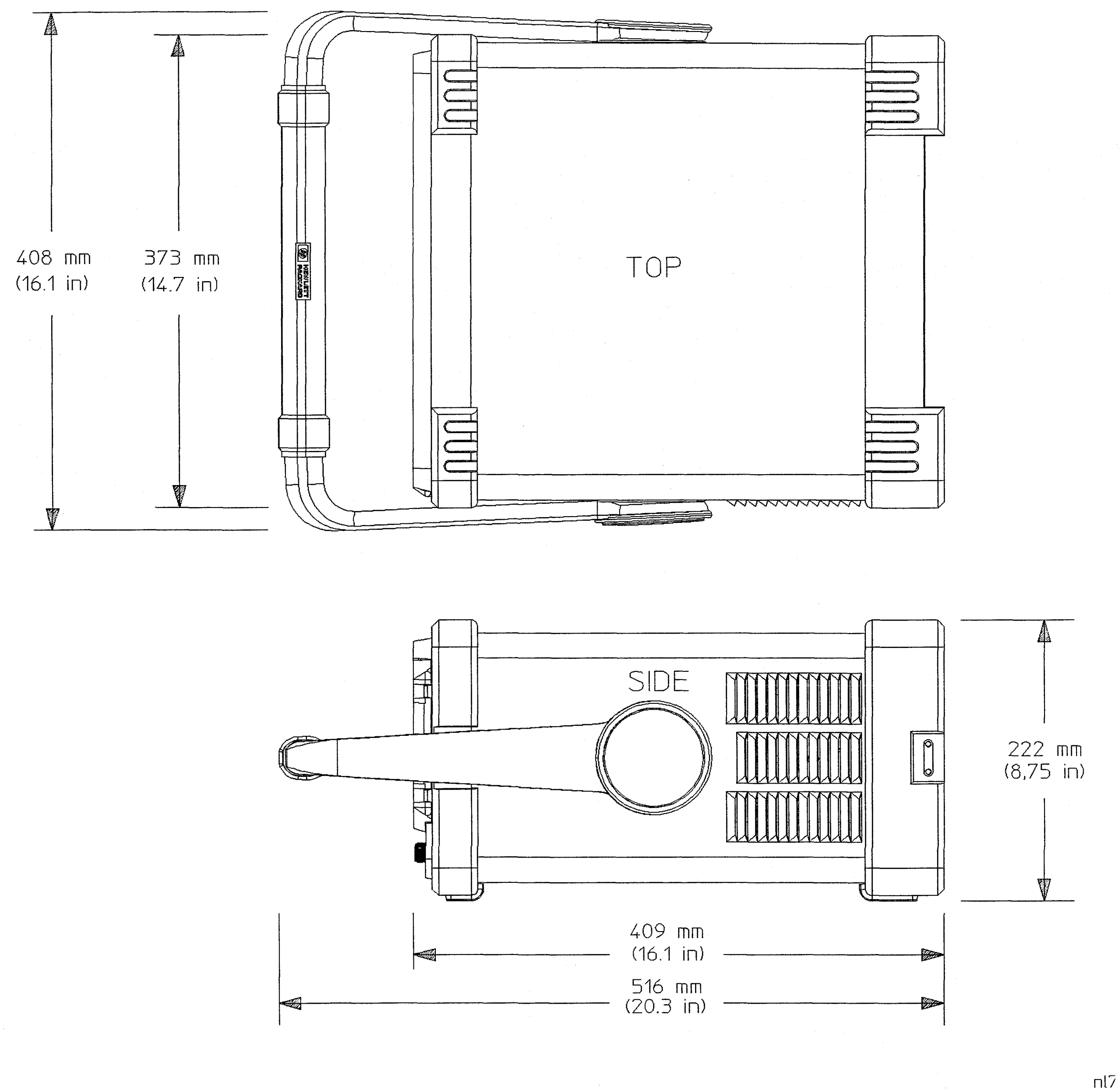
	Specifications	Supplemental Information
Data Storage		
Internal		200 Traces or States
External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS® compatible floppy disk		200 Traces or States

	Specifications	Supplemental Information
Downloadable Program Memory		2 MB available memory
(Option B72)		10 MB available memory

	Specifications	Supplemental Information
Demod Tune Listen		
AM		Internal speaker, front-panel earphone jack and front-panel volume control.
FM *(Option BAA)*		
(Option A4J, AYX, or BAA)		An uncalibrated demodulated signal is available on the AUX VIDEO OUT or EXT VIDEO OUT connectors at the rear panel.

	Specifications	Supplemental Information
Weight (without options)		
Net		16.2 kg (35.6 lb), characteristic
Shipping		31.0 kg (68 lb), characteristic

Dimensions


408 mm
(16.1 in)
373 mm
(14.7 in)
TOP
SIDE
222 mm
(8,75 in)
409 mm
(16.1 in)
516 mm
(20.3 in)
nl7

Inputs and Outputs

Front Panel

	Specifications	Supplemental Information
INPUT 50 Ω		
Connector	Type-N female	
Impedance		50 Ω, nominal

	Specifications	Supplemental Information
RF OUT 50 Ω, *(Option 1DN)*		
Connector	Type-N female	
Impedance		50 Ω, nominal

	Specifications	Supplemental Information
AMPTD REF OUT[a]		Amplitude Reference
Connector	BNC Female	
Impedance		50 Ω, nominal
Frequency		50 MHz
Frequency Accuracy		Frequency reference error[b]
50 Ω Amplitude[c]		–20 dBm, nominal

a. Turn the amplitude reference on/off by pressing the keys: **Input**, **Amptd Ref Out**.
b. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).
c. The internal amplitude reference actual power is stored internally.

	Specifications	Supplemental Information
PROBE POWER		
Voltage/Current		+15 Vdc, ±7% at 150 mA max., characteristic –12.6 Vdc ±10% at 150 mA max., characteristic

	Specifications	Supplemental Information
EXT KEYBOARD		Feature not implemented.
Connector	6-pin mini-DIN	

	Specifications	Supplemental Information
Speaker		Front panel knob controls volume

	Specifications	Supplemental Information
Headphone		Front panel knob controls volume
Connector	3.5 mm (1/8 inch) miniature audio jack	
Power Output		0.2 W into 4 Ω, characteristic

Rear Panel

	Specifications	Supplemental Information
10 MHz REF OUT		
Connector	BNC female	
Impedance		50 Ω, nominal
Output Amplitude		>0 dBm, characteristic

	Specifications	Supplemental Information
10 MHz REF IN		
Connector	BNC female	Note: Analyzer noise sidebands and spurious response performance may be affected by the quality of the external reference used.
Impedance		50 Ω, nominal
Input Amplitude Range		–15 to +10 dBm, characteristic
Frequency		10 MHz, nominal

	Specifications	Supplemental Information
GATE TRIG/EXT TRIG IN		
Connector	BNC female	
External Trigger Input		
Trigger Level		Selectable positive or negative edge initiates sweep in EXT TRIG mode (5 V TTL)
Gate Trigger Input *(Option 1D6)*		
Minimum Pulse Width		>30 ns (5 V TTL)

	Specifications	Supplemental Information
GATE/HI SWP OUT		
Connector	BNC female	
High Sweep Output		
Level		High = sweep; Low = retrace (5 V TTL)
Gate Output *(Option 1D6)*		
Level		High = gate on; Low = gate off (5 V TTL)

	Specifications	Supplemental Information
VGA OUTPUT		
Connector	VGA compatible, 15-pin mini D-SUB	
Format		VGA (31.5 kHz horizontal, 60 Hz vertical sync rates, non-interlaced) Analog RGB
Resolution	640 × 480	

	Specifications	Supplemental Information
AUX IF OUT *(Option A4J or AYX)*		RBW ≥ 1 kHz
Connector	BNC female	
Frequency		21.4 MHz, nominal
Amplitude Range (for signal at reference level and for reference levels – input attenuation + preamp gain of –10 to –70 dBm)		–10 dBm (uncorrected), characteristic
Impedance		50 Ω, nominal

	Specifications	Supplemental Information
AUX VIDEO OUT *(Option A4J or AYX)*		RBW ≥ 1 kHz
Connector	BNC female	
Amplitude Range (into >10 kΩ)		0 to 1 V (uncorrected), characteristic

	Specifications	Supplemental Information
HI SWP IN *(Option A4J or AYX)*		
Connector	BNC female	
Input		Open collector, low stops sweep (5 V TTL)

	Specifications	Supplemental Information
HI SWP OUT *(Option A4J or AYX)*		
Connector	BNC female	
Output		High = sweep, Low = retrace (5 V TTL)

	Specifications	Supplemental Information
SWP OUT *(Option A4J or AYX)*		
Connector	BNC female	
Amplitude		0 to +10 V ramp, characteristic

	Specifications	Supplemental Information
PRESEL TUNE OUTPUT		
Connector	BNC female	
Load Impedance (dc coupled)		> 10 kΩ, nominal
Range		0 to +10 V, characteristic
Sensitivity		0.33 V/GHz of tuned frequency > 3 GHz, characteristic

	Specifications	Supplemental Information
HP-IB Interface *(Option A4H)*		
Connector	IEEE-488 bus connector	
HP-IB Codes		SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3 and C28

	Specifications	Supplemental Information
Serial Interface *(Option 1AX)*		
Connector	9-pin D-SUB male	RS-232

	Specifications	Supplemental Information
Parallel Interface *(Option A4H or 1AX)*		Printer port only
Connector	25-pin D-SUB female	

	Specifications	Supplemental Information
EXT VIDEO IN/TV TRIG OUT[a] *(Option B7B or BAA)*		EXT VIDEO IN is the Baseband composite video input for TV trigger and picture on screen. TV TRIG OUT is the TV trigger output.
Connector	BNC Female (75 Ω)	
Impedance		75 Ω, characteristic.
(Option BAA without Option B7B)		Feature not implemented.
(Option BAA with Option B7B)		
External Video Input Video Amplitude		1 Vp–p, nominal, characteristic
TV Trigger Output		Positive edge indicates start of selected TV line after sync. pulse.
Amplitude		TTL (0 V and 3.4 V with 75 Ω series resistance), characteristic

a. This connector is labelled EXT VIDEO IN on older spectrum analyzers and EXT VIDEO IN/TV TRIG OUT on newer spectrum analyzers.

	Specifications	Supplemental Information
EXT VIDEO OUT *(Option B7B or BAA)*		Baseband video output RBW ≥ 1 kHz
Connector	BNC Female (75 Ω)	
Impedance		75 Ω, characteristic.
Amplitude *(Option BAA without Option B7B)*		0 to 1 V (uncorrected), characteristic
Amplitude *(Option BAA with Option B7B)*		
TV Source: SA		0 to 1 V (uncorrected), characteristic
TV Source and EXT VIDEO IN		Same as level at EXT VIDEO IN/TV TRIG OUT, characteristic

Regulatory Information

CAUTION This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 1010 and 664 respectively.

NOTE This product has been designed and tested in accordance with IEC Publication 1010, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

The CE mark is a registered trademark of the European Community (if accompanied by a year, it is the year when the design was proven).

The CSA mark is the Canadian Standards Association safety mark.

ISM 1-A This is a symbol of an Industrial Scientific and Medical Group 1 Class A product. (CISPR 11, Clause 4)

Declaration of Conformity

DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name: Hewlett-Packard Co.

Manufacturer's Address: 1400 Fountaingrove Parkway
Santa Rosa, CA 95403-1799
USA

Declares that the products

Product Name: Spectrum Analyzer

Model Number: HP E4401B, HP E4402B, HP E4403B,
HP E4404B, HP E4405B, HP E4407B,
HP E4408B, HP E4411B

Product Options: This declaration covers all options of the above products.

Conform to the following Product specifications:

Safety: IEC 61010-1:1990 / EN 61010-1:1993
CAN/CSA-C22.2 No. 1010.1-92

EMC: CISPR 11:1990/EN 55011:1991 Group 1, Class A
IEC 801-2:1984/EN 50082-1:1992 4 kV CD, 8 kV AD
IEC 801-3:1984/EN 50082-1:1992 3 V/m, 27-500 MHz
IEC 801-4:1988/EN 50082-1:1992 0.5 kV sig. lines, 1 kV power lines

Supplementary Information:

The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.

Santa Rosa, CA, USA 7 Jan. 1999

Greg Pfeiffer/Quality Engineering Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH Department HQ-TRE, Herreneberger Strasse 130, D71034 Boblingen, Germany (FAX +49-7031-14-3143)

9 HP E4407B Specifications and Characteristics

About This Chapter

This chapter contains specifications and characteristics for the HP E4407B spectrum analyzer. The distinction between specifications and characteristics is described as follows.

- Specifications describe the performance of parameters covered by the product warranty. (The temperature range is 0 °C to 55 °C, unless otherwise noted.)
- Characteristics describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- Typical performance describes additional product performance information that is not covered by the product warranty. It is performance beyond an indicated specification, that most units will exhibit.
- Nominal values indicate the expected, but not warranted, value of a parameter.

The following conditions must be met for the analyzer to meet its specifications.

❑ The analyzer is within the one year calibration cycle.

❑ If **Auto Align All** is selected:

— After 2 hours of storage within the operating temperature range.

— 5 minutes after the analyzer is turned on with sweep times less than 4 seconds.

— After the front-panel amplitude reference is connected to the INPUT, and **Align Now RF** has been run, after the analyzer is turned on. And, once every 24 hours, or if ambient temperature changes more than 30 °C[1].

❑ If **Auto Align Off** is selected:

— When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes,

— After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now All** has been run.

— When **Align Now All** is run:

- Every hour

1. °10 C if Option 1DS is active.

   - If the ambient temperature changes more than 3 °C
   - If the 10 MHz reference changes
 - When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):
   - Every 24 hours
   - If the ambient temperature changes more than 30 °C[1]

- ❑ If **Auto Align All but RF** is selected:
  - When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.
  - After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now RF** has been run.
  - When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):
    - Every hour
    - If the ambient temperature changes more than 3 °C

1. 10 °C if Option 1DS is active.

Frequency

	Specifications	Supplemental Information	
Frequency Range			
	9 kHz to 26.5 GHz		
Band		Harmonic Mixing Mode (N[a])	
0	9 kHz to 3.0 GHz	1–	
1	2.85 GHz to 6.7 GHz	1–	
2	6.2 GHz to 13.2 GHz	2–	
3	12.8 GHz to 19.2 GHz	4–	
4	18.7 GHz to 26.5 GHz	4–	
Preamp On *(Option 1DS)*	1 MHz to 3 GHz		
External Mixing *(Option AYZ)*	18 GHz to 325 GHz		
		Harmonic Mixing Mode (N[a])	
Band		Preselected	Unpreselected
K	18.0 GHz to 26.5 GHz	n/a	6–
A	26.5 GHz to 40.0 GHz	8+	8–
Q	33.0 GHz to 50.0 GHz	10+	10–
U	40.0 GHz to 60.0 GHz	10+	10–
V	50.0 GHz to 75.0 GHz	14+	14–
E	60.0 GHz to 90.0 GHz	n/a	16–
W	75.0 GHz to 110.0 GHz	n/a	18–
F	90.0 GHz to 140.0 GHz	n/a	20–
D	110.0 GHz to 170.0 GHz	n/a	24–
G	140.0 GHz to 220.0 GHz	n/a	32–
Y	170.0 GHz to 260.0 GHz	n/a	38–
J	220.0 GHz to 325.0 GHz	n/a	46–

a. N is the harmonic mixing mode. For negative mixing modes (as indicated by the "–"), the desired 1st LO harmonic is higher than the tuned frequency by the 1st IF (3.9214 for the 9 kHz to 3 GHz band, 321.4 MHz for all other bands) For positive mixing modes, the desired 1st LO harmonic is lower than the tuned frequency by 321.4 MHz.

	Specifications	Supplemental Information
Frequency Reference		
Aging Rate	$\pm 2 \times 10^{-6}$/year	$\pm 1.0 \times 10^{-7}$/day, characteristic
Settability	$\pm 5 \times 10^{-7}$	
Temperature Stability	$\pm 5 \times 10^{-6}$	

	Specifications	Supplemental Information
High Stability Frequency Reference *(Option 1D5)*		
Aging Rate	$\pm 1 \times 10^{-7}$/year	$\pm 5 \times 10^{-10}$/day, 7-day average after being powered on for 7 days, characteristic
Settability	$\pm 1 \times 10^{-8}$	
Temperature Stability		
20 to 30 °C	$\pm 1 \times 10^{-8}$	
0 to 55 °C	$\pm 5 \times 10^{-8}$	
Warm-Up (Internal frequency reference selected)		
After 5 minutes		< $\pm 1 \times 10^{-7}$ of final frequency,[a] characteristic
After 15 minutes		< $\pm 1 \times 10^{-8}$ of final frequency,[a] characteristic

a. Final frequency is defined as frequency 60 minutes after power-on with analyzer set to internal frequency reference.

	Specifications	Supplemental Information
Frequency Readout Accuracy		
(Start, Stop, Center, Marker)	±(frequency indication × frequency reference error[a] + span accuracy + 15% of RBW + 10 Hz + 1 Hz × N^b)	

a. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).
b. N is the harmonic mixing mode.

	Specifications	Supplemental Information
Marker Frequency Counter		
Resolution	Selectable from 1 Hz to 100 kHz	
Accuracy[a]	±(marker frequency × frequency reference error[b] + counter resolution)[c]	For RBW ≥ 1 kHz

a. Marker level to displayed noise level > 25 dB, RBW/ Span ≥ 0.002, frequency offset = 0 Hz.
b. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).
c. For firmware revisions prior to A.03.00, add 1 Hz x N, where N is the harmonic mixing mode.

	Specifications	Supplemental Information
Frequency Span		
Range		
Internal Mixing	0 Hz (zero span), 100 Hz to 26.5 GHz	
External Mixing *(Option AYZ)*	0 Hz (zero span), Minimum span = 100 Hz	
Resolution	2 Hz x N[a]	
Accuracy	±1% of span	

a. N is the harmonic mixing mode.

	Specifications	Supplemental Information
Sweep Time		
Range	5 ms to 2000 s	50 ms is the minimum sweep time with the tracking generator in operation *(Option 1DN)*
(Option AYX)	20 μs to 2000 s	For Span = 0 Hz, RBW ≥ 1 kHz
Accuracy		
Span = 0 Hz 5 ms to 2000 s	±1%	
20 μs to < 5ms *(Option AYX)*	±1%	
Sweep Trigger[a][b]	Free Run, Single, Line, Video, External, Delayed, Gate *(Option 1D6)*, TV *(Option B7B)*	
Delayed Trigger[a][c]		
Range	1 μs to 400 s	
Resolution	[(delay in seconds)/65000] rounded up to nearest μs	
Accuracy	±(500 ns +(0.01% of delay))	

a. Gate cannot be used simultaneously with delayed or TV trigger.
b. Auto align is suspended in video, external, gate, and delayed trigger modes while waiting for a trigger event to occur.
c. Delayed trigger is available with line, external, and TV trigger (Option B7B).

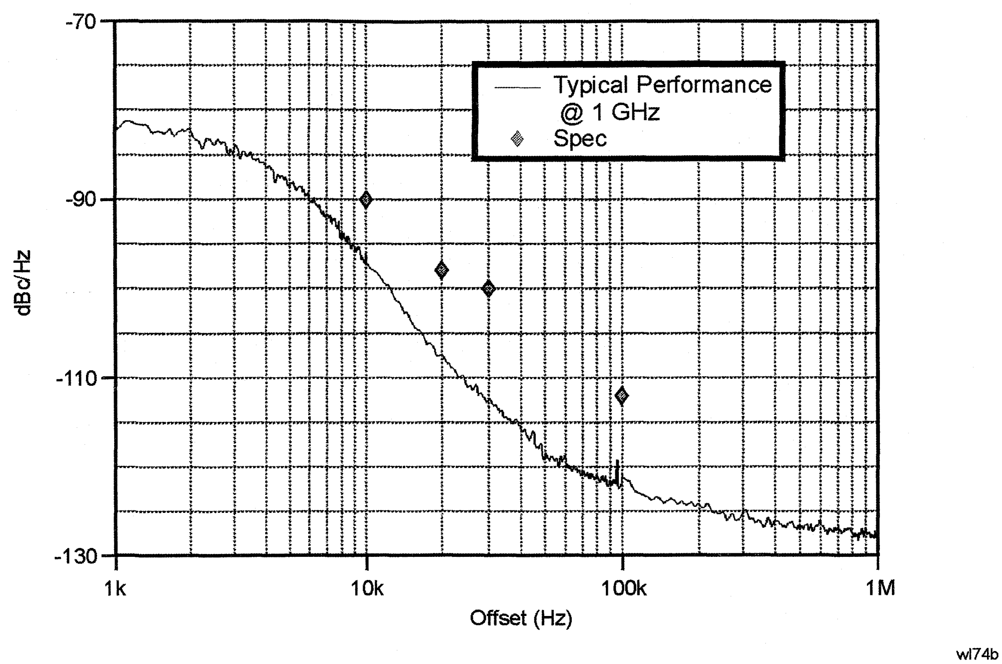
	Specifications	Supplemental Information
Resolution Bandwidth (RBW)		
Range		
–3 dB bandwidth	1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz	
–6 dB bandwidth (EMI)	9 kHz and 120 kHz	
(Option 1DR)		Only available in spans ≤ 5 MHz, sweep times ≥ 5 ms, and not usable with tracking generator in operation (*Option 1DN*)
–3 dB bandwidth	Adds 10, 30, 100, 300 Hz	
–6 dB bandwidth (EMI)	Add 200 Hz	
Accuracy		
1 kHz to 3 MHz RBW	±15%	
5 MHz RBW	±30%	
10 Hz to 300 Hz RBW *(Option 1DR)*	±10%	
Shape		
1 kHz to 5 MHz RBW		Synchronously tuned four poles, approximately Gaussian shape
10 Hz to 300 Hz RBW *(Option 1DR)*		Digital, approximately Gaussian shape
Selectivity (60 dB/3 dB bandwidth ratio)		
1 kHz to 5 MHz RBW		<15:1, characteristic
10 Hz to 300 Hz RBW *(Option 1DR)*		<5:1, characteristic

	Specifications	Supplemental Information
Video Bandwidth (VBW) (–3 dB)		
Range	30 Hz to 1 MHz in 1-3-10 sequence	3 MHz, characteristic
(Option 1DR)	Adds 1, 3, 10 Hz for RBW's <1 kHz	
Accuracy		±30%, characteristic
Shape		Post detection, single pole low-pass filter used to average displayed noise Video bandwidths below 30 Hz are digital bandwidths with anti-aliasing filtering.

	Specifications	Supplemental Information
Stability		
Noise Sidebands, offset from CW signal with 1 kHz RBW, 30 Hz VBW and sample detector		
≥10 kHz	≤ –90 dBc/Hz[a]	
≥20 kHz	≤ –98 dBc/Hz[a]	
≥30 kHz	≤ –100 dBc/Hz[a]	
≥100 kHz	≤ –112 dBc/Hz[a]	
Residual FM		
1 kHz RBW, 1 kHz VBW	≤150 Hz × N p–p in 100 ms	
(Option 1D5)	≤100 Hz × N p–p in 100 ms	
10 Hz RBW, 10 Hz VBW *(Option 1DR)*	≤2 Hz × N p–p in 20 ms	
10 Hz RBW, 10 Hz VBW *(Option 1DR)*		≤10 Hz × N p–p in 20 ms, characteristic
System-Related Sidebands, offset from CW signal		
≥30 kHz	≤ –65 dBc[a]	
Line-Related Sidebands, offset from CW signal *(Option 1DR)*		
<300 Hz		≤ –50 dBc[a], characteristic
>300 Hz to 30 kHz		≤ –55 dBc[a], characteristic

a. Add 20 Log(N) for frequencies > 3 GHz

Noise Sidebands Normalized to 1 Hz Versus Offset From Carrier



Amplitude

Amplitude specifications do not apply for the negative peak detector mode.

	Specifications	Supplemental Information
Measurement Range	Displayed Average Noise Level to Maximum Safe Input Level	
Input Attenuator Range	0 to 65 dB, in 5 dB steps	

	Specifications	Supplemental Information
Maximum Safe Input Level		
Average Continuous Power	+30 dBm (1 W)	
Input attenuator setting ≥5 dB		
Peak Pulse Power for <10 μsec pulse width, <1% duty cycle, and input attenuation ≥30 dB	+50 dBm (100 W)	
dc	0 Vdc	

	Specifications	Supplemental Information
1 dB Gain Compression		
Total power at input mixer [a][b]		
50 MHz to 3.0 GHz	0 dBm	
3.0 GHz to 6.7 GHz	0 dBm	
6.7 GHz to 13.2 GHz	–3 dBm	
13.2 GHz to 26.5 GHz	–5 dBm	
Preamp On *(Option 1DS)* Total power at the preamp[c]		–20 dBm, characteristic

a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).

b. For resolution bandwidths 1 kHz to 30 kHz, the maximum input signal amplitude must be ≤ reference level +10 dB.

c. Total power at the preamp (dBm) = total power at the input (dBm) – input attenuation (dB).

	Specifications		Supplemental Information	
Displayed Average Noise Level				
(Input terminated, 0 dB attenuation, sample detector, Reference Level = –70 dBm)				
	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW *(Option 1DR)*	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW *(Option 1DR)*
1 MHz to 10 MHz			≤ –116 dBm, characteristic	≤ –134 dBm, characteristic
10 MHz to 1.0 GHz	≤ –116 dBm	≤ –135 dBm		
1.0 GHz to 2.0 GHz	≤ –115 dBm	≤ –134 dBm		
2.0 GHz to 3.0 GHz	≤ –112 dBm	≤ –131 dBm		
3.0 GHz to 6.0 GHz	≤ –112 dBm	≤ –131 dBm		
6.0 GHz to 12 GHz	≤ –110 dBm	≤ –129 dBm		
12 GHz to 22 GHz	≤ –107 dBm	≤ –126 dBm		
22 GHz to 26.5 GHz	≤ –101 dBm	≤ –120 dBm		
Preamp On *(Option 1DS)*	1 kHz RBW 30 Hz VBW	10 Hz RBW 1 Hz VBW *(Option 1DR)*	1 kHz RBW 30 Hz VBW	10 kHz RBW 1 Hz VBW *(Option 1DR)*
0 to 55 °C				
1 MHz to 10 MHz			≤ –131 dBm, characteristic	≤ –149 dBm, characteristic
10 MHz to 1.0 GHz	≤ –131 dBm	≤ –149 dBm		
1.0 GHz to 2.0 GHz	≤ –129 dBm	≤ –147 dBm		
2.0 GHz to 3.0 GHz	≤ –127 dBm	≤ –145 dBm		
20 to 30 °C				
10 MHz to 1.0 GHz	≤ –132 dBm	≤ –150 dBm		
1.0 GHz to 2.0 GHz	≤ –131 dBm	≤ –149 dBm		
2.0 GHz to 3.0 GHz	≤ –130 dBm	≤ –148 dBm		

	Specifications		Supplemental Information	
External Mixer *(Option AYZ)*			1 kHz RBW 30 Hz VBW ≤ -134 dBm + external mixer conversion loss, characteristic	10 Hz RBW 1 Hz VBW *(Option 1DR)* ≤ -153 dBm + external mixer conversion loss, characteristic

	Specifications	Supplemental Information
Display Range		
Log Scale	Ten divisions displayed; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps	
RBW $\geq$ 1 kHz	Calibrated 0 to −85 dB from Reference Level	
RBW $\leq$ 300 Hz *(Option 1DR)*	Calibrated 0 to −120 dB[a] from Reference Level	
Linear Scale	Ten divisions	
Scale Units	dBm, dBmV, dBμV, V,W and Hz (Option BAA)	

a. 0 to −70 dB range when span = 0 Hz, or when auto ranging is off: (:DISPlay:WINDow:TRACe:Y[:SCALe]:LOG:RANGe:AUTO OFF).

	Specifications	Supplemental Information
Marker Readout Resolution		
Log scale		
RBW ≥ 1 kHz		
0 to −85 dB from ref level	0.04 dB	
RBW ≤ 300 Hz		
0 to −120 dB from ref level	0.04 dB	
Linear scale	0.01% of Reference Level	
Fast Sweep Times for Zero Span		
20 μs to <5 ms *(Option AYX)*		
Log		
0 to −85 dB from ref level	0.3 dB	
Linear	0.3% of Reference Level for linear scale	

	Specifications	Supplemental Information
Frequency Response		
50 Ω, Absolute[a]/Relative		
9 kHz to 3.0 GHz		
10 dB attenuation		
20 to 30 °C	±0.5 dB	
0 to 55 °C	±1.0 dB	
50 Ω, Absolute[a]/Relative Preamp On *(Option 1DS)*		
1 MHz to 3.0 GHz		
0 dB attenuation	±2.0 dB	
Preselector centered for frequency >3.0 GHz		
3.0 GHz to 6.7 GHz		
10 dB attenuation		
Absolute[a]		
20 to 30 °C	±1.5 dB	
0 to 55 °C	±2.5 dB	
Relative		
20 to 30 °C	±1.3 dB	
0 to 55 °C	±1.5 dB	
6.7 GHz to 13.2 GHz		
10 dB attenuation		
Absolute[a]		
20 to 30 °C	±2.0 dB	
0 to 55 °C	±3.0 dB	
Relative		
20 to 30 °C	±1.8 dB	
0 to 55 °C	±2.0 dB	

	Specifications	Supplemental Information
13.2 GHz to 26.5 GHz		
10 dB attenuation		
Absolute[a]		
20 to 30 °C	±2.0 dB	
0 to 55 °C	±3.0 dB	
Relative		
20 to 30 °C	±1.8 dB	
0 to 55 °C	±2.0 dB	

a. Absolute flatness values are referenced to the amplitude at 50 MHz.

	Specifications	Supplemental Information
Input Attenuation Switching Uncertainty at 50 MHz		
Attenuator Setting		
0 dB to 5 dB	±0.3 dB	
10 dB	Reference	
15 dB	±0.3 dB	
20 to 65 dB	±(0.1 dB + 0.01 × Attenuator Setting)	

	Specifications	Supplemental Information
Preamp *(Option 1DS)*		
Gain		+20 dB, nominal[a]
Noise figure		5 dB, characteristic

a. Amplifier is between the input attenuator and the input mixer.

Attenuation Accuracy Relative to the 10 dB Attenuator Setting, Characteristic					
	Frequency Range				
Attenuation, dB	**dc–3.0 GHz (± dB)**	**3.0–13.2 GHz (± dB)**	**13.2–19 GHz (± dB)**	**19–22 GHz (± dB)**	**22–26.5 GHz (± dB)**
0	0.3	0.5	0.8	0.9	1.0
5	0.3	0.5	0.8	0.9	1.0
10 (Reference)	Reference	Reference	Reference	Reference	Reference
15	0.4	0.5	0.8	1.0	1.5
20	0.4	0.5	0.8	1.0	1.5
25	0.5	0.6	0.8	1.2	2.0
30	0.5	0.6	0.8	1.2	2.0
35	0.6	0.7	1.0	1.8	3.0
40	0.6	0.7	1.0	1.8	3.0
45	0.7	1.0	1.3	2.2	3.4
50	0.7	1.0	1.3	2.2	3.4
55	0.9	1.1	1.6	2.7	3.5
60	0.9	1.1	1.6	2.7	3.5
65	1.0	1.6	2.0	3.2	3.8

	Specifications	Supplemental Information
Absolute Amplitude Accuracy		
At reference settings [a]	±0.34 dB	
Preamp On[b] *(Option 1DS)*	±0.5 dB	
External Mixer *(Option AYZ)*	IF INPUT absolute amplitude accuracy + external mixer conversion loss accuracy[c]	
Overall Amplitude Accuracy[d]		
20 to 30 °C	± (0.54 dB + Absolute Frequency Response)	

a. Settings are: reference level –20 dBm; input attenuation 10 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, sample detector, signal at reference level.
b. Settings are: reference level –30 dBm; input attenuation 0 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, signal at reference level.
c. Preselector centered with HP 11974-Series mixers.
d. For reference level 0 to –50 dBm; input attenuation 10 dB; RBW 1 kHz; VBW 1 kHz; scale log, log range 0 to 50 dB from reference level; sweep time coupled; signal input 0 to –50 dBm; span ≤20 kHz; internal mixing.

	Specifications	Supplemental Information
RF Input VSWR (at tuned frequency)		
Attenuator setting 0 dB		
9 kHz to 26.5 GHz		3.0:1, characteristic
Attenuator setting 5 dB		
9 kHz to 100 kHz		2.0:1, characteristic
100 kHz to 6.7 GHz		1.4:1, characteristic
6.7 GHz to 13.2 GHz		1.7:1, characteristic
13.2 GHz to 22.0 GHz		2.3:1, characteristic
22.0 GHz to 26.5 GHz		2.6:1, characteristic
Attenuator setting 10 to 65 dB		
9 kHz to 6.7 GHz		1.3:1, characteristic
6.7 GHz to 13.2 GHz		1.5:1, characteristic
13.2 GHz to 22.0 GHz		2.0:1, characteristic
22.0 GHz to 26.5 GHz		2.2:1, characteristic

	Specifications	Supplemental Information
Auto Alignment[a]		
Sweep-to-sweep variation		±0.1 dB, characteristic

a. Set **Auto Align** to **Off** and use **Align Now, All** to eliminate this variation.

	Specifications	Supplemental Information
Resolution Bandwidth Switching Uncertainty (at Reference Level)		
1 kHz RBW	Reference	
3 kHz to 3 MHz RBW	±0.3 dB	
5 MHz RBW	±0.6 dB	
10 Hz to 300 Hz RBW *(Option 1DR)*	±0.3 dB	

	Specifications	Supplemental Information
Reference Level		
Range	Adjustable over Amplitude Measurement Range	
Resolution		
Log Scale	±0.1 dB	
Linear Scale	±0.12% of Reference Level	
Accuracy (at a fixed frequency, a fixed attenuator, and referenced to –30 dBm (–10 dBm, Preamp On *(Option 1DS)*))		
Reference Level (dBm) – input attenuator setting (dB) + preamp gain (dB)		
–10 dBm to > –60 dBm	±0.3 dB	
–60 dBm to > –85 dBm	±0.5 dB	
–85 dBm to –90 dBm	±0.7 dB	

	Specifications	Supplemental Information
Display Scale Switching Uncertainty		
Switching between Linear and Log	±0.15 dB at Reference Level	
Log Scale Switching	No error	

	Specifications	Supplemental Information
Display Scale Fidelity		
Log Maximum Cumulative		
0 to –85 dB from Reference Level	±(0.3 dB + 0.01 × dB from Reference Level)	
RBW ≤ 300 Hz *(Option 1DR)*		
Span > 0 Hz		
0 to –98 dB from Reference Level	±(0.3 dB + 0.01 × dB from Reference Level)	
–98 to –120 dB from Reference Level		±2.0 dB, characteristic
Span = 0 Hz[a]		
0 to –60 dB from Reference Level	±(0.3 dB + 0.015 × dB from Reference Level)	
–60 to –70 dB from Reference Level	±1.5 dB	
Log Incremental Accuracy		
0 to –80 dB[b] from reference level	±0.4 dB/4 dB	
Linear Accuracy	±2% of Reference Level	

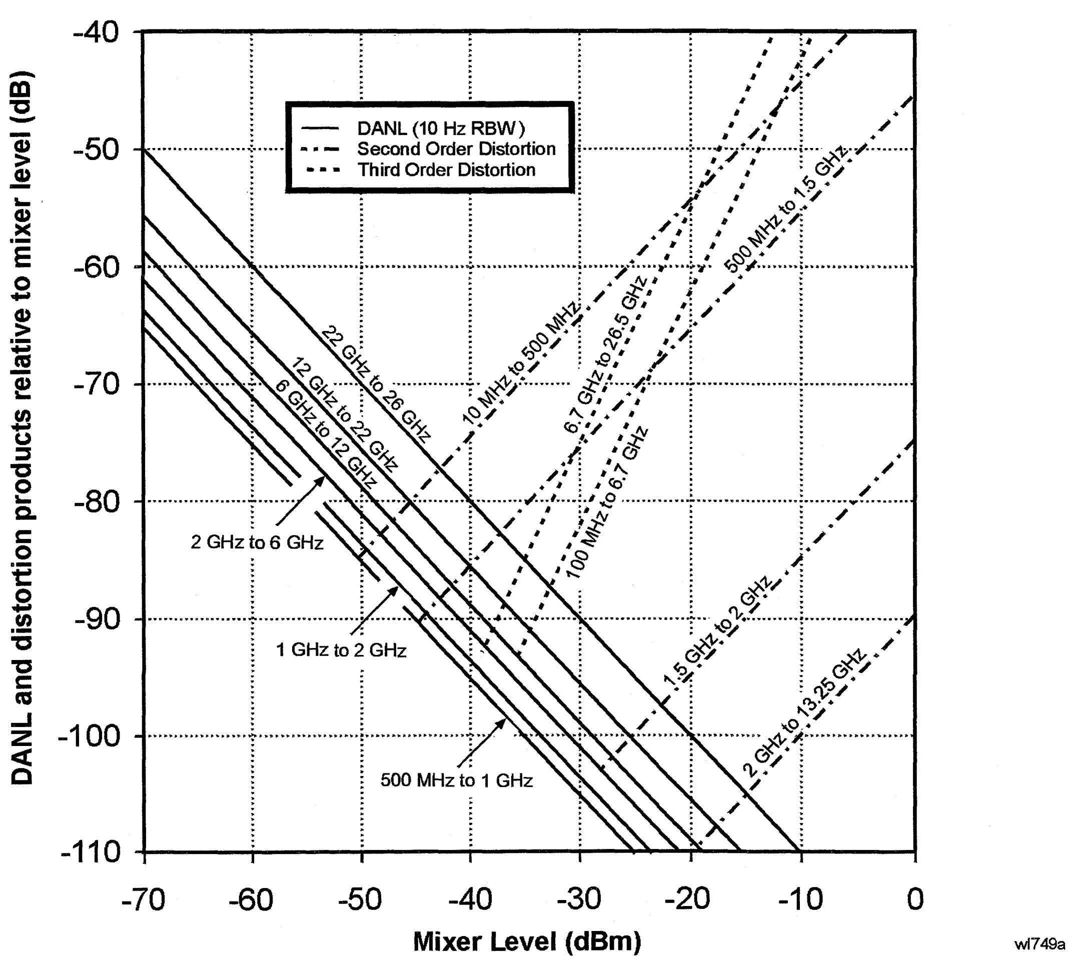
a. or when auto ranging is off: (:DISPlay:WINDow:TRACe:Y[:SCALe]:LOG:RANGe:AUTO OFF)
b. 0 to –50 dB for RBWs ≤ 300 Hz and span = 0 Hz, or when auto ranging is off.

	Specifications	Supplemental Information
Spurious Responses		
Second Harmonic Distortion		
Input Signal		
10 MHz to 500 MHz	< –65 dBc for –30 dBm signal at input mixer[a]	+35 dBm SHI (second harmonic intercept)
500 MHz to 1.5 GHz	< –75 dBc for –30 dBm signal at input mixer[a]	+45 dBm SHI
1.5 GHz to 2.0 GHz	< –85 dBc for –10 dBm signal at input mixer[a]	+75 dBm SHI
2.0 GHz to 3.35 GHz	< –100 dBc[b] for –10 dBm signal at input mixer[a]	+90 dBm SHI
3.35 GHz to 6.6 GHz	< –100 dBc[b] for –10 dBm signal at input mixer[a]	+90 dBm SHI
6.6 GHz to 13.25 GHz	< –100 dBc[b] for –10 dBm signal at input mixer[a]	+90 dBm SHI
Preamp On *(Option 1DS)* 10 MHz to 1.5 GHz		–5 dBm SHI, characteristic
Third Order Intermodulation Distortion		
10 MHz to 100 MHz		+7 dBm TOI (third order intercept), characteristic
100 MHz to 3 GHz	< –82 dBc for two –30 dBm signals at input mixer[a] and >50 kHz separation	+11 dBm TOI +16 dBm TOI, typical, 20 to 30 °C
3.0 GHz to 6.7 GHz	< –82 dBc for two –30 dBm signals at input mixer[a] and >50 kHz separation	+11 dBm TOI +18 dBm TOI, typical, 20 to 30 °C
6.7 GHz to 13.2 GHz	< –75 dBc for two –30 dBm signals at input mixer[a] and >50 kHz separation	+7.5 dBm TOI +12 dBm TOI, typical, 20 to 30 °C
13.2 GHz to 26.5 GHz	< –75 dBc for two –30 dBm signals at input mixer[a] and >50 kHz separation	+7.5 dBm TOI +11 dBm TOI, typical, 20 to 30 °C
Preamp On *(Option 1DS)* 10 MHz to 3 GHz,		–16 dBm TOI, characteristic

	Specifications	Supplemental Information
Other Input Related Spurious		
Inband Responses		
>30 kHz offset	< –65 dBc for –20 dBm signal at input mixer[a]	
Out-of-band Responses	< –80 dBc for –10 dBm signal at input mixer[a]	

a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
b. or signal below displayed average noise level.

Specified Dynamic Range



	Specifications	Supplemental Information
Residual Responses (Input terminated and 0 dB attenuation)		
150 kHz to 6.7 GHz	< –90 dBm	

Options

Time Gated Spectrum Analysis (Option 1D6)

	Specifications	Supplemental Information
Gate Delay		
Range	1 μs to 400 s	
Accuracy	±(500 ns + (0.01% × (maximum of gate delay or length)))	From gate trigger input to positive edge of gate output
Gate Length		
Range	1 μs to 400 s	
Accuracy	±(500 ns + (0.01% × (maximum of gate delay or length)))	From positive edge to negative edge of gate output
Resolution	[(maximum of gate delay or length in seconds)/65000] rounded up to nearest μs	Dependent on the greater of gate delay or gate length
Additional Amplitude Error[a]		
Log Scale	±0.2 dB	
Linear Scale	±0.1 % of reference level	

a. While in gate mode.

Tracking Generator (Option 1DN)

The spectrum analyzer tracking generator combination will meet its specification after a cable (8120-5148) and adapter are connected between RF OUT and INPUT and **Align Now**, **TG** has been run.

	Specifications	Supplemental Information
Warm-Up	5 minutes	

	Specifications	Supplemental Information
Output Frequency Range	9 kHz to 3.0 GHz	

	Specifications	Supplemental Information
Minimum Resolution BW	1 kHz	Not usable with resolution bandwidths ≤300 Hz *(Option 1DR)*

	Specifications	Supplemental Information
Output Power Level		
Range	–2 to –66 dBm	
Resolution	0.1 dB	
Absolute Accuracy (at 50 MHz with coupled source attenuator, referenced to –20 dBm)	± 0.75 dB	
Vernier		
Range	8 dB	
Accuracy (with coupled source attenuator, 50 MHz, –20 dBm)		
Incremental	±0.2 dB/dB	
Cumulative	±0.5 dB, total	
Output Attenuator Range	0 to 56 dB in 8 dB steps	

	Specifications	Supplemental Information
Maximum Safe Reverse Level		+30 dBm (1 W), +30 Vdc, characteristic

	Specifications	Supplemental Information
Output Power Sweep		
Range	(–10 dBm to –2 dBm) – (Source Attenuator Setting)	
Resolution	0.1 dB	
Accuracy (zero span)	<1 dB peak-to-peak	

	Specifications	Supplemental Information
Output Flatness		
Referenced to 50 MHz, –20 dBm		
9 kHz to 10 MHz	±3 dB	
10 MHz to 3 GHz	±2 dB	

	Specifications	Supplemental Information
Spurious Outputs		
(–2 dBm output)		
Harmonic Spurs		
TG Output 9 kHz to 20 kHz	≤ –15 dBc	
TG Output 20 kHz to 3 GHz	≤ –25 dBc	
Non-harmonic Spurs		
TG Output 9 kHz to 2 GHz	≤ –27 dBc	
TG Output 2 GHz to 3 GHz	≤ –23 dBc	
LO Feedthrough		
LO Frequency 3.921409 to 6.9214 GHz	≤ –16 dBm	

	Specifications	Supplemental Information
Dynamic Range	Maximum Output Power Level – Displayed Average Noise Level	

	Specifications	Supplemental Information
Output Tracking		
Drift		1.5 kHz/5 minute, characteristic
Swept Tracking Error		Usable in 1 kHz RBW after 5 minutes of warm-up

	Specifications	Supplemental Information
RF Power-Off Residuals		
9 kHz to 3 GHz		< –120 dBm, characteristic

	Specifications	Supplemental Information
Output Attenuator Repeatability		
9 kHz to 300 MHz		±0.1 dB, characteristic
300 MHz to 2.0 GHz		±0.2 dB, characteristic
2.0 GHz to 3 GHz		±0.3 dB, characteristic

	Specifications	Supplemental Information
Output VSWR		
0 dB attenuation		<2.0:1, characteristic
≥ 8 dB attenuation		<1.5:1, characteristic

	Specifications	Supplemental Information
Output Attenuator Accuracy		
0 dB		±0.5 dB, characteristic
8 dB		±0.5 dB, characteristic
16 dB	Reference	
24 dB		±0.5 dB, characteristic
32 dB		±0.6 dB, characteristic
40 dB		±0.8 dB, characteristic
48 dB		±1.0 dB, characteristic
56 dB		±1.1 dB, characteristic

Tracking Generator Output Accuracy
Relative Accuracy (Referred to –20 dBm) = Output Attenuator Accuracy + Vernier Accuracy + Output Flatness
Absolute Accuracy = Relative Accuracy (Referred to –20 dBm) + Absolute Accuracy at 50 MHz

	Specifications	Supplemental Information
Output Power Level		
Range	–2 to –66 dBm	
Resolution	0.1 dB	
Absolute Accuracy (at 50 MHz with coupled source attenuator, referenced to –20 dBm)	± 0.75 dB	
Vernier		
Range	8 dB	
Accuracy (with coupled source attenuator, 50 MHz, –20 dBm)		
Incremental	±0.2 dB/dB	
Cumulative	±0.5 dB, total	
Output Attenuator Range	0 to 56 dB in 8 dB steps	

External Mixing (Option AYZ)

	Specifications		Supplemental Information
LO OUTPUT			
Frequency Range	2.9 to 7.1 GHz		
Power			
2.9 to 6.1 GHz			
20 to 30°C	15.5 to 17 dBm		When connected to external mixers with an HP 5061-5458 cable, provides 14.5 to 16 dBm at the mixer, characteristic.
0 to 55°C	15 to 17.5 dBm		
2.9 to 7.1 GHz	13 to 17.5 dBm		
VSWR			<1.9:1, characteristic
IF INPUT			
Frequency Range			321.4 MHz ±5 MHz, characteristic
Maximum Safe Input Level			
ac			10 dBm, characteristic
dc			±10 V, characteristic
VSWR			<1.9:1, characteristic
Absolute Amplitude Accuracy[a]			
For Reference Levels from –10 to –60 dB			
Amplitude Corrections	20 to 30 °C	0 to 55 °C	
15 to 30 dB	±1.0 dB	±1.5 dB	
>30 to 50 dB	±1.2 dB	±1.7 dB	
>50 to 60 dB	±1.4 dB	±1.9 dB	
1 dB Gain Compression Level[b]			–20 dBm, characteristic with –10 dBm reference level

	Specifications	Supplemental Information
Mixer Bias (IF INPUT)		
Voltage		
Maximum Range		±3.3 V, characteristic
Linear Compliant Range		±2 V, characteristic
Current (0 Ω load)		
Range	±10 mA	
Resolution		< 20 μA, characteristic
Accuracy		±(3% + Resolution), characteristic
Output Impedance		490 Ω, characteristic

a. Settings are: RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, sample detector, signal at reference level.
b. With amplitude corrections 0 dB.

FM Demodulation (Option BAA)

The FM demodulation characteristics will be met after an **Align Now, FM Demod** has been run.

	Specifications	Supplemental Information
Input Level		≥ (–60 dBm + attenuator setting – preamp gain), characteristic
Signal Level		0 to –30 dB below reference level, characteristic
FM Deviation		
Range		10 kHz to 1 MHz
Resolution		Provides 1 Hz display annotation resolution
FM Deviation Range		
10 kHz to 40 kHz		12 Hz, characteristic
>40 kHz to 200 kHz		60 Hz, characteristic
>200 kHz to 1 MHz		300 Hz, characteristic
Accuracy[a] FM Rate < FM BW/100, VBW ≥(30 × FM Rate), RBW > the maximum of (30 × FM deviation) or (30 × FM Rate)		< (2% of FM deviation range + 2 × Resolution), characteristic
Offset Error[a]		5% of FM Deviation Range + 300 Hz, characteristic
FM Bandwidth *(–3 dB)*		
FM Deviation Range		
10 kHz to 40 kHz		7.5 × FM deviation range, characteristic
>40 kHz to 200 kHz		1.3 × FM deviation range, characteristic
>200 kHz to 1 MHz		0.3 × FM deviation range, characteristic

a. In time domain sweeps (span = 0 Hz).

TV Trigger and Picture On Screen (Option B7B)

	Specifications	Supplemental Information
TV Trigger and Picture On Screen		TV Trigger initiates a sweep of the analyzer after the sync pulse of a selected line of a TV video field. Picture On Screen displays the TV picture on the analyzer display.
Amplitude Requirements		
TV Source: SA		Top 50% of linear display, characteristic
TV Source: EXT VIDEO IN		500 mVp–p to 2 Vp–p, characteristic
Compatible Standards	NTSC–M, NTSC–Japan, PAL–M, PAL–B,D,G,H,I, PAL–N, PAL–N Combination, SECAM-L	
Field Selection	Entire frame, even, odd	
Sync Polarity	Positive or negative	
TV Trigger		
Line Selection	1 to 525, or 1 to 625, standard dependent	

General

	Specifications	Supplemental Information
Temperature Range		
Operating	0 to 55 °C	Floppy disk 10 to 40 °C
Storage	–40 to +75 °C	

	Specifications	Supplemental Information
Audible Noise (ISO 7779)		
Sound Pressure at 25 °C		<40 dBa, (<4.6 Bels power)

	Specifications	Supplemental Information
Military Specification	Has been type tested to the environmental specifications of MIL-PRF-28800F class 3.	

	Specifications	Supplemental Information
EMI Compatibility	Conducted and radiated emission is in compliance with CISPR Pub. 11/1990 Group 1 Class A.	

	Specifications	Supplemental Information
Immunity Testing		
Radiated Immunity		Testing was done at 3 V/m according to IEC 801-3/1984. When the analyzer tuned frequency is identical to the immunity test signal frequency there may be signals of up to –60 dBm displayed on the screen.
Electrostatic Discharge		Air discharges of up to 8 kV were applied according to IEC 801-2/1991. Discharges to center pins of any of the connectors may cause damage to the associated circuitry.

	Specifications	Supplemental Information
Power Requirements		Uses CUKonverter® topology in the power supply.
ac Operation		
Voltage, frequency	90 to 132 V rms, 47 to 440 Hz 195 to 250 V rms, 47 to 66 Hz	
Power Consumption, On	<300 W	
Power Consumption, Standby	<5 W	
dc Operation		
Voltage	12 to 20 Vdc	
Power Consumption	<200 W	

	Specifications	Supplemental Information
Measurement Speed		
Local Measurement and Display Update rate[a]		≥ 28/s, characteristic
Remote Measurement and HP-IB Transfer Rate[b] *(Option A4H)*		≥ 19/s, characteristic

a. Auto align off, 5 ms sweep time, fixed center frequency.
b. Auto align off, 5 ms sweep time, fixed center frequency, 401 point trace, display off (DISPlay:ENABle off), and 32-bit integer data format (FORMat:DATA INT,32).

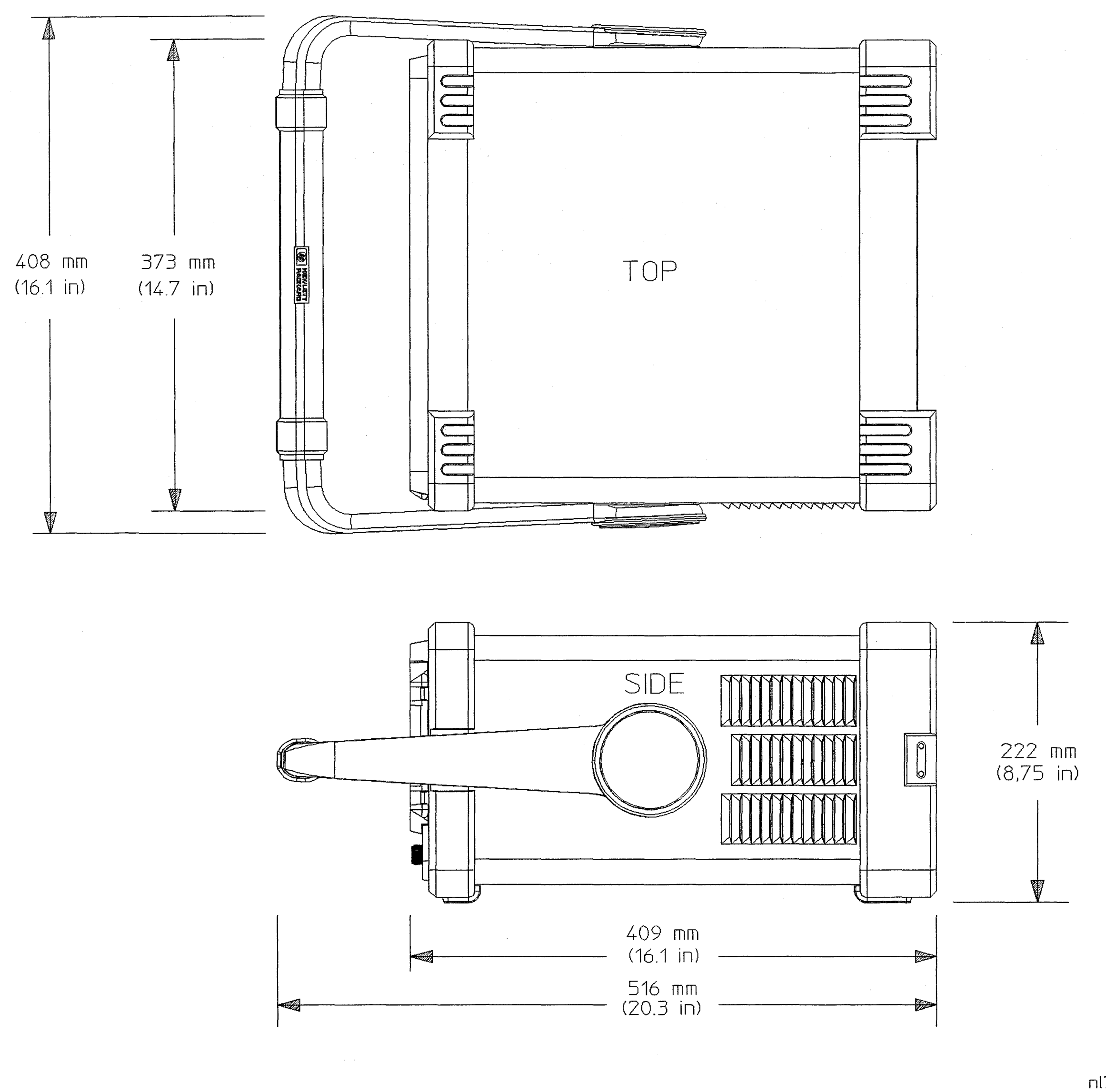
	Specifications	Supplemental Information
Data Storage		
Internal		200 Traces or States
External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS® compatible floppy disk		200 Traces or States

	Specifications	Supplemental Information
Downloadable Program Memory		2 MB available memory
(Option B72)		10 MB available memory

	Specifications	Supplemental Information
Demod Tune Listen		
AM		Internal speaker, front-panel earphone jack and front-panel volume control.
FM *(Option BAA)*		
(Option A4J, AYX, or BAA)		An uncalibrated demodulated signal is available on the AUX VIDEO OUT or EXT VIDEO OUT connectors at the rear panel.

	Specifications	Supplemental Information
Weight (without options)		
Net		16.2 kg (35.6 lb), characteristic
Shipping		31.0 kg (68 lb), characteristic

Dimensions


408 mm
(16.1 in)
373 mm
(14.7 in)
TOP
SIDE
222 mm
(8.75 in)
409 mm
(16.1 in)
516 mm
(20.3 in)
nl7

Inputs and Outputs

Front Panel

	Specifications	Supplemental Information
INPUT 50 Ω		
Connector	Type-N female	
(Option BAB)	APC 3.5 male	
Impedance		50 Ω, nominal

	Specifications	Supplemental Information
RF OUT 50 Ω, *(Option 1DN)*		
Connector	Type-N female	
Impedance		50 Ω, nominal

	Specifications	Supplemental Information
AMPTD REF OUT[a]		Amplitude Reference
Connector	BNC Female	
Impedance		50 Ω, nominal
Frequency		50 MHz
Frequency Accuracy		Frequency reference error[b]
50 Ω Amplitude[c]		–20 dBm, nominal

a. Turn the amplitude reference on/off by pressing the keys: **Input**, **Amptd Ref Out**.
b. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).
c. The internal amplitude reference actual power is stored internally.

	Specifications	Supplemental Information
PROBE POWER		
Voltage/Current		+15 Vdc, ±7% at 150 mA max., characteristic –12.6 Vdc ±10% at 150 mA max., characteristic

	Specifications	Supplemental Information
EXT KEYBOARD		Feature not implemented.
Connector	6-pin mini-DIN	

	Specifications	Supplemental Information
Speaker		Front panel knob controls volume

	Specifications	Supplemental Information
Headphone		Front panel knob controls volume
Connector	3.5 mm (1/8 inch) miniature audio jack	
Power Output		0.2 W into 4 Ω, characteristic

Rear Panel

	Specifications	Supplemental Information
10 MHz REF OUT		
Connector	BNC female	
Impedance		50 Ω, nominal
Output Amplitude		>0 dBm, characteristic

	Specifications	Supplemental Information
10 MHz REF IN		
Connector	BNC female	Note: Analyzer noise sidebands and spurious response performance may be affected by the quality of the external reference used.
Impedance		50 Ω, nominal
Input Amplitude Range		−15 to +10 dBm, characteristic
Frequency		10 MHz, nominal

	Specifications	Supplemental Information
GATE TRIG/EXT TRIG IN		
Connector	BNC female	
External Trigger Input		
Trigger Level		Selectable positive or negative edge initiates sweep in EXT TRIG mode (5 V TTL)
Gate Trigger Input *(Option 1D6)*		
Minimum Pulse Width		>30 ns (5 V TTL)

	Specifications	Supplemental Information
GATE/HI SWP OUT		
Connector	BNC female	
High Sweep Output		
Level		High = sweep; Low = retrace (5 V TTL)
Gate Output *(Option 1D6)*		
Level		High = gate on; Low = gate off (5 V TTL)

	Specifications	Supplemental Information
VGA OUTPUT		
Connector	VGA compatible, 15-pin mini D-SUB	
Format		VGA (31.5 kHz horizontal, 60 Hz vertical sync rates, non-interlaced) Analog RGB
Resolution	640×480	

	Specifications	Supplemental Information
AUX IF OUT *(Option A4J or AYX)*		RBW $\geq$ 1 kHz
Connector	BNC female	
Frequency		21.4 MHz, nominal

	Specifications	Supplemental Information
Amplitude Range (for signal at reference level and for reference levels – input attenuation + preamp gain of –10 to –70 dBm)		–10 dBm (uncorrected), characteristic
Impedance		50 Ω, nominal

	Specifications	Supplemental Information
AUX VIDEO OUT *(Option A4J or AYX)*		RBW ≥ 1 kHz
Connector	BNC female	
Amplitude Range (into >10 kΩ)		0 to 1 V (uncorrected), characteristic

	Specifications	Supplemental Information
HI SWP IN *(Option A4J or AYX)*		
Connector	BNC female	
Input		Open collector, low stops sweep (5 V TTL)

	Specifications	Supplemental Information
HI SWP OUT *(Option A4J or AYX)*		
Connector	BNC female	
Output		High = sweep, Low = retrace (5 V TTL)

	Specifications	Supplemental Information
SWP OUT *(Option A4J or AYX)*		
Connector	BNC female	
Amplitude		0 to +10 V ramp, characteristic

	Specifications	Supplemental Information
PRESEL TUNE OUTPUT		
Connector	BNC female	
Load Impedance (dc coupled)		> 10 kΩ, nominal
Range		0 to +10 V, characteristic
Sensitivity		
Internal Mixer		0.33 V/GHz of tuned frequency > 3 GHz, characteristic
External Mixer *(Option AYZ)*		1.5 V/GHz of tuned L.O. frequency, characteristic

	Specifications	Supplemental Information
HP-IB Interface *(Option A4H)*		
Connector	IEEE-488 bus connector	
HP-IB Codes		SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3 and C28

	Specifications	Supplemental Information
Serial Interface *(Option 1AX)*		
Connector	9-pin D-SUB male	RS-232

	Specifications	Supplemental Information
Parallel Interface *(Option A4H or 1AX)*		Printer port only
Connector	25-pin D-SUB female	

	Specifications	Supplemental Information
EXT VIDEO IN/TV TRIG OUT[a] *(Option B7B or BAA)*		EXT VIDEO IN is the Baseband composite video input for TV trigger and picture on screen. TV TRIG OUT is the TV trigger output.
Connector	BNC Female (75 Ω)	
Impedance		75 Ω, characteristic.

	Specifications	Supplemental Information
(Option BAA without Option B7B)		Feature not implemented.
(Option BAA with Option B7B)		
External Video Input Video Amplitude		1 Vp–p, nominal, characteristic
TV Trigger Output		Positive edge indicates start of selected TV line after sync. pulse.
Amplitude		TTL (0 V and 3.4 V with 75 Ω series resistance), characteristic

a. This connector is labelled EXT VIDEO IN on older spectrum analyzers and EXT VIDEO IN/TV TRIG OUT on newer spectrum analyzers.

	Specifications	Supplemental Information
EXT VIDEO OUT *(Option B7B or BAA)*		Baseband video output RBW ≥ 1 kHz
Connector	BNC Female (75 Ω)	
Impedance		75 Ω, characteristic
Amplitude *(Option BAA without Option B7B)*		0 to 1 V (uncorrected), characteristic
Amplitude *(Option BAA with Option B7B)*		
TV Source: SA		0 to 1 V (uncorrected), characteristic
TV Source and EXT VIDEO IN		Same as level at EXT VIDEO IN/TV TRIG OUT, characteristic

Regulatory Information

CAUTION This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 1010 and 664 respectively.

NOTE This product has been designed and tested in accordance with IEC Publication 1010, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

The CE mark is a registered trademark of the European Community (if accompanied by a year, it is the year when the design was proven).

The CSA mark is the Canadian Standards Association safety mark.

ISM 1-A This is a symbol of an Industrial Scientific and Medical Group 1 Class A product. (CISPR 11, Clause 4)

Declaration of Conformity

DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name: Hewlett-Packard Co.

Manufacturer's Address: 1400 Fountaingrove Parkway
Santa Rosa, CA 95403-1799
USA

Declares that the products

Product Name: Spectrum Analyzer

Model Number: HP E4401B, HP E4402B, HP E4403B,
HP E4404B, HP E4405B, HP E4407B,
HP E4408B, HP E4411B

Product Options: This declaration covers all options of the above products.

Conform to the following Product specifications:

Safety: IEC 61010-1:1990 / EN 61010-1:1993
CAN/CSA-C22.2 No. 1010.1-92

EMC: CISPR 11:1990/EN 55011:1991 Group 1, Class A
IEC 801-2:1984/EN 50082-1:1992 4 kV CD, 8 kV AD
IEC 801-3:1984/EN 50082-1:1992 3 V/m, 27-500 MHz
IEC 801-4:1988/EN 50082-1:1992 0.5 kV sig. lines, 1 kV power lines

Supplementary Information:

The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.

Santa Rosa, CA, USA 7 Jan. 1999

Greg Pfeiffer/Quality Engineering Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH Department HQ-TRE, Herreneberger Strasse 130, D71034 Boblingen, Germany (FAX +49-7031-14-3143)

10 HP E4408B Specifications and Characteristics

About This Chapter

This chapter contains specifications and characteristics for the HP E4408B spectrum analyzer. The distinction between specifications and characteristics is described as follows.

- Specifications describe the performance of parameters covered by the product warranty. (The temperature range is 0 °C to 55 °C, unless otherwise noted.)
- Characteristics describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- Typical performance describes additional product performance information that is not covered by the product warranty. It is performance beyond an indicated specification, that most units will exhibit.
- Nominal values indicate the expected, but not warranted, value of a parameter.

The following conditions must be met for the analyzer to meet its specifications.

❑ The analyzer is within the one year calibration cycle.

❑ If **Auto Align All** is selected:

  — After 2 hours of storage within the operating temperature range.

  — 5 minutes after the analyzer is turned on with sweep times less than 4 seconds.

  — After the front-panel amplitude reference is connected to the INPUT, and **Align Now RF** has been run, after the analyzer is turned on. And, once every 24 hours, or if ambient temperature changes more than 30 °C.

❑ If **Auto Align Off** is selected:

  — When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes,

  — After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now All** has been run.

  — When **Align Now All** is run:

  - Every hour
  - If the ambient temperature changes more than 3 °C
  - If the 10 MHz reference changes

- When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):
  - Every 24 hours
  - If the ambient temperature changes more than 30 °C[1]

❑ If **Auto Align All but RF** is selected:

- When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.
- After the analyzer is turned on for a minimum of 90 minutes, the front panel amplitude reference has been connected to the INPUT, and **Align Now RF** has been run.
- When **Align Now RF** is run (with the front-panel amplitude reference connected to the INPUT):
  - Every hour
  - If the ambient temperature changes more than 3 °C

1. 10 °C if Option 1DS is active.

Frequency

	Specifications	Supplemental Information
Frequency Range		
	9 kHz to 26.5 GHz	
Band		Harmonic Mixing Mode (N[a])
0	9 kHz to 3.0 GHz	1–
1	2.85 GHz to 6.7 GHz	1–
2	6.2 GHz to 13.2 GHz	2–
3	12.8 GHz to 19.2 GHz	4–
4	18.7 GHz to 26.5 GHz	4–

a. N is the harmonic mixing mode. For negative mixing modes (as indicated by the "–"), the desired 1st LO harmonic is higher than the tuned frequency by the 1st IF (3.9214 for the 9 kHz to 3 GHz band, 321.4 MHz for all other bands) For positive mixing modes, the desired 1st LO harmonic is lower than the tuned frequency by 321.4 MHz

	Specifications	Supplemental Information
Frequency Reference		
Aging Rate	$\pm 2 \times 10^{-6}$/year	$\pm 1.0 \times 10^{-7}$/day, characteristic
Settability	$\pm 5 \times 10^{-7}$	
Temperature Stability	$\pm 5 \times 10^{-6}$	

	Specifications	Supplemental Information
Frequency Readout Accuracy		
(Start, Stop, Center, Marker)	±(frequency indication × frequency reference error[a] + span accuracy + 15% of RBW + 10 Hz + 1 Hz × N[b])	

a. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).
b. N is the harmonic mixing mode.

	Specifications	Supplemental Information
Marker Frequency Counter		
Resolution	Selectable from 1 Hz to 100 kHz	
Accuracy[a]	±(marker frequency × frequency reference error[b] + counter resolution)[c]	

a. Marker level to displayed noise level > 25 dB, RBW/ Span ≥ 0.002, frequency offset = 0 Hz.
b. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).
c. For firmware revisions prior to A.03.00, add 1 Hz x N, where N is the harmonic mixing mode.

	Specifications	Supplemental Information
Frequency Span		
Range	0 Hz (zero span), 100 Hz to 26.5 GHz	
Resolution	2 Hz x N[a]	
Accuracy	±1% of span	

a. N is the harmonic mixing mode.

	Specifications	Supplemental Information
Sweep Time		
Range	5 ms to 2000 s	50 ms is the minimum sweep time with the tracking generator in operation *(Option 1DN)*
Accuracy		
Span = 0 Hz 5 ms to 2000 s	±1%	
Sweep Trigger[a]	Free Run, Single, Line, Video, External	
Delayed Trigger[b]		
Range	1 μs to 400 s	
Resolution	[(delay in seconds)/65000] rounded up to nearest μs	
Accuracy	±(500 ns +(0.01% of delay))	

a. Auto align is suspended in video, external, and delayed trigger modes while waiting for a trigger event to occur.
b. Delayed trigger is available with line and external trigger.

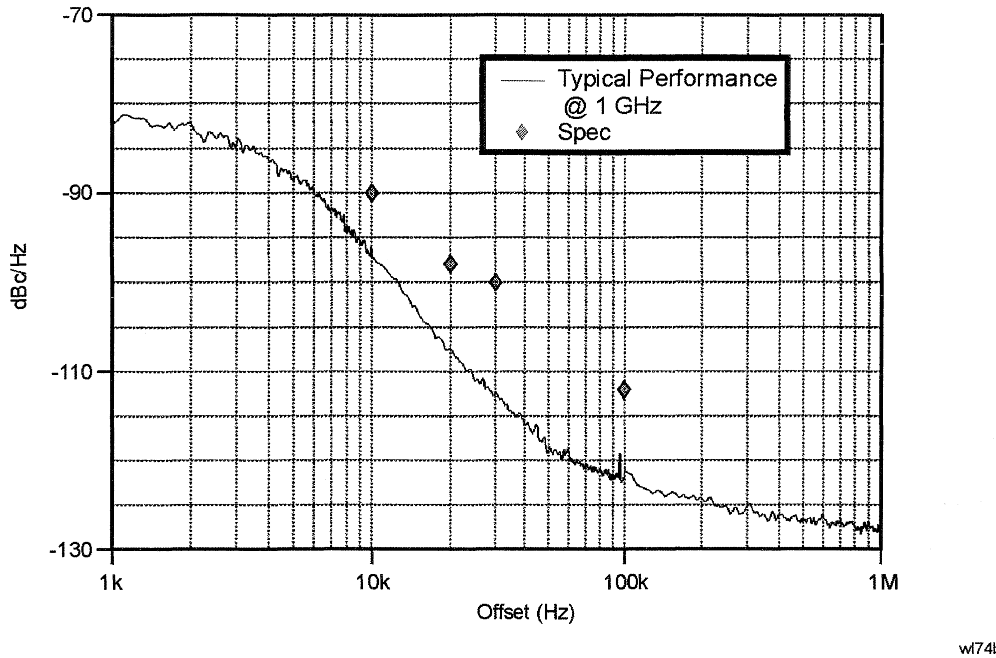
	Specifications	Supplemental Information
Resolution Bandwidth (RBW)		
Range		
–3 dB bandwidth	1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz	
–6 dB bandwidth (EMI)	9 kHz and 120 kHz	
Accuracy		
1 kHz to 3 MHz RBW	±15%	
5 MHz RBW	±30%	
Shape		
1 kHz to 5 MHz RBW		Synchronously tuned four poles, approximately Gaussian shape
Selectivity (60 dB/3 dB bandwidth ratio)		
1 kHz to 5 MHz RBW		<15:1, characteristic

	Specifications	Supplemental Information
Video Bandwidth (VBW) (–3 dB)		
Range	30 Hz to 1 MHz in 1-3-10 sequence	3 MHz, characteristic
Accuracy		±30%, characteristic
Shape		Post detection, single pole low-pass filter used to average displayed noise

	Specifications	Supplemental Information
Stability		
Noise Sidebands, offset from CW signal with 1 kHz RBW, 30 Hz VBW and sample detector		
≥10 kHz	≤ –90 dBc/Hz[a]	
≥20 kHz	≤ –98 dBc/Hz[a]	
≥30 kHz	≤ –100 dBc/Hz[a]	
≥100 kHz	≤ –112 dBc/Hz[a]	
Residual FM		
1 kHz RBW, 1 kHz VBW	≤150 Hz × N p–p in 100 ms	
System-Related Sidebands, offset from CW signal		
≥30 kHz	≤ –65 dBc[a]	

a. Add 20 Log(N) for frequencies > 3 GHz

Noise Sidebands Normalized to 1 Hz Versus Offset From Carrier



Amplitude

Amplitude specifications do not apply for the negative peak detector mode.

	Specifications	Supplemental Information
Measurement Range	Displayed Average Noise Level to Maximum Safe Input Level	
Input Attenuator Range	0 to 65 dB, in 5 dB steps	

	Specifications	Supplemental Information
Maximum Safe Input Level		
Average Continuous Power	+30 dBm (1 W)	
Input attenuator setting ≥5 dB		
Peak Pulse Power for <10 μsec pulse width, <1% duty cycle, and input attenuation ≥30 dB	+50 dBm (100 W)	
dc	0 Vdc	

	Specifications	Supplemental Information
1 dB Gain Compression		
Total power at input mixer [a][b]		
50 MHz to 3.0 GHz	0 dBm	
3.0 GHz to 6.7 GHz	0 dBm	
6.7 GHz to 13.2 GHz	–3 dBm	
13.2 GHz to 26.5 GHz	–5 dBm	

a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).

b. For resolution bandwidths 1 kHz to 30 kHz, the maximum input signal amplitude must be ≤ reference level +10 dB.

	Specifications	Supplemental Information
Displayed Average Noise Level		
(Input terminated, 0 dB attenuation, sample detector, Reference Level = –70 dBm)		
	1 kHz RBW 30 Hz VBW	1 kHz RBW 30 Hz VBW
1 MHz to 10 MHz		≤ –116 dBm, characteristic
10 MHz to 1.0 GHz	≤ –116 dBm	
1.0 GHz to 2.0 GHz	≤ –115 dBm	
2.0 GHz to 3.0 GHz	≤ –112 dBm	
3.0 GHz to 6.0 GHz	≤ –112 dBm	
6.0 GHz to 12 GHz	≤ –110 dBm	
12 GHz to 22 GHz	≤ –107 dBm	
22 GHz to 26.5 GHz	≤ –101 dBm	

	Specifications	Supplemental Information
Display Range		
Log Scale	Ten divisions displayed; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps	
	Calibrated 0 to –85 dB from Reference Level	
Linear Scale	Ten divisions	
Scale Units	dBm, dBmV, dBμV, V and W	

	Specifications	Supplemental Information
Marker Readout Resolution		
Log scale		
0 to –85 dB from ref level	0.04 dB	
Linear scale	0.01% of Reference Level	

	Specifications	Supplemental Information
Frequency Response		
50 Ω, Absolute[a]/Relative		
9 kHz to 3.0 GHz		
10 dB attenuation		
20 to 30 °C	±0.5 dB	
0 to 55 °C	±1.0 dB	
Preselector centered for frequency >3.0 GHz		
3.0 GHz to 6.7 GHz		
10 dB attenuation		
Absolute[a]		
20 to 30 °C	±1.5 dB	
0 to 55 °C	±2.5 dB	
Relative		
20 to 30 °C	±1.3 dB	
0 to 55 °C	±1.5 dB	
6.7 GHz to 13.2 GHz		
10 dB attenuation		
Absolute[a]		
20 to 30 °C	±2.0 dB	
0 to 55 °C	±3.0 dB	
Relative		
20 to 30 °C	±1.8 dB	
0 to 55 °C	±2.0 dB	
13.2 GHz to 26.5 GHz		
10 dB attenuation		
Absolute[a]		
20 to 30 °C	±2.0 dB	
0 to 55 °C	±3.0 dB	
Relative		

	Specifications	Supplemental Information
20 to 30 °C	±1.8 dB	
0 to 55 °C	±2.0 dB	

a. Absolute flatness values are referenced to the amplitude at 50 MHz.

	Specifications	Supplemental Information
Input Attenuation Switching Uncertainty at 50 MHz		
Attenuator Setting		
0 dB to 5 dB	±0.3 dB	
10 dB	Reference	
15 dB	±0.3 dB	
20 to 65 dB	±(0.1 dB + 0.01 × Attenuator Setting)	

Attenuation Accuracy Relative to the 10 dB Attenuator Setting, Characteristic					
	Frequency Range				
Attenuation, dB	**dc–3.0 GHz (± dB)**	**3.0–13.2 GHz (± dB)**	**13.2–19 GHz (± dB)**	**19–22 GHz (± dB)**	**22–26.5 GHz (± dB)**
0	0.3	0.5	0.8	0.9	1.0
5	0.3	0.5	0.8	0.9	1.0
10 (Reference)	Reference	Reference	Reference	Reference	Reference
15	0.4	0.5	0.8	1.0	1.5
20	0.4	0.5	0.8	1.0	1.5
25	0.5	0.6	0.8	1.2	2.0
30	0.5	0.6	0.8	1.2	2.0
35	0.6	0.7	1.0	1.8	3.0
40	0.6	0.7	1.0	1.8	3.0
45	0.7	1.0	1.3	2.2	3.4
50	0.7	1.0	1.3	2.2	3.4
55	0.9	1.1	1.6	2.7	3.5
60	0.9	1.1	1.6	2.7	3.5
65	1.0	1.6	2.0	3.2	3.8

	Specifications	Supplemental Information
Absolute Amplitude Accuracy		
At reference settings [a]	±0.4 dB	
Overall Amplitude Accuracy[b]		
20 to 30 °C	± (0.6 dB + Absolute Frequency Response)	

a. Settings are: reference level –20 dBm; input attenuation 10 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, signal at reference level.

b. For reference level 0 to –50 dBm; input attenuation 10 dB; RBW 1 kHz; VBW 1 kHz; scale log, log range 0 to 50 dB from reference level; sweep time coupled; signal input 0 to –50 dBm; span ≤20 kHz.

	Specifications	Supplemental Information
RF Input VSWR (at tuned frequency)		
Attenuator setting 0 dB		
9 kHz to 26.5 GHz		3.0:1, characteristic
Attenuator setting 5 dB		
9 kHz to 100 kHz		2.0:1, characteristic
100 kHz to 6.7 GHz		1.4:1, characteristic
6.7 GHz to 13.2 GHz		1.7:1, characteristic
13.2 GHz to 22.0 GHz		2.3:1, characteristic
22.0 GHz to 26.5 GHz		2.6:1, characteristic
Attenuator setting 10 to 65 dB		
9 kHz to 6.7 GHz		1.3:1, characteristic
6.7 GHz to 13.2 GHz		1.5:1, characteristic
13.2 GHz to 22.0 GHz		2.0:1, characteristic
22.0 GHz to 26.5 GHz		2.2:1, characteristic

	Specifications	Supplemental Information
Auto Alignment[a]		
Sweep-to-sweep variation		±0.1 dB, characteristic

a. Set **Auto Align** to **Off** and use **Align Now, All** to eliminate this variation.

	Specifications	Supplemental Information
Resolution Bandwidth Switching Uncertainty (at Reference Level)		
1 kHz RBW	Reference	
3 kHz to 3 MHz RBW	±0.3 dB	
5 MHz RBW	±0.6 dB	

	Specifications	Supplemental Information
Reference Level		
Range	Adjustable over Amplitude Measurement Range	
Resolution		
Log Scale	±0.1 dB	
Linear Scale	±0.12% of Reference Level	
Accuracy (at a fixed frequency, a fixed attenuator, and referenced to –30 dBm)		
Reference Level (dBm) – input attenuator setting (dB)		
–10 dBm to > –60 dBm	±0.3 dB	
–60 dBm to > –85 dBm	±0.5 dB	
–85 dBm to –90 dBm	±0.7 dB	

	Specifications	Supplemental Information
Display Scale Switching Uncertainty		
Switching between Linear and Log	±0.15 dB at Reference Level	
Log Scale Switching	No error	

	Specifications	Supplemental Information
Display Scale Fidelity		
Log Maximum Cumulative		
0 to –85 dB from Reference Level	±(0.3 dB + 0.01 × dB from Reference Level)	
Log Incremental Accuracy		
0 to –80 dB[a] from reference level	±0.4 dB/4 dB	
Linear Accuracy	±2% of Reference Level	

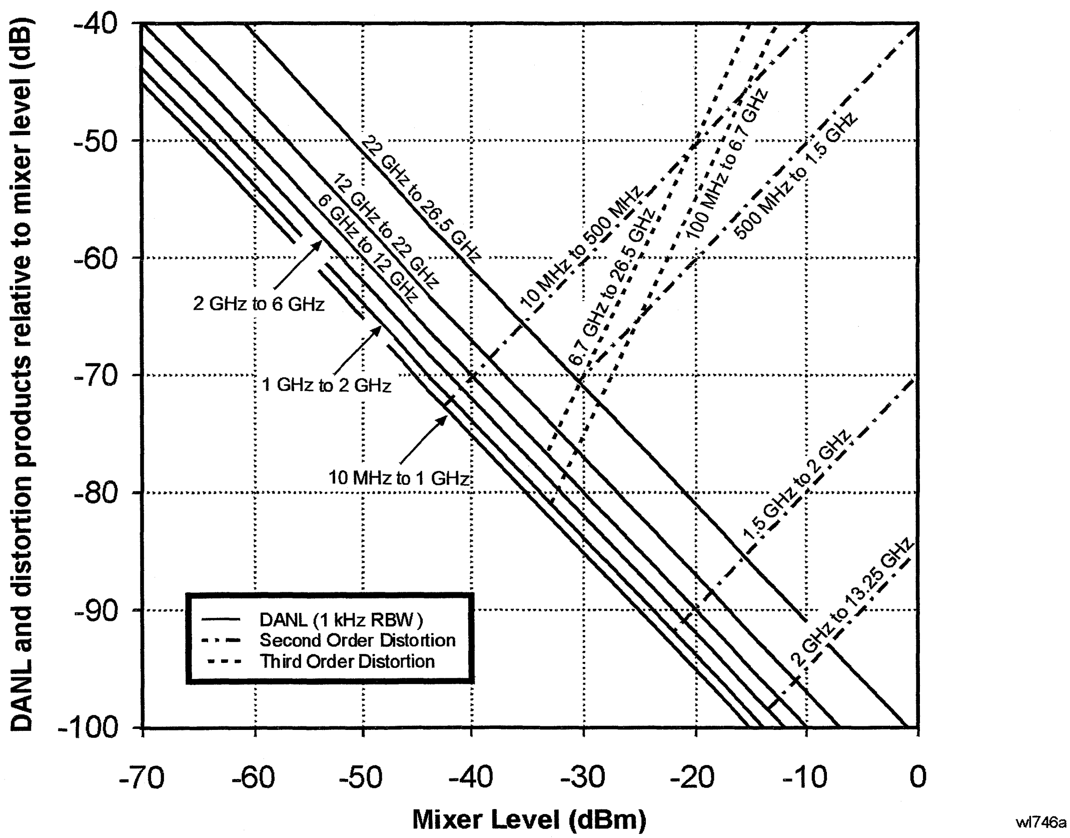
a. 0 to –50 dB for RBWs ≤ 300 Hz and span = 0 Hz, or when auto ranging is off.

	Specifications	Supplemental Information
Spurious Responses		
Second Harmonic Distortion		
Input Signal		
10 MHz to 500 MHz	< –60 dBc for –30 dBm signal at input mixer[a]	+30 dBm SHI (second harmonic intercept)
500 MHz to 1.5 GHz	< –70 dBc for –30 dBm signal at input mixer[a]	+40 dBm SHI
1.5 GHz to 2.0 GHz	< –80 dBc for –10 dBm signal at input mixer[a]	+70 dBm SHI
2.0 GHz to 3.35 GHz	< –95 dBc[b] for –10 dBm signal at input mixer[a]	+85 dBm SHI
3.35 GHz to 6.6 GHz	< –95 dBc[b] for –10 dBm signal at input mixer[a]	+85 dBm SHI
6.6 GHz to 13.25 GHz	< –95 dBc[b] for –10 dBm signal at input mixer[a]	+85 dBm SHI
Third Order Intermodulation Distortion		
10 MHz to 100 MHz		+5 dBm TOI (third order intercept), characteristic
100 MHz to 3 GHz	< –75 dBc for two –30 dBm signals at input mixer[a] and >50 kHz separation	+7.5 dBm TOI
3.0 GHz to 6.7 GHz	< –75 dBc for two –30 dBm signals at input mixer[a] and >50 kHz separation	+7.5 dBm TOI
6.7 GHz to 13.2 GHz	< –70 dBc for two –30 dBm signals at input mixer[a] and >50 kHz separation	+5.0 dBm TOI
13.2 GHz to 26.5 GHz	< –70 dBc for two –30 dBm signals at input mixer[a] and >50 kHz separation	+5.0 dBm TOI

	Specifications	Supplemental Information
Other Input Related Spurious		
Inband Responses		
>30 kHz offset	< –65 dBc for –20 dBm signal at input mixer[a]	
Out-of-band Responses	< –80 dBc for –10 dBm signal at input mixer[a]	

a. Mixer power level (dBm) = input power (dBm – input attentuation (dB)
b. or signal below displayed average noise level.

Specified Dynamic Range



	Specifications	Supplemental Information
Residual Responses (Input terminated and 0 dB attenuation)		
150 kHz to 6.7 GHz	< –90 dBm	

Options

Tracking Generator (Option 1DN)

The spectrum analyzer tracking generator combination will meet its specification after a cable (8120-5148) and adapter are connected between RF OUT and INPUT and **Align Now**, **TG** has been run.

	Specifications	Supplemental Information
Warm-Up	5 minutes	

	Specifications	Supplemental Information
Output Frequency Range	9 kHz to 3.0 GHz	

	Specifications	Supplemental Information
Output Power Level		
Range	–2 to –66 dBm	
Resolution	0.1 dB	
Absolute Accuracy (at 50 MHz with coupled source attenuator, referenced to –20 dBm)	± 0.75 dB	
Vernier		
Range	8 dB	
Accuracy (with coupled source attenuator, 50 MHz, –20 dBm)		
Incremental	±0.2 dB/dB	
Cumulative	±0.5 dB, total	
Output Attenuator Range	0 to 56 dB in 8 dB steps	

	Specifications	Supplemental Information
Maximum Safe Reverse Level		+30 dBm (1 W), +30 Vdc, characteristic

	Specifications	Supplemental Information
Output Power Sweep		
Range	(–10 dBm to –2 dBm) – (Source Attenuator Setting)	
Resolution	0.1 dB	
Accuracy (zero span)	<1 dB peak-to-peak	

	Specifications	Supplemental Information
Output Flatness		
Referenced to 50 MHz, –20 dBm		
9 kHz to 10 MHz	±3 dB	
10 MHz to 3 GHz	±2 dB	

	Specifications	Supplemental Information
Spurious Outputs		
(–2 dBm output)		
Harmonic Spurs		
TG Output 9 kHz to 20 kHz	≤ –15 dBc	
TG Output 20 kHz to 3 GHz	≤ –25 dBc	
Non-harmonic Spurs		
TG Output 9 kHz to 2 GHz	≤ –27 dBc	
TG Output 2 GHz to 3 GHz	≤ –23 dBc	
LO Feedthrough		
LO Frequency 3.921409 to 6.9214 GHz	≤ –16 dBm	

	Specifications	Supplemental Information
Dynamic Range	Maximum Output Power Level – Displayed Average Noise Level	

	Specifications	Supplemental Information
Output Tracking		
Drift		1.5 kHz/5 minute, characteristic
Swept Tracking Error		Usable in 1 kHz RBW after 5 minutes of warm-up

	Specifications	Supplemental Information
RF Power-Off Residuals		
9 kHz to 3 GHz		< –120 dBm, characteristic

	Specifications	Supplemental Information
Output Attenuator Repeatability		
9 kHz to 300 MHz		±0.1 dB, characteristic
300 MHz to 2.0 GHz		±0.2 dB, characteristic
2.0 GHz to 3 GHz		±0.3 dB, characteristic

	Specifications	Supplemental Information
Output VSWR		
0 dB attenuation		<2.0:1, characteristic
≥ 8 dB attenuation		<1.5:1, characteristic

Tracking Generator Output Accuracy
Relative Accuracy (Referred to –20 dBm) = Output Attenuator Accuracy + Vernier Accuracy + Output Flatness
Absolute Accuracy = Relative Accuracy (Referred to –20 dBm) + Absolute Accuracy at 50 MHz

	Specifications	Supplemental Information
Output Power Level		
Range	–2 to –66 dBm	
Resolution	0.1 dB	
Absolute Accuracy (at 50 MHz with coupled source attenuator, referenced to –20 dBm)	± 0.75 dB	
Vernier		
Range	8 dB	
Accuracy (with coupled source attenuator, 50 MHz, –20 dBm)		
Incremental	±0.2 dB/dB	
Cumulative	±0.5 dB, total	
Output Attenuator Range	0 to 56 dB in 8 dB steps	

General

	Specifications	Supplemental Information
Temperature Range		
Operating	0 to 55 °C	Floppy disk 10 to 40 °C
Storage	–40 to +75 °C	

	Specifications	Supplemental Information
Audible Noise (ISO 7779)		
Sound Pressure at 25 °C		<40 dBa, (<4.6 Bels power)

	Specifications	Supplemental Information
Military Specification	Has been type tested to the environmental specifications of MIL-PRF-28800F class 3.	

	Specifications	Supplemental Information
EMI Compatibility	Conducted and radiated emission is in compliance with CISPR Pub. 11/1990 Group 1 Class A.	

	Specifications	Supplemental Information
Immunity Testing		
Radiated Immunity		Testing was done at 3 V/m according to IEC 801-3/1984. When the analyzer tuned frequency is identical to the immunity test signal frequency there may be signals of up to –60 dBm displayed on the screen.
Electrostatic Discharge		Air discharges of up to 8 kV were applied according to IEC 801-2/1991. Discharges to center pins of any of the connectors may cause damage to the associated circuitry.

	Specifications	Supplemental Information
Power Requirements		Uses CUKonverter® topology in the power supply.
ac Operation		
Voltage, frequency	90 to 132 V rms, 47 to 440 Hz 195 to 250 V rms, 47 to 66 Hz	
Power Consumption, On	<300 W	
Power Consumption, Standby	<5 W	
dc Operation		
Voltage	12 to 20 Vdc	
Power Consumption	<200 W	

	Specifications	Supplemental Information
Measurement Speed		
Local Measurement and Display Update rate[a]		≥ 28/s, characteristic
Remote Measurement and HP-IB Transfer Rate[b] *(Option A4H)*		≥ 19/s, characteristic

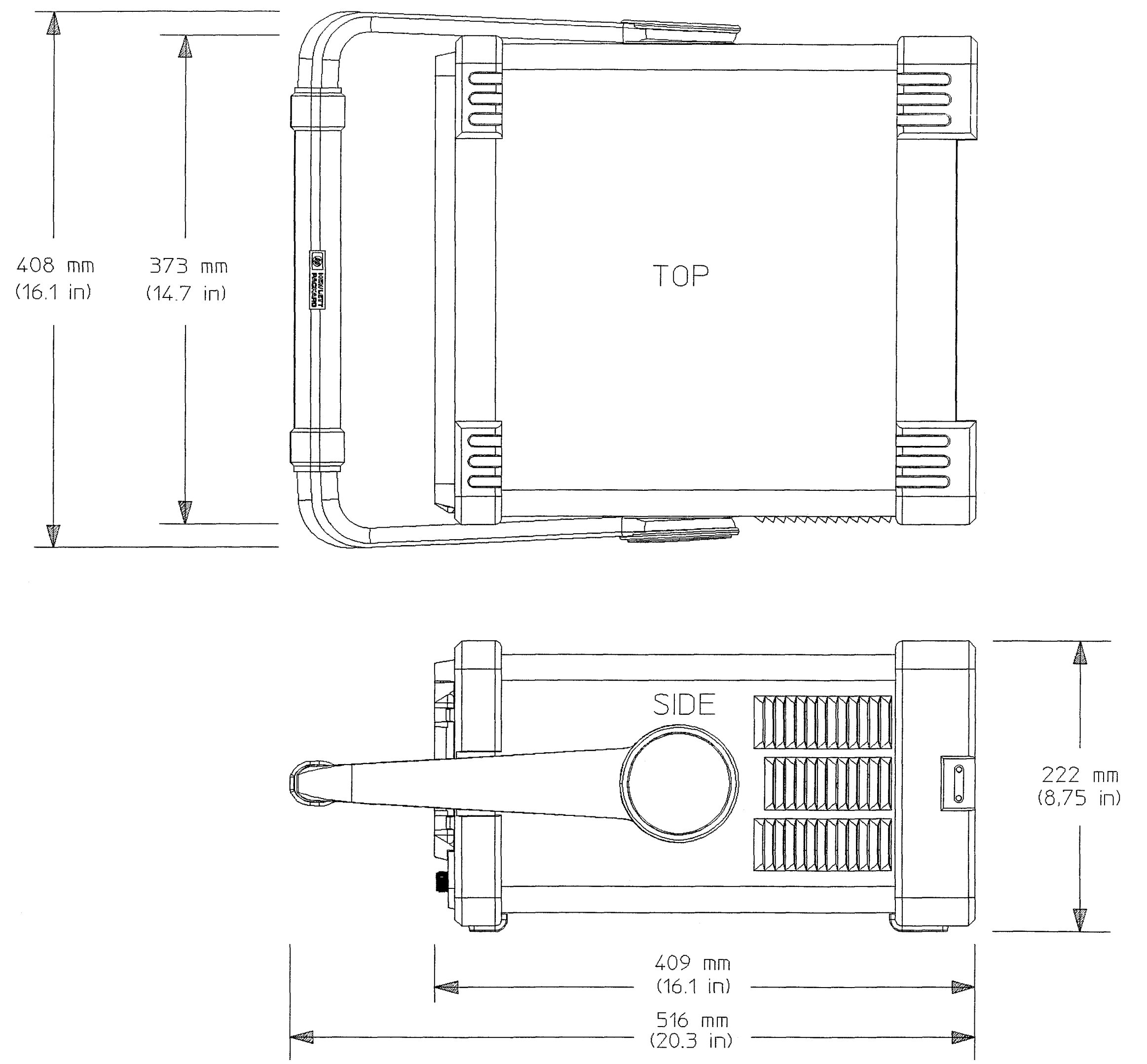
a. Auto align off, 5 ms sweep time, fixed center frequency.
b. Auto align off, 5 ms sweep time, fixed center frequency, 401 point trace, display off (DISPlay:ENABle off), and 32-bit integer data format (FORMat:DATA INT,32).

	Specifications	Supplemental Information
Data Storage		
Internal		200 Traces or States
External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS® compatible floppy disk		200 Traces or States

	Specifications	Supplemental Information
Demod Tune Listen		
AM		Internal speaker, front-panel earphone jack and front-panel volume control.
(Option A4J)		An uncalibrated demodulated signal is available on the AUX VIDEO OUT connector at the rear panel.

	Specifications	Supplemental Information
Weight (without options)		
Net		16.2 kg (35.6 lb), characteristic
Shipping		31.0 kg (68 lb), characteristic

Dimensions


408 mm
(16.1 in)
373 mm
(14.7 in)
TOP
SIDE
222 mm
(8.75 in)
409 mm
(16.1 in)
516 mm
(20.3 in)
nl7

Inputs and Outputs

Front Panel

	Specifications	Supplemental Information
INPUT 50 Ω		
Connector	Type-N female	
(Option BAB)	APC 3.5 male	
Impedance		50 Ω, nominal

	Specifications	Supplemental Information
RF OUT 50 Ω, *(Option 1DN)*		
Connector	Type-N female	
Impedance		50 Ω, nominal

	Specifications	Supplemental Information
AMPTD REF OUT[a]		Amplitude Reference
Connector	BNC Female	
Impedance		50 Ω, nominal
Frequency		50 MHz
Frequency Accuracy		Frequency reference error[b]
50 Ω Amplitude[c]		–20 dBm, nominal

a. Turn the amplitude reference on/off by pressing the keys: **Input**, **Amptd Ref Out**.
b. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).
c. The internal amplitude reference actual power is stored internally.

	Specifications	Supplemental Information
PROBE POWER		
Voltage/Current		+15 Vdc, ±7% at 150 mA max., characteristic –12.6 Vdc ±10% at 150 mA max., characteristic

	Specifications	Supplemental Information
EXT KEYBOARD		Feature not implemented.
Connector	6-pin mini-DIN	

	Specifications	Supplemental Information
Speaker		Front panel knob controls volume

	Specifications	Supplemental Information
Headphone		Front panel knob controls volume
Connector	3.5 mm (1/8 inch) miniature audio jack	
Power Output		0.2 W into 4 Ω, characteristic

Rear Panel

	Specifications	Supplemental Information
10 MHz REF OUT		
Connector	BNC female	
Impedance		50 Ω, nominal
Output Amplitude		>0 dBm, characteristic

	Specifications	Supplemental Information
10 MHz REF IN		
Connector	BNC female	Note: Analyzer noise sidebands and spurious response performance may be affected by the quality of the external reference used.
Impedance		50 Ω, nominal
Input Amplitude Range		–15 to +10 dBm, characteristic
Frequency		10 MHz, nominal

	Specifications	Supplemental Information
GATE TRIG/EXT TRIG IN		
Connector	BNC female	
External Trigger Input		
Trigger Level		Selectable positive or negative edge initiates sweep in EXT TRIG mode (5 V TTL)

	Specifications	Supplemental Information
GATE/HI SWP OUT		
Connector	BNC female	
High Sweep Output		
Level		High = sweep; Low = retrace (5 V TTL)

	Specifications	Supplemental Information
VGA OUTPUT		
Connector	VGA compatible, 15-pin mini D-SUB	
Format		VGA (31.5 kHz horizontal, 60 Hz vertical sync rates, non-interlaced) Analog RGB
Resolution	640 × 480	

	Specifications	Supplemental Information
AUX IF OUT *(Option A4J)*		
Connector	BNC female	
Frequency		21.4 MHz, nominal
Amplitude Range (for signal at reference level and for reference levels – input attenuation of –10 to –70 dBm)		–10 dBm (uncorrected), characteristic
Impedance		50 Ω, nominal

	Specifications	Supplemental Information
AUX VIDEO OUT *(Option A4J)*		
Connector	BNC female	
Amplitude Range (into >10 kΩ)		0 to 1 V (uncorrected), characteristic

	Specifications	Supplemental Information
HI SWP IN *(Option A4J)*		
Connector	BNC female	
Input		Open collector, low stops sweep (5 V TTL)

	Specifications	Supplemental Information
HI SWP OUT *(Option A4J)*		
Connector	BNC female	
Output		High = sweep, Low = retrace (5 V TTL)

	Specifications	Supplemental Information
SWP OUT *(Option A4J)*		
Connector	BNC female	
Amplitude		0 to +10 V ramp, characteristic

	Specifications	Supplemental Information
PRESEL TUNE OUTPUT		
Connector	BNC female	
Load Impedance (dc coupled)		> 10 kΩ, nominal
Range		0 to +10 V, characteristic
Sensitivity		0.33 V/GHz of tuned frequency > 3 GHz, characteristic

	Specifications	Supplemental Information
HP-IB Interface *(Option A4H)*		
Connector	IEEE-488 bus connector	
HP-IB Codes		SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3 and C28

	Specifications	Supplemental Information
Serial Interface *(Option 1AX)*		
Connector	9-pin D-SUB male	RS-232

	Specifications	Supplemental Information
Parallel Interface *(Option A4H or 1AX)*		Printer port only
Connector	25-pin D-SUB female	

Regulatory Information

CAUTION

This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 1010 and 664 respectively.

NOTE

This product has been designed and tested in accordance with IEC Publication 1010, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

CE — The CE mark is a registered trademark of the European Community (if accompanied by a year, it is the year when the design was proven).

SP — The CSA mark is the Canadian Standards Association safety mark.

ISM 1-A — This is a symbol of an Industrial Scientific and Medical Group 1 Class A product. (CISPR 11, Clause 4)

Declaration of Conformity

DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name: Hewlett-Packard Co.

Manufacturer's Address: 1400 Fountaingrove Parkway
Santa Rosa, CA 95403-1799
USA

Declares that the products

Product Name: Spectrum Analyzer

Model Number: HP E4401B, HP E4402B, HP E4403B,
HP E4404B, HP E4405B, HP E4407B,
HP E4408B, HP E4411B

Product Options: This declaration covers all options of the above products.

Conform to the following Product specifications:

Safety: IEC 61010-1:1990 / EN 61010-1:1993
CAN/CSA-C22.2 No. 1010.1-92

EMC: CISPR 11:1990/EN 55011:1991 Group 1, Class A
IEC 801-2:1984/EN 50082-1:1992 4 kV CD, 8 kV AD
IEC 801-3:1984/EN 50082-1:1992 3 V/m, 27-500 MHz
IEC 801-4:1988/EN 50082-1:1992 0.5 kV sig. lines, 1 kV power lines

Supplementary Information:

The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.

Santa Rosa, CA, USA 7 Jan. 1999

Greg Pfeiffer/Quality Engineering Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH Department HQ-TRE, Herreneberger Strasse 130, D71034 Boblingen, Germany (FAX +49-7031-14-3143)

11 HP E4411B Specifications and Characteristics

About This Chapter

This chapter contains specifications and characteristics for the HP E4411B spectrum analyzer. The distinction between specifications and characteristics is described as follows.

- Specifications describe the performance of parameters covered by the product warranty. (The temperature range is 0 °C to 55 °C, unless otherwise noted.)
- Characteristics describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- Typical performance describes additional product performance information that is not covered by the product warranty. It is performance beyond an indicated specification, that most units will exhibit.
- Nominal values indicate the expected, but not warranted, value of a parameter.

The following conditions must be met for the analyzer to meet its specifications.

❑ The analyzer is within the one year calibration cycle.

❑ If **Auto Align All** is selected:

— After 2 hours of storage within the operating temperature range.

— 5 minutes after the analyzer is turned on with sweep times less than 4 seconds.

❑ If **Auto Align Off** is selected:

— When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes,

— After the analyzer is turned on for a minimum of 90 minutes, and **Align Now All** has been run.

— When **Align Now All** is run:

- Every hour
- If the ambient temperature changes more than 3 °C
- If the 10 MHz reference changes

❑ If **Auto Align All but RF** is selected:

— When the analyzer is at a constant temperature, within the operating temperature range, for a minimum of 90 minutes.

— After the analyzer is turned on for a minimum of 90 minutes, and

Align Now RF has been run.

— When **Align Now RF** is run:

- Every hour
- If the ambient temperature changes more than 3 °C

Frequency

	Specifications	Supplemental Information
Frequency Range		
50 Ω	9 kHz to 1.5 GHz	
75 Ω *(Option 1DP)*	1 MHz to 1.5 GHz	

	Specifications	Supplemental Information
Frequency Reference		
Aging Rate	$\pm 2 \times 10^{-6}$/year	$\pm 1.0 \times 10^{-7}$/day, characteristic
Settability	$\pm 5 \times 10^{-7}$	
Temperature Stability	$\pm 5 \times 10^{-6}$	

	Specifications	Supplemental Information
Frequency Readout Accuracy		
(Start, Stop, Center, Marker)	±(frequency indication × frequency reference error[a] + span accuracy + 15% of RBW + 10 Hz)	

a. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).

	Specifications	Supplemental Information
Marker Frequency Counter		
Resolution	Selectable from 1 Hz to 100 kHz	
Accuracy[a]	±(marker frequency × frequency reference error[b] + counter resolution)	

a. Marker level to displayed noise level > 25 dB, RBW/ Span ≥ 0.002, frequency offset = 0 Hz.
b. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).

	Specifications	Supplemental Information
Frequency Span		
Range	0 Hz (zero span), 100 Hz to 1.5 GHz	
Resolution	2 Hz	
Accuracy	±1% of span	

	Specifications	Supplemental Information
Sweep Time		
Range	5 ms to 2000 s	50 ms is the minimum sweep time with the tracking generator in operation *(Option 1DN or 1DQ)*
Accuracy		
Span = 0 Hz 5 ms to 2000 s	±1%	
Sweep Trigger[a]	Free Run, Single, Line, Video, External, Delayed	
Delayed Trigger[b]		
Range	1 µs to 400 s	
Resolution	[(delay in seconds)/65000] rounded up to nearest µs	
Accuracy	±(500 ns +(0.01% of delay))	

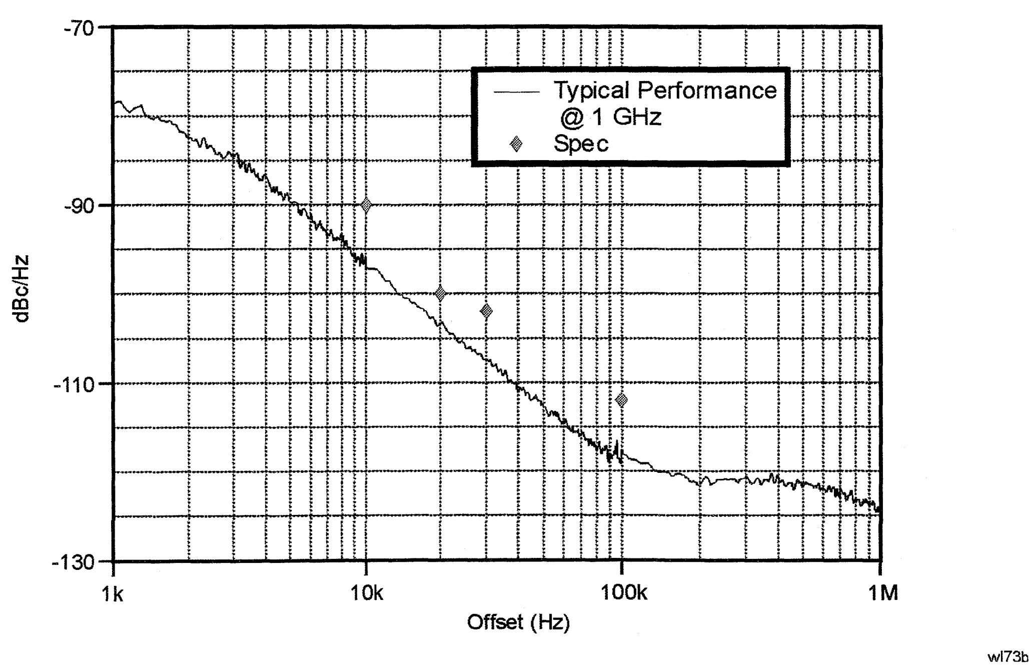
a. Auto align is suspended in video, external, and delayed trigger modes while waiting for a trigger event to occur.
b. Delayed trigger is available with line and external trigger.

	Specifications	Supplemental Information
Resolution Bandwidth (RBW)		
Range		
–3 dB bandwidth	1 kHz to 3 MHz, in 1-3-10 sequence, 5 MHz	
–6 dB bandwidth (EMI)	9 kHz and 120 kHz	
Accuracy		
1 kHz to 3 MHz RBW	±15%	
5 MHz RBW	±30%	
Shape		
1 kHz to 5 MHz RBW		Synchronously tuned four poles, approximately Gaussian shape
Selectivity (60 dB/3 dB bandwidth ratio)		
1 kHz to 5 MHz RBW		<15:1, characteristic

	Specifications	Supplemental Information
Video Bandwidth (VBW) (–3 dB)		
Range	30 Hz to 1 MHz in 1-3-10 sequence	3 MHz, characteristic
Accuracy		±30%, characteristic
Shape		Post detection, single pole low-pass filter used to average displayed noise

	Specifications	Supplemental Information
Stability		
Noise Sidebands, offset from CW signal with 1 kHz RBW, 30 Hz VBW and sample detector		
≥10 kHz	≤ –90 dBc/Hz	
≥20 kHz	≤ –100 dBc/Hz	
≥30 kHz	≤ –102 dBc/Hz	
≥100 kHz	≤ –112 dBc/Hz	
Residual FM		
1 kHz RBW, 1 kHz VBW	≤150 Hz p–p in 100 ms	
System-Related Sidebands, offset from CW signal		
≥30 kHz	≤ –65 dBc	

Noise Sidebands Normalized to 1 Hz Versus Offset From Carrier



Amplitude

Amplitude specifications do not apply for the negative peak detector mode.

	Specifications	Supplemental Information
Measurement Range	Displayed Average Noise Level to Maximum Safe Input Level	
Input Attenuator Range	0 to 60 dB, in 5 dB steps	

	Specifications	Supplemental Information
Maximum Safe Input Level		
Input attenuator setting ≥15 dB		Signals > +33 dBm (2 W) nominal may trigger input protection, which disconnects the input path. (75 Ω: signals > +79 dBmV (1 W))
Average Continuous Power or Peak Pulse Power		
50 Ω	+30 dBm (1 W)	
75 Ω *(Option 1DP)*	+75 dBmV (0.4 W)	
dc	100 Vdc	dc transients may momentarily trigger input protection
Input attenuator setting <15 dB		Signals > +6 dBm (4 mW) nominal may trigger input protection, which automatically increases input attenuation to 15 dB. (75 Ω: signals > +61 dBmV (15 mW))
Average Continuous Power or Peak Pulse Power		
50 Ω	+3 dBm (2 mW)	
75 Ω *(Option 1DP)*	+59 dBmV (10 mW)	
dc	100 Vdc	dc transients may trigger input protection

	Specifications	Supplemental Information
1 dB Gain Compression		
Total power at input mixer [ab]		
50 MHz to 1.5 GHz		
50 Ω	0 dBm	
75 Ω *(Option 1DP)*	+46.75 dBmV	

a. Mixer power level (dBm) = input power (dBm) – input attenuation (dB).
b. For resolution bandwidths 1 kHz to 30 kHz, the maximum input signal amplitude must be ≤ reference level +10 dB. *(Option 1DP: For resolution bandwidths 1 kHz to 30 kHz, the maximum input signal amplitude must be ≤ reference level +5 dB).*

	Specifications	Supplemental Information
Displayed Average Noise Level		
(Input terminated, 0 dB attenuation, sample detector, Reference Level = –70 dBm) (75 Ω: Reference Level = –21.24 dBmV)		
50 Ω	1 kHz RBW 30 HzVBW	
400 kHz to 10 MHz	≤ –115 dBm	
10 MHz to 500 MHz	≤ –119 dBm	
500 MHz to 1.0 GHz	≤ –117 dBm	
1.0 GHz to 1.5 GHz	≤ –113 dBm	
75 Ω, *(Option 1DP)*	1 kHz RBW 30 Hz VBW	
1 MHz to 10 MHz	≤ –63 dBmV	
10 MHz to 500 MHz	≤ –65 dBmV	
500 MHz to 1.0 GHz	≤ –60 dBmV	
1.0 GHz to 1.5 GHz	≤ –53 dBmV	

	Specifications	Supplemental Information
Display Range		
Log Scale	Ten divisions displayed; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps	
	Calibrated 0 to –85 dB from Reference Level	
Linear Scale	Ten divisions	
Scale Units	dBm, dBmV, dBμV, V and W	

	Specifications	Supplemental Information
Marker Readout Resolution		
Log scale		
0 to –85 dB from ref level	0.04 dB	
Linear scale	0.01% of Reference Level	

	Specifications	Supplemental Information
Frequency Response		
50 Ω, Absolute[a]/Relative		
9 kHz to 1.5 GHz		
10 dB attenuation		
20 to 30 °C	±0.5 dB	
0 to 55 °C	±1.0 dB	
0 dB, 5 dB, 15 to 60 dB attenuation		±1.0 dB, characteristic
75 Ω, Absolute[a]/Relative *(Option 1DP)*		
1 MHz to 1.5 GHz		
10 dB attenuation		
20 to 30 °C	±0.5 dB	
0 to 55 °C	±1.0 dB	
0, 5, 15 to 50 dB attenuation		±1.0 dB, characteristic
55 to 60 dB attenuation		
1 MHz to 1 GHz		±1.0 dB, characteristic
1 GHz to 1.5 GHz		±1.25 dB, characteristic

a. Absolute flatness values are referenced to the amplitude at 50 MHz.

	Specifications	Supplemental Information
Input Attenuation Switching Uncertainty at 50 MHz		
Attenuator Setting		
0 dB to 5 dB	±0.3 dB	
10 dB	Reference	
15 dB	±0.3 dB	
20 to 60 dB	±(0.1 dB + 0.01 × Attenuator Setting)	

	Specifications	Supplemental Information
Absolute Amplitude Accuracy		
At reference settings [a]	±0.4 dB	
Overall Amplitude Accuracy[b]		
20 to 30 °C	± (0.6 dB + Absolute Frequency Response)	

a. Settings are: reference level –25 dBm; (75 Ω reference level +28.75 dBmV); input attenuation 10 dB; center frequency 50 MHz; RBW 1 kHz; VBW 1 kHz; scale linear or log; span 2 kHz; sweep time coupled, signal at reference level.

b. For reference level 0 to –50 dBm; input attenuation 10 dB; RBW 1 kHz; VBW 1 kHz; scale log, log range 0 to 50 dB from reference level; sweep time coupled; signal input 0 to –50 dBm; span ≤20 kHz.

	Specifications	Supplemental Information
RF Input VSWR (at tuned frequency)		
Attenuator setting		
50 Ω		
0 to 5 dB attenuation		1.55:1, characteristic
10 to 60 dB attenuation		1.35:1, characteristic
75 Ω		
1 MHz to 1.1 GHz		
0 to 5 dB attenuation		1.55:1, characteristic
10 to 60 dB attenuation		1.35:1, characteristic
1.1 GHz to 1.5 GHz		
0 to 60 dB attenuation		2.0:1, characteristic
Input protection is tripped		Open input, characteristic
Amptd Ref is On		Open input, characteristic
Auto Align All is selected		Open input momentarily during retrace, characteristic

	Specifications	Supplemental Information
Auto Alignment[a]		
Sweep-to-sweep variation		±0.1 dB, characteristic

a. Set **Auto Align** to **Off** and use **Align Now, All** to eliminate this variation.

	Specifications	Supplemental Information
Resolution Bandwidth Switching Uncertainty (at Reference Level)		
1 kHz RBW	Reference	
3 kHz to 3 MHz RBW	±0.3 dB	
5 MHz RBW	±0.6 dB	

	Specifications	Supplemental Information
Reference Level		
Range	Adjustable over Amplitude Measurement Range	
Resolution		
Log Scale	±0.1 dB	
Linear Scale	±0.12% of Reference Level	
50 Ω, Accuracy (at a fixed frequency, a fixed attenuator, and referenced to –35 dBm)		
Reference Level (dBm) – input attenuator setting (dB)		
–10 dBm to > –60 dBm	±0.3 dB	
–60 dBm to > –85 dBm	±0.5 dB	
–85 dBm to –90 dBm	±0.7 dB	
75 Ω *(Option 1DP)*, Accuracy (at a fixed frequency, a fixed attenuator, and referenced to 18.75 dBmV)		
Reference Level (dBmV) – input attenuator setting (dB)		
38.75 dBmV to > –11.25 dBmV	±0.3 dB	
–11.25 dBmV to > –26.25 dBmV	±0.5 dB	
–26.25 dBmV to –41.25 dBmV	±0.7 dB	

	Specifications	Supplemental Information
Display Scale Switching Uncertainty		
Switching between Linear and Log	±0.15 dB at Reference Level	
Log Scale Switching	No error	

	Specifications	Supplemental Information
Display Scale Fidelity		
Log Maximum Cumulative		
0 to –85 dB from Reference Level	±(0.3 dB + 0.01 × dB from Reference Level)	
Log Incremental Accuracy		
0 to –80 dB[a] from reference level	±0.4 dB/4 dB	
Linear Accuracy	±2% of Reference Level	

a. 0 to –50 dB for RBWs ≤ 300 Hz and span = 0 Hz, or when auto ranging is off.

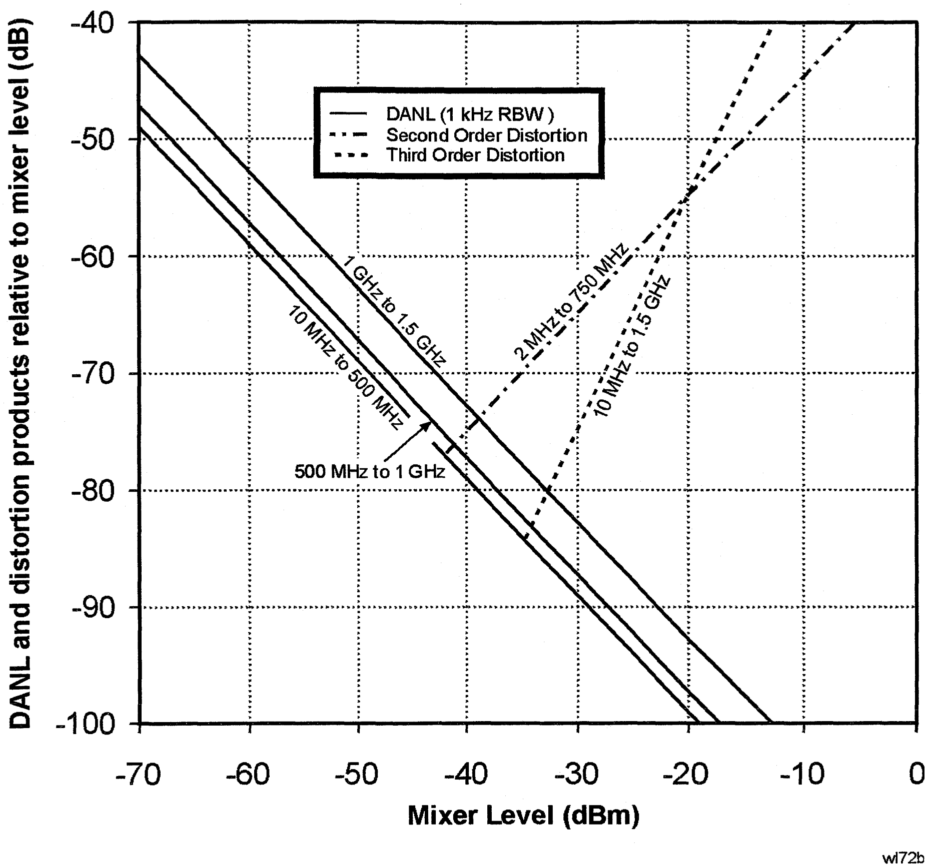
	Specifications	Supplemental Information
Spurious Responses		
50 Ω		
Second Harmonic Distortion		
Input Signal		
2 MHz to 750 MHz	< –75 dBc for –40 dBm signal at input mixer.[a]	+35 dBm SHI (second harmonic intercept)
Third Order Intermodulation Distortion		
2 MHz to 10 MHz		+5 dBm TOI (third order intercept), characteristic
10 MHz to 1.5 GHz	< –75 dBc for two –30 dBm signals at input mixer[a] and >50 kHz separation.	+7.5 dBm TOI
Other Input Related Spurious		
30 kHz ≤ offset ≤1200 MHz	< –65 dBc for –20 dBm signals at input mixer[a] ≤1.5 GHz.	
Offset >1200 MHz	< –45 dBc for –20 dBm signal at input mixer[a] ≤1.5 GHz.	
Noise Floor Degradation		
Input frequency = 1210.7 MHz ± RBW		< –62 dBc for –45 dBm signal at input mixer[a]

a. Mixer Power Level (dBm) = Input Power (dBm) – Input Attenuation (dB).

	Specifications	Supplemental Information
Spurious Responses		
75 Ω, *(Option 1DP)*		
Second Harmonic Distortion Input signal		
2 MHz to 750 MHz	< –75 dBc for +8.75 dBmV signal at input mixer.[a]	
Third Order Intermodulation Distortion		
10 MHz to 1.5 GHz	< –75 dBc for two +18.75 dBmV signals at input mixer[a] and >50 kHz separation.	
Other Input Related Spurious		
30 kHz ≤ offset ≤1200 MHz	< –65 dBc for +28.75 dBmV signal at input mixer[a] ≤1.5 GHz.	
Offset >1200 MHz	< –45 dBc, for +28.75 dBmV signal at input mixer[a] ≤1.5 GHz.	
Noise Floor Degradation		
Input frequency = 1210.7 MHz ± RBW		< –62 dBc, for +3.75 dBmV signal at input mixer[a]

a. Mixer Power Level (dBm) = Input Power (dBm) – Input Attenuation (dB)

Specified Dynamic Range



	Specifications	Supplemental Information
Residual Responses (Input terminated and 0 dB attenuation)		
50 Ω		
150 kHz to 1.5 GHz	< –90 dBm	
75 Ω, *(Option 1DP)*		
1 MHz to 1.5 GHz	< –36 dBmV	

Options

Tracking Generator (Option 1DN or 1DQ)

	Specifications	Supplemental Information
Warm-Up	5 minutes	

	Specifications	Supplemental Information
Output Frequency Range		
50 Ω *(Option 1DN)*	9 kHz to 1.5 GHz	
75 Ω *(Option 1DQ)*	1 MHz to 1.5 GHz	

	Specifications	Supplemental Information
Output Power Level		
20 to 30 °C		
Range		
50 Ω *(Option 1DN)*	0 to –70 dBm	
75 Ω *(Option 1DQ)*	+42.75 to –27.25 dBmV	
Resolution	0.1 dB	
Absolute Accuracy (at 50 MHz with coupled source attenuator)		
50 Ω *(Option 1DN)* referenced to 0 dBm	± 0.5 dB	
75 Ω *(Option 1DQ)* referenced to +42.75 dBmV	± 1.5 dB	
Vernier		
Range	10 dB	
Accuracy (with coupled source attenuator)		
50 Ω *(Option 1DN)* referenced to 0 dBm	±0.75 dB, for 0 to –10 dBm	
75 Ω *(Option 1DQ)* referenced to 42.75 dBmV	±0.9 dB, for +42.75 to +32.75 dBmV	
Output Attenuator Range	0 to 60 dB in 10 dB steps	

	Specifications	Supplemental Information
Maximum Safe Reverse Level		dc transients may trigger output protection
50 Ω *(Option 1DN)*[a]		+20 dBm (0.1 W), 100 Vdc, characteristic
75 Ω *(Option 1DQ)*[a]		+69 dBmV (0.1 W), 100 Vdc, characteristic

a. dc transients may trigger reverse power protection.

	Specifications	Supplemental Information
Output Power Sweep		
20 to 30 °C		
Range		
50 Ω *(Option 1DN)*	(–15 dBm to 0 dBm) – (Source Attenuator Setting)	
75 Ω *(Option 1DQ)*	(+27.75 dBm to +42.75 dBmV) – (Source Attenuator Setting)	
Resolution	0.1 dB	
Accuracy (zero span)		
50 Ω *(Option 1DN)*	<1.5 dB peak-to-peak	
75 Ω *(Option 1DQ)*	<1.8 dB peak-to-peak	

	Specifications	Supplemental Information
Output Flatness		
Referenced to 50 MHz, 0 dB attenuator		
50 Ω *(Option 1DN)*		
9 kHz to 10 MHz	±2 dB	
10 MHz to 1.5 GHz	±1.5 dB	
75 Ω *(Option 1DQ)*		
1 MHz to 10 MHz	±2.5 dB	
10 MHz to 1.5 GHz	±2 dB	

	Specifications	Supplemental Information
Spurious Outputs		
50 Ω *(Option 1DN)* (0 dBm output), 75 Ω *(Option 1DQ)* (+42.75 dBmV output)		
Harmonic Spurs		
9 kHz to 20 MHz	< –20 dBc	
20 MHz to 1.5 GHz	< –25 dBc	
Non-harmonic Spurs	< –35 dBc	

	Specifications	Supplemental Information
Dynamic Range	Maximum Output Power Level – Displayed Average Noise Level	

	Specifications	Supplemental Information
Output Tracking		
Drift		No error
Swept Tracking Error		No error for coupled sweep times

	Specifications	Supplemental Information
RF Power-Off Residuals		
50 Ω *(Option 1DN)* 100 kHz to 1.5 GHz		< –120 dBm, characteristic
75 Ω *(Option 1DQ)* 1 MHz to 1.5 GHz		< –65 dBmV, characteristic

	Specifications	Supplemental Information
Output Attenuator Repeatability		±0.2 dB, characteristic

	Specifications	Supplemental Information
Output VSWR		
50 Ω *(Option 1DN)*		<2.5:1, characteristic
75 Ω *(Option 1DQ)*		<2.0:1, characteristic

	Specifications	Supplemental Information
Output Attenuator Accuracy		
0 dB	Reference	
10 dB		±0.6 dB, characteristic
20 dB		±0.9 dB, characteristic
30 dB		±1.2 dB, characteristic
40 dB		±1.5 dB, characteristic
50 dB		±1.8 dB, characteristic
60 dB		±2.1 dB, characteristic

Tracking Generator Output Accuracy 50 Ω (Option 1DN)
Relative Accuracy (Referred to 0 dBm) = Output Attenuator Accuracy + Vernier Accuracy + Output Flatness
Absolute Accuracy = Relative Accuracy (Referred to 0 dBm) + Absolute Accuracy at 50 MHz

Tracking Generator Output Accuracy 75 Ω (Option 1DQ)
Relative Accuracy (Referred to +42.75 dBmV) = Output Attenuator Accuracy + Vernier Accuracy + Output Flatness
Absolute Accuracy = Relative Accuracy (Referred to +42.75 dBmV) + Absolute Accuracy at 50 MHz

General

	Specifications	Supplemental Information
Temperature Range		
Operating	0 to 55 °C	Floppy disk 10 to 40 °C
Storage	–40 to +75 °C	

	Specifications	Supplemental Information
Audible Noise (ISO 7779)		
Sound Pressure at 25 °C		<40 dBa, (<4.6 Bels power)

	Specifications	Supplemental Information
Military Specification	Has been type tested to the environmental specifications of MIL-PRF-28800F class 3.	

	Specifications	Supplemental Information
EMI Compatibility	Conducted and radiated emission is in compliance with CISPR Pub. 11/1990 Group 1 Class A.	

	Specifications	Supplemental Information
Immunity Testing		
Radiated Immunity		Testing was done at 3 V/m according to IEC 801-3/1984. When the analyzer tuned frequency is identical to the immunity test signal frequency there may be signals of up to –60 dBm displayed on the screen.
Electrostatic Discharge		Air discharges of up to 8 kV were applied according to IEC 801-2/1991. Discharges to center pins of any of the connectors may cause damage to the associated circuitry.

	Specifications	Supplemental Information
Power Requirements		Uses CUKonverter® topology in the power supply.
ac Operation		
Voltage, frequency	90 to 132 V rms, 47 to 440 Hz 195 to 250 V rms, 47 to 66 Hz	
Power Consumption, On	<300 W	
Power Consumption, Standby	<5 W	
dc Operation		
Voltage	12 to 20 Vdc	
Power Consumption	<200 W	

	Specifications	Supplemental Information
Measurement Speed		
Local Measurement and Display Update rate[a]		≥ 28/s, characteristic
Remote Measurement and HP-IB Transfer Rate[b] *(Option A4H)*		≥ 19/s, characteristic

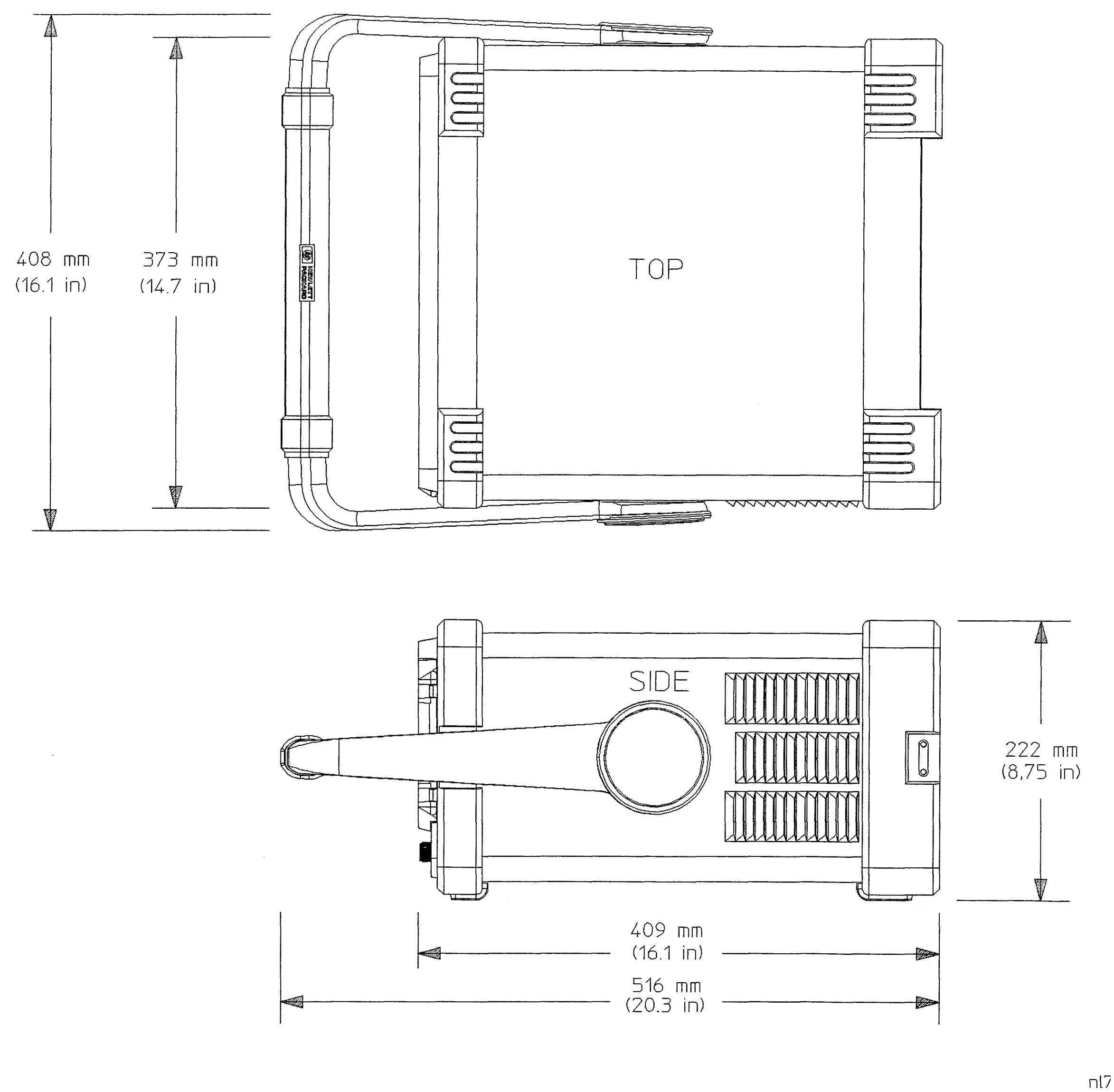
a. Auto align off, 5 ms sweep time, fixed center frequency.
b. Auto align off, 5 ms sweep time, fixed center frequency, 401 point trace, display off (DISPlay:ENABle off), and 32-bit integer data format (FORMat:DATA INT,32).

	Specifications	Supplemental Information
Data Storage		
Internal		200 Traces or States
External (10 to 40 °C) 3.5" 1.44 MB, MS-DOS® compatible floppy disk		200 Traces or States

	Specifications	Supplemental Information
Demod Tune Listen		
AM		Internal speaker, front-panel earphone jack and front-panel volume control.
(Option A4J)		An uncalibrated demodulated signal is available on the AUX VIDEO OUT connector at the rear panel.

	Specifications	Supplemental Information
Weight (without options)		
Net		12.6 kg (27.7 lb), characteristic
Shipping		27.3 kg (60 lb), characteristic

Dimensions


408 mm
(16.1 in)
373 mm
(14.7 in)
TOP
SIDE
222 mm
(8.75 in)
409 mm
(16.1 in)
516 mm
(20.3 in)
nl7

Inputs and Outputs

Internal

	Specifications	Supplemental Information
Amptd Ref[a]		Amplitude reference
Frequency		50 MHz
Frequency Accuracy		Frequency reference error[b]
50 Ω Amplitude		–25 dBm[c], nominal
75 Ω Amplitude *(Option 1DP)*		+28.75 dBmV[c], nominal

a. Turn the amplitude reference signal on/off by pressing the keys: **Input/Output**, **Amptd Ref**.
b. Frequency reference error = (aging rate × period of time since adjustment + settability + temperature stability).
c. The internal amplitude reference actual power is stored internally.

Front Panel

	Specifications	Supplemental Information
INPUT 50 Ω		
Connector	Type-N female	
Impedance		50 Ω, nominal
INPUT 75 Ω *(Option 1DP)*		
Connector	BNC female	
Impedance		75 Ω, nominal

	Specifications	Supplemental Information
RF OUT 50 Ω, *(Option 1DN)*		
Connector	Type-N female	
Impedance		50 Ω, nominal
RF OUT 75 Ω, *(Option 1DQ)*		
Connector	BNC female	
Impedance		75 Ω, nominal

	Specifications	Supplemental Information
PROBE POWER		
Voltage/Current		+15 Vdc, ±7% at 150 mA max., characteristic −12.6 Vdc ±10% at 150 mA max., characteristic

	Specifications	Supplemental Information
EXT KEYBOARD		Feature not implemented.
Connector	6-pin mini-DIN	

	Specifications	Supplemental Information
Speaker		Front panel knob controls volume

	Specifications	Supplemental Information
Headphone		Front panel knob controls volume
Connector	3.5 mm (1/8 inch) miniature audio jack	
Power Output		0.2 W into 4 Ω, characteristic

Rear Panel

	Specifications	Supplemental Information
10 MHz REF OUT		
Connector	BNC female	
Impedance		50 Ω, nominal
Output Amplitude		>0 dBm, characteristic

	Specifications	Supplemental Information
10 MHz REF IN		
Connector	BNC female	Note: Analyzer noise sidebands and spurious response performance may be affected by the quality of the external reference used.
Impedance		50 Ω, nominal
Input Amplitude Range		–15 to +10 dBm, characteristic
Frequency		10 MHz, nominal

	Specifications	Supplemental Information
GATE TRIG/EXT TRIG IN		
Connector	BNC female	
External Trigger Input		
Trigger Level		Selectable positive or negative edge initiates sweep in EXT TRIG mode (5 V TTL)

	Specifications	Supplemental Information
GATE/HI SWP OUT		
Connector	BNC female	
High Sweep Output		
Level		High = sweep; Low = retrace (5 V TTL)

	Specifications	Supplemental Information
VGA OUTPUT		
Connector	VGA compatible, 15-pin mini D-SUB	
Format		VGA (31.5 kHz horizontal, 60 Hz vertical sync rates, non-interlaced) Analog RGB
Resolution	640 × 480	

	Specifications	Supplemental Information
AUX IF OUT *(Option A4J)*		
Connector	BNC female	
Frequency		21.4 MHz, nominal
Amplitude Range (for signal at reference level and for reference levels – input attenuation of –10 to –70 dBm)		–10 dBm (uncorrected), characteristic
Impedance		50 Ω, nominal

	Specifications	Supplemental Information
AUX VIDEO OUT *(Option A4J)*		
Connector	BNC female	
Amplitude Range (into >10 kΩ)		0 to 1 V (uncorrected), characteristic

	Specifications	Supplemental Information
HI SWP IN *(Option A4J)*		
Connector	BNC female	
Input		Open collector, low stops sweep (5 V TTL)

	Specifications	Supplemental Information
HI SWP OUT *(Option A4J)*		
Connector	BNC female	
Output		High = sweep, Low = retrace (5 V TTL)

	Specifications	Supplemental Information
SWP OUT *(Option A4J)*		
Connector	BNC female	
Amplitude		0 to +10 V ramp, characteristic

	Specifications	Supplemental Information
HP-IB Interface *(Option A4H)*		
Connector	IEEE-488 bus connector	
HP-IB Codes		SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3 and C28

	Specifications	Supplemental Information
Serial Interface *(Option 1AX)*		
Connector	9-pin D-SUB male	RS-232

	Specifications	Supplemental Information
Parallel Interface *(Option A4H or 1AX)*		Printer port only
Connector	25-pin D-SUB female	

Regulatory Information

CAUTION

This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 1010 and 664 respectively.

NOTE

This product has been designed and tested in accordance with IEC Publication 1010, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

The CE mark is a registered trademark of the European Community (if accompanied by a year, it is the year when the design was proven).

The CSA mark is the Canadian Standards Association safety mark.

ISM 1-A

This is a symbol of an Industrial Scientific and Medical Group 1 Class A product. (CISPR 11, Clause 4)

Declaration of Conformity

DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name: Hewlett-Packard Co.

Manufacturer's Address: 1400 Fountaingrove Parkway
Santa Rosa, CA 95403-1799
USA

Declares that the products

Product Name: Spectrum Analyzer

Model Number: HP E4401B, HP E4402B, HP E4403B,
HP E4404B, HP E4405B, HP E4407B,
HP E4408B, HP E4411B

Product Options: This declaration covers all options of the above products.

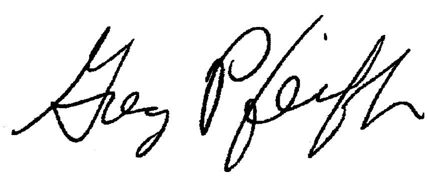
Conform to the following Product specifications:

Safety: IEC 61010-1:1990 / EN 61010-1:1993
CAN/CSA-C22.2 No. 1010.1-92

EMC: CISPR 11:1990/EN 55011:1991 Group 1, Class A
IEC 801-2:1984/EN 50082-1:1992 4 kV CD, 8 kV AD
IEC 801-3:1984/EN 50082-1:1992 3 V/m, 27-500 MHz
IEC 801-4:1988/EN 50082-1:1992 0.5 kV sig. lines, 1 kV power lines

Supplementary Information:

The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.



Santa Rosa, CA, USA 7 Jan. 1999

Greg Pfeiffer/Quality Engineering Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH Department HQ-TRE, Herreneberger Strasse 130, D71034 Boblingen, Germany (FAX +49-7031-14-3143)

12 If You Have a Problem

This chapter includes information on how to check for a problem with your HP ESA spectrum analyzer, and how to return it for service. It also includes descriptions of the types of built-in messages.

What You'll Find in This Chapter

This chapter includes information on how to check for a problem with your HP ESA spectrum analyzer, and how to return it for service. It also includes descriptions of all of the analyzer built-in messages.

Your analyzer is built to provide dependable service. However, if you experience a problem, or if you desire additional information or wish to order parts, options, or accessories, Hewlett-Packard's worldwide sales and service organization is ready to provide the support you need.

In general, a problem can be caused by a hardware failure, a software error, or a user error. Follow these general steps to determine the cause and to resolve the problem.

1. Perform the quick checks listed in "Check the Basics" in this chapter. It is possible that a quick check may eliminate your problem altogether.
2. If the problem is a hardware problem, you have several options:
   - Repair it yourself; see the "Service Options" section in this chapter.
   - Return the analyzer to Hewlett-Packard for repair; if the analyzer is still under warranty or is covered by an HP maintenance contract, it will be repaired under the terms of the warranty or plan (the warranty is at the front of this manual).

     If the analyzer is no longer under warranty or is not covered by an HP maintenance plan, Hewlett-Packard will notify you of the cost of the repair after examining the instrument. See "How to Call Hewlett-Packard" and "How to Return Your Analyzer for Service" for more information.

WARNING **No operator serviceable parts inside the analyzer. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.**

Before You Call Hewlett-Packard

Check the Basics

A problem can often be resolved by repeating the procedure you were following when the problem occurred. Before calling Hewlett-Packard or returning the analyzer for service, please make the following checks:

- ❑ Check the line fuse.
- ❑ Is there power at the receptacle?
- ❑ Is the analyzer turned on? Make sure the fan is running, which indicates that the power supply is on.
- ❑ If the display is dark or dim, press the upper **Viewing Angle** key in the upper-left corner of the front panel. If the display is too bright, adjust the lower **Viewing Angle** key in the upper-left corner of the front panel.
- ❑ If other equipment, cables, and connectors are being used with your HP ESA spectrum analyzer, make sure they are connected properly and operating correctly.
- ❑ Review the procedure for the measurement being performed when the problem appeared. Are all the settings correct?
- ❑ If the analyzer is not functioning as expected, return the analyzer to a known state by pressing the **Preset** key.

  Some analyzer settings are not affected by a Preset. If you wish to reset the analyzer configuration to the state it was in when it was originally sent from the factory, press **System**, **Power On/Preset**, **Preset (Factory)**.

- ❑ Is the measurement being performed, and the results that are expected, within the specifications and capabilities of the analyzer? Refer to the “Specifications” chapters in this guide for analyzer specifications.

- ❑ In order to meet specifications, the analyzer must be aligned. Either Auto Align All must be selected (press **System**, **Alignments**, **Auto Align**, **All**), or the analyzer must be manually aligned at least once per hour, or whenever the temperature changes more than 3 °C. When **Auto Align**, **All** is selected, AA appears on the left edge of the display.
- ❑ If the necessary test equipment is available, perform the Chapter 2, “Performance Verification Tests” of this guide. Record all results on the appropriate form in Chapter 3 , “Performance Verification Test Records” which follows the tests chapter.
- ❑ If the equipment to perform the performance verification tests is not available, you may still be able to perform the functional checks in the ***HP ESA Spectrum Analyzers User’s Guide***.

Read the Warranty

The warranty for your analyzer is at the front of this manual. Please read it and become familiar with its terms.

If your analyzer is covered by a separate maintenance agreement, please be familiar with its terms.

Service Options

Hewlett-Packard offers several optional maintenance plans to service your analyzer after the warranty has expired. Call your Hewlett-Packard sales and service office for full details.

If you want to service the analyzer yourself after the warranty expires, you can purchase the service documentation that provides all necessary test and maintenance information.

You can order the service documentation, Option 0BV (component level information including parts lists, component location diagrams and schematic diagrams) and Option 0BW (assembly level troubleshooting and adjustment procedures), through your Hewlett-Packard sales and service office. Service documentation is described under “Component Level Service Documentation (Option 0BV)” and “Service Documentation and Adjustment Software (Option 0BW)” in Chapter 6 of the user’s guide.

How to Call Hewlett-Packard

Hewlett-Packard has sales and service offices around the world to provide you with complete support for your analyzer. To obtain servicing information or to order replacement parts, contact the nearest Hewlett-Packard sales and service office listed in Table 12-1. In any correspondence or telephone conversations, refer to your analyzer by its product number, full serial number, and firmware revision. (Press **System**, **More 1 of 3**, **Show System**, and the product number, serial number, and firmware revision information will be displayed on your analyzer screen.) A serial number label is also attached to the rear panel of the analyzer.

Table 12-1 Hewlett-Packard Sales and Service Offices

UNITED STATES		
Instrument Support Center Hewlett-Packard Company (800) 403-0801		
EUROPEAN FIELD OPERATIONS		
Headquarters Hewlett-Packard S.A. 150, Route du Nant-d'Avril 1217 Meyrin 2/ Geneva Switzerland (41 22) 780.8111	France Hewlett-Packard France 1 Avenue Du Canada Zone D'Activite De Courtaboeuf F-91947 Les Ulis Cedex France (33 1) 69 82 60 60	Germany Hewlett-Packard GmbH Hewlett-Packard Strasse 61352 Bad Homburg v.d.H Germany (49 6172) 16-0
Great Britain Hewlett-Packard Ltd. Eskdale Road, Winnersh Triangle Wokingham, Berkshire RG41 5DZ England (44 118) 9696622		
INTERCON FIELD OPERATIONS		
Headquarters Hewlett-Packard Company 3495 Deer Creek Rd. Palo Alto, CA 94304-1316 USA (415) 857-5027	Australia Hewlett-Packard Australia Ltd. 31-41 Joseph Street Blackburn, Victoria 3130 (61 3) 895-2895	Canada Hewlett-Packard (Canada) Ltd. 17500 South Service Road Trans-Canada Highway Kirkland, Quebec H9J 2X8 Canada (514) 697-4232
Japan Hewlett-Packard Japan, Ltd. 9-1 Takakura-Cho, Hachioji Tokyo 192, Japan (81 426) 60-2111	Singapore Hewlett-Packard Singapore (Pte.) Ltd. 150 Beach Road #29-00 Gateway West Singapore 0718 (65) 291-9088	Taiwan Hewlett-Packard Taiwan 8th Floor, H-P Building 337 Fu Hsing North Road Taipei, Taiwan (886 2) 712-0404
China China Hewlett-Packard Co. 38 Bei San Huan X1 Road Shuang Yu Shu Hai Dian District Beijing, China (86 1) 256-6888		

How to Return Your Analyzer for Service

Service Tag

If you are returning your analyzer to Hewlett-Packard for servicing, fill in and attach a blue service tag. Several service tags are supplied at the rear of this chapter. Please be as specific as possible about the nature of the problem. If you have recorded any error messages that appeared on the display, or have completed a Performance Test Record, or have any other specific data on the performance of your analyzer, please send a copy of this information with your return.

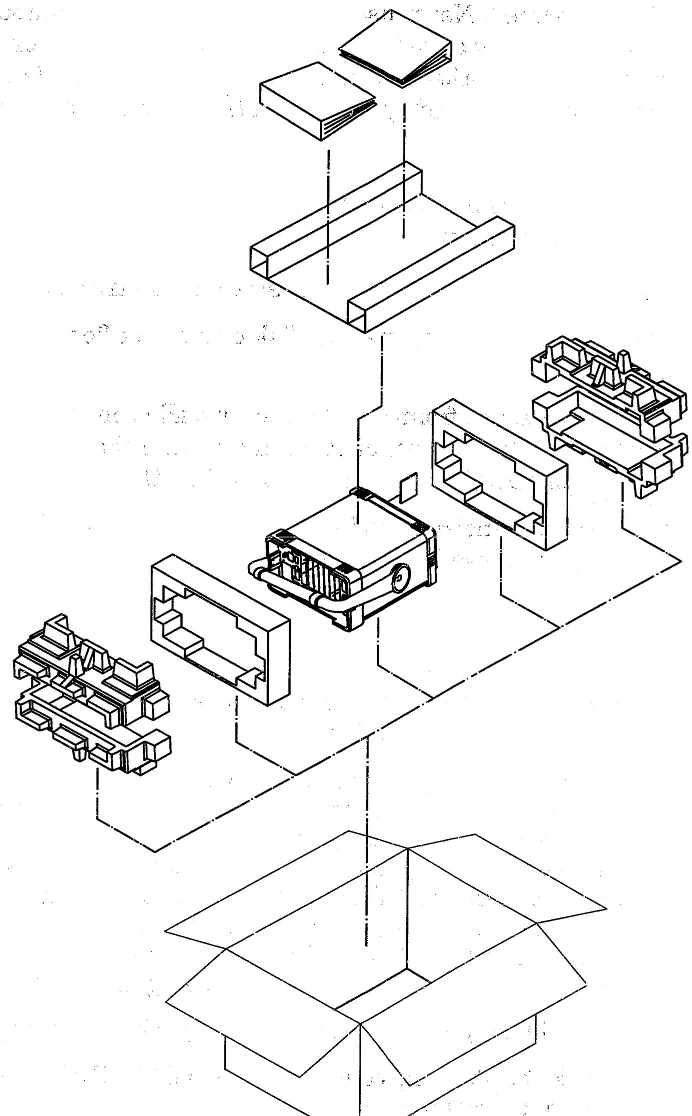
Original Packaging

Before shipping, pack the unit in the original factory packaging materials if they are available. If the original materials were not retained, see "Other Packaging".

NOTE Ensure that the instrument handle is in the rear-facing position in order to reduce the possibility of damage during shipping. Refer to Figure 12-1.

NOTE Install the transportation disk into the floppy drive to reduce the possibility of damage during shipping. If the original transportation disk is not available, a blank floppy may be substituted.

Figure 12-1



formt122

Other Packaging

CAUTION Analyzer damage can result from using packaging materials other than those specified. Never use styrene pellets in any shape as packaging materials. They do not adequately cushion the equipment or prevent it from shifting in the carton. They cause equipment damage by generating static electricity and by lodging in the analyzer louvers, blocking airflow.

You can repackage the instrument with commercially available materials, as follows:

1. Attach a completed service tag to the instrument.
2. Install the transportation disk or a blank floppy disk into the disk drive.
3. If you have a front-panel cover, install it on the instrument. If you do not have a front panel cover, make sure the instrument handle is in the forward-facing position to protect the control panel.
4. Wrap the instrument in antistatic plastic to reduce the possibility of damage caused by electrostatic discharge.
5. Use a strong shipping container. A double-walled, corrugated cardboard carton with 159 kg (350 lb) bursting strength is adequate. The carton must be both large enough and strong enough to accommodate the analyzer. Allow at least 3 to 4 inches on all sides of the analyzer for packing material.
6. Surround the equipment with three to four inches of packing material and prevent the equipment from moving in the carton. If packing foam is not available, the best alternative is S.D.-240 Air Cap™ from Sealed Air Corporation (Hayward, California, 94545). Air Cap looks like a plastic sheet filled with 1-1/4 inch air bubbles. Use the pink-colored Air Cap to reduce static electricity. Wrapping the equipment several times in this material should both protect the equipment and prevent it from moving in the carton.
7. Seal the shipping container securely with strong nylon adhesive tape.
8. Mark the shipping container "FRAGILE, HANDLE WITH CARE" to assure careful handling.
9. Retain copies of all shipping papers.

Error Messages

The analyzer can generate various messages that appear on the display during operation. There are four types of messages.

- **Status Messages** appear on the right side of the analyzer display and/or set status bits in the SCPI Status Register system. These messages indicate a condition that may result in erroneous data being displayed. Although most messages display and set a status bit, some will only be displayed until the error condition is corrected. Multiple messages can be displayed and will be listed in the display area.
- **Informational Messages** provide information that requires no intervention. These messages appear in the status line at the bottom of the display, in green if you have a color display. The message will remain until you preset the analyzer, press **ESC**, or another message is displayed in the status line.
- **User Error Messages** appear when an attempt has been made to set a parameter incorrectly or an operation has failed (such as saving a file). These messages are often generated during remote operation when an invalid programming command has been entered. These messages appear in the status line at the bottom of the display, in yellow if you have a color display. The message will remain until you preset the analyzer, press **ESC**, or another message is displayed in the status line. A summary of the last 11 error messages may be viewed by pressing, **System** then **Show Errors**. When generated by activity on the remote bus, the messages are output to the remote bus. When output to the remote bus, they are preceded by an error number. Note that the error number is not displayed under the **System**, **Show Errors** key sequence.
- **Pop-up Messages** indicate a condition that may require intervention. They display in the middle of the display in a framed box. The message will remain until the appropriate intervention has taken place or the condition has corrected.