Agilent ESA Series Performance Verification Software

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1 Agilent ESA Series Performance Verification Software

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What You Will Find in This Chapter

This chapter is divided into three sections. The first, "Introduction" is a brief description of performance verification. The second, "Getting Started" describes how to begin using the adjustment software and the equipment you will need to complete the tests. The third, "Test Descriptions" describes the various tests and their implementation.

Introduction

Test Environment

Agilent Test Management Environment is the new high performance, 32 bit, component-based calibration platform from Agilent Technologies. Agilent Test Management Environment can be expanded by purchasing test packages to test additional Agilent instruments. Agilent Test Management Environment reduces the cost of instrument maintenance by providing quick and accurate automated tests--reducing instrument downtime--and providing a "common look and feel"--reducing operator training. Agilent Test Management Environment feature highlights:

Runs on Microsoft Windows 95/98 or NT 4.0.

Provides fast automated testing.

Provides easy customizing of test sequences.

Provides ANSI Z540 compliant test reports.

It is Y2K compliant.

Runs from a graphic user interface.

Provides test standard tracking.

Provides administration security to control the test standards used.

Provides comprehensive on-line help.

Performance Verification Tests

Performance verification tests are tests designed to provide the highest level of confidence that the instrument being tested conforms to published, factory-set specifications. The tests are supplied in an automated test software package. The automatic execution of the full set of performance tests will take between two and three hours to complete. Performance tests are designed to test an instrument operating

within the operational temperature range defined by the instrument specifications. Some repairs require a performance test to be run after the repair.

If the instrument is unable to pass any of the performance tests, adjustment tests or further repairs are needed.

The Agilent ESA Series Performance Verification Software is included in option 0BW, Assembly-Level Service Documentation, and compliments the Agilent Technologies ESA spectrum analyzer products. For ordering information contact your local Agilent Technologies sales and service office.

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Getting Started

NOTE Refer to the Agilent ESA Series online help documentation for complete information on using the performance verification software.

Before You Start

You must do the following *before* starting performance verification:

1. Ensure you have a compatible controller (IBM compatible computer), refer to Table 1.
2. Install Performance Verification software on the computer.
3. Ensure you have the proper test equipment, refer to Table 1 through Table 5 for a list of test equipment.
4. Switch the unit under test (UUT) on and let it warm up in accordance with warm-up requirements in the instrument specifications.

Software Installation and Configuration

Refer to the instructions on the Performance Verification Software CD-ROM packaging for installation instructions.

After installation, refer to the online help instructions for configuring the software for performing tests.

Test Equipment

The following tables list the equipment required to run the performance verification tests. The tables list the equipment type, critical specifications, and the recommended Agilent model number. The "Recommended Agilent Model" is the preferred equipment. The critical specifications in this table are the most restrictive specifications for all of the tests.

Not all of the listed test equipment needs to be connected to perform an individual test. To run a test,

only the equipment specified for that test needs to be connected.

NOTE The validity of the performance verification program measurements depends in part on required test equipment measurement accuracy. Verify proper calibration of test equipment before running tests with this software.

Warm-up Time

Test Equipment Warmup

Allow sufficient warmup time for the test equipment. Refer to individual operating and service manuals for warmup specifications.

UUT Warmup

The UUT must be stored at a constant temperature, within the specified operating temperature range, for a minimum of two hours prior to running the performance verification tests. Switch on the instrument and let it warm up in accordance with warm-up requirements in the instrument specifications.

Table 1 Required Controller and AccessoriesRequired Controller and Accessories

Equipment	Critical Specifications	Recommended Model Number	Alternative Model Number
Controller			
Computer	IBM compatible PC Intel Pentium 90 MHz or greater MS Windows 95/98/2000 or NT 4.0 At least 32 MB RAM At least 200 MB of free hard disk space CD-ROM Drive 800x600 Minimum monitor resolution Web browser[1]		
IEEE 488 Interface Card	High-performance GPIB with: Agilent -VISA 1.2[2] or greater or NI -VISA 1.2[3] or greater	National part number AT-GPIB/TNT	
Software	Performance verification and Adjustment software for ESA-Series Specrum Analyzers	E4401-90416	

Table 2 Recommended Test Equipment Recommended Test Equipment

Equipment	Critical Specifications for Equipment Substitution	Recommended Model	Use [4]
Digital Multimeter	Input Resistance: >10 Mohm Accuracy: ± 10 mV on 100 V range	Agilent 3458A	P,A,T
DVM Test Leads	For use with 3458A Digital Multimeter	Agilent 34118B	T
Universal Counter	Time Interval Range: 25 ms to 100 ms Single Operation Range: +2.5 Vdc to -2.5 Vdc	Agilent 53132A	P,A,T
Frequency Standard	Frequency: 10 MHz Timebase Accuracy (Aging): $<1 \times 10^{-9}$/day	Agilent 5071A	P,A
Oscilloscope	Bandwidth: >10 MHz Functions: Area, Vp-p, Pulse Width Vertical Scale Factor of 0.5 V to 5 V/Div	Agilent 54820A	P, T
Power Meter	Compatible with 8480 series power sensors. dB relative mode. Resolution: 0.01 dB Reference Accuracy: 1.2% Dual Channel	Agilent E4419B/A	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	Agilent 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	Agilent 8485A	P,A,T

75 ohm Power Sensor (Option 1DP)	Frequency Range: 1 MHz to 1500 MHz Maximum SWR: 1.18 (600 kHz to 1500 MHz) Impedance: 75 ohm Amplitude Range: -30 dBm to +20 dBm	Agilent 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)	Agilent 8481D	P,A,T
Spectrum Analyzer, Microwave (required for Option 1DN or 1DQ)	Frequency Range: 100 kHz to 7 GHz Relative Amplitude Accuracy: 100 kHz to 3.0 GHz: < 1.8 dB Frequency Accuracy: < 10 kHz @ 7 GHz	Agilent 8563E	P,T
Synthesized Signal Generator	Frequency Range: 100 kHz to 2500 MHz Amplitude Range: -35 to +16 dBm SSB Noise: <-120 dBc/Hz at 20 kHz offset	Agilent 8663A	P,A
Synthesized Signal Generator Not Required for E4401B/E7401A/E4411B/E4403B or E4408B	Frequency: 1 GHz non-option 120 Phase Noise at 1 GHz: < -131 dBc/Hz @ 100 kHz offset < -137 dBc/Hz @ 1 MHz offset < -139 dBc/Hz @ 5 MHz offset < -143 dBc/Hz @ 10 MHz offset option 120 Phase Noise at 1 GHz: < -131 dBc/Hz @ 100 kHz offset < -145 dBc/Hz @ 1 MHz offset < -147 dBc/Hz @ 5 MHz offset < -149 dBc/Hz @ 10 MHz offset	Agilent 8665B/64A/64B	P

Synthesized Sweeper *(2 required for all but E4401B and E4411B)*	Frequency Range: 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: -35 to +16 dBm	Agilent 83630/40/50B 83620/30/40/50B	P,A,T
Function Generator	Frequency Range: 0.1 Hz to 20 MHz Frequency Accuracy: 0.02% Waveform: Triangle, Square	Agilent 33120A	P,A,T
RF Signal Generator Required for options BAC, BAH	(Options IE5 and UN8)	E4433B	P
Pulse Generator Required for EMC models only	Mainframe with 81103A and 81106A 10V/2nS Output Channel and External PLL/Clock	8110A	P
Switch/Pulse Modulator Required for EMC models only		0955-0533 or SC35B	P
Attenuator/Switch Driver	Compatible with 8494G and Agilent 8496G Programmable step attenuators	Agilent 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.	Agilent 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	Agilent 8496A/G	P

Attenuator, 20 dB Fixed (Option 1DS)	Nominal attenuation: 20 dB Frequency Range: dc to 3.0 GHz Connectors: Type N (m) and Type N (f) Maximum SWR: <1.2 (dc to 3 GHz)	Agilent 8491A Option 020	P, A
Attenuator, 10 dB Fixed	Nominal attenuation: 10 dB Frequency Range: dc to 12.4 GHz Connectors: Type-N (m) and Type-N (f)	Agilent 8491A Option 010	P
Attenuator, 6 dB Fixed	Nominal attenuation: 6 dB Frequency Range: dc to 12.4 GHz Connectors: Type-N (m) and Type-N (f) Maximum SWR: <1.15 at 50 MHz	Agilent 8491A Option 010 and H47	P
Attenuator Interconnect Kit	Mechanically and electrically connects 8494A/G and 8496A/G	Agilent 11716 Series	

Recommended Accessories

Equipment	Critical Specifications for Accessory Substitution	Recommended Agilent Model	Use [5]
6 GHz Directional Bridge	Frequency Range: 5 MHz to 3.0 GHz Directivity: >40 dB Coupling factor: 16 dB nominal Insertion Loss: 2 dB maximum	Agilent 86205A	P
Power Splitter (Agilent E4401B/02B/ 03B/04B/05B/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	Agilent 11667A	P,A
Power Splitter (Agilent E4407B/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	Agilent 11667B	

Directional Coupler	Frequency Range: 2 GHz to 8 GHz Directivity>20 dB Max.VSWR: 1.35:1 Transmission Arm Loss: < 1 dB nominal Coupled Arm Loss: ~ 16 dB nominal	Agilent 0995-0098	
Directional Coupler	Frequency Range: 2 GHz to 15 GHz Directivity>14 dB Max.VSWR: 1.35:1 Transmission Arm Loss: < 1.5 dB nominal Coupled Arm Loss: ~ 10 dB nominal	Agilent 87300B	
Termination, 50 ohm (Agilent E4401B/02B/ 03B/04B/05B/11B) (2 required for Option 1DN)	Impedance: 50 ohm nominal Connector: Type-N (m)	Agilent 909A (Option 012)	P,T
Termination, 50 ohm (Agilent E4407B/ 08B)	Impedance: 50 ohm nominal Connector: APC 3.5 (f)	Agilent 909D (Option 011)	P,T
Termination, 50 ohm	Impedance: 50 ohm nominal Connector: BNC (m)	Agilent 11593A	P,A
Termination, 75 ohm (Option 1DQ and 1DP)	Impedance: 75 ohm nominal *(2 required for Option 1DQ)* *(1 required for Option 1DP)*	Agilent 909E (Option 201)	P,T
Filter, 50 MHz Low Pass	Cutoff frequency: 50 MHz Rejection at 65 MHz: >40 dB Rejection at 75 MHz: >60 dB	Agilent 0955-0306	P
Filter, 300 MHz Low Pass	Cutoff frequency: 300 MHz Rejection at >43 MHz: >45 dB	Agilent 0955-0455	P
Filter, 1 GHz Low Pass	Cutoff frequency: 1 GHz Rejection at 2 GHz: >60 dB	Agilent 0955-0487	P
Filter, 1.8 GHz Low Pass (2 required) (Agilent E4404B/ 05B/ 07B/ 08B)	Cutoff frequency: 1.8 GHz Rejection at >3 GHz: >45 dB	Agilent 0955-0491	P
Filter, 4.4 GHz Low Pass (2 required) (Agilent E4404B/ 05B/ 07B/ 08B)	Cutoff frequency: 4.4 GHz Rejection at >5.5 GHz: >42 dB	Agilent 9135-0005 or Agilent 360D	P

Recommended Adapters

Critical Specifications for Adapter Substitution	Recommended Agilent Model	Use [6]

BNC (m) to BNC (m)	Agilent 1250-0216	P,T
BNC tee (f,m,f)	Agilent 1250-0781	A,T
Type-N (f) to APC-3.5 (f)	Agilent 1250-1745	P,A,T
Type-N (f) to BNC (m)	Agilent 1250-1477	P,T
Type-N (f) to BNC (m), 75 ohm *(2 required for* Option 1DQ) *(1 required for* Option 1DP)	Agilent 1250-1534	P,A,T
Type-N (m) to BNC (f) *(4 required)*	Agilent 1250-1476	P,A,T
Type-N (m) to BNC (m) *(2 required)*	Agilent 1250-1473	P,T
Type-N (m) to BNC (m), 75 ohm (Option 1DP)	Agilent 1250-1533	P,A,T
Type-N (f) to Type-N (f)	Agilent 1250-1472	P,T
Type-N (m) to Type-N (m)	Agilent 1250-1475	P,A,T
Type-N (f) to Type-N (f), 75 ohm (Option 1DP)	Agilent 1250-1529	P,A,T
Type-N (f), 75 ohm to Type-N (m), 50 ohm (Option 1DP)	Agilent 1250-0597	P,A,T
Type-N (m) to SMA (m)	Agilent 1250-1636	P
BNC (m) to SMA (f)	Agilent 1250-2015	P
50 ohm to 75 ohm Minimum Loss Pad Frequency Range: dc to 1.5 GHz Insertion Loss: 5.7 dB (Option 1DP)	Agilent 11852B	P,A,T
Type-N (f) to Type-N (f)	Agilent 1250-0777	

Type-N (f) to BNC (f), 75 ohm (Option 1DP)	Agilent 1250-1535	
Type-N (m) to APC-3.5 (f) *(3 required)*	Agilent 1250-1744	
APC-3.5 (f) to APC-3.5 (f)	Agilent 1250-1749	
Dual Banana to BNC (f)	Agilent 1251-2277	P,A,T
Type-N (m) to BNC (f) *(2 required)*	Agilent 1250-0780	

Recommended Cables

Critical Specifications for Cable Substitution	Recommended Model	Use [7]
Frequency Range: dc to 1 GHz Length: >122 cm (48 in) Connectors: BNC (m) (2) *(4 required)*	Agilent 10503A	P,A,T
Frequency Range: dc to 310 MHz Length: 23 cm (9 in) Connectors: BNC (m) (2)	Agilent 10502A	P,T
BNC, 75 ohm, 30 cm (12 in) (option 1DP)	Agilent 5062-6452	P,A,T
Type-N, Precision 62 cm (24 in)	Agilent 11500C	P,A,T
Type-N, Precision 152 cm (60 in) *(2 required)*	Agilent 11500D	P,A,T
APC-3.5 Cable Frequency: 9 kHz to 26.5 GHz Connectors: APC-3.5 (m) (2) Length: >92 cm (36 in) *(2 required)*	Agilent 8120-4921	
Cable, Test Length: >91 cm (36 in) Connectors: SMB (f) to BNC (m) *(2 required)*	Agilent 85680-60093	T

Equipment Connections

GPIB Cables

All test equipment controlled by GPIB should be connected to the internal GPIB connector of the controller (select code 7). If the controller has only one GPIB connector, connect the UUT to it as well. If the controller has dual GPIB connectors, connect the UUT to the second GPIB (typically, select code 8).

Test Setups

Abbreviated test setup illustrations for each test are included with the test located in the section titled "Test Descriptions" on page 10-14, and complete detailed illustrations are located in the online help supplied with the test software. The program prompts the operator to make appropriate equipment connections.

Failure to Meet Specifications

If the instrument does not meet one or more of the specifications during testing, check the test setup for proper configuration, check the condition of all connectors, and ensure all connections are tight. After these things have been checked and confirmed correct, run the failed tests again.

Calibration Cycle

The performance verification tests should be used to check the instrument against the instrument specifications every twelve months.

The instrument requires periodic verification of performance. Under most conditions of use, you should check the instrument against the instrument specifications every twelve months using the complete set of automated performance verification tests located on the *Agilent ESA Series Performance Verification/Adjustment Software* CD-ROM and described in "Test Descriptions" on page 10-14 or perform the manual performance tests in the ESA Spectrum Analyzers Calibration Guide.

When test results show proper operation and calibration, no adjustments are necessary.

Footnotes

1 Microsoft Internet Explorer 4.0 or greater or Netscape 4.0 or greater.
2 Agilent -VISA is available at http://www.agilent.com.
3 National Instruments NI-VISA is available at http://www.ni.com.
4 P = Performance Test, A = Adjustment, T = Troubleshooting
5 P = Performance Test, A = Adjustment, T = Troubleshooting
6 P = Performance Test, A = Adjustment, T = Troubleshooting
7 P = Performance Test, A = Adjustment, T = Troubleshooting

Test Descriptions

Each of the following test descriptions include the related specification, the related adjustment, a description of what it does (or what it measures), a list of equipment required for the execution, an abbreviated illustration of the equipment setup, related measurement data, and additional important information that may be necessary to understand the test. They are designed to be run on an instrument operating within a temperature range of 20° C to 30° C.

NOTE EMC models are treated the same as their E-Series counterparts unless otherwise stated

The following is a list of the tests included in this section:

10 MHz Reference Frequency Accuracy

10 MHz Precision Reference Frequency Accuracy, (Opt 1D5)

Frequency Readout Accuracy

Frequency Span Readout Accuracy

Noise Sidebands

Noise Sidebands - Wide Offsets

System Related Sidebands

Residual FM

Sweep Time Accuracy

Scale Fidelity

Input Attenuation Switching Uncertainty at 50 MHz

Reference Level Accuracy

Resolution BW Switching Uncertainty

Absolute Amplitude Accuracy

Overall Amplitude Accuracy

Resolution BW Accuracy

Frequency Response

Other Input Related Spurious Responses

Spurious Responses - TOI

Gain Compression

Displayed Average Noise Level (DANL)

Residual Responses

Fast Time Domain Amplitude Accuracy, Option AYX & B7D

Tracking Generator Absolute Amplitude and Vernier Accuracy

Tracking Generator Level Flatness

Tracking Generator Harmonic Spurious Outputs

Tracking Generator Non-Harmonic Spurious Outputs

Tracking Generator LO Feedthrough Amplitude

Gate Delay and Gate Length Accuracy

Gate Mode Additional Amplitude Error

IF Input Accuracy
1st LO Output Amplitude Accuracy
Impulse Bandwidth Accuracy
GSM - Phase and Frequency Error
COMMS - Frequency Response
COMMS - Absolute Amplitude Accuracy

NOTE For additional information on these tests, refer to the manual performance test listed. The manual performance tests are located in the calibration guide, and provide additional information about the test including the steps required for the manual performance of the test.

PREVIOUS Getting Started

10 MHz Reference Frequency Accuracy NEXT

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10 MHz Reference Frequency Accuracy

Related Specification

Frequency Reference: Settability

Related Adjustment

10 MHz Reference Frequency

Test Description

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.

NOTE This test applies only to analyzers that are not equipped with the precision reference, Option 1D5. If your analyzer has Option 1D5, perform "10 MHz Precision Reference Frequency Accuracy, (Opt 1D5)" on page 10-18, instead.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

Required Test Equipment

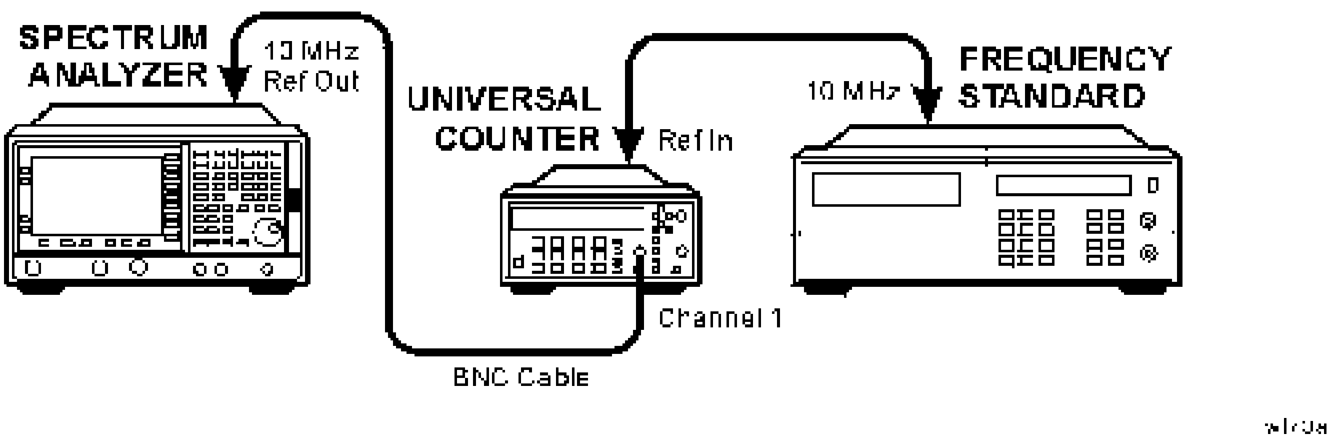
Equipment	Recommended Agilent Model	For Model
Counters		
Universal Counter	Agilent 53132A	All
Standards		
Frequency Standard	Agilent 5071A	All

Cables		
BNC, 2 required	Agilent 10503A	All

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

10 MHz Reference Frequency Accuracy Test Setup



Important Information

10 MHz Reference Output Accuracy Error

The 10 MHz reference settability is calculated using the following equation:

$$Y = (F_{nom} - F_{nom\pm1}) / 2$$

where

F_{nom} is the frequency measured DAC set to nominal.

$F_{nom\pm1}$ is the frequency measured with DAC set to nominal plus or minus one.

10 MHz Precision Reference Frequency Accuracy, (Opt 1D5)

Related Specification

Frequency Reference: Warm-up (Option 1D5)

Related Adjustment

10 MHz Reference Frequency

Test Description

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.

A 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.

NOTE This test applies only to analyzers that are equipped with the precision reference, Option 1D5. If your analyzer does not have Option 1D5, perform "10 MHz Reference Frequency Accuracy" on page 10-16, instead.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

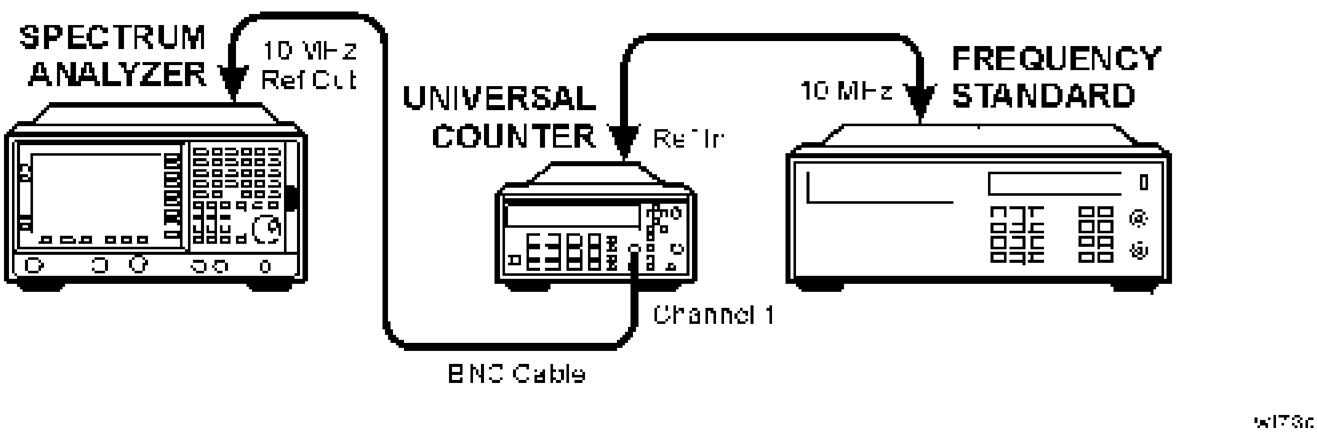
Required Test Equipment

Equipment	Recommended Agilent Model	For Model
Counters		
Universal Counter	Agilent 53132A	All
Standards		
Frequency Standard	Agilent 5071A	All
Cables		
BNC, 2 required	Agilent 10503A	All

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

10 MHz Precision Reference Frequency Output Accuracy Test Setup



Important Information

Warm-up Error

The 10 MHz reference 5 minute warm-up error is calculated using the following equation:

$$Y = (F_{5min} - F_{60min}) / 10$$

The 10 MHz reference 15 minute warm-up error is calculated using the following equation:

$Y = (F_{15min} - F_{60min}) / 10$

where

F_{5min} is the frequency measured 5 minutes after power-on.

F_{15min} is the frequency measured 15 minutes after power-on.

F_{60min} is the frequency measured 60 minutes after power-on.

PREVIOUS 10 MHz Reference Frequency Accuracy

Frequency Readout Accuracy NEXT

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Frequency Readout Accuracy

Related Specification

Frequency Readout Accuracy

Related Adjustment

None

Test Description

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

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

Required Test Equipment

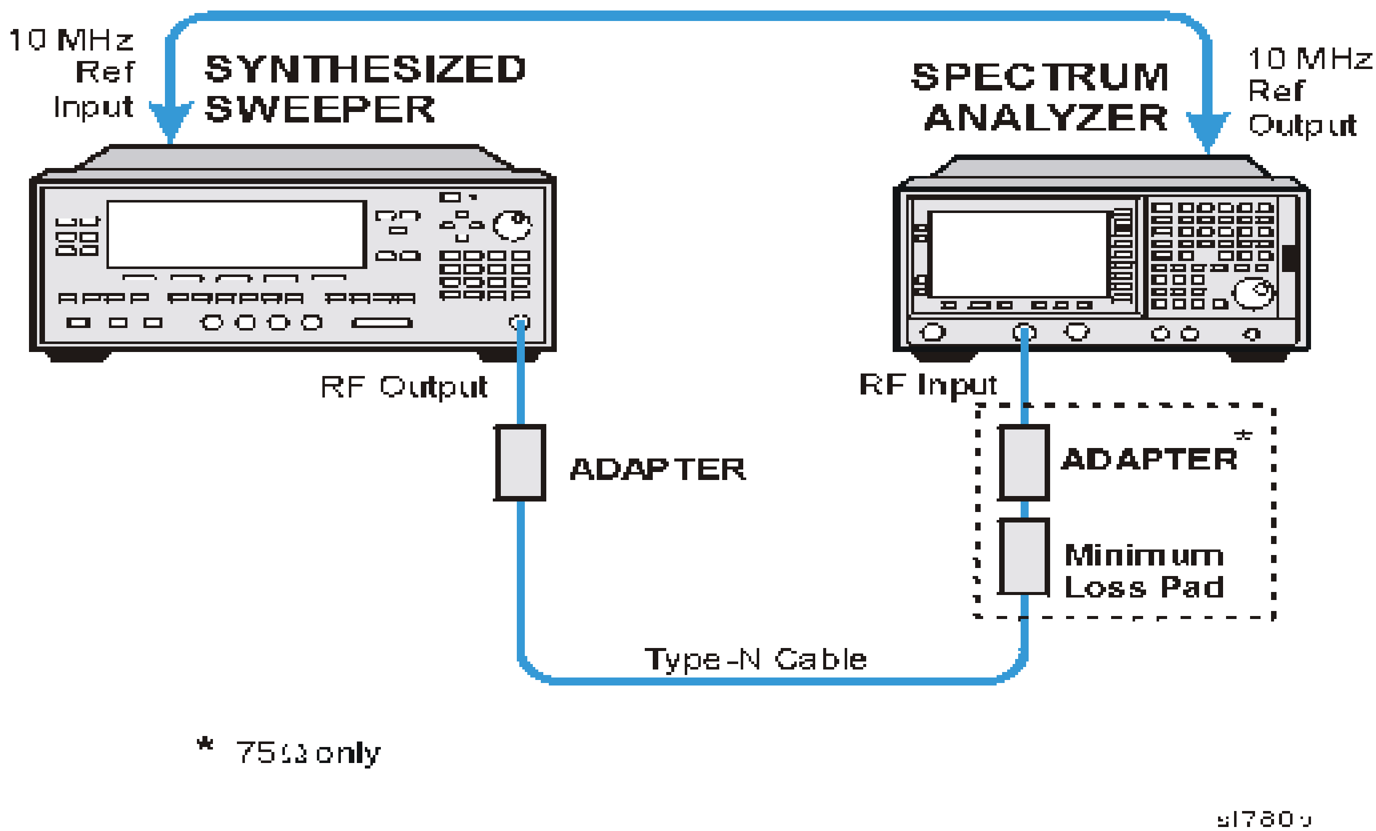
Equipment	Recommended Agilent Model	For Model
Signal Source		
Synthesized Sweeper	Agilent 83620/30/40/50B	All
Cables		
Type-N	Agilent 11500A	All
BNC, 2 required	Agilent 10503A	All
Miscellaneous Devices		
50 ohm to 75 ohm Minimum Loss Pad (for Option 1DP only)	Agilent 11852B	All
Adapters		

Type-N (f) to BNC (m), 75 ohm (for Option 1DP only)	1250-1534	All
Type-N (f) to APC-3.5 (f)	1250-1745	All

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

Frequency Readout Accuracy



Data

The table below lists the center frequency settings at which the Frequency Readout Accuracy measurements are taken.

Frequency Readout Accuracy

Center Frequency (GHz)
1.49[1]
1.5

4.0
9.0
16.0
21.0

Footnotes

1 E4401B, E4411B and E7401A only

Frequency Count Accuracy

Related Specification

Marker Frequency Count Accuracy

Related Adjustment

None

Test Description

The frequency count 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.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

Required Test Equipment

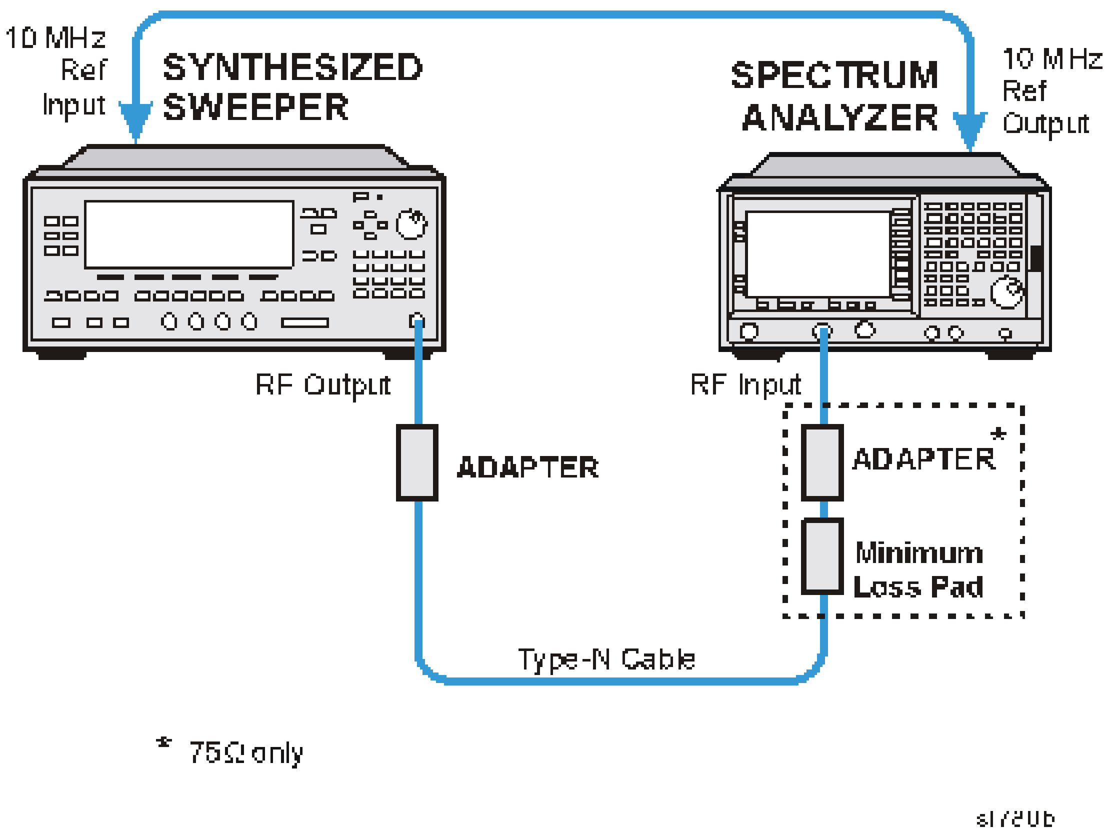
Equipment	Recommended Agilent Model	For Model
Signal Source		
Synthesized Sweeper	Agilent 83620/30/40/50B	All
Cables		
Type-N	Agilent 11500A	All
BNC, 2 required	Agilent 10503A	All
Miscellaneous Devices		
50 ohm to 75 ohm Minimum Loss Pad (for Option 1DP only)	Agilent 11852B	All
Adapters		

Type-N (f) to BNC (m), 75 ohm (for Option 1DP only)	1250-1534	All
Type-N (f) to APC-3.5 (f)	1250-1745	All

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

Frequency Count Accuracy



Data

The following table lists the center frequency settings at which the measurements are taken.

Frequency Count Accuracy

Center Frequency (GHz)
1.49[1]
1.5

4.0
9.0
16.0
21.0

Footnotes

1 E4401B, E4411B and E7401A only

PREVIOUS Frequency Readout Accuracy Frequency Span Readout Accuracy NEXT

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Frequency Span Readout Accuracy

Related Specification

Frequency Span Readout Accuracy

Related Adjustment

None

Test Description

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.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

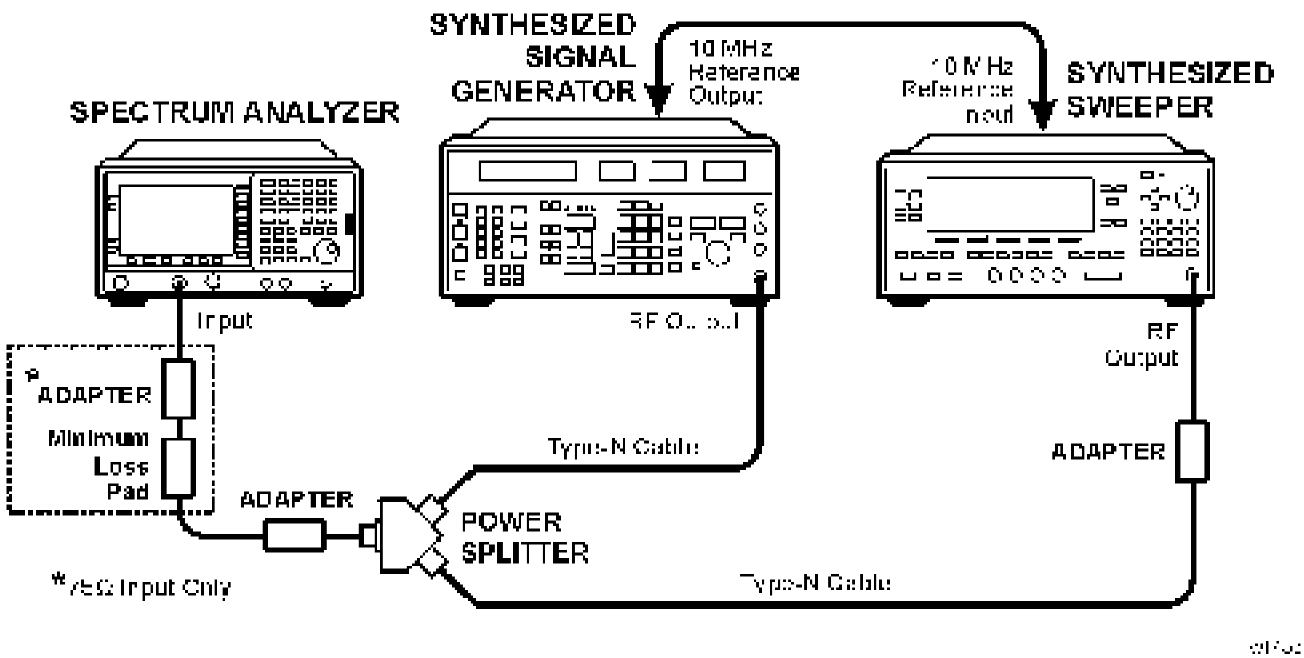
Required Test Equipment

Equipment	Recommended Agilent Model	For Model
Signal Source		
Synthesized Signal Generator	Agilent 8663A	All
Synthesized Sweeper	Agilent 83630/40/50B	All
Miscellaneous Devices		
Power Splitter	Agilent 11667A	All
50 ohm to 75 ohm Minimum Loss Pad (Option 1DP)	Agilent 11852B	E4401B and E4411B 75 ohm

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

Frequency Span Readout Accuracy Test Setup



Data

The following table lists the nominal settings at which the Frequency Span Readout Accuracy measurements are taken.

Frequency Span Readout Accuracy

UUT Center Frequency (MHz)	UUT Span Frequency (MHz)	Synthesized Signal Generator Frequency (MHz)	Synthesized Sweeper Frequency (MHz)
750[1]	1500.00	150.00	1350.00
1500[2]	3000.00	300.00	2700.00
60	100.00	20.00	100.00
10	0.10	10.01	10.09
850	100.00	810.00	890.00
800	0.10	800.01	800.09
1450	100.00	1410.00	1490.00
1500	0.10	1499.01	1499.09

Important Information

Span Accuracy Calculation

The span accuracy is calculated using the following equation:

$$Y = \frac{(F_{right} - F_{left}) - (F_2 - F_1)}{Span} \times 100$$

where

F_{right} is the marker frequency of the right-most signal measured (higher frequency).

F_{left} is the marker frequency of the left-most signal measured (lower frequency).

F_2 is the synthesized sweeper frequency (higher frequency).

F_1 is the synthesized signal generator frequency (lower frequency).

Span is the frequency span setting of the analyzer.

Footnotes

1 E4401B, E4411B and E7401A only

2 Used for all models except Agilent E4401B, E4411B and E7401A

Noise Sidebands

Related Specification

Stability: Noise Sidebands

Related Adjustment

None

Test Description

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.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

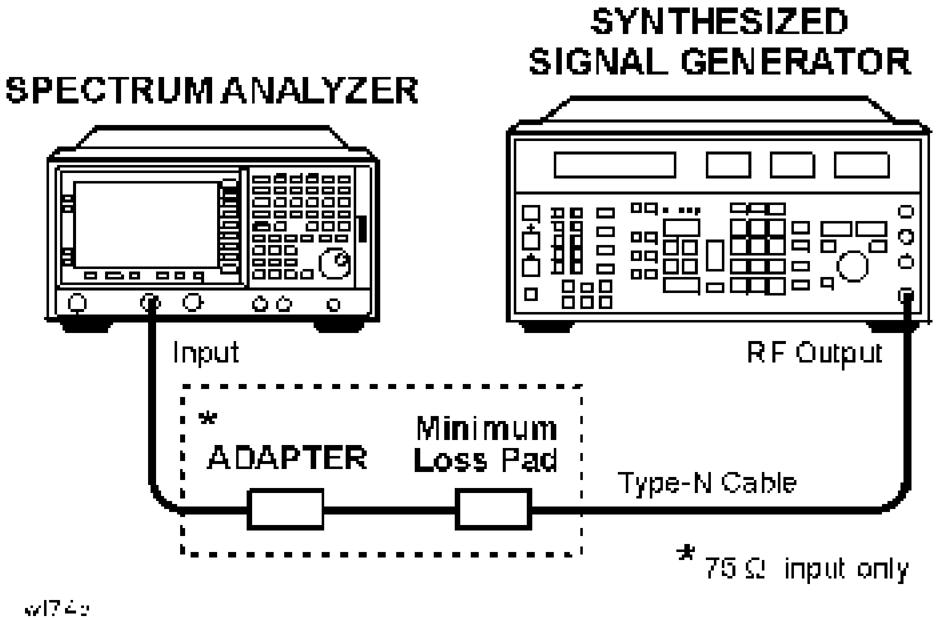
Required Test Equipment

Equipment	Recommended Agilent Model	For Model
Signal Source		
Synthesized Signal Generator	Agilent 8663A	All
Miscellaneous Devices		
50 ohm to 75 ohm Minimum Loss Pad (Option 1DP)	Agilent 11852B	E4401B and E4411B 75 ohm

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

Noise Sidebands Test Setup



Data

The following table lists the center and offset frequency settings at which the Noise Sidebands measurements are taken.

Input Attenuation Switching Uncertainty

Center Frequency (GHz)	Offset Frequency (kHz)
1.0	10
1.0	20
1.0	30
1.0	100

Important Information

Noise Sidebands

The noise sideband level is calculated using the following equation:

$$Y = A_{carrier} - A_{noise}$$

where

$A_{carrier}$ is the measured amplitude of the carrier frequency.

A_{noise} is the measured noise amplitude.

PREVIOUS [Frequency Span Readout Accuracy] [Noise Sidebands - Wide Offsets] NEXT

TOP

Noise Sidebands - Wide Offsets

Related Specification

Stability: Noise Sidebands

Related Adjustment

None

Test Description

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 100 kHz, 1 MHz, and 10 MHz above and below the carrier.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

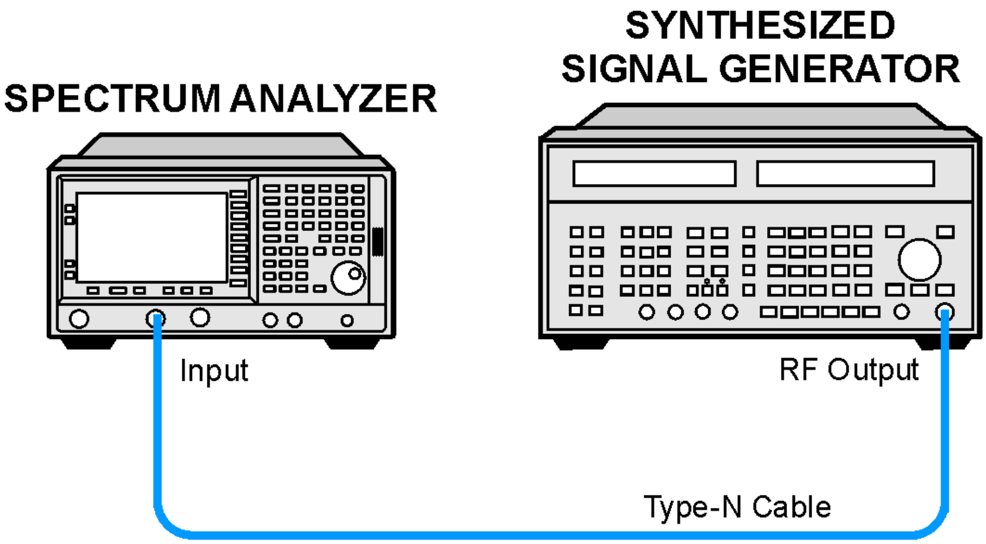
Required Test Equipment

Equipment	Recommended Agilent Model	For Model
Signal Source		
Synthesized Signal Generator	Agilent 8664A/B or 8665B	All

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

Noise Sidebands Test Setup



wl771a

Data

The following table lists the center and offset frequency settings at which the Noise Sidebands measurements are taken.

Input Attenuation Switching Uncertainty

Center Frequency (GHz)	Offset Frequency (MHz)
1.0	0.1
1.0	1
1.0	5
1.0	10

Important Information

Noise Sidebands

The noise sideband level is calculated using the following equation:

$$Y = A_{carrier} - A_{noise}$$

where

$A_{carrier}$ is the measured amplitude of the carrier frequency.

A_{noise} is the measured noise amplitude.

PREVIOUS Frequency Span Readout Accuracy

System Related Sidebands NEXT

TOP

System Related Sidebands

Related Specification

Stability: System Related Sidebands

Related Adjustment

None

Test Description

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.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

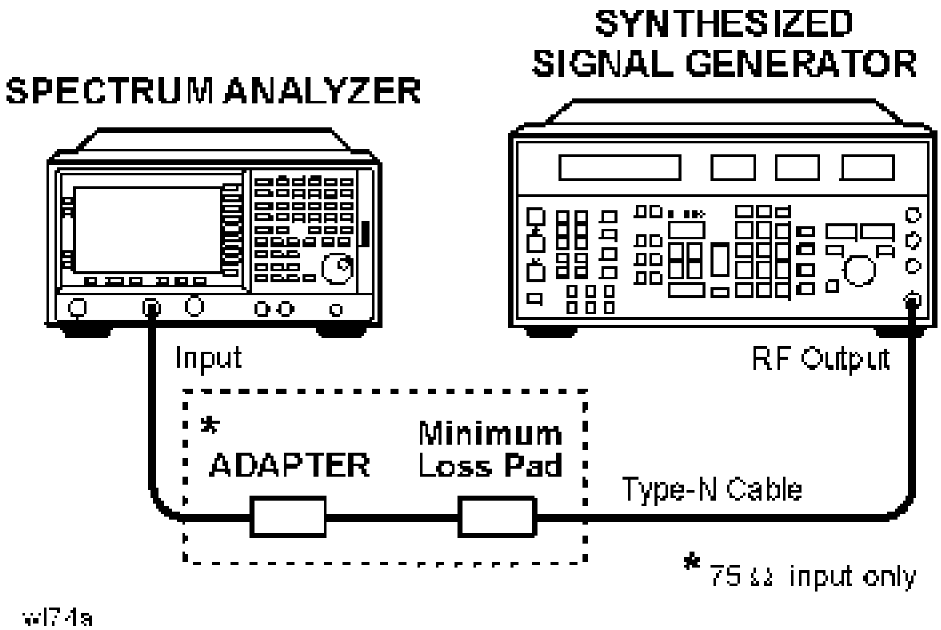
Required Test Equipment

Equipment	Recommended Agilent Model	For Model
Signal Source		
Synthesized Signal Generator	Agilent 8663A	All
Miscellaneous Devices		
50 ohm to 75 ohm Minimum Loss Pad (Option 1DP)	Agilent 11852B	E4401B and E4411B 75 ohm

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

System Related Sidebands Test Setup



Data

The following table lists the nominal measured amplitude and the settings for the external attenuators at which the System Related Sidebands measurements are taken.

System Related Sidebands

Center Frequency (MHz)	Offset Range (kHz)
500	30 to 230
500	-230 to -30

Important Information

Noise Sidebands

The system related sideband level is calculated using the following equation:

$$Y = A_{carrier} - A_{sideband}$$

where

$A_{carrier}$ is the measured amplitude of the carrier frequency--the center frequency without the offset applied.

$A_{sideband}$ is the measured system related sideband amplitude.

PREVIOUS Noise Sidebands

Residual FM NEXT

TOP

Residual FM

Related Specification

Stability: Residual FM

Related Adjustment

None

Test Description

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 Res BW 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.

NOTE The residual FM specification in the 10 Hz resolution bandwidth applies only if the analyzer is also equipped with the high-stability frequency reference, Option 1DS.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

Required Test Equipment

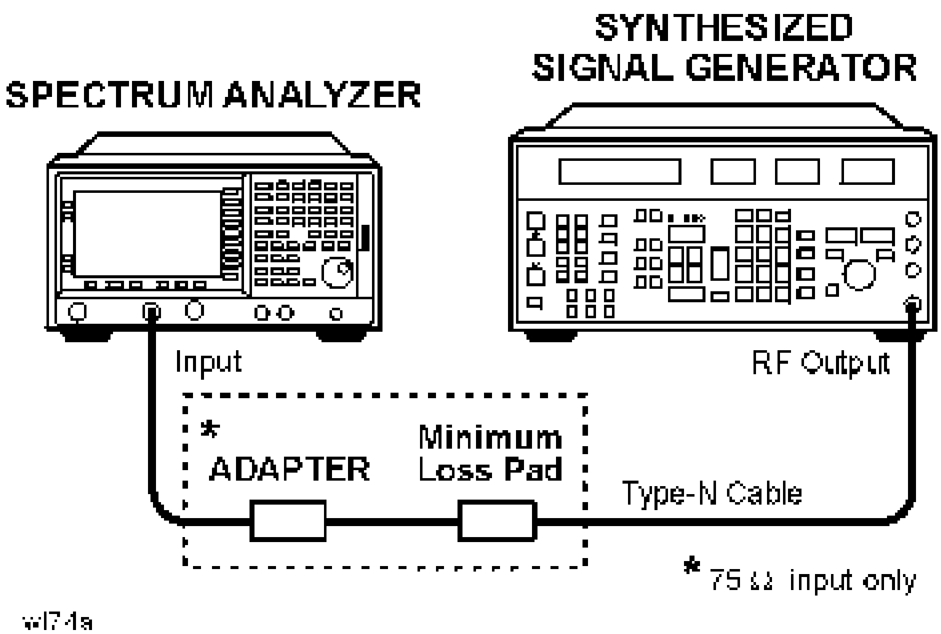
Equipment	Recommended Agilent Model	For Model
Signal Source		

Synthesized Signal Generator	Agilent 8663A	All
Miscellaneous Devices		
50 ohm to 75 ohm Minimum Loss Pad (Option 1DP)	Agilent 11852B	E4401B and E4411B 75 ohm

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

Residual FM Test Setup



Important Information

Residual FM Level

The residual FM level is calculated using the following equation:

$$Y = A_{dev} \times \text{Slope}$$

where

A_{dev} is the measured deviation in dB.

Slope is the slope of the residual BW filter (1 kHz or 10 Hz) in Hz/dB.

Sweep Time Accuracy

Related Specification

Sweep Time Accuracy

Related Adjustment

None

Test Description

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 delta 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.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

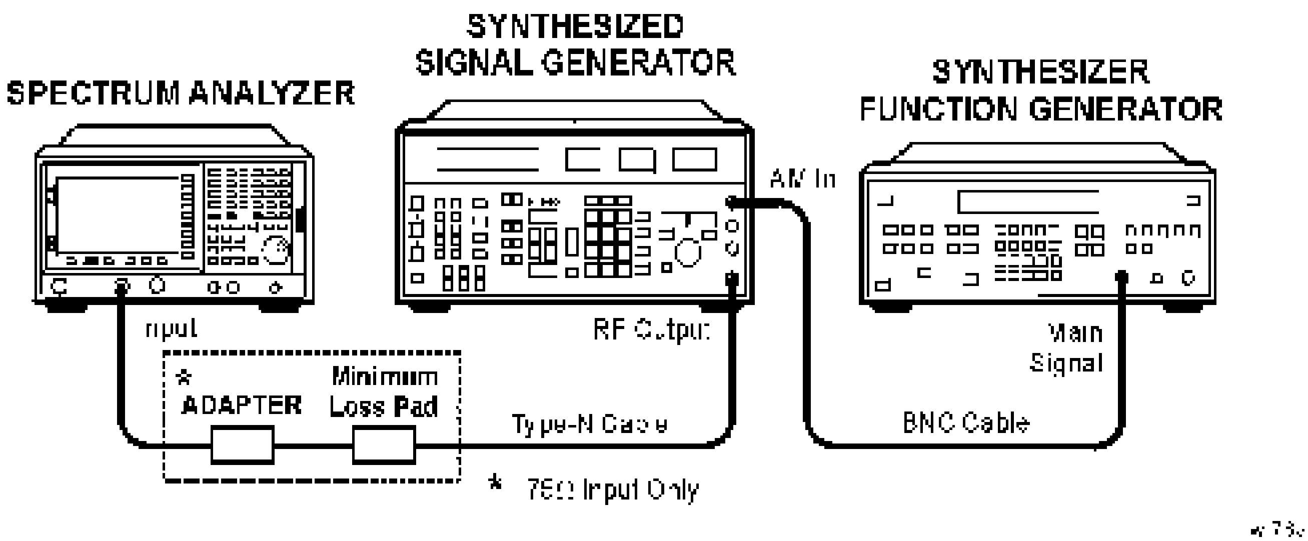
Required Test Equipment

Equipment	Recommended Agilent Model	For Model
Signal Source		
Synthesized Signal Generator	Agilent 8663A	All
Function Generator	Agilent 33120A or Agilent 3325B	All
Miscellaneous Devices		
50 ohm to 75 ohm Minimum Loss Pad	Agilent 11852B	E4401B and E4411B 75 ohm

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

Sweep Time Accuracy Test Setup



Data

The following table lists the source and UUT frequency settings and sweep time settings at which the Sweep Time Accuracy measurements are taken.

Sweep Time Accuracy

Synthesizer Signal Generator Frequency	UUT		Function Generator Frequency
	Center Frequency	Sweep Time	
500 MHz	500 MHz	5 ms	2.0 kHz
		20 ms	500.0 Hz
		100 ms	100.0 Hz
		1 s	10.0 Hz
		10 s	1.0 Hz
		1 ms[1]	10.0 kHza
		500 µsa	20.0 kHza
		100 µsa	100.0 kHza

Important Information

Sweep Time Accuracy

The sweep time accuracy is calculated using the following equation:

$$Y = 100 \times \left[\frac{\Delta Mkr1 - (0.8 \times Sweeptime)}{Sweeptime}\right]$$

where

1. DMkr1 is the delta marker time reading over the middle 80% of the display.
2. Sweeptime is the normal sweeptime setting.

Footnotes

1 Option AYX, only

Scale Fidelity

Related Specification

Display Scale Fidelity: Log Maximum Cumulative Log Incremental Accuracy Linear Accuracy

Related Adjustment

IF Amplitude

Test Description

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 in a 3 kHz resolution bandwidth.

If the analyzer is equipped with Narrow Resolution Bandwidth, Option 1DR, the Scale Fidelity-Narrow RBW test should be performed instead.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

Required Test Equipment

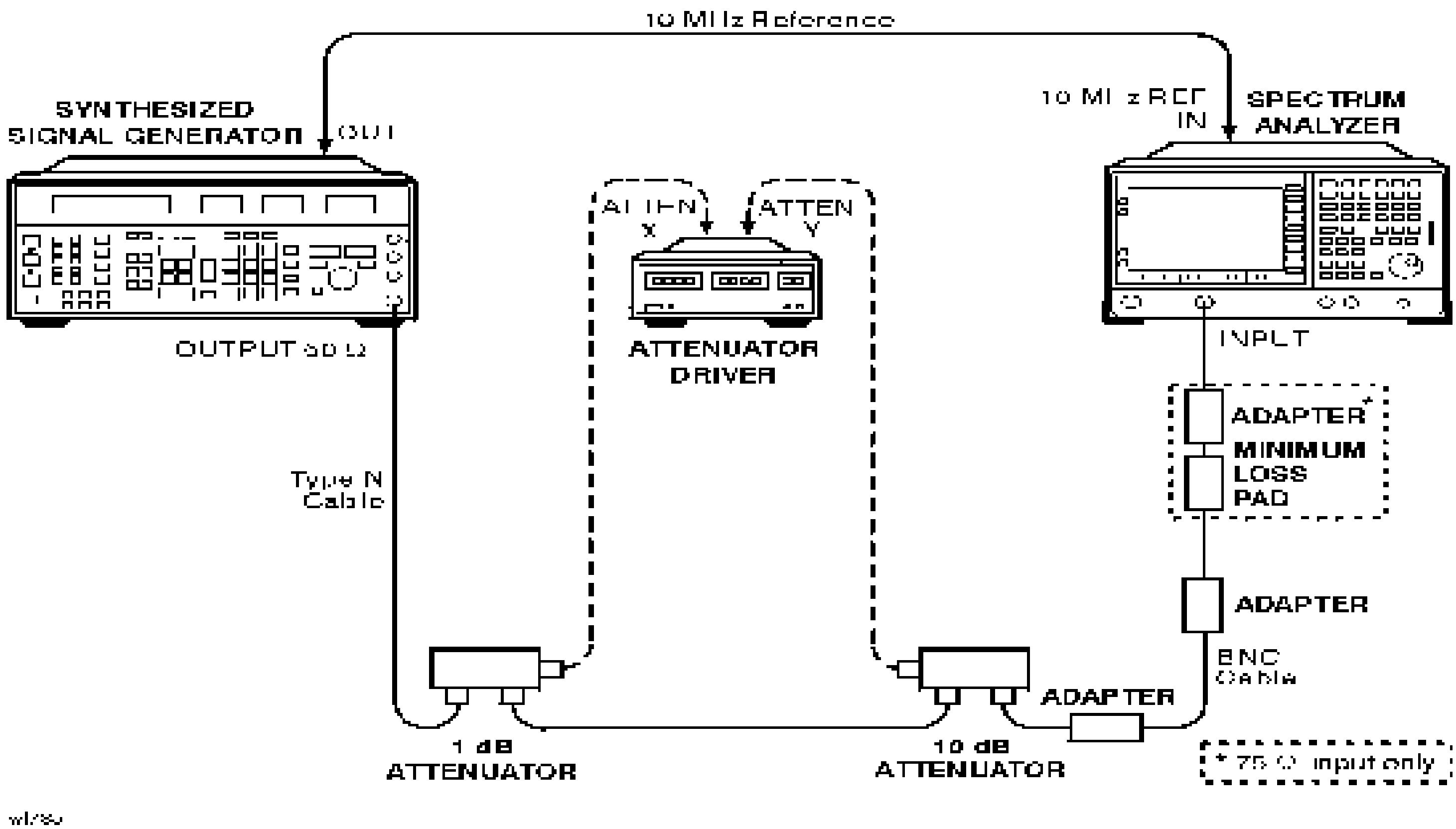
Equipment	Recommended Agilent Model	For Model
Signal Source		
Synthesized Signal Generator	Agilent 8663A	All
Attenuators		
Attenuator, 1 dB Step	Agilent 8494A/G	All

Attenuator, 10 dB Step	Agilent 8496A/G	All
Attenuator/Switch Driver	Agilent 11713A	All
Attenuator Interconnect Kit	Agilent 11716 Series	All

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

Display Scale Fidelity Test Setup



Data

The following table lists the UUT center and source frequency settings, the settings for the external attenuators, and the offset from the reference level at which the Display Scale Fidelity measurements are taken.

Display Scale Fidelity

UUT Center Frequency	Synthesized Signal Generator Frequency	dB from Reference Level (dB)	1 dB Attenuator (dB)	10 dB Attenuator (dB)

50 MHz	50 MHz	0 ref[1]	0a	0a
		-4a	4a	0a
		-8a	8a	0a
		-12a	2a	10a
		-16a	6a	10a
		-20a	0a	20a
		-24	4	20
		-28	8	20
		-32	2	30
		-36	6	30
		-40	0	40
		-44	4	40
		-48	8	40
		-52	2	50
		-56	6	50
		-60	0	60
		-64	4	60
		-68	8	60
		-72	2	70
		-76	6	70
		-80	0	80
		-84	4	80

Important Information

Scale Fidelity

The the scale fidelity error is calculated using the following equation:

$$Y = (A_{mkr\_x} - A_{mkr\_ref}) - (A_{atten\_x} - A_{atten\_ref})$$

where

A_{mkr_x} is the marker amplitude measured at the points -4 dB to -84 dB from the reference level.

A_{mkr_ref} is the marker amplitude measured at the reference level.

A_{atten_x} is the step attenuator error at the points -4 dB to -84 dB from the reference level.

A_{atten_ref} is the step attenuator error at the reference level.

Footnotes

1 Linear mode measures at only these points. Log mode measures at all points

---

PREVIOUS Sweep Time Accuracy

Scale Fidelity - Narrow RBW NEXT

TOP

Scale Fidelity - Narrow RBW

Related Specification

Display Scale Fidelity: Log Maximum Cumulative Log Incremental Accuracy Linear Accuracy

Related Adjustment

IF Amplitude

Test Description

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 in 3 kHz and 10 Hz resolution bandwidth settings.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

Required Test Equipment

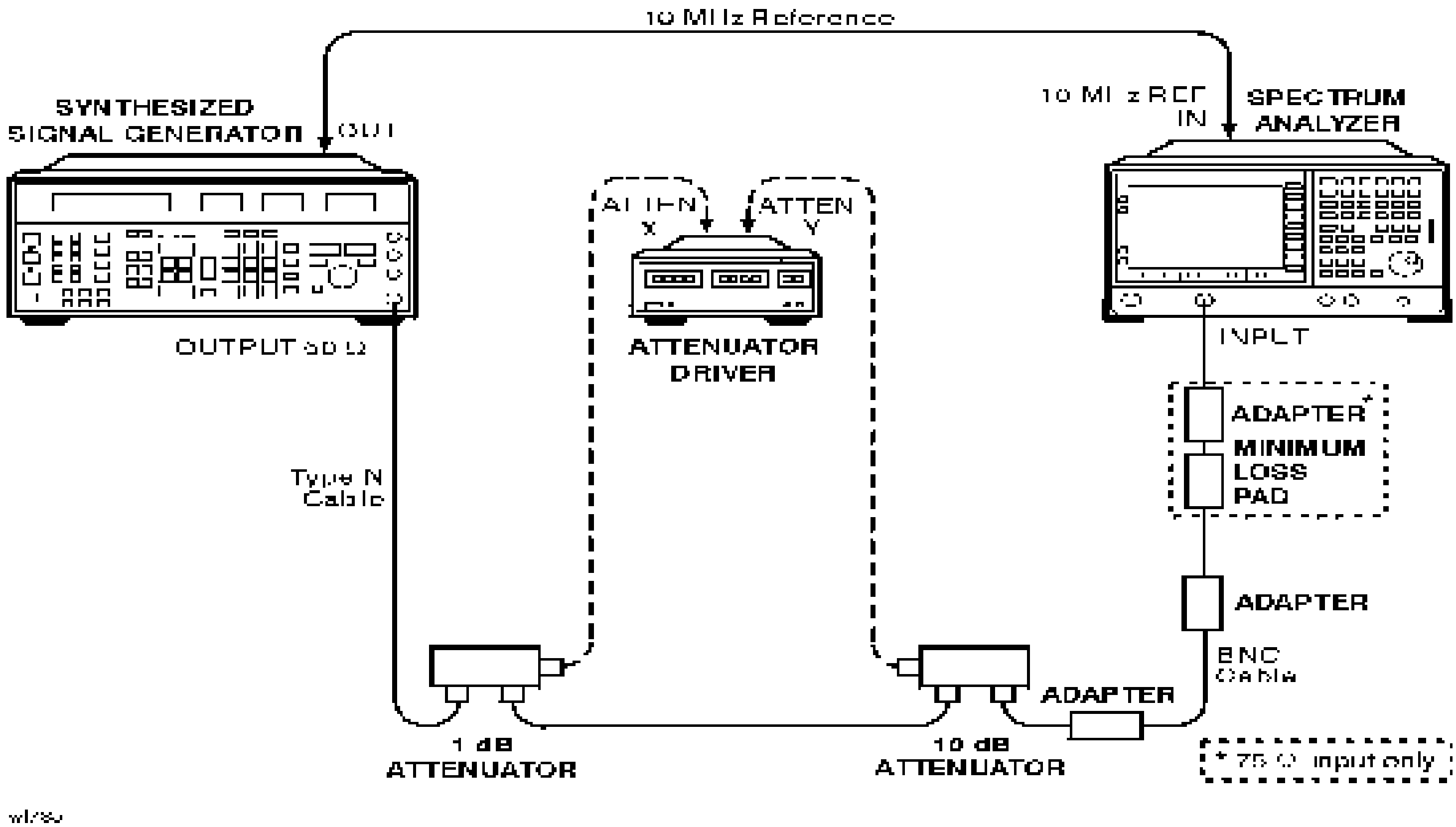
Equipment	Recommended Agilent Model	For Model
Signal Source		
Synthesized Signal Generator	Agilent 8663A	All
Attenuators		
Attenuator, 1 dB Step	Agilent 8494A/G	All
Attenuator, 10 dB Step	Agilent 8496A/G	All
Attenuator/Switch Driver	Agilent 11713A	All

Attenuator Interconnect Kit	Agilent 11716 Series	All

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

Display Scale Fidelity Test Setup



Data

The following table lists the UUT center and source frequency settings, the settings for the external attenuators, and the offset from the reference level at which the Display Scale Fidelity measurements are taken.

Display Scale Fidelity

UUT Center Frequency	Synthesized Signal Generator Frequency	dB from Reference Level (dB)	1 dB Attenuator (dB)	10 dB Attenuator (dB)
50 MHz	50 MHz	0 ref[1]	0	0
		-4[1]	4	0

		-8[1]	8	0
		-12[1]	2	10
		-16[1]	6	10
		-20	0	20
		-24	4	20
		-28	8	20
		-32	2	30
		-36	6	30
		-40	0	40
		-44	4	40
		-48	8	40
		-52	2	50
		-56	6	50
		-60	0	60
		-64	4	60
		-68	8	60
		-72	2	70
		-76	6	70
		-80	0	80
		-84	4	80
		-88[2]	8	80
		-92[2]	2	90
		-96[2]	6	90
		-98[2]	8	90

Important Information

Scale Fidelity

The the scale fidelity error is calculated using the following equation:

$$Y = (A_{mkr\_x} - A_{mkr\_ref}) - (A_{atten\_x} - A_{atten\_ref})$$

where

A_{mkr_x} is the marker amplitude measured at the points -4 dB to -98 dB from the reference level.

A_{mkr_ref} is the marker amplitude measured at the reference level.

A_{atten_x} is the step attenuator error at the points -4 dB to -98 dB from the reference level.

A_{atten_ref} is the step attenuator error at the reference level.

Footnotes

1 Linear mode measures at only these points. Log mode measures at all points

2 These points measured only with resolution bandwidth of 10 Hz.

PREVIOUS Scale Fidelity

Input Attenuation Switching Uncertainty at 50 MHz NEXT

TOP

Input Attenuation Switching Uncertainty at 50 MHz

Related Specification

Input Attenuation Switching Uncertainty at 50 MHz

Related Adjustment

Frequency Response

Test Description

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.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

Required Test Equipment

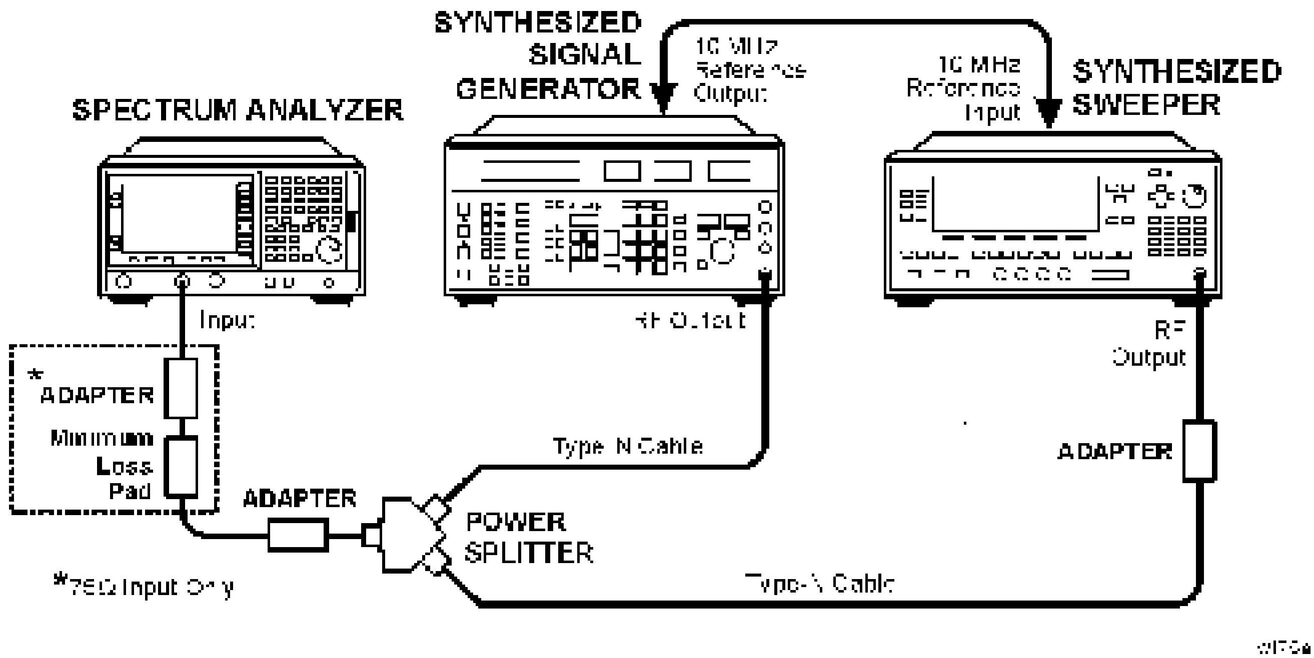
Equipment	Recommended Agilent Model	For Model
Signal Source		
Synthesized Signal Generator	Agilent 8663A	All
Attenuator		
Attenuator, 10 dB Step	Agilent 8496A/G	All
Attenuator, 1 dB Step	Agilent 8494A/G	All
Attenuator/Switch Driver	Agilent 11713A	All

Attenuator, 10 dB Fixed	Agilent 8491A Option 010	All

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

Input Attenuation Switching Uncertainty Test Setup



Data

The following table lists the nominal reference levels and input attenuation external attenuator settings at which the Input Attenuation Switching Uncertainty measurements are taken.

Input Attenuation Switching Uncertainty

Input Attenuator (dB)	Reference Level		1 dB Attenuator (dB)	10 dB Attenuator (dB)
	50 ohm Input (dBm)	75 ohm Input (dBmV)		
10	-55	-6.2	5	50
0	-65	-16.2	5	60
5	-60	-11.2	0	60
15	-50	-1.2	0	50

20	-45	3.8	5	40
25	-40	8.8	0	40
30	-35	13.8	5	30
35	-30	18.8	0	30
40	-25	23.8	5	20
45	-20	28.8	0	20
50	-15	33.8	5	10
55	-10	38.8	0	10
60	-5	43.8	5	0
65[1]	-0	48.8	0	0

Important Information

Actual External Attenuation

The external attenuation is calculated for every attenuator setting listed in Table 10-26 using the following equation:

$$AcctAtten_{i\ dB} = Atten\_10_{i\ dB} + Atten\_1_{i\ dB}$$

where

$Atten\_xx_{i\ dB}$ is the actual (metrological) attenuation for the external attenuator.

Reference Actual External Attenuation

The reference actual external attenuation is calculated for 55 dB using the following equation:

$$AcctAtten_{ref\ dB} = Atten\_10_{ref\ dB} + Atten\_1_{ref\ dB}$$

where

$Atten\_x_{ref\ dB}$ is the actual (metrological) attenuation when the external attenuators are set to 5 dB and 50 dB for a total nominal attenuation of 55 dB.

Attenuation Error

The attenuation error is calculated for every attenuator setting listed in Table 10-26 using the following equation:

$$Atten_{error\ dB} = (AcctAtten_{ref\ dB} - 55\ dB) - (AcctAtten_{i\ dB} - X\ dB)$$

where

$Atten\_x_{ref\ dB}$ is the reference actual (metrological) external attenuation calculated above.

55 dB is the reference nominal external attenuation.

$AcctAtten_{i\ dB}$ is the actual (metrological) external attenuation calculated above.

X dB is the nominal attenuation.

Switching Error

The Switching error is calculated using the following equation:

$$Swch\_Err_{i\ dB} = \Delta Mkr_{m\ dB} - \Delta Mkr_{i\ dB} - Atten_{error\ dB}$$

where

$\Delta Mkr_{m\ dB}$ is the measured marker delta reading.

$\Delta Mkr_{i\ dB}$ is the ideal amplitude marker delta reading.

$Atten_{error\ dB}$ is the attenuation error calculated above.

Reference Level Accuracy

Related Specification

Reference Level

Related Adjustment

IF Amplitude

Test Description

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 calibrated step attenuators are used as the reference standard. The test is performed in both log and linear amplitude scales in a 3 kHz resolution bandwidth.

If the analyzer is equipped with Narrow Resolution Bandwidths, Option 1DR, perform the Reference Level Accuracy-Narrow RBW test instead.

It is only necessary to test reference levels as low as -70 dBm (with 10 dB input 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.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

Required Test Equipment

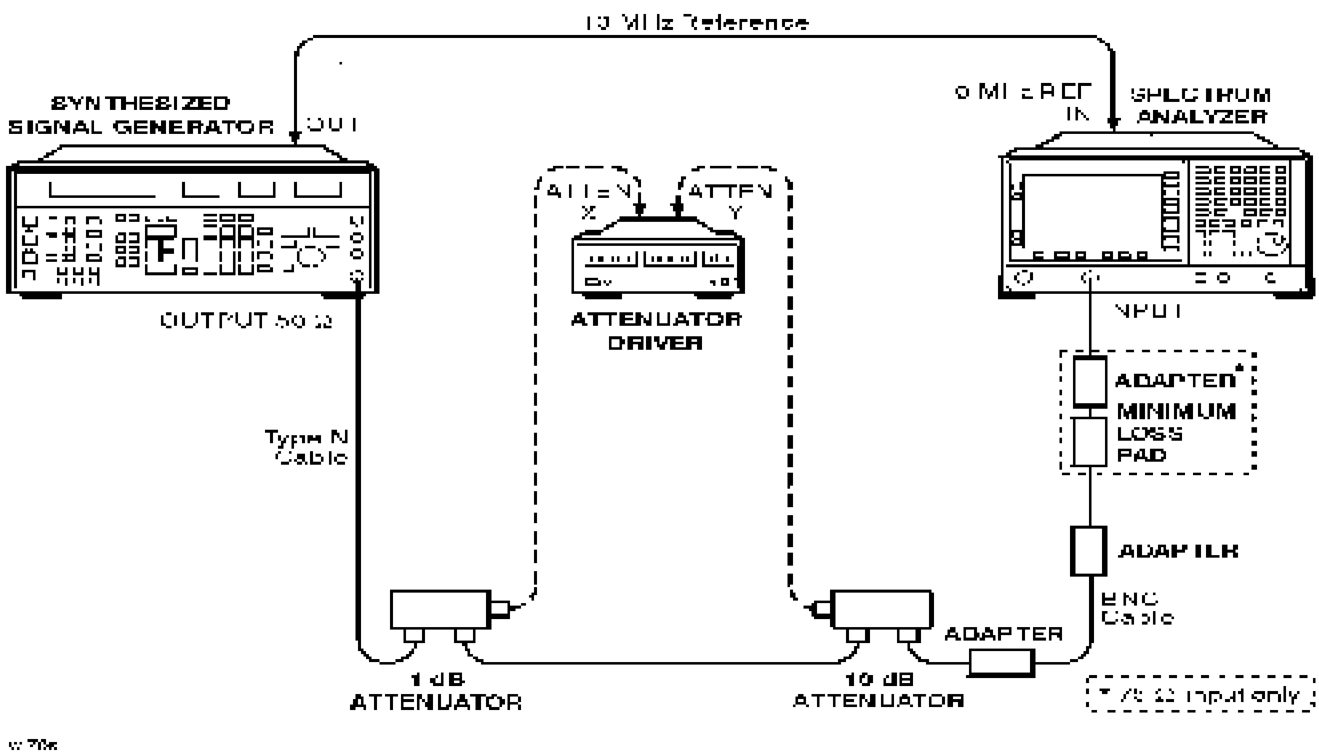
Equipment	Recommended Agilent Model	For Model
Signal Source		
Synthesized Signal Generator	Agilent 8663A	All

Attenuators		
Attenuator, 1 dB Step	Agilent 8494A/G	All
Attenuator, 10 dB Step	Agilent 8496A/G	All
Attenuator/Switch Driver	Agilent 11713A	All
Attenuator Interconnect Kit	Agilent 11716 Series	All

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

Reference Level Accuracy Test Setup



Data

The following table lists the UUT center and source frequency settings, the external 10 dB step attenuator settings, and the UUT reference levels at which the Reference Level Accuracy measurements are taken.

Reference Level Accuracy

		UUT Reference Level	

UUT Center Frequency	Synthesized Signal Generator Frequency	All Others	E4401B and E4411B		10 dB Attenuator (dB)
		50 ohm Input (dBm)	50 ohm Input (dBm)	75 ohm Input (dBmV)	
50 MHz	50 MHz	-20[1]	-25a	26.76a	20
		-10	-15	36.76	10
		0	-5	46.76	0
		-30	-35	16.76	30
		-40	-45	6.76	40
		-50	-55	-3.24	50
		-60	-65	-13.24	60
		-70	-75	-23.24	70

Important Information

Reference Level Accuracy

The the reference level error is calculated using the following equation:

$$Y = (A_{mkr\_x} - A_{mkr\_ref}) - (A_{atten\_x} - A_{atten\_ref})$$

where

A_{mkr_x} is the marker amplitude measured at reference level x.

A_{mkr_ref} is the marker amplitude at the reference measurement.

A_{atten_x} is the 10 dB step attenuator error at reference level x.

A_{atten_ref} is the 10 dB step attenuator error at the reference measurement.

Reference measurement is -25 dBm for E4401B and E4411B with a 50 Ω input, 26.76 dBmV for E4401B and E4411B with a 75 Ω input, and -20 dBm for E4402B, E4403B, E4404B, E4405, E4407B and E4408B.

Footnotes

1 Reference measurement.

(Number takes you back)

Reference Level Accuracy - Narrow RBW

Related Specification

Reference Level

Related Adjustment

IF Amplitude

Test Description

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 calibrated step attenuators are used as the reference standard. The test is performed in both log and linear amplitude scales in 3 kHz and 10 Hz resolution bandwidths.

This test applies only to analyzers equipped with Narrow Resolution Bandwidths, Option 1DR.

It is only necessary to test reference levels as low as -70 dBm (with 10 dB input 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.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

Required Test Equipment

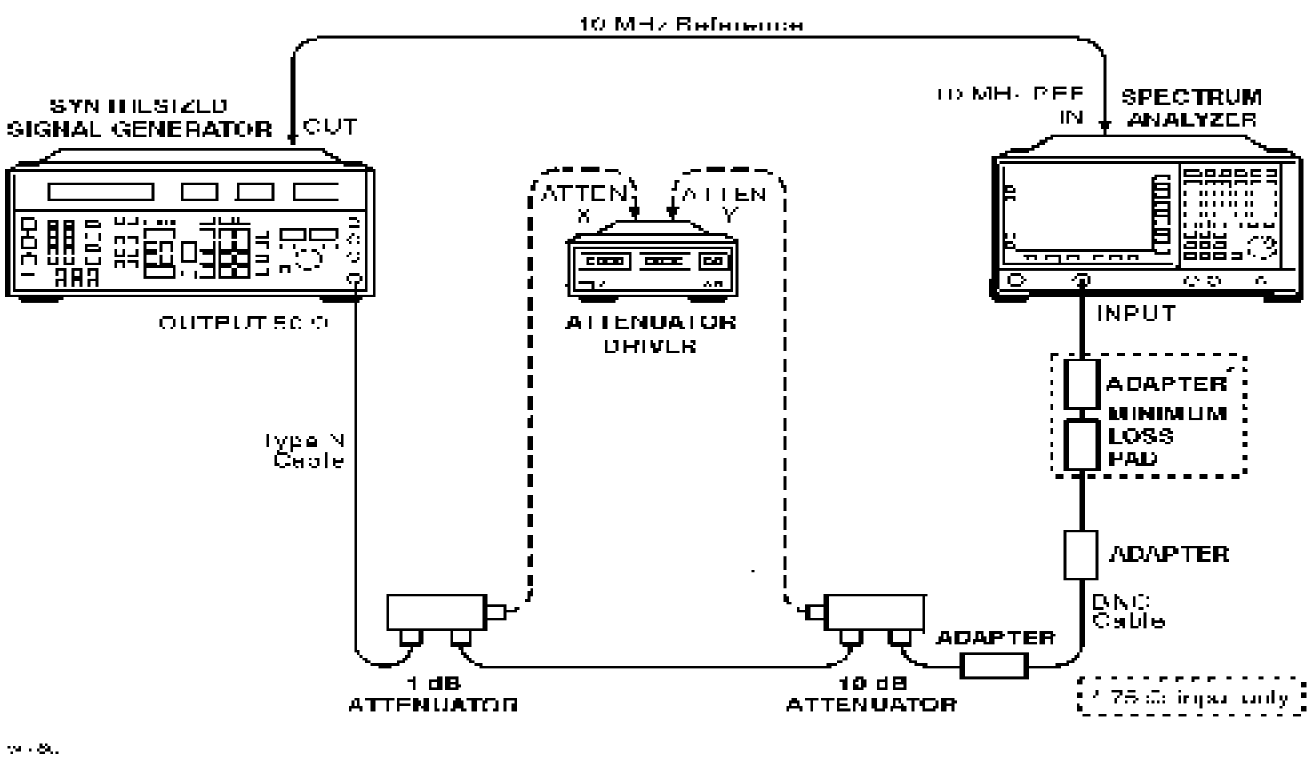
Equipment	Recommended Agilent Model	For Model
Signal Source		
Synthesized Signal Generator	Agilent 8663A	All
Attenuators		

Attenuator, 1 dB Step	Agilent 8494A/G	All
Attenuator, 10 dB Step	Agilent 8496A/G	All
Attenuator/Switch Driver	Agilent 11713A	All
Attenuator Interconnect Kit	Agilent 11716 Series	All
Cables		
Type-N	Agilent 11500D	All
BNC, 2 required	Agilent 10503A	All
Adapters		
Type-N (m) to BNC (f)	1250-1476	All
Type-N (f) to BNC (m), 75 ohm (Option 1DP)	1250-1534	E4401B and E4411B 75 ohm
50 ohm to 75 ohm Minimum Loss Pad (Option 1DP)	Agilent 11852B	E4401B and E4411B 75 ohm

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

Reference Level Accuracy Test Setup



Data

The following table lists the UUT center and source frequency settings, the external 10 dB step attenuator settings, and the UUT reference levels at which the Reference Level Accuracy measurements are taken.

Reference Level Accuracy

UUT Center Frequency	Synthesized Signal Generator Frequency	UUT Reference Level			10 dB Attenuator (dB)
		All Others	E4401B and E4411B		
		50 ohm Input (dBm)	50 ohm Input (dBm)	75 ohm Input (dBmV)	
50 MHz	50 MHz	-20[1]	-25a	26.76a	20
		-10	-15	36.76	10
		0	-5	46.76	0
		-30	-35	16.76	30
		-40	-45	6.76	40
		-50	-55	-3.24	50
		-60	-65	-13.24	60
		-70	-75	-23.24	70

Important Information

Reference Level Accuracy

The the reference level error is calculated using the following equation:

$$Y = (A_{mkr\_x} - A_{mkr\_ref}) - (A_{atten\_x} - A_{atten\_ref})$$

where

A_{mkr_x} is the marker amplitude measured at reference level x.

A_{mkr_ref} is the marker amplitude at the reference measurement.

A_{atten_x} is the 10 dB step attenuator error at reference level x.

A_{atten_ref} is the 10 dB step attenuator error at the reference measurement.

Reference measurement is -25 dBm for E4401B with a 50 ohm input, 26.76 dBmV for E4401B with a 75 ohm input, and -20 dBm for E4402B, E4404B, E4405, and E4407B.

Footnotes

1 Reference measurement.

Resolution BW Switching Uncertainty

Related Specification

Resolution BW Switching Uncertainty

Related Adjustment

IF Amplitude

Test Description

To measure the resolution bandwidth switching uncertainty an amplitude reference is taken with the resolution bandwidth set to 1 kHz using the marker delta function. The resolution bandwidth is changed to settings between 5 MHz and 3 kHz (5 MHz to 10 Hz if Option 1DR is installed) and the amplitude variation is measured at each setting. The span is changed as necessary to maintain approximately the same aspect ratio.

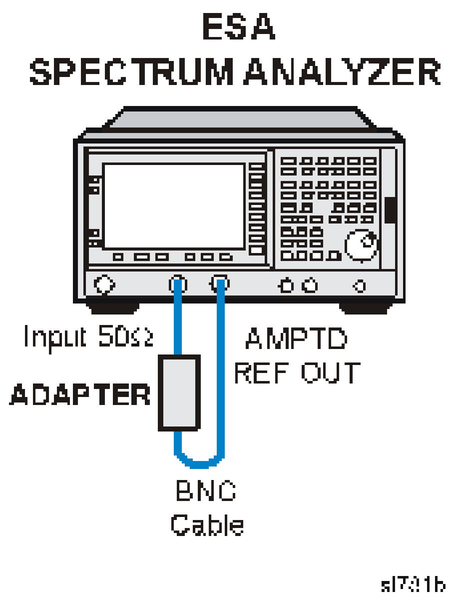
Required Equipment

none

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

Resolution BW Switching Uncertainty Test Setup



Data

The following table lists the resolution BW settings at which the Resolution BW Switching Uncertainty measurements are taken.

Resolution BW Switching Uncertainty

Resolution BW Setting		
3 kHz	100 kHz	300 Hz[1]
1 kHz	120 kHz[2]	200 Hza[1] [2]
9 kHz[2]	300 kHz	100 Hz[2]
10 kHz	1 MHz	30 Hz[2]
30 kHz	3 MHz	10 Hz[2]

Important Information

Resolution BW Switching Uncertainty

The resolution bandwidth switching uncertainty error is calculated using the following equation:

$Y = A_{ref} - A_{meas}$

where

A_{ref} is the amplitude measured at the 1 kHz resolution bandwidth setting.

A_{meas} is the amplitude measured at all other resolution bandwidth settings.

Footnotes

1 Option 1DR only.

2 200 kHz, 9 Hz, and 120 kHz must be entered from the keypad, they cannot be accessed from the step keys or the RPG (knob).

Absolute Amplitude Accuracy

Related Specification

Absolute Amplitude Accuracy: At reference settings

Related Adjustments

IF Amplitude

Amplitude Reference

Test Description

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.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

Required Test Equipment

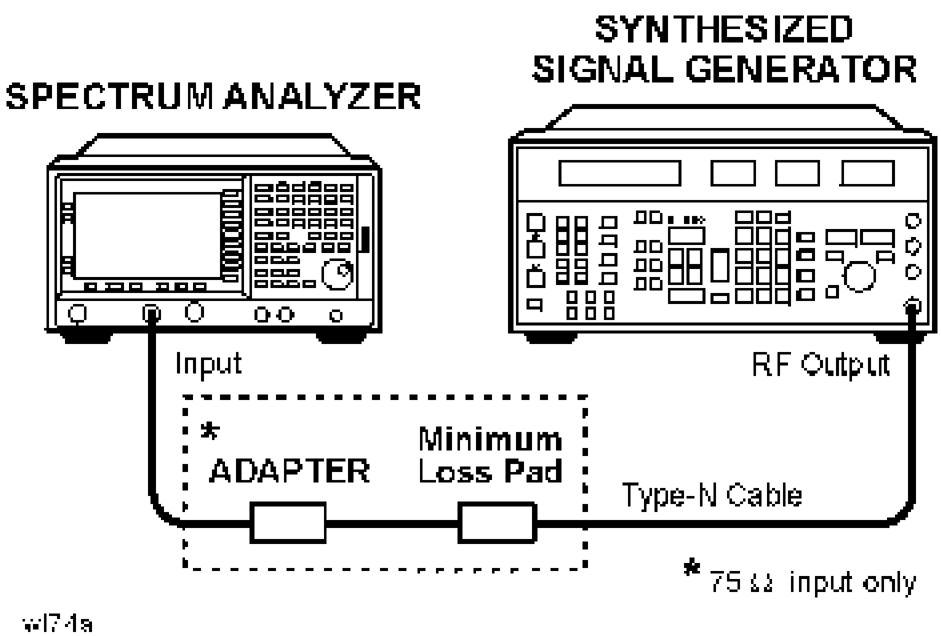
Equipment	Recommended Agilent Model	For Model
Signal Source		
Synthesized Signal Generator	Agilent 8663A	All
Meters		
Power Meter	Agilent E4419A	All
RF Power Sensor	Agilent 8482A	All
Power Sensor, Low Power	Agilent 8481D	All with Option 1DS
75 ohm Power Sensor	Agilent 8483A	E4401B and E4411B 75 ohm

Miscellaneous Devices		
50 ohm to 75 ohm Minimum Loss Pad (Option 1DP)	Agilent 11852B	E4401B and E4411B 75 ohm

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

Amplitude Accuracy Test Setup



Important Information

Marker Amplitude Conversion

The marker amplitude reading is converted from volts to dBm using one of the following equations:

50 Ω Input: $A_{mkr} = 10 \times LOG(Mkr\_V^2 / 0.050)$

or

75 Ω Input: $A_{mkr} = 10 \times LOG(Mkr\_V^2 / 0.075)$

where

Mkr_V is the marker amplitude value in volts.

Absolute Amplitude Accuracy Error

The absolute amplitude accuracy error is calculated using one of the following equations:

$AbsAmpAcc_{Log} = A_{mkr\_meas} - A_{actual}$

or

$AbsAmpAcc_{Lin} = A_{mkr\_meas} - A_{actual}$

where

$AbsAmpAcc_{Log}$ is the absolute amplitude accuracy error when using the Log scale type for the measurement.

$AbsAmpAcc_{Lin}$ is the absolute amplitude accuracy error when using the Linear scale type for the measurement.

A_{mkr_meas} is the amplitude measured by the analyzer marker.

A_{actual} is the amplitude measured by the power meter.

PREVIOUS Resolution BW Switching Uncertainty Overall Amplitude Accuracy NEXT

TOP

Overall Amplitude Accuracy

Related Specification

Absolute Amplitude Accuracy: Overall Amplitude Accuracy

Related Adjustment

Amplitude Reference

IF Amplitude

Test Description

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.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

Required Test Equipment

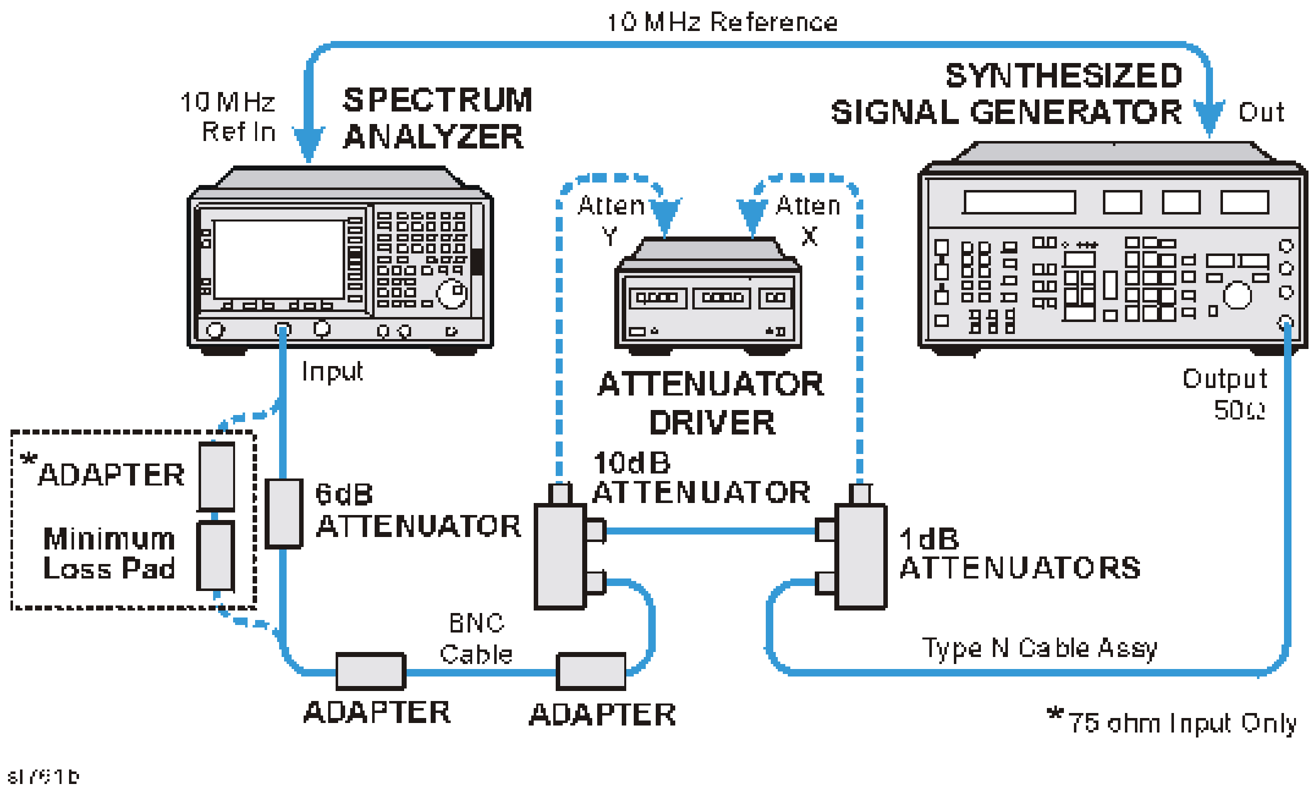
Equipment	Recommended Agilent Model	For Model
Signal Source		
Synthesized Signal Generator	Agilent 8663A	All
Meters		
Power Meter	Agilent E4419A	All
75 ohm Power Sensor	Agilent 8483A	E4401B and E4411B 75 ohm
RF Power Sensor 2 required	Agilent 8482A	All
Attenuators		
Attenuator, 1 dB Step	Agilent 8494A/G	All

Attenuator, 10 dB Step	Agilent 8496A/G	All
Attenuator/Switch Driver	Agilent 11713A	All
Attenuator Interconnect Kit	Agilent 11716 Series	All
Attenuator, 6 dB Fixed	Agilent 8491A Option 010 and H47	All

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

Overall Amplitude Accuracy Test Setup



Data

The following table lists the UUT center and source frequency settings and the external attenuator settings at which the Overall Amplitude Accuracy measurements are taken.

Overall Amplitude Accuracy

UUT Center Frequency	Synthesized Signal Generator Frequency	Step Attenuator	
		1 dB (dB)	10 dB (dB)
50 MHz	50 MHz	0	0

		0	10
		0	20
		0	30
		0	40
		0	50

Important Information

Reference Attenuation

The reference attenuation is calculated using the following equation:

$$RefAtten_{0\ dB} = 10\ dBAcct_{0\ dB} + 1\ dbAcct_{0\ dB}$$

where

$10\ dBAcct_{0\ dB}$ is the actual (metrological) attenuation of the 10 dB attenuator.

$1\ dBAcct_{0\ dB}$ is the actual (metrological) attenuation of the 1 dB attenuator.

Amplitude Accuracy

The amplitude accuracy is calculated using the following equation:

$$AmpAcc = A_{meas} - (A_{0\ dB} - AcctAtten_{total} + RefAtten_{0\ dB})$$

where

A_{meas} is the amplitude of the input signal measured by the UUT.

$A_{0\ dB}$ is the source amplitude measured by the power meter with the attenuators set to 0 dB.

$AcctAtten_{toeal}$ is the total actual (metrological) attenuation.

PREVIOUS [Absolute Amplitude Accuracy](#) [Resolution BW Accuracy](#) NEXT

TOP

Resolution BW Accuracy

Related Specification

Resolution Bandwidth Accuracy

Related Adjustment

IF Amplitude

Test Description

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 (or 6 dB if measuring the 200 Hz, 9 kHz, or 120 kHz resolution bandwidth settings).

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 (or 6 dB) bandwidth. The first marker is set on the left filter skirt so that the marker delta amplitude is 0 dB plus the attenuator error for the 3 dB (or 6 dB) setting. The second marker is similarly set on the right filter skirt. The frequency difference between the two markers is the 3 dB (or 6 dB) bandwidth.

The narrow resolution bandwidths (≤ 300 Hz) are not tested. These bandwidths are digitally derived; therefore their accuracy is guaranteed by design.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

Required Test Equipment

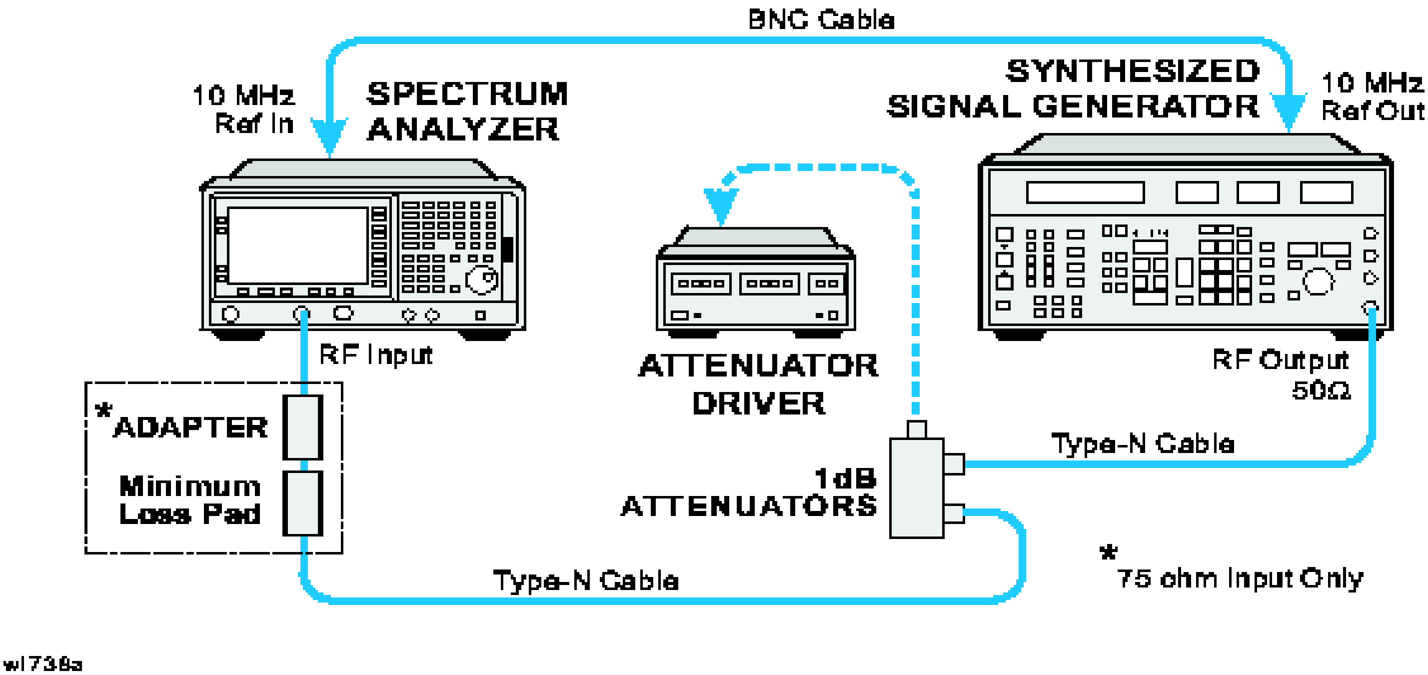
Equipment	Recommended Agilent Model	For Model
Signal Source		
Synthesized Signal Generator	Agilent 8663A	All
Attenuators		

Attenuator, 1 dB Step	Agilent 8494A/G	All
Attenuator/Switch Driver	Agilent 11713A	All
Attenuator Interconnect Kit	Agilent 11716 Series	All

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

Resolution BW Accuracy Test Setup wl75a



Data

The following table lists the nominal measured amplitude and the settings for the external attenuators at which the Resolution BW Accuracy measurements are taken.

Resolution BW Accuracy

UUT Center Frequency	Synthesized Signal Generator Frequency	UUT Resolution BW
50 MHz	50 MHz	5 MHz
		3 MHz
		1 MHz
		300 kHz
		100 kHz

		30 kHz
		10 kHz
		3 kHz
		1 kHz
		120 kHz
		9 kHz

Important Information

Resolution BW Accuracy

The -3 dB (-6 dB) resolution bandwidth accuracy error is calculated using the following equation:

Y = [(DMkr - Res BW)/Res BW] x 100%

where

DMkr is the delta marker frequency at the -3dB (or -6 dB) bandwidth.

Res BW is the nominal resolution bandwidth setting.

PREVIOUS Overall Amplitude Accuracy

Frequency Response Low Band NEXT

TOP

Frequency Response Low Band

This Test covers frequencies up to 3GHz.

Related Specification

Frequency Response

Related Adjustment

Frequency Response, YTF

Test Description

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 another 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.

Analyzers with 75 Ω inputs are tested only down to 1 MHz.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

Required Test Equipment

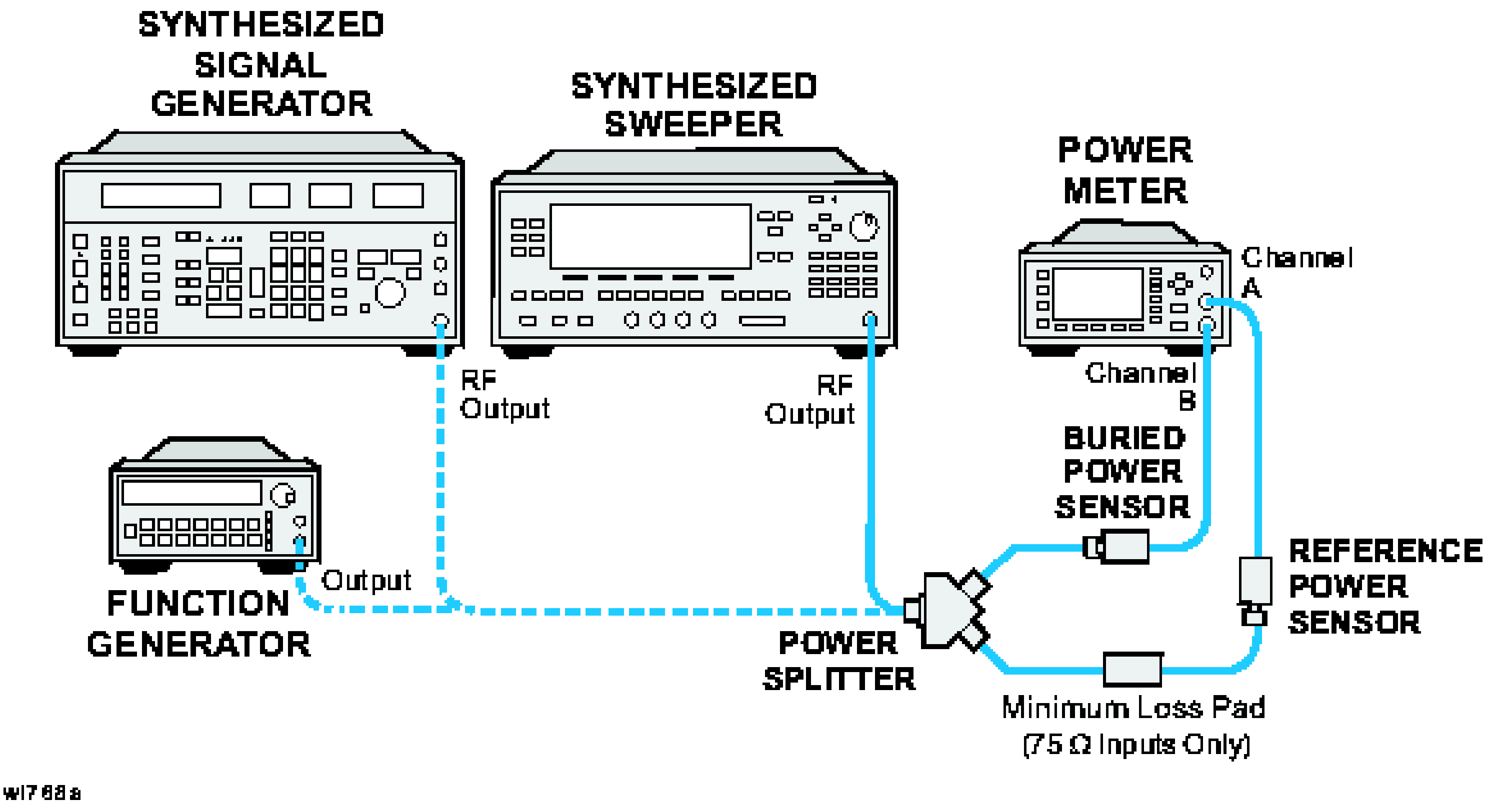
Equipment	Recommended Agilent Model	For Model

Signal Source		
Synthesized Signal Generator	Agilent 8663A	All 1.5GHz Models
Synthesized Sweeper	Agilent 83620/30/40/50B	All except 1.5GHz models
Function Generator	Agilent 33120A or Agilent 3325B	All
Meters		
Digital Multimeter	Agilent 3458A	All
Power Meter	Agilent E4419A	All
75 ohm Power Sensor "Reference" Sensor	Agilent 8483A	E4401B and E4411B 75 ohm
RF Power Sensor 2 required "Reference" and "Buried" Sensor	Agilent 8482A	All
Terminations		
Termination, 50 ohm	Agilent 11593A	All
Miscellaneous Devices		
Power Splitter	Agilent 11667A	All
20 dB fixed attenuator	Agilent 8491A Option 020	All with Option 1DS

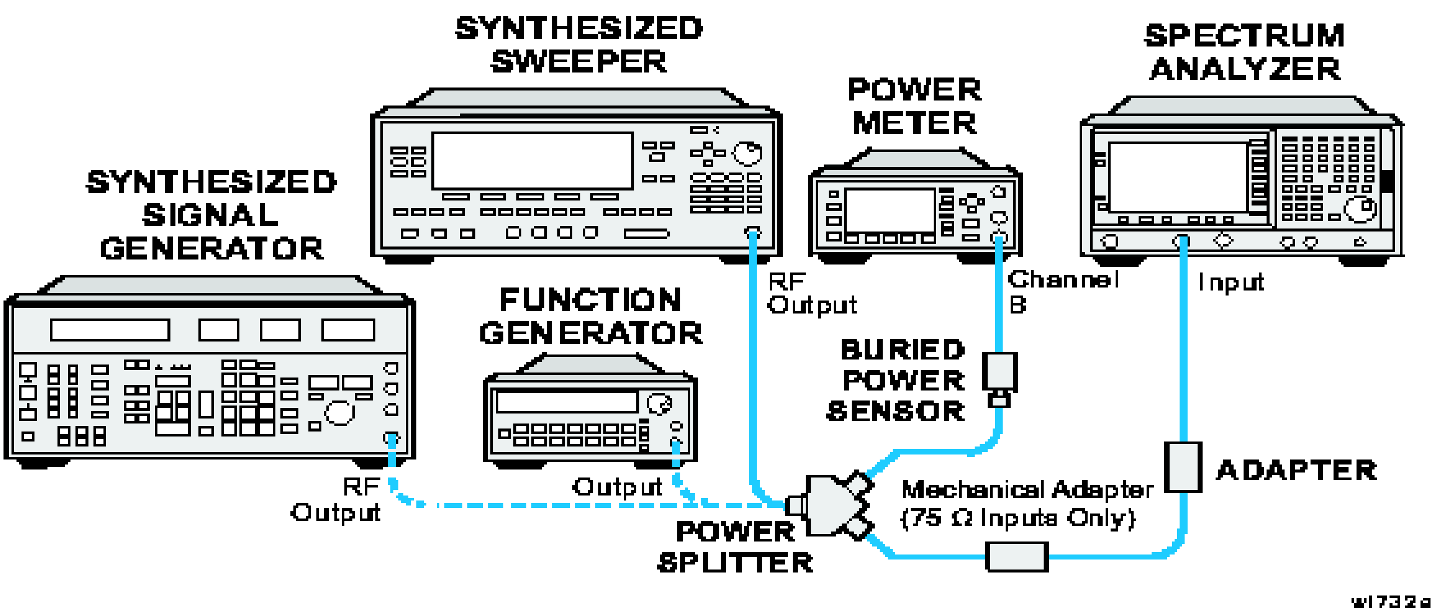
Test Setups Illustrations

The following figure illustrates the equipment setup for the test.

Frequency Response Splitter Characterization



Frequency Response Test Setup



Important Information

Splitter Tracking Error

The splitter tracking error ($Track_{Error}$) is determined by measuring the source amplitude of the first arm of the

splitter on power meter channel A (ChA) and the source amplitude of the second arm of the splitter on power meter channel B (ChB). The splitter tracking error is then calculated by subtracting the channel B reading from the channel A reading. Tracking errors are calculated for the same frequencies at which flatness is measured.

When measuring frequency response with the preamp on, the splitter tracking errors will be nominally 20 dB due to the presence of the 20 dB fixed attenuator connected to one splitter output port.

$$Track_{Error} = ChA - ChB$$

Flatness Error

The flatness error ($Flat_{Error}$) is determined by using the UUT to measure the source amplitude out of the first arm of the splitter ($Meas_{Amp}$) and using power meter channel B to measure the source amplitude of the second arm of the splitter (ChB_{Amp}). The flatness error ($Track_{Error}$) is then calculated by subtracting the channel B reading and the tracking error from the UUT reading.

$$Flat_{Error} = Meas_{Amp} - ChB_{Amp} - Track_{Error}$$

Then the flatness error is normalized to 50 MHz for all measured frequencies.

Frequency Response High Band

This Test covers frequencies Above 3GHz.

Related Specification

Frequency Response

Related Adjustment

Frequency Response, YTF

Test Description

This test measures the amplitude error of the analyzer as a function of frequency. 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.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

Required Test Equipment

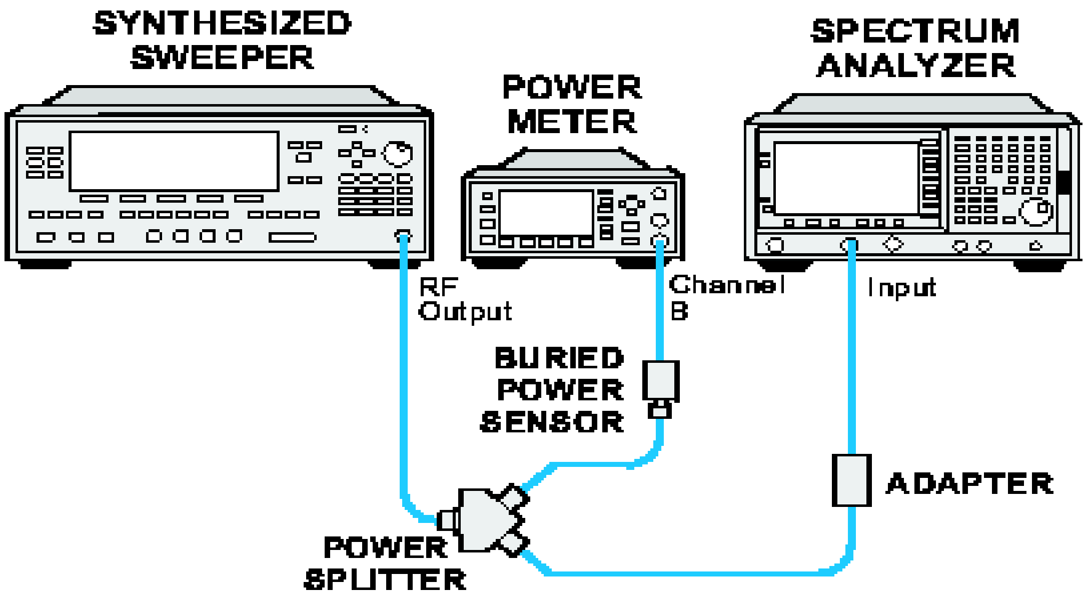
Equipment	Recommended Agilent Model	For Model
Signal Source		
Synthesized Sweeper	Agilent 83620/30/40/50B	All
Synthesized Sweeper	Agilent 83630/40/50B	26.5GHz models
Meters		
Power Meter	Agilent E4419A	All

Microwave Power Sensor	Agilent 8485A	All
Miscellaneous Devices		
Power Splitter	Agilent 11667A	All non 26.5GHz units
Power Splitter	Agilent 11667B	E4407B and E4408B E7405A

Test Setups Illustrations

The following figure illustrates the equipment setup for the test.

Frequency Response Test Setup



Flatness Error

The flatness error ($Flat_{Error}$) is determined by using the UUT to measure the source amplitude out of the first arm of the splitter ($Meas_{Amp}$) and using power meter channel B to measure the source amplitude of the second arm of the splitter (ChB_{Amp}). The flatness error ($Track_{Error}$) is then calculated by subtracting the channel B reading from the UUT reading.

$$Flat_{Error} = Meas_{Amp} - ChB_{Amp} - Track_{Error}$$

Then the flatness error is normalized to 50 MHz for all measured frequencies.

Other Input Related Spurious Responses

Related Specification

Other Input Related Spurious Responses

Related Adjustment

None

Test Description

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 yield the specified mixer level, either -10 dBm or -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 the specified mixer level and the amplitude of the response, if any, is measured using the spectrum analyzer marker functions.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices, cables, and adapters.

Required Test Equipment

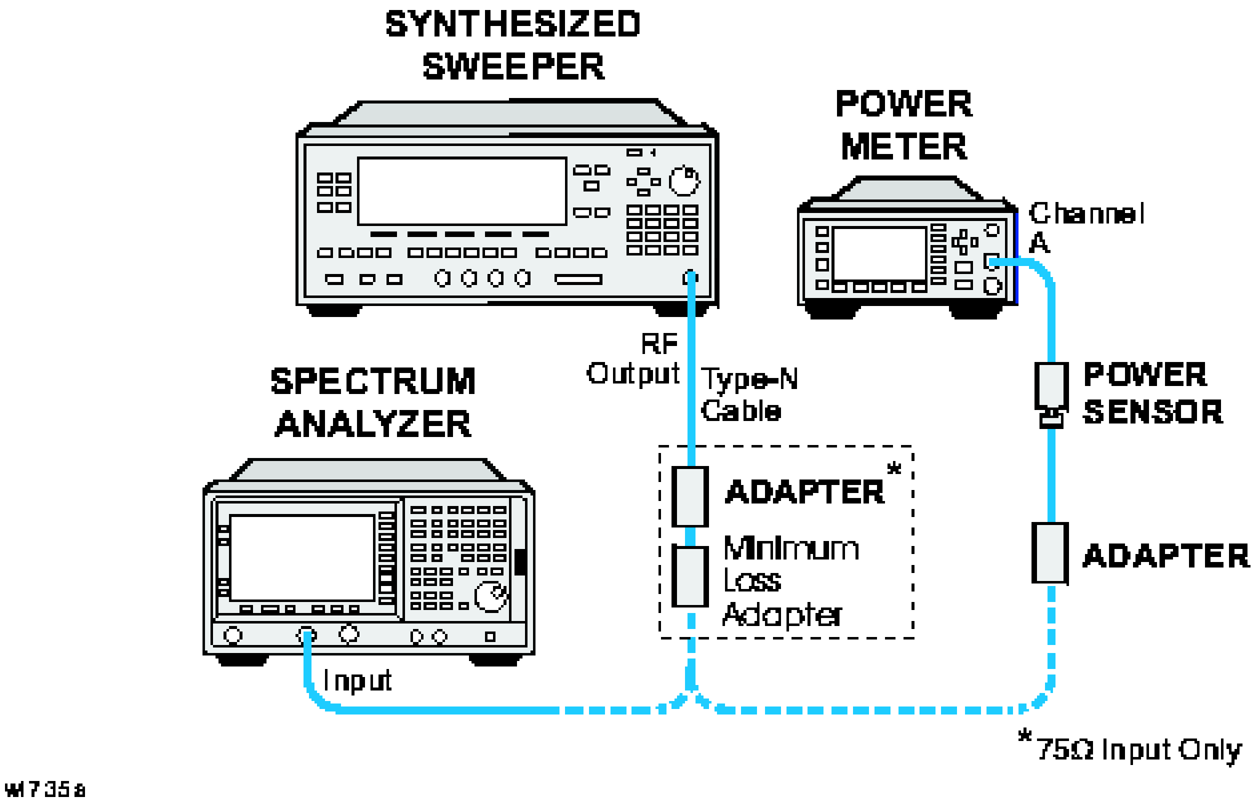
Equipment	Recommended Agilent Model	For Model
Signal Source		
Synthesized Signal Generator	Agilent 8663A	E4401B and E4411B
Synthesized Sweeper	Agilent 83620/30/40/50B	E4402B, E4403B, E4404B, and E4405B
Synthesized Sweeper	Agilent 83630/40/50B	E4407B and E4408B
Meters		
Power Meter	Agilent E4419A	All

75 ohm Power Sensor	Agilent 8483A	E4401B and E4411B 75 ohm
RF Power Sensor	Agilent 8482A	E4401B and E4411B 50 ohm, E4402B, and E4403B
Microwave Power Sensor	Agilent 8485A	E4404B, E4405B, E4407B, and E4408B
Miscellaneous Devices		
Power Splitter	Agilent 11667A	E4401B, E4402B, E4403B, E4404B, and E4405B
Power Splitter	Agilent 11667B	E4407B, and E4408B
Cables		
Type-N	Agilent 11500C	E4401B and E4411B
APC-3.5	8120-4921	E4402B, E4403B, E4404B, E4405B, E4407B, and E4408B
Adapters		
Type-N (f) to Type-N (f)	1250-1472	All
Type-N (m) to APC-3.5 (f)	1250-1744	E4402B, E4403B, E4404B, E4405B, E4407B, and E4408B
Type-N (f) to BNC (f), 75 ohm (Option 1DP)	1250-1535	E4401B and E4411B 75 ohm
Type-N (f) to BNC (m), 75 ohm (Option 1DP)	1250-1534	E4401B and E4411B 75 ohm
50 ohm to 75 ohm Minimum Loss Pad (Option 1DP)	Agilent 11852B	E4401B and E4411B 75 ohm
APC-3.5 (f) to APC-3.5 (f)	1250-1749	E4402B, E4403B, E4404B, E4405B, E4407B, and E4408B
Type-N (f), 75 ohm to Type-N (m), 50 ohm (Option 1DP)	1250-0597	E4401B and E4411B 75 ohm
Type-N (m) to BNC (m), 75 ohm (Option 1DP)	1250-1533	E4401B and E4411B 75 ohm

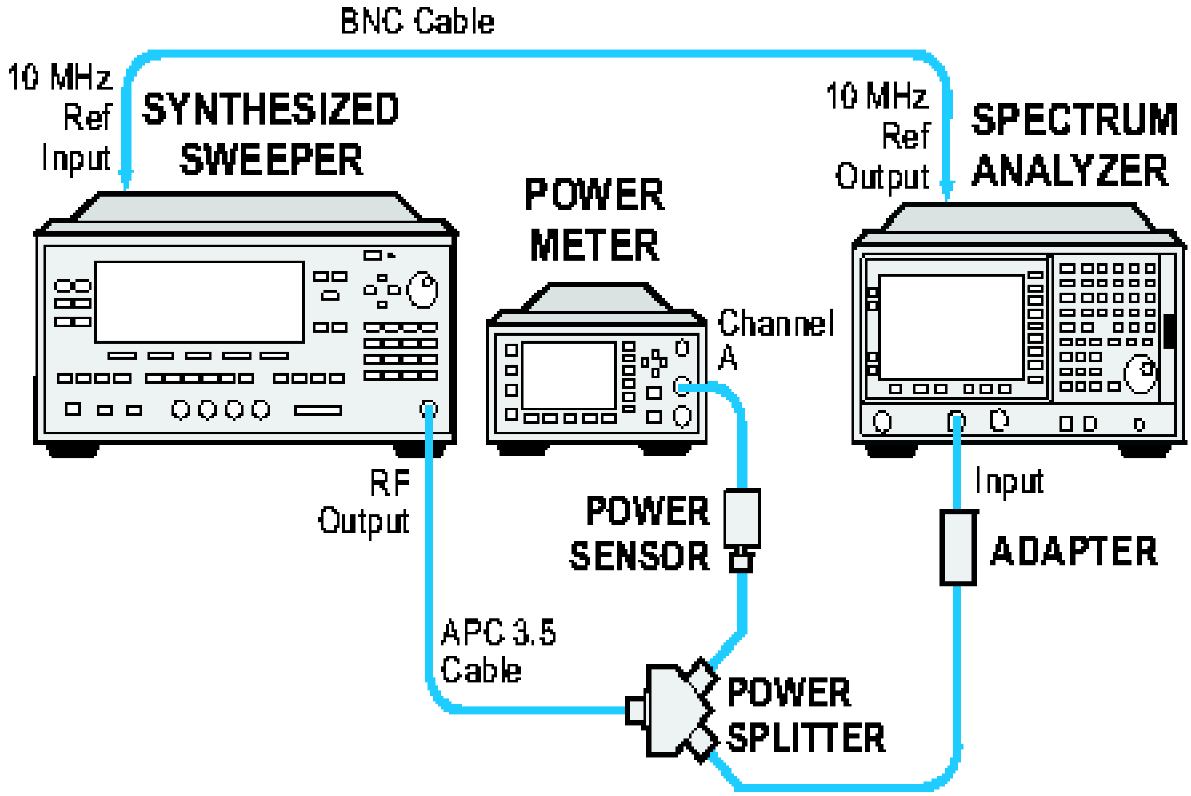
Test Setup Illustrations

The following figures illustrate the equipment setups for the test.

Other Input Related Spurious Responses (<3 GHz) Test Setup



Other Input Related Spurious Responses (≥3 GHz) Test Setup



Data

The following table lists the UUT center and source frequency settings at which the Other Input Related Spurious Responses measurements are taken. In addition, the type of response of each measurement point and the models applicable for those points.

Input Other Input Related Spurious Responses Attenuation Switching Uncertainty

UUT Center Frequency (GHz)	Source Frequency (MHz)	Type of Response	Model
0.50	542.8	Image	E4401B, and E4411B
0.50	510.7	Multiple	
0.10	1310.7	Multiple	
2.0	2042.8	Image	E4402B, E4403B, E4404B, E4405B, E4407B and E4408B
2.0	2642.8	Image	
2.0	1820.8	Multiple	
2.0	278.5	Multiple	
2.0	5600.0	Out-of-Band	E4404B, E4405B,

2.0	6242.8	Out-of-Band	E4407B, and E4408B
4.0	4042.8	Image	
4.0	4642.8	Image	
4.0	3742.9	Multiple	
4.0	2242.8	Out-of-Band	
9.0	9042.8	Image	E4405B, E4407B, and E4408B
9.0	9642.8	Image	
9.0	9342.8	Multiple	
9.0	4982.1	Out-of-Band	
15.0	15042.8	Image	E4407B, and E4408B
15.0	15642.8	Image	
15.0	18830.35	Multiple	
15.0	4151.75	Out-of-Band	
21.0	21042.8	Image	
21.0	21642.8	Image	
21.0	21342.8	Multiple	
21.0	5008.95	Out-of-Band	

Important Information

Other Input Related Spurious Responses

The spurious response level is calculated using the following equation:

$$Y = (P_{saref} - P_{saspur}) - (P_{swpref} - P_{swpspur})$$

where

P_{saref} is the power of the reference measured by the UUT.

P_{saspur} is the power of the spurious response measured by the UUT.

P_{swpref} is the power of the reference from the source applied to the UUT.

$P_{swpspur}$ is the power of the signal generating spur from the source applied to the UUT.

Spurious Responses - TOI

Related Specification

Spurious Responses: Third Order Intermodulation Distortion

Related Adjustment

None

Test Description

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, if the specification states that with two -30 dBm signals at the input mixer, the distortion products should be suppressed by > 80 dBc, this would yield 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)).

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

Required Test Equipment

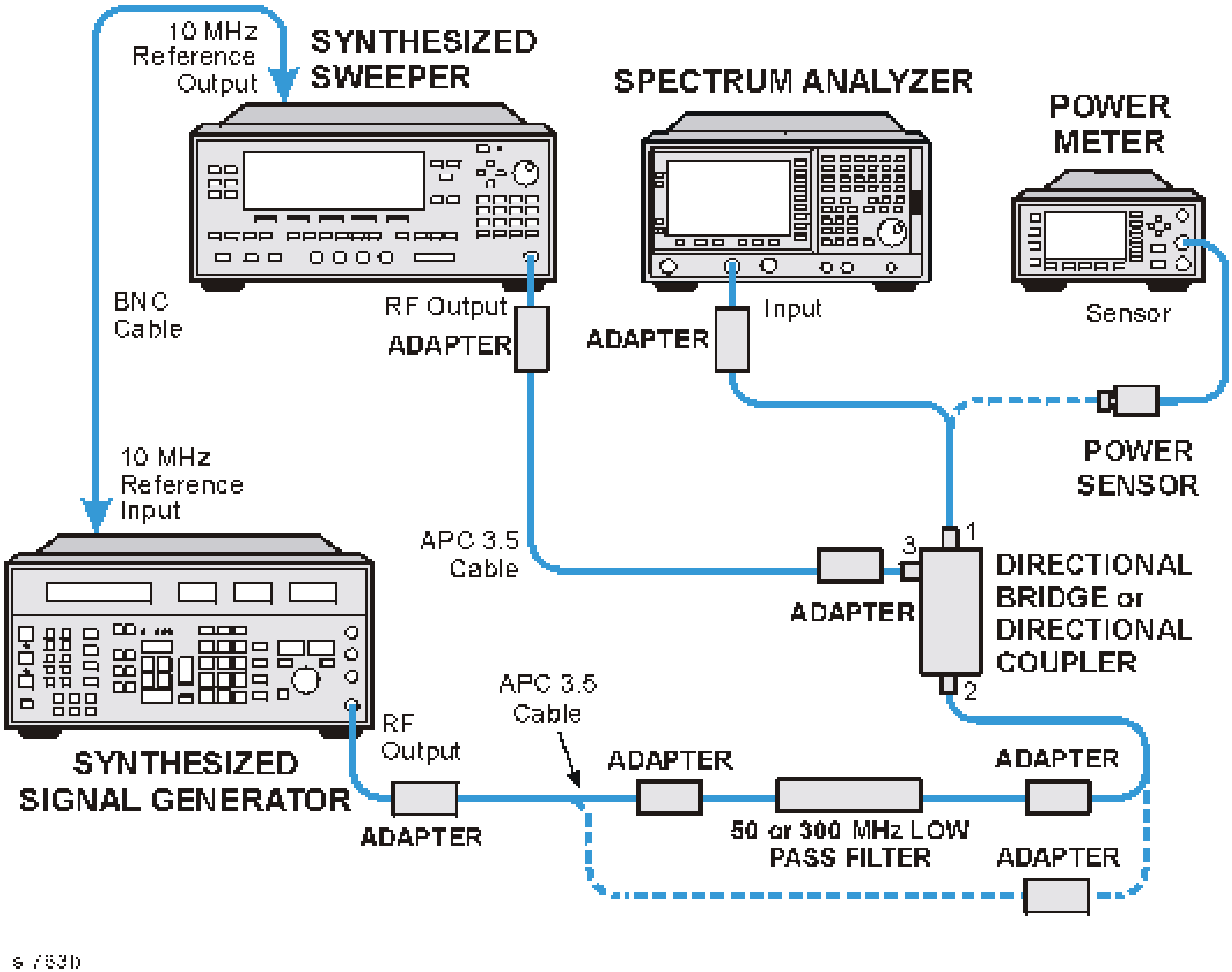
Equipment	Recommended Agilent Model	For Model
Signal Source		
Synthesized Signal Generator	Agilent 8663A	E4401B, E4411B, E4402B, and E4403B,
Synthesized Sweeper	Agilent 83620/30/40/50B	E4401B, E4411B, E4402B, and E4403B,

Synthesized Sweeper 2 required	Agilent 83620/30/40/50B	E4404B, E4405B, E4407B, and E4408B
Meters		
Power Meter	Agilent E4419A	All
75 ohm Power Sensor, 75 ohm	Agilent 8483A	E4401B and E4411B 75 ohm
RF Power Sensor	Agilent 8482A	E4401B and E4411B 50 ohm, E4402B, and E4403B
Microwave Power Sensor	Agilent 8485A	E4404B, E4405B, E4407B, and E4408B
Miscellaneous Devices		
6 GHz Directional Bridge	Agilent 86205A	All
Directional Coupler	0995-0098	E4404B, E4405B, E4407B, and E4408B

Test Setup Illustration

The following figure illustrates the equipment setup for the tests.

Third Order Intermodulation Distortion Test Setup



Data

The following table lists the source number one frequency settings, the frequency separation between source number one and two, and the UUT center frequency steps at which the Third Order Intermodulation Distortion measurements are taken. Also listed is the applicable model for the measurement points.

Third Order Intermodulation Distortion

Source 1 Frequency (MHz)	Source 2 Frequency Separation (kHz)	UUT Center Frequency Step (kHz)	For Model
50.0	50.0	50.0	E4401B and E4411B

300.0	50.0	50.0	E4402B, E4403B, E4404B, E4405B, E4407B, and E4408B
5000.0	50.0	50.0	E4404B, E4405B, E4407B, and E4408B
8000.0	50.0	50.0	E4404B, E4405B, E4407B, and E4408B

Important Information

Third Order Intermodulation Distortion

The TOI is calculated using the following equation:

Y = ML - D/2

where

ML is the mixer level, expressed in dBm or dBmV. The mixer level is the input signal amplitude minus the input attenuation.

D is the suppression of the third order intermodulation distortion products, expressed in dB.

PREVIOUS Other Input Related Spurious Responses Spurious Responses - SHD NEXT

TOP

Spurious Responses - SHD

Related Specification

Second Harmonic Distortion

Related Adjustment

None

Test Description

To test 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, if the specification states that with two -40 dBm at the input mixer, the distortion products should be suppressed by >75 dBc, this would yield an equivalent second harmonic intercept (SHI) is > +35 dBm (-40 dBm + 75 dBc). Measuring with -15 dBm at the mixer and verifying the distortion products are suppressed by >50 dBc also ensures the SHI is > +35 dBm (-15 dBm + 50 dBc).

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

Required Test Equipment

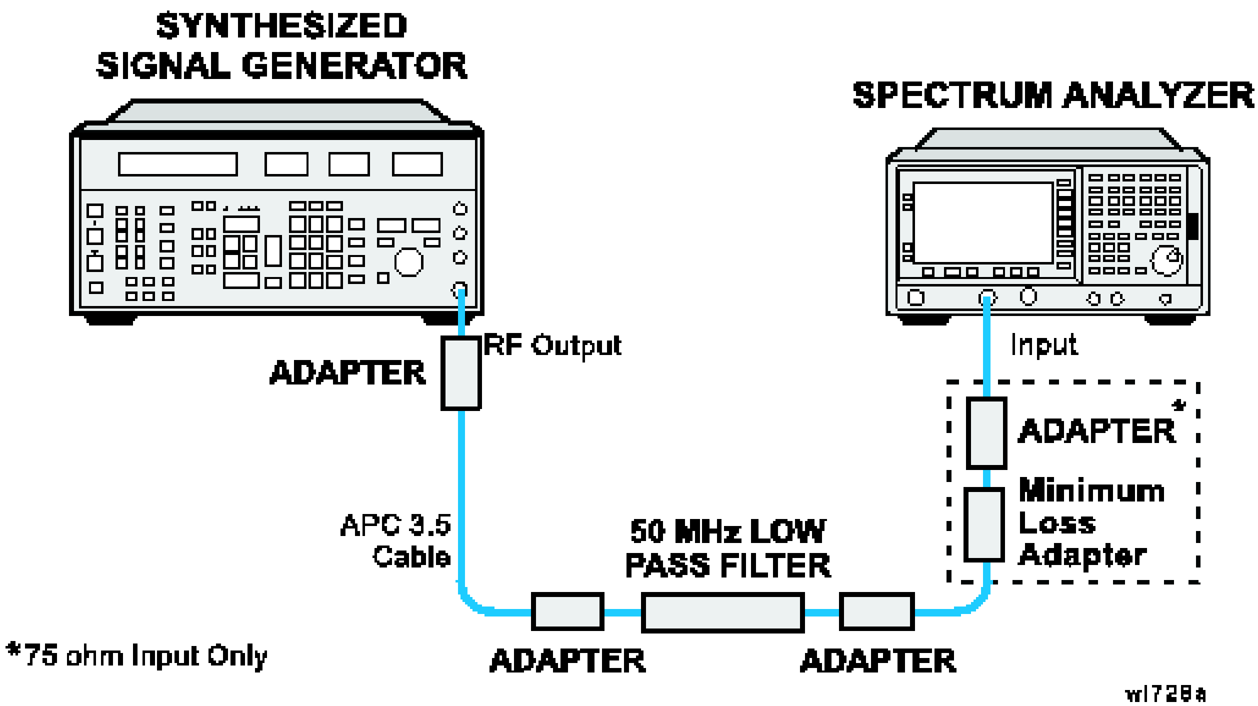
Equipment	Recommended Agilent Model	For Model
Signal Source		
Synthesized Signal Generator	Agilent 8663A	E4401B and E4411B
Synthesized Sweeper	Agilent 83620/30/40/50B	E4402B, E4403B, E4404B, E4405B, E4407B, and E4408B
Meters		
Power Meter	Agilent E4419A	All except on E4401B, and E4411B
RF Power Sensor	Agilent 8482A	E4402B and E4403B
Microwave Power Sensor	Agilent 8485A	E4404B, E4405B, E4407B, and E4408B

Miscellaneous Devices		
Power Splitter	Agilent 11667A	E4402B, E4403B, E4404B, and E4405B
Power Splitter	Agilent 11667B	E4407B and E4408B
Type-N (m) to BNC (m), 75 ohm (Option 1DP)	1250-1533	E4401B and E4411B 75 ohm

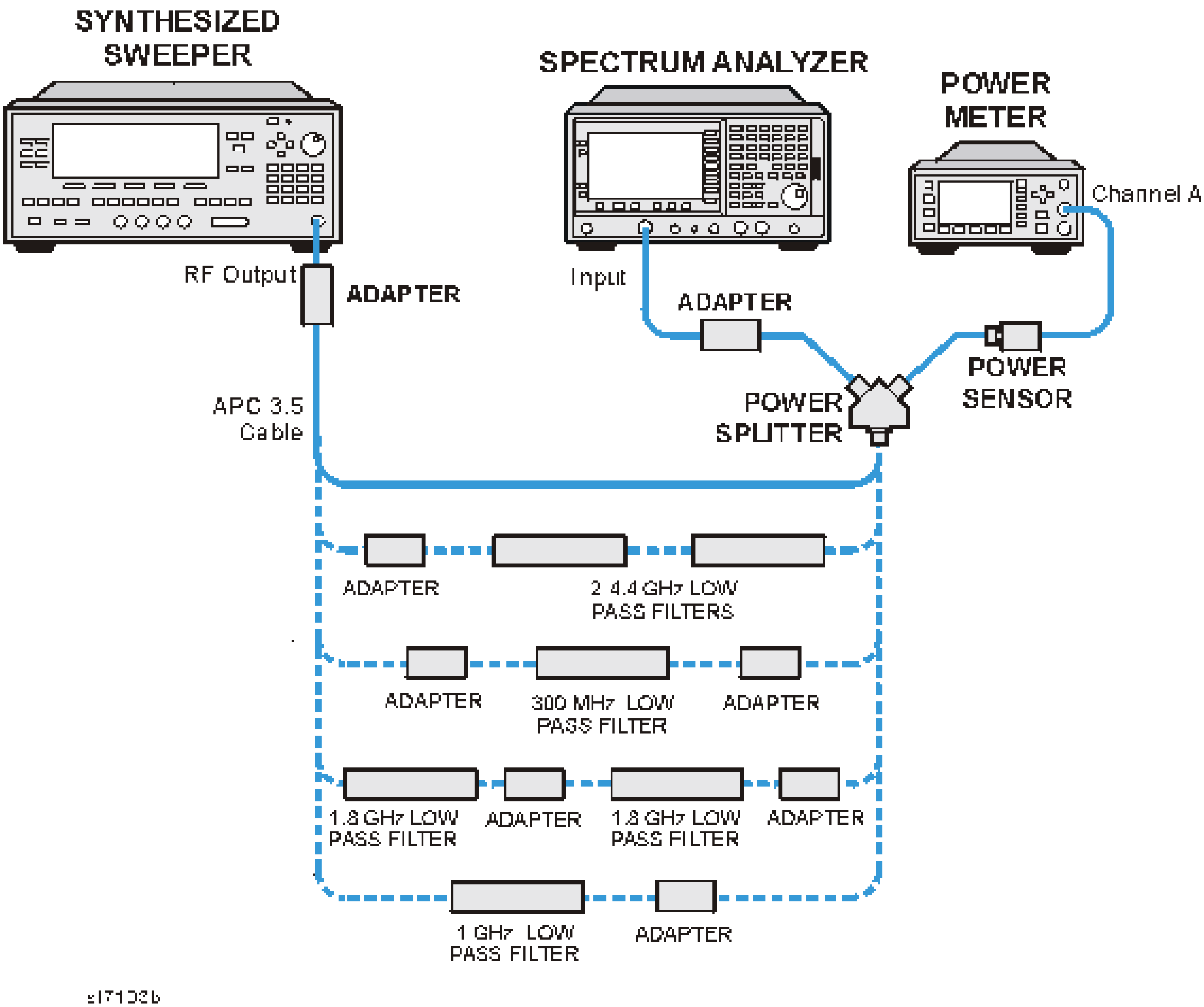
Test Setup Illustrations

The following figures illustrate the equipment setups for the test.

Second Harmonic Distortion (≤1.5 GHz) Test Setup



Second Harmonic Distortion (≥ 3 GHz) Test Setup



Data

The following table lists the source frequency and UUT center frequency settings at which the Second Harmonic Distortion measurements are taken. Also listed is the applicable model for the measurement points.

Second Harmonic Distortion

Source (MHz)	UUT Center Frequency (MHz)	For Model
40.0	40.0	E4401B and E4411B
300.00	300.00	E4402B, E4403B, E4404B, E4405B, E4406B, E4407B, and E4408B
900.00	900.00	E4404B, E4405B, E4407B, and E4408B
1555.0	1550.0	E4404B, E4405B, E4406B, E4407B, and E4408B

3100.0	3100.0	

PREVIOUS Spurious Responses - TOI

Gain Compression NEXT

TOP

Gain Compression

Related Specification

1 dB Gain Compression

Related Adjustment

None

Test Description

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.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

Required Test Equipment

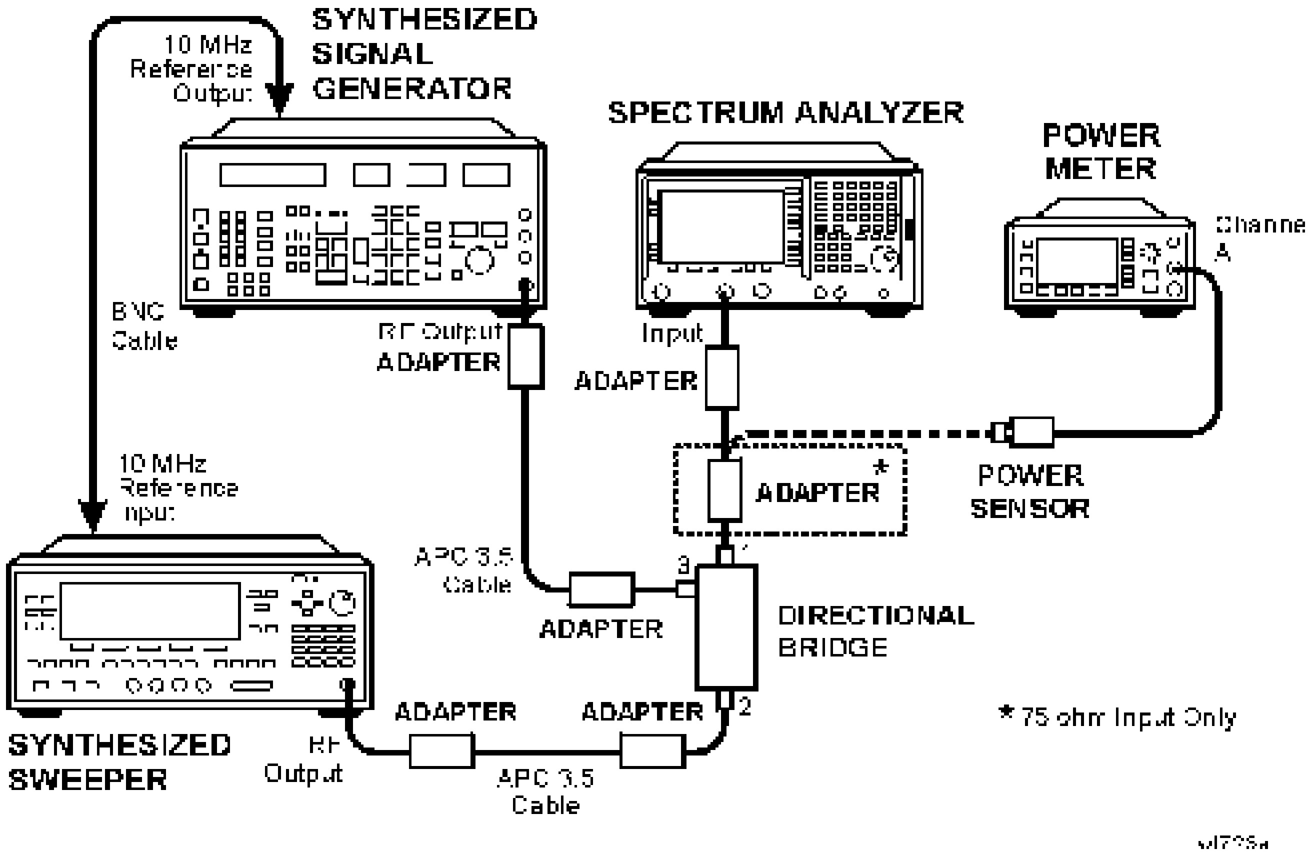
Equipment	Recommended Agilent Model	For Model
Signal Source		
Synthesized Signal Generator	Agilent 8663A	E4401B, E4411B, E4402B, and E4403B

Synthesized Sweeper (2 required)	Agilent 83620/30/40/50B	E4404B, E4405B, E4407B, and E4408B
Synthesized Sweeper	Agilent 83620/83630 /40/50B	E4401B, E4411B, E4402B, and E4403B
Meters		
Power Meter	Agilent E4419B	All
75 ohm Power Sensor	Agilent 8483A	E4401B and E4411B 75 ohm
Microwave Power Sensor	Agilent 8485A	All except E4402B and E4411B, 75 ohm
Miscellaneous Devices		
6 GHz Directional Bridge	Agilent 86205A	E4401B, E4402B, E4403B, E4404B, and E4405B
Directional Coupler	Agilent 87300B or 0955-0101	E4404B, E4405B, E4407B, and E4408B

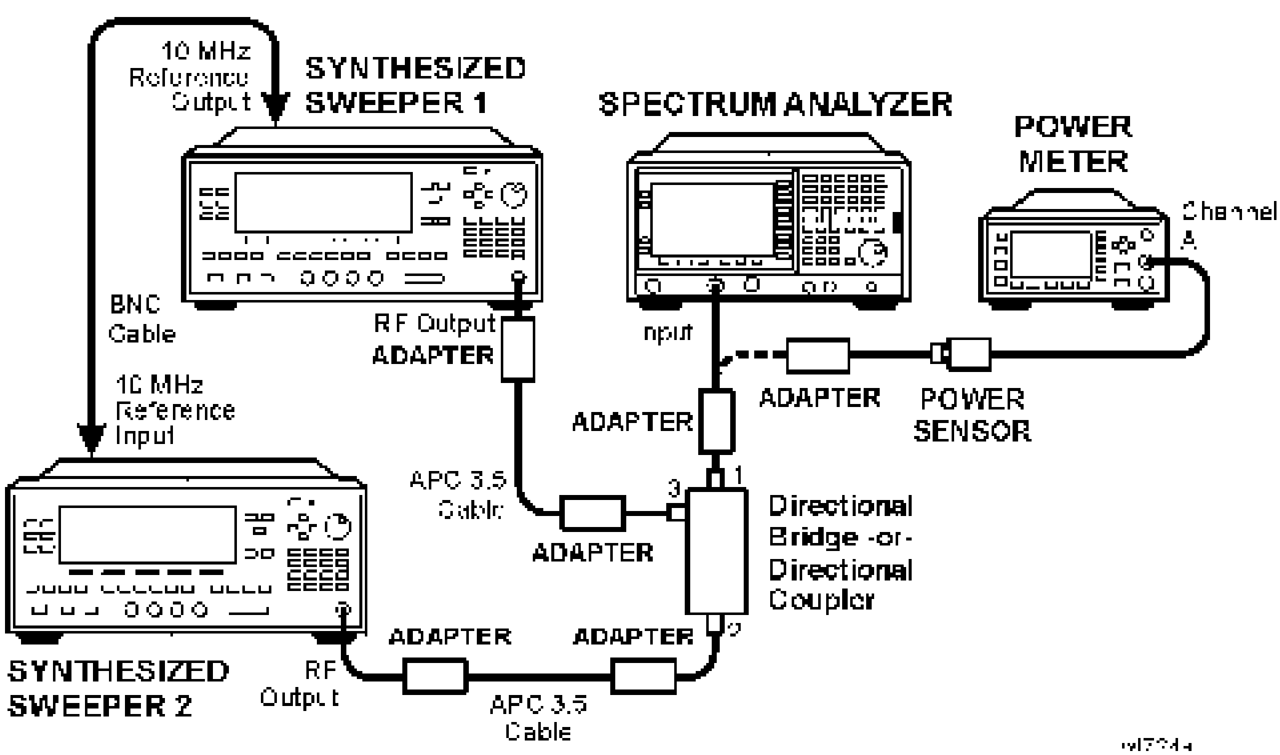
Test Setup Illustrations

The following figures illustrate the equipment setups for the test.

Gain Compression ($\leq$3 GHz) Test Setup



Gain Compression (≥3 GHz) Test Setup



Data

The following tables list the nominal measured amplitude and the settings for the external attenuators at which the Two-Tone Gain Compression measurements are taken.

Table 47 Measurement Values

Sweeper 1		Sweeper 2		Agilent E4401B and E4411B, 50 Ohm						
Amptd (dBm)	Freq (GHz)	Amptd (dBm)	Delta Freq (kHz)	Center Freq (GHz)	Span (kHz)	RBW (kHz)	VBW (kHz)	RefLvl (dBm)	Scale (dB/)	Atten (dB)
-40	0.05	0.0	3000	0.05	150	30	0.300	-10.0	10	0.0
-40[1]	0.05a	0.0a	4.0a	0.05a	1.0a	0.030a	0.030a	-10.0a	10a	0.0a
-40	1.40	0.0	3000	1.40	150	30	0.300	-10.0	10	0.0
-40	0.05	-2.0	3000	0.05	150	30	0.300	-10.0	10	0.0
-40a	0.05a	-2.0a	4.0a	0.05a	1.0a	0.030a	0.030a	-10.0a	10a	0.0a
-40	1.40	-2.0	3000	1.40	150	30	0.300	-10.0	10	0.0

Table 48 Measurement Values

Sweeper 1		Sweeper 2		Agilent E4402B and E4403B, 50 Ohm						
Amptd (dBm)	Freq (GHz)	Amptd (dBm)	Delta Freq (kHz)	Center Freq (GHz)	Span (kHz)	RBW (kHz)	VBW (kHz)	RefLvl (dBm)	Scale (dB/)	Atten (dB)
-40	0.05	0.0	3000	0.05	150	30	0.300	-10.0	10	0.0
-40[2]	0.05a	0.0a	4.0a	0.05a	1.0a	0.030a	0.030a	-10.0a	10a	0.0a
-40	1.40	0.0	3000	1.40	150	30	0.300	-10.0	10	0.0
-40	0.05	0.0	3000	0.05	150	30	0.300	-10.0	10	0.0

Table 49 Measurement Values

Sweeper 1	Sweeper 2	Agilent E4404B, E4405B, E4407B, and E4408B

Amptd (dBm)	Freq (GHz)	Amptd (dBm)	Delta Freq (kHz)	Center Freq (GHz)	Span (kHz)	RBW (kHz)	VBW (kHz)	RefLvl (dBm)	Scale (dB/)	Atten (dB)
-40	0.05	0.0	3000	0.05	150	30	0.300	-10.0	10	0.0
-40[3]	0.05a	0.0a	4.0a	0.05a	1.0a	0.030a	0.030a	-10.0a	10a	0.0a
-40	1.40	0.0	3000	1.40	150	30	0.300	-10.0	10	0.0
-40	2.50	0.0	3000	2.50	150	30	0.300	-10.0	10	0.0
-40	4.40	0.0	3000	4.40	150	30	0.300	-10.0	10	0.0
-40	7.60	-3.0	3000	7.60	150	30	0.300	-10.0	10	0.0
-40	14.0	-5.0	3000	14.0	150	30	0.300	-10.0	10	0.0

Important Information

Two-Tone Gain Compression

The two-tone gain compression is calculated using the following equation:

$$Y = A_{low} - A_{high}$$

where

A_{low} is the UUT measured amplitude with only the low-level signal applied.

A_{high} is the UUT measured amplitude with both the high- and low-level signals applied.

Footnotes

1 Option 1DR, Narrow Resolution Bandwidth
2 Option 1DR, Narrow Resolution Bandwidth
3 Option 1DR, Narrow Resolution Bandwidth

PREVIOUS Spurious Responses - SHD

Displayed Average Noise Level (DANL) NEXT

Displayed Average Noise Level (DANL)

Related Specification

Displayed Average Noise Level

Related Adjustment

Frequency Response

Test Description

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 levelled 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 zero span.

To reduce the 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 an amplitude reference for determining the amount of offset required. The offset is removed at the end of the test by presetting the analyzer.

For analyzers equipped with narrow resolution bandwidths (Option 1DR), DANL is also tested in the 10 Hz resolution bandwidth setting.

Required Equipment

The following table lists the test equipment required for the test.

Required Test Equipment

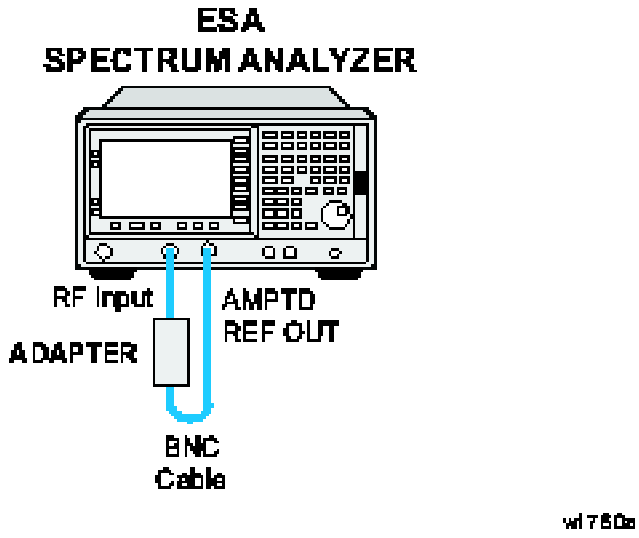
Equipment	Recommended Agilent Model	For Model
Terminations		

Termination, 50 W	Agilent 909A (Option12)	E4401B and E4411B 50 ohmE4402B, E4403B, E4404B, and E4405B
Termination, 75 ohm (Option 1DP)	Agilent 909E (Option 011)	E4401B and E4411B 75 ohm
Termination, 50 ohm (Agilent E4407B/ 08B)	Agilent 909D (Option 011)	E4407B and E4408B
Cables		
BNC	Agilent 10503A	E4402B, E4403B, E4404B, E4405B, E4407B, and E4408B
Adapters		
Type-N (f) to BNC (m), 75 ohm (Option 1DP)	1250-1534	E4401B and E4411B 75 W
Type-N (f) to APC-3.5 (f) (Option BAB)	1250-1745	E4407B and E4408B
Type-N (m) to BNC (f)	1250-0780	E4407B and E4408B

Test Setups Illustrations

The following figure illustrates the equipment setup for the test.

Displayed Average Noise Level Test Setup



Data

The following table lists the frequency ranges at which the DANL measurements are taken.

Displayed Average Noise Level

UUT Model	Measured Frequency Range		
E4402B, E4403B, E4404B, E4405B, E4407B, E4408B	1 MHz	to	10 MHz
	10 MHz	to	1.0 GHz
	1.0 GHz	to	2.0 GHz
	2.0 GHz	to	3.0 GHz
E4404B	3.0 GHz	to	6.0 GHz
	6.0 GHz	to	6.7 GHz
E4405B	6.0 GHz	to	12.0 GHz
	12.0 GHz	to	13.2 GHz
E4407B and E4408B	12.0 GHz	to	22.0 GHz
	22.0 GHz	to	26.5 GHz
E4401B, and E4401B	400 kHz	to	1 MHz[1]
	1 MHz	to	10 MHz
	10 MHz	to	500 MHz
	500 MHz	to	1 GHz
	1 GHz	to	1.5 GHz

Footnotes

1 This range is not tested on analysis with 75Ω input (Option 1DP).

(Number takes you back)

PREVIOUS Gain Compression

Residual Responses NEXT

TOP

Residual Responses

Related Specification

Residual Responses

Related Adjustment

None

Test Description

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 maximum specified frequency for residual responses. Any responses above the specification are noted.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

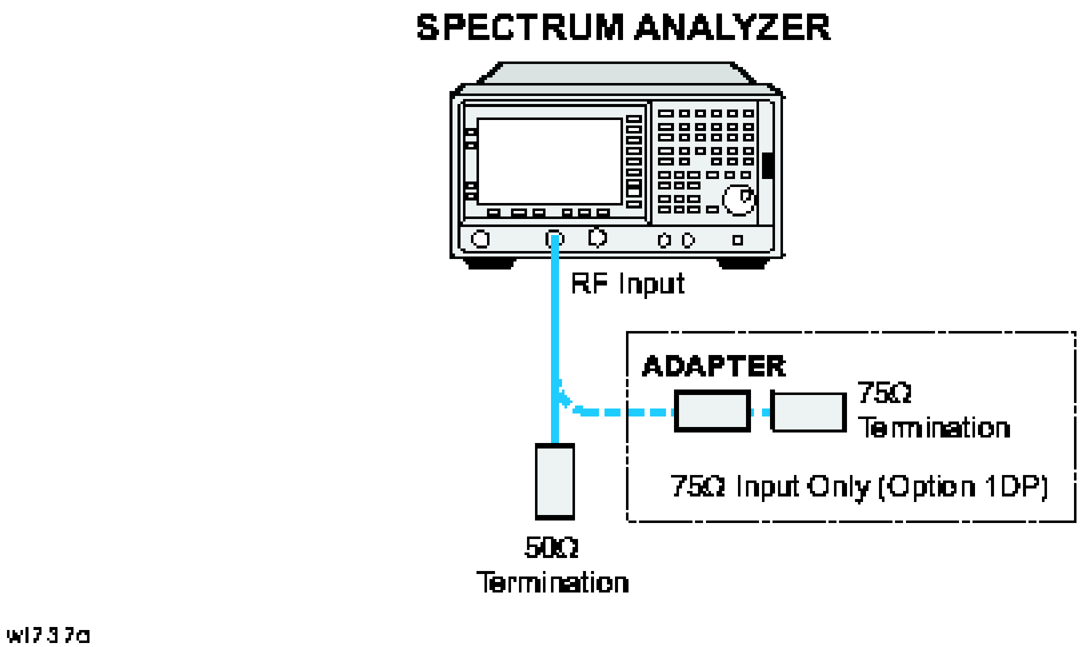
Required Test Equipment

Equipment	Recommended Agilent Model	For Model
Terminations		
Termination, 50 W	Agilent 909A (Option12)	All except E4401B and E4411B, 75ohm
Termination, 75 ohm (Option 1DP)	Agilent 909E (Option 011)	E4401B and E4411B

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

Residual Responses Test Setup



Data

The following table lists the frequency range settings at which the Residual Responses measurements are taken and the associated UUT models.

Residual Responses

Frequency Range			For Model
150 kHz	to	1.5 GHz	E4401B and E4411B 50 ohm
1 MHz	to	1.5 GHz	E4401B and E4411B 75 ohm
150 kHz	to	3.0 GHz	E4402B and E4403B
150 kHz	to	6.7 GHz	E4404B, E4405B, E4407B, and E4408B

Fast Time Domain Amplitude Accuracy, Options AYX & B7D

Related Specification

Marker Readout Resolution

Related Adjustment

None

Test Description

The amplitude reference signal is used to compare the amplitude level of a normal sweep time (such as >=5ms) to a fast sweep time (< 5ms) using the marker delta function. The difference should be less than the marker amplitude resolution for the fast sweeptimes.

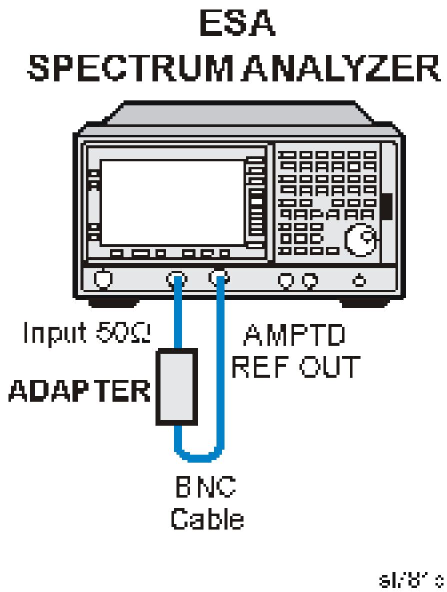
Required Equipment

none

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

Fast Time Domain Amplitude Accuracy Test Setup



No setup connections are required for the E4401B or E7401A

Data

The following table lists the sweep times at which the fast time domain amplitude accuracy measurements are taken.

Fast Time Domain Amplitude Accuracy

Sweep Time	
Slow	**Fast**
5 ms	1 ms

Important Information

Fast Time Domain Amplitude Accuracy

The fast time domain amplitude accuracy is calculated using the following equation:

$$Y = \frac{A_{slow}}{A_{fast}}$$

where

A_{slow} is the measured amplitude with a 5 ms sweep time.

A_{fast} is the measured amplitude with a 1 ms sweep time.

Tracking Generator Absolute Amplitude and Vernier Accuracy

Related Specification

TG Output Power Level

TG Vernier

TG Output Attenuator

TG Output Power Sweep

Related Adjustment

Tracking Generator ALC Amplitude (E4401B and E4411B only)

Test Description

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.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

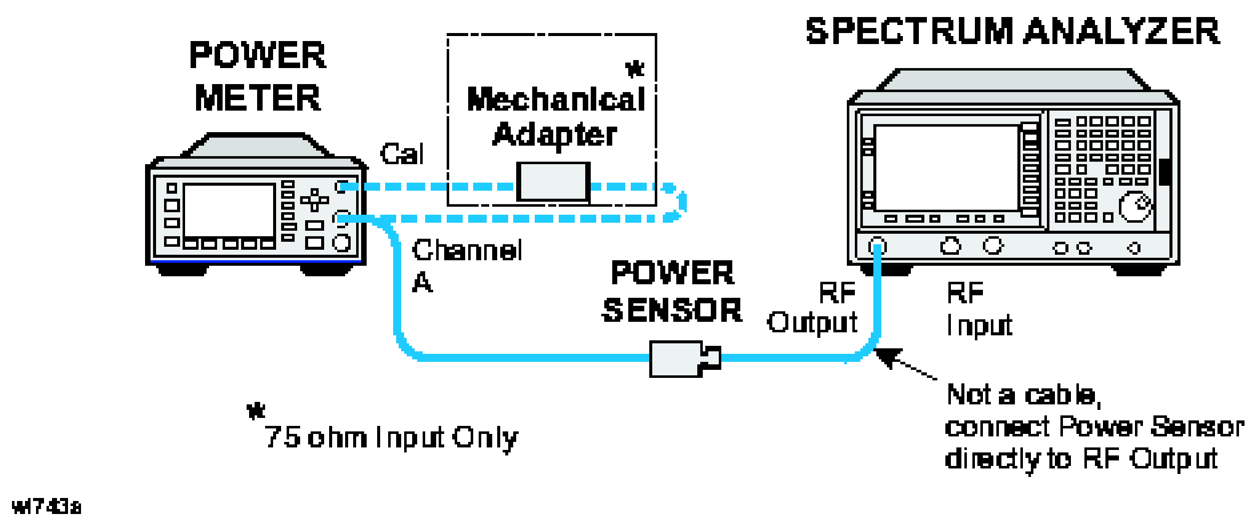
Required Test Equipment

Equipment	Recommended Agilent Model	For Model
Meters		
Power Meter	Agilent E4419A or Agilent E4419A	All
75 ohm Power Sensor (Option 1DQ)	Agilent 8483A	E4401B and E4411B 75 ohm
RF Power Sensor (Option 1DN)	Agilent 8482A	All 50 ohm

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

TG Absolute Amplitude and Vernier Accuracy Setup



Data

The following table lists the source amplitude and vernier settings at which the Tracking Generator Absolute Amplitude, Vernier, and Power Sweep Accuracy measurements are taken and the associated UUT models.

TG Absolute Amplitude and Vernier Accuracy

Source Amplitude Setting	Source Vernier Setting (dB)

E4401B and E4411B with Option 1DN (dBm)	E4401B and E4411B with Option 1DQ (dBmV)	E4402B, E4403B, E4404B, E4405B, E4407B, and E4408B with Option 1DN (dBm)	
0 (ref)	42.76 (ref)		0
-1	41.76		-1
-2	40.76	-18	-2
-3	39.76	-19	-3
-4	38.76	-20 (ref)	-4
-5	37.76	-21	-5
-6	36.76	-22	-6
-7	35.76	-23	-7
-8	34.76	-24	-8
-9	33.76	-25	-9
-10	32.76	-26	-10
-11	31.76	N/A	-11
-12	30.76	N/A	-12
-13	29.76	N/A	-13
-14	28.76	N/A	-14
-15	27.76	N/A	-15

Important Information

Tracking Generator Absolute Amplitude Accuracy

The TG absolute amplitude is calculated using the following equation:

$Y_{abs} = P_{ideal} - P_{actual}$

where

P_{ideal} is the ideal power output of the tracking generator.

P_{actual} is the actual power output of the tracking generator.

Tracking Generator Vernier and Power Sweep Accuracy

The TG vernier and power sweep accuracy is calculated using the following equation:

$Y_{vern} = P_{ref} - P_{vern - P_{diff}}$

where

P_{ref} is the power measured at the 50 MHz reference level.

P_{vern} is the power measured at all other vernier settings.

P_{diff} is the nominal difference in the TG output power settings.

Tracking Generator Level Flatness

Related Specification

Output Flatness

Related Adjustment

Tracking Generator ALC Amplitude (E4401B and E4411B only)

Tracking Generator Frequency Slope Adjustment (E4401B and E4411B only)

LO Power Adjustment (TG) (E4402B, E4403B, E4405B, E4405B, E4407B, E4408B)

Test Description

This test verifies that ESA 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, or 3000 MHz.

Option 1DQ, 75 Ω tracking generators are tested from 1 MHz to 1500 MHz.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

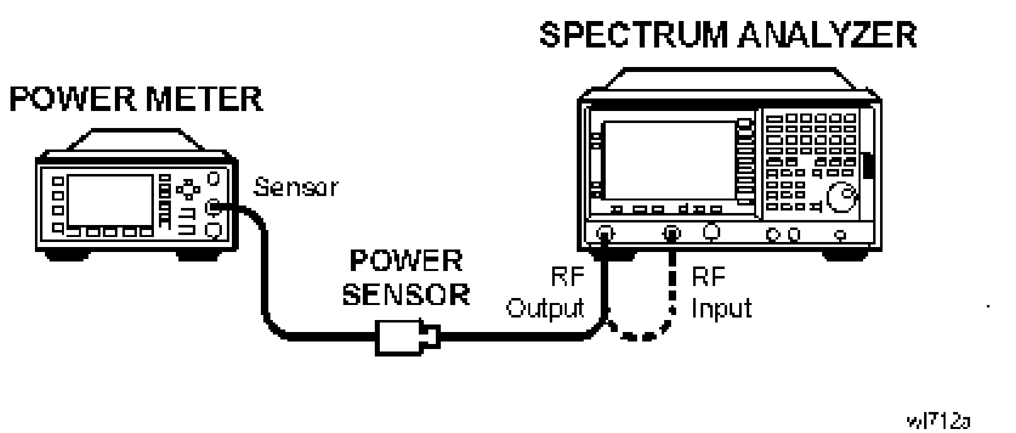
Required Test Equipment

Equipment	Recommended Agilent Model	For Model
Meters		
Power Meter	Agilent E4419A or Agilent E4419A	All
75 ohm Power Sensor 75 ohm (Option 1DQ)	Agilent 8483A	E4401B and E4411B 75 ohm
RF Power Sensor 50 ohm (Option 1DN)	Agilent 8482A	E4401B and E4411B 50 ohm, E4402B, E4403B, E4404B, E4405B, E4407B, and E4408B
Digital Multimeter (Option 1DN)	Agilent 3458A	E4401B, E4411B 50 ohm, E4402B, E4403B, E4404B, E4405B, E4407B, and E4408B
Terminations		
Termination, 50 ohm (Option 1DN)	Agilent 11593A	All except E4401B and E4411B, 75 ohm

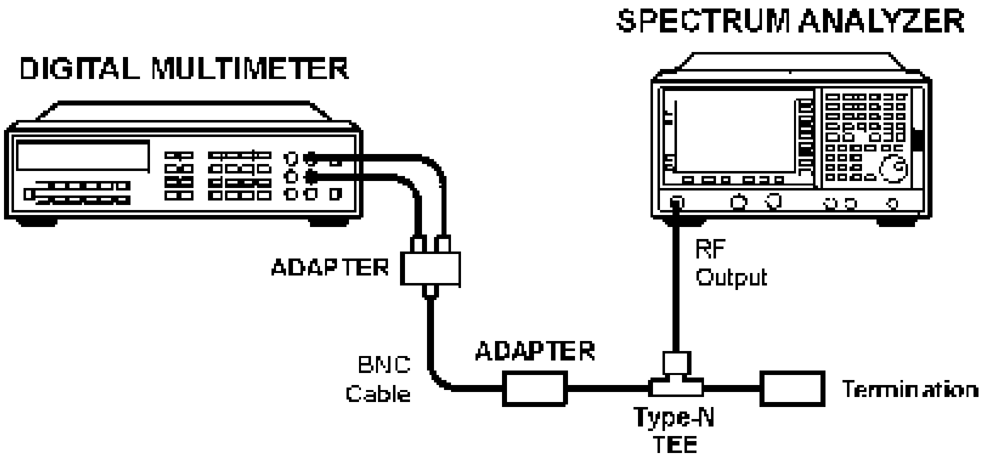
Test Setup Illustrations

The following figures illustrate the equipment setup for the test.

Tracking Generator Level Flatness (≥ 100 kHz) Test Setup



Tracking Generator Level Flatness (≤ 100 kHz with Option 1DN) Test Setup



Data

The following table lists the frequency ranges at which the Tracking Generator Level Flatness measurements are taken.

Frequency Response

Frequency Range			UUT Model	Input Z
Start		**Stop**		
9 kHz	to	100 kHz	E4401B and E4411B	50 ohm
100 kHz	to	1.5 GHz	E4401B and E4411B	
1 MHz	to	1.5 GHz	E4401B and E4411B	75 ohm
9 kHz	to	100 kHz	E4402B, E4403B, E4404B, E4405B, E4407B, and E4408B	50 ohm
100 kHz	to	1.5 GHz		
1.5 GHz	to	3.0 GHz		

Important Information

Tracking Generator Level Flatness

The TG flatness is calculated using the following equation:

$Y = P_{ref} - P_{meas}$

where

P_{ref} is the output power of the tracking generator at 50 MHz.

P_{meas} is the output power of the tracking generator at frequencies between 9 kHz and 1.5 GHz (if E4401B or E4411B) or 3.0 GHz (otherwise).

Tracking Generator Harmonic Spurious Outputs

Related Specification

Spurious Outputs: Harmonic Spurs

Related Adjustment

None

Test Description

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.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

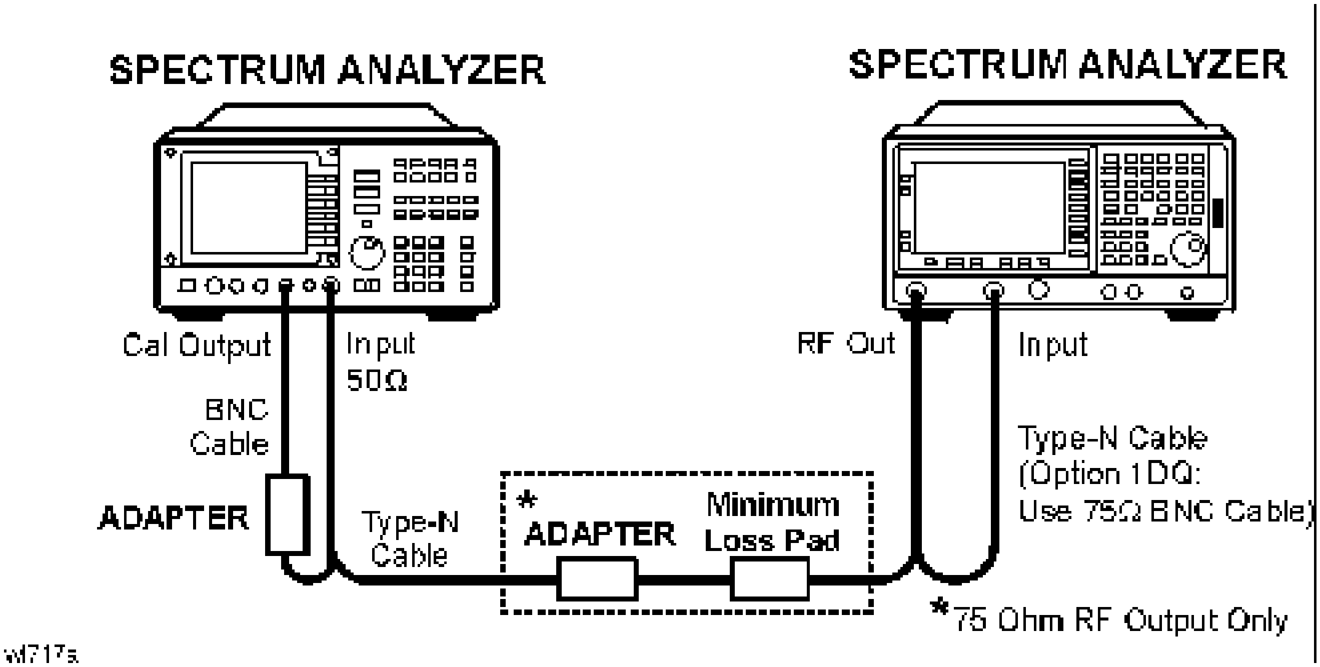
Required Test Equipment

Equipment	Recommended Agilent Model	For Model
Signal Source		
Spectrum Analyzer, Microwave	Agilent 8563E	All

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

TG Harmonic Spurious Outputs Test Setup ADD 10 MHz REF SYNC



Data

The following table lists the nominal measured amplitude and the settings for the external attenuators at which the TG Harmonic Spurious Outputs measurements are taken.

TG Harmonic Spurious Outputs

Center Frequency (MHz)	For Model
10	E4401B and E4411B
100	
300	
750	
.009	E4402B, E4403B, E4404B, E4407B, and E4408B
.025	
100	
300	
900	
1500	

Important Information

Tracking Generator Harmonic Spurious Outputs

The Tracking Generator Harmonic Spurious Output level is calculated using the following equation:

$$Y = A_{carr} - A_{harm}$$

where

A_{carr} is the measured carrier frequency amplitude.

A_{harm} is the measured harmonic frequency amplitude.

PREVIOUS Tracking Generator Level Flatness

Tracking Generator Non-Harmonic Spurious Outputs NEXT

TOP

Tracking Generator Non-Harmonic Spurious Outputs

Related Specification

Spurious Outputs: Non-harmonic Spurs

Related Adjustment

None

Test Description

This procedure determines the maximum level of the tracking generator's non-harmonic spurious outputs. 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.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

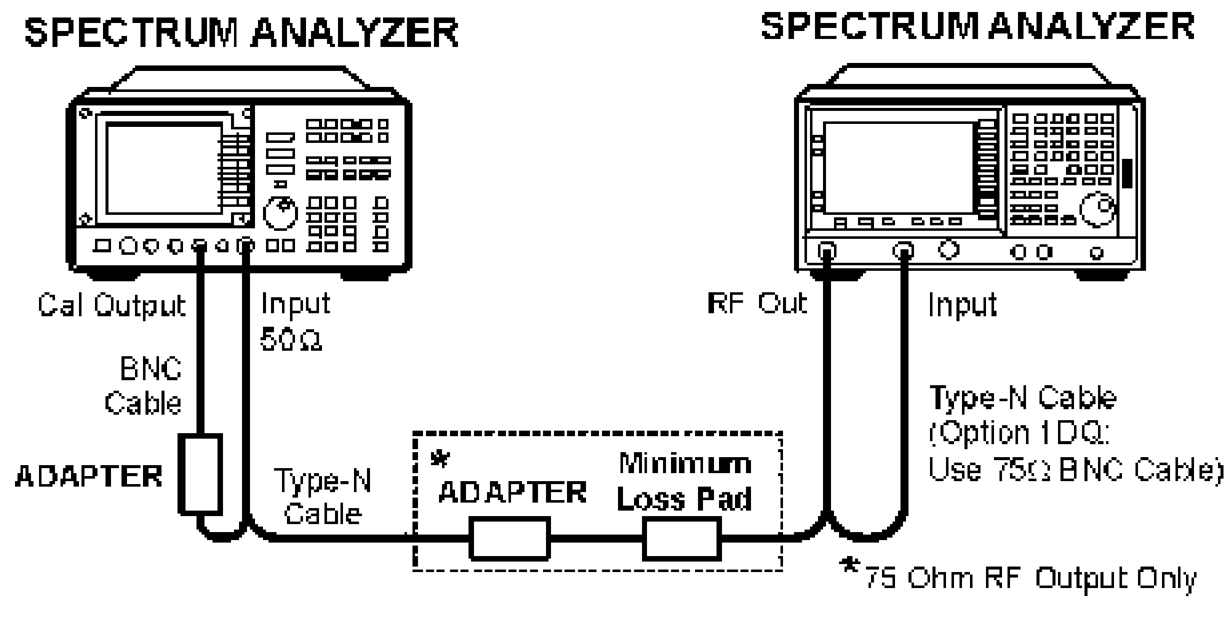
Required Test Equipment

Equipment	Recommended Agilent Model	For Model
Analyzers		
Spectrum Analyzer, Microwave	Agilent 8563E	All

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

TG Non-Harmonic Spurious Outputs Test Setup



Data

The following table lists the frequency points at which the TG Non-Harmonic Spurious Outputs measurements are taken.

TG Non-Harmonic Spurious Outputs

UUT Center Frequency	Microwave Spectrum Analyzer Frequency Span		
10 MHz	9 kHz	to	100 kHz[1]
	100 kHz	to	5 MHz[2]
	5 MHz	to	55 MHz
	55 MHz	to	1240 MHz
	1240 MHz	to	1500 MHz
	1240 MHz	to	2000 MHzc
	2000 MHz	to	3000 MHz[3]
750 MHz	9 kHz	to	100 kHza
	100 kHzb	to	5 MHz
	5 MHz	to	55 MHz
	55 MHz	to	1240 MHz

	1240 MHz	to	1500 MHz
	1240 MHz	to	2000 MHzc
	2000 MHz	to	3000 MHzc
1.5 GHz	9 kHz	to	100 kHza
	100 kHzb	to	5 MHz
	5 MHz	to	55 MHz
	55 MHz	to	1240 MHz
	1240 MHz	to	1500 MHz
	1240 MHz	to	2000 MHzc
	2000 MHz	to	3000 MHzc

Important Information

Non-Harmonic Response Amplitude

The non-harmonic response amplitude is calculated using the following equation:

$$Amp_{non\text{-}harm} = Amp_{mkr} - Amp_{fund}$$

where

Amp_{mkr} is the power level of the non-harmonic response measured at the marker.

Amp_{fund} is the measured power level of the tracking generator fundamental frequency.

Footnotes

1 75 Ω RF Outputs: Omit this frequency range.
2 75 Ω RF Outputs: Set the start frequency to 1 MHz.
3 1.5 GHz TG: Omit this frequency range.

Tracking Generator LO Feedthrough Amplitude

Related Specification

Spurious Outputs: LO Feedthrough

Related Adjustment

LO Power Adjustment (TG)

Test Description

The tracking generator output is connected to the spectrum analyzer INPUT 50 ohm 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.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

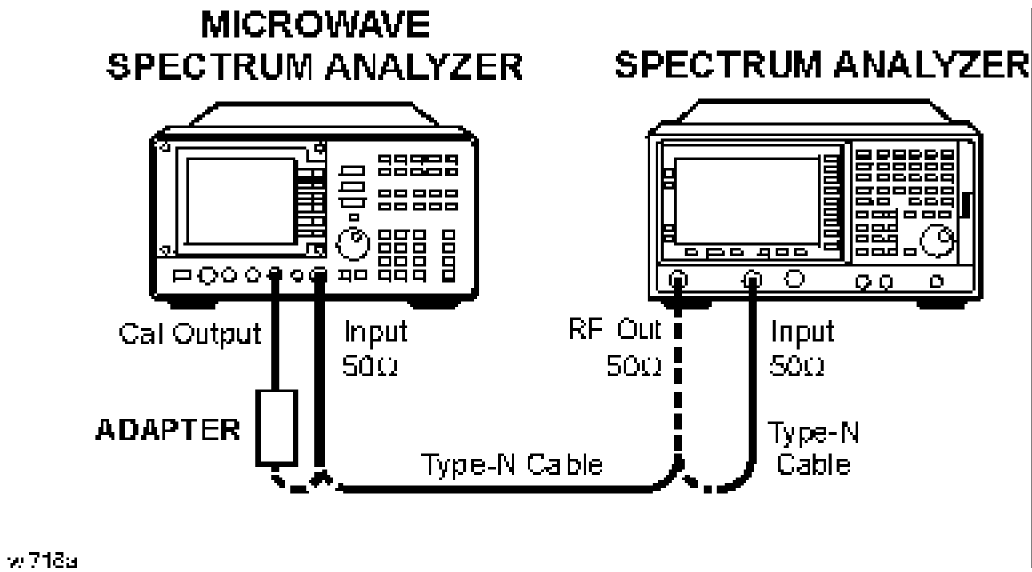
Required Test Equipment

Equipment	Recommended Agilent Model	For Model
Analyzers		
Spectrum Analyzer, Microwave	Agilent 8563E	All
Cables		
Type-N	Agilent 11500B or Agilent 11500C	All
BNC	Agilent 10502A	All
Adapters		
Type-N (m) to BNC (f)	1250-1476	All

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

TG LO Feedthrough Amplitude Test Setup



Data

The following table lists the frequency points at which the TG LO feedthrough amplitude measurements are taken.

TG LO Feedthrough Amplitude

UUT Center Frequency	Microwave Spectrum Analyzer Center Frequency (GHz)
9 kHz	3.921409
70 MHz	3.991400
150 MHz	4.071400
1.5 GHz	5.421400
3.0 GHz	6.921400

Important Information

Tracking Generator LO Feedthrough Amplitude

The TG LO Feedthrough Amplitude is calculated using the following equation:

$Y = A_{tg\_lo}$

where

A_{tg_lo} is the measured tracking generator feedthrough power level.

Gate Delay and Gate Length Accuracy

Related Specification

Gate Delay Accuracy

Gate Length Accuracy

Related Adjustment

None

Test Description

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. There is often up to 100 ns of jitter due to the 100 ns resolution of the gate delay clock. 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.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

Required Test Equipment

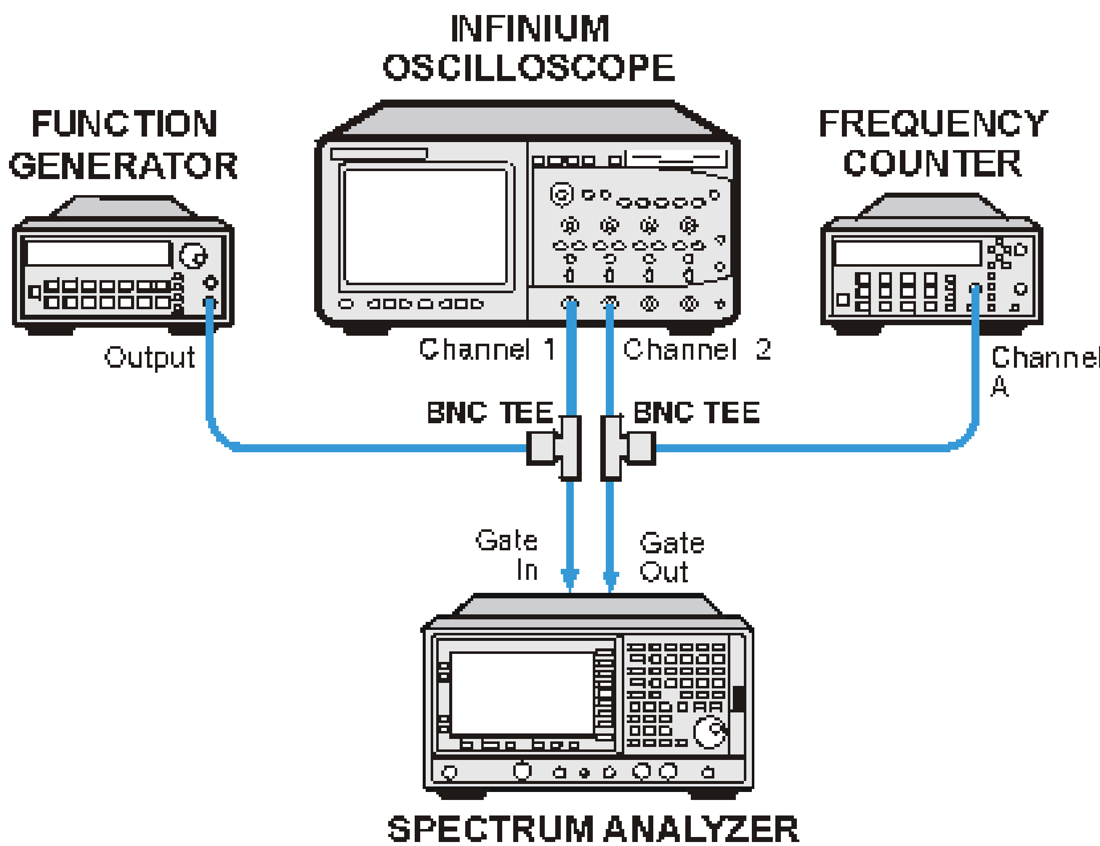
Equipment	Recommended Agilent Model	For Model
Signal Source		

Function Generator	Agilent 33120A or Agilent 3325B	All
Counters		
Universal Counter	Agilent 53132A	All
Receivers		
Oscilloscope	Agilent 54820A	All

Test Setups Illustrations

The following figure illustrates the equipment setup for the test.

Gate Delay and Gate Length Accuracy Test Setup



Data

The following table lists the function generator square wave frequency and the UUT settings at which the Gate Delay and Gate Length Accuracy measurements are taken.

Gate Delay and Gate Length Accuracy

Function Generator	UUT		
Frequency (Hz)	Sweeptime (ms)	Gate Delay (µs)	Gate Length (µs)
100	20	1	1
	150	10	65

Important Information

Gate Delay Accuracy

The Gate Delay Accuracy calculated using the following equation:

$$Gate_{delay} = T_{gtdly}$$

where

T_{gtdly} is the time difference between the rising edge of the pulse generator output and the rising edge of the gate output of the UUT.

Gate Length Accuracy

The Gate Length Accuracy is calculated using the following equation:

$$Gate_{length} = T_{gtlen}$$

where

T_{gtleny} is the time difference between the rising and falling edge of the gate output of the UUT.

PREVIOUS [Tracking Generator LO Feedthrough Amplitude]

[Gate Mode Additional Amplitude Error] NEXT

TOP

Gate Mode Additional Amplitude Error

Related Specification

Gate Mode Additional Amplitude Error

Related Adjustment

None

Test Description

This procedure measures the additional amplitude error while gate mode is 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.

Required Equipment

The following table lists the test equipment required for the test. The list includes any miscellaneous devices.

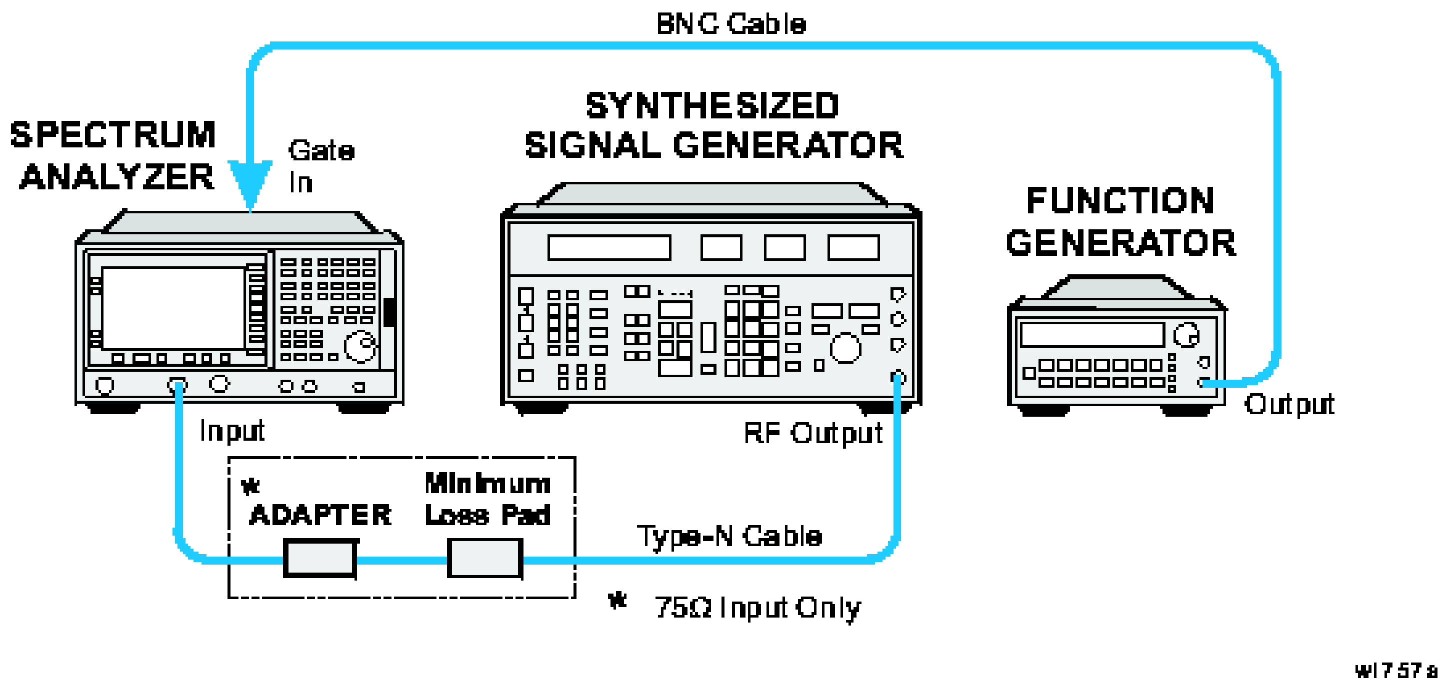
Required Test Equipment

Equipment	Recommended Agilent Model	For Model
Signal Source		
Synthesized Signal Generator	Agilent 8663A	All
Function Generator	Agilent 33120A or Agilent 3325B	All
Miscellaneous Devices		
Minimum Loss Pad (Option 1DP)	Agilent 11852B	E4401B and E4411B 75 ohm

Test Setup Illustration

The following figure illustrates the equipment setup for the test.

Gate Mode Amplitude Error Test Setup



IF Input Accuracy

(Option AYZ only)

Specification:

IF INPUT

Absolute Amplitude Accuracy

20 to 30 degC ±1.0 dB

0 to 55 degC ±1.5 dB

Description:

This performance test only applies to analyzers equipped with external mixing, Option AYZ.

This test measures the accuracy of the IF INPUT. A nominally –40 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 50Ω. 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.

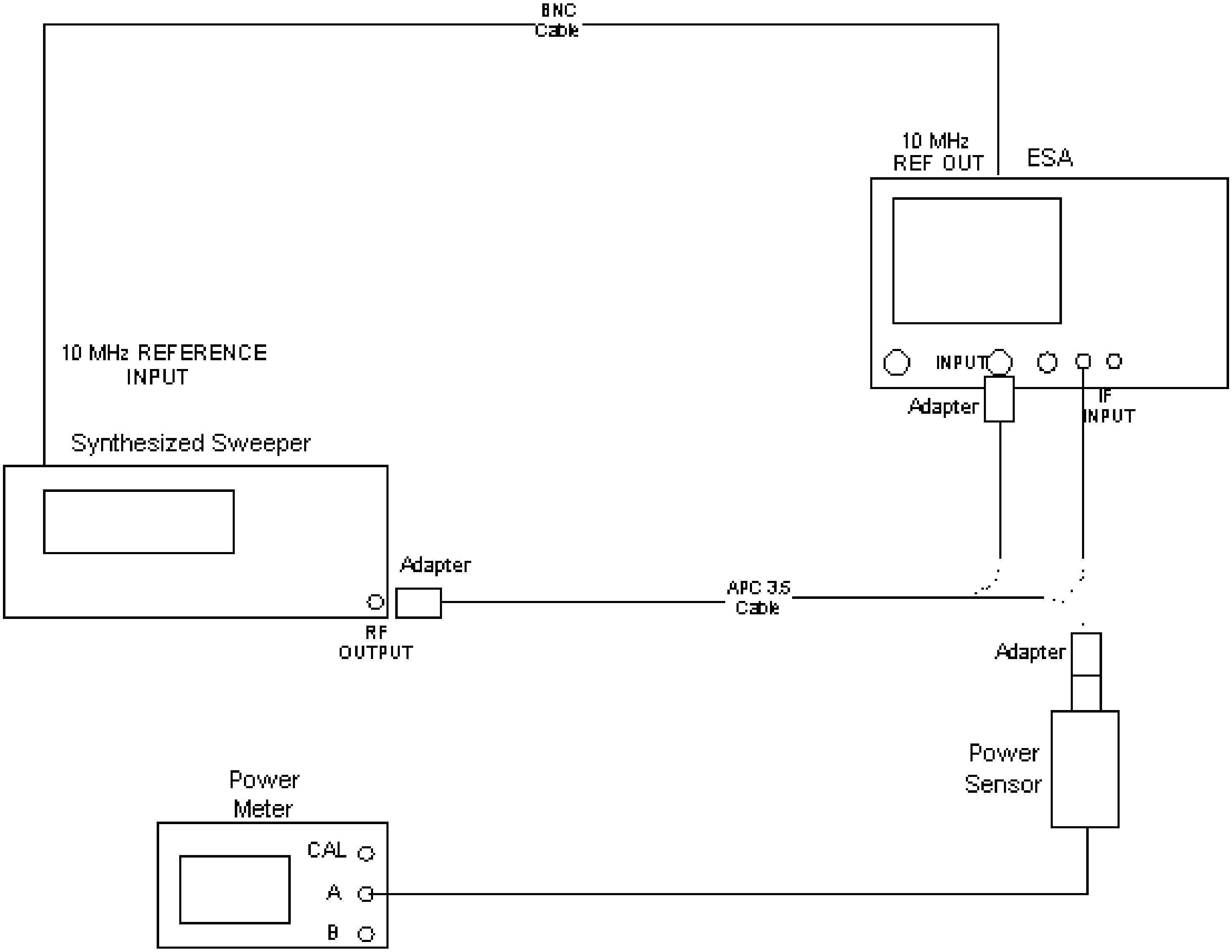
This signal is then applied to the ESA’s IF INPUT with the analyzer set to external mixing mode in A band (26.5 GHz to 40 GHz). Amplitude corrections are set to 30 dB. The amplitude is measured by the analyzer and recorded. The difference between the two measurements is the IF INPUT accuracy.

The related adjustment procedure for this performance test is “IF INPUT Correction”

Equipment:

Instrument	Critical Specifications (for this test)	Recommended Model
Signal Sources		
Synthesized Sweeper	Amplitude: -30 dBm +/- 2 dB Frequency: 321.4 MHz (nominal)	83620A/B, 83630A/B, 83640A/B, 83650A/B
Meters		
Power Meter		E4419A
Low-Power Power Sensor	Amplitude: --30 dBm +/- 2 dB Frequency: 321.4 MHz (nominal)	8484A or 8481D
Miscellaneous Devices		
30 dB Reference Attenuator	Frequency: 50 MHz Attenuation: 30 dB	11708A

Test Setup



PREVIOUS [Gate Mode Additional Amplitude Error]

[1st LO Output Amplitude Accuracy] NEXT

TOP

1st LO Output Amplitude Accuracy

(Option AYZ only)

Specification:

LO OUTPUT

Power

2.9 to <4.0 GHz	+12.0 to +16 dBm
4.0 to 6.0 GHz	+14.0 to +16.0 dBm
>6.0 to 7.1 GHz	+12.0 to +16.0 dBm

Description:

This test applies only to analyzers equipped with external mixing, Option AYZ.

This test verifies that ESA Spectrum Analyzers with External Mixing, Option AYZ, meet their specification for 1st LO (Local Oscillator) output level. The flatness of the 1st LO output determines the flatness of measurements made using external mixers. In this test, a calibrated power sensor is connected to the 1st LO OUTPUT to measure the power level at frequencies between 3.0 GHz and 6.9 GHz.

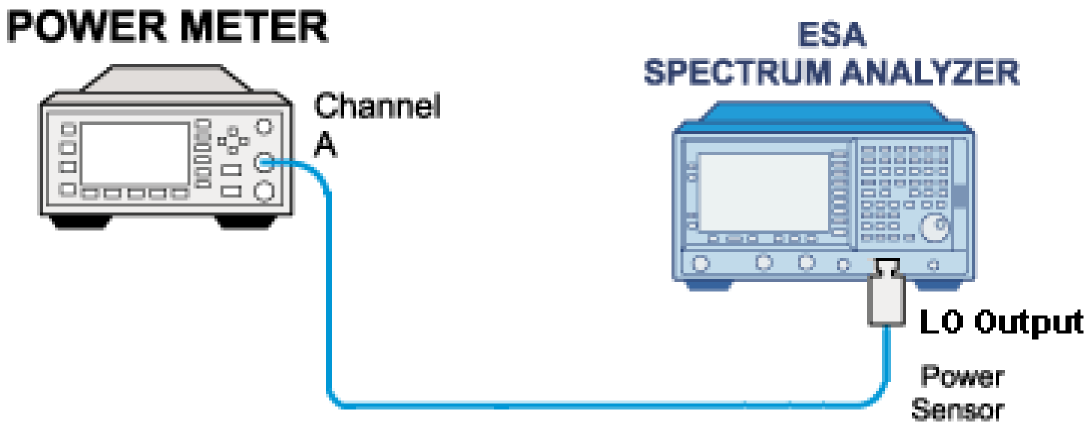
The ESA is put into external mixing mode using a harmonic number of –10. The ESA's tuned frequency will be therefore be 321.4 MHz (the frequency of the 2nd IF) below the 10th harmonic of the 1st LO. A 321.4 MHz frequency offset is used so that the center frequency will be exactly 10 times the 1st LO 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 the “LO Amplitude Adjustment”.

Equipment:

Instrument	Critical Specifications (for this test)	Recommended Model
Meters		
Power Meter		E4419A/B
Microwave Power Sensor	Frequency Range: 3 GHz to 6.9 GHz Amplitude Range: +14 dBm to +17 dBm Maximum SWR: 1.15:1 (3 to 6.9 GHz) Impedance: 50 Ω	8485A
Adapters		
Adapter, Type-N (m) to SMA(f)		1250-1250

Test Setup



PREVIOUS IF Input Accuracy

Impulse Bandwidth Accuracy NEXT

TOP

Impulse Bandwidth Accuracy

Specification:

1 MHz (Impulse) RBW ±15% [a]

[a] Scale Linear, VBW 3 MHz, signal 0 to –10 dB from reference level

Description:

This test measures the bandwidth accuracy of the 1 MHz impulse resolution bandwidth filter. The analyzer's amplitude response to the same pulsed-RF signal is measured in both pulse mode and line mode. The amplitude difference and the pulse repetition frequency (PRF) are used to calculate the impulse bandwidth. A power splitter and power meter are used to correct for reference level accuracy, scale fidelity, and bandwidth switching uncertainty errors in the amplitude response.

When making the pulse and line-mode measurements, the analyzer is tuned to the 13th spectral line below the carrier frequency (carrier frequency – (13 x PRF)). The amplitude correction measurements are made with the analyzer and source tuned to the same frequency. The pulse generator output is set to a positive voltage output to keep the pulse modulator always turned on during the amplitude correction measurements.

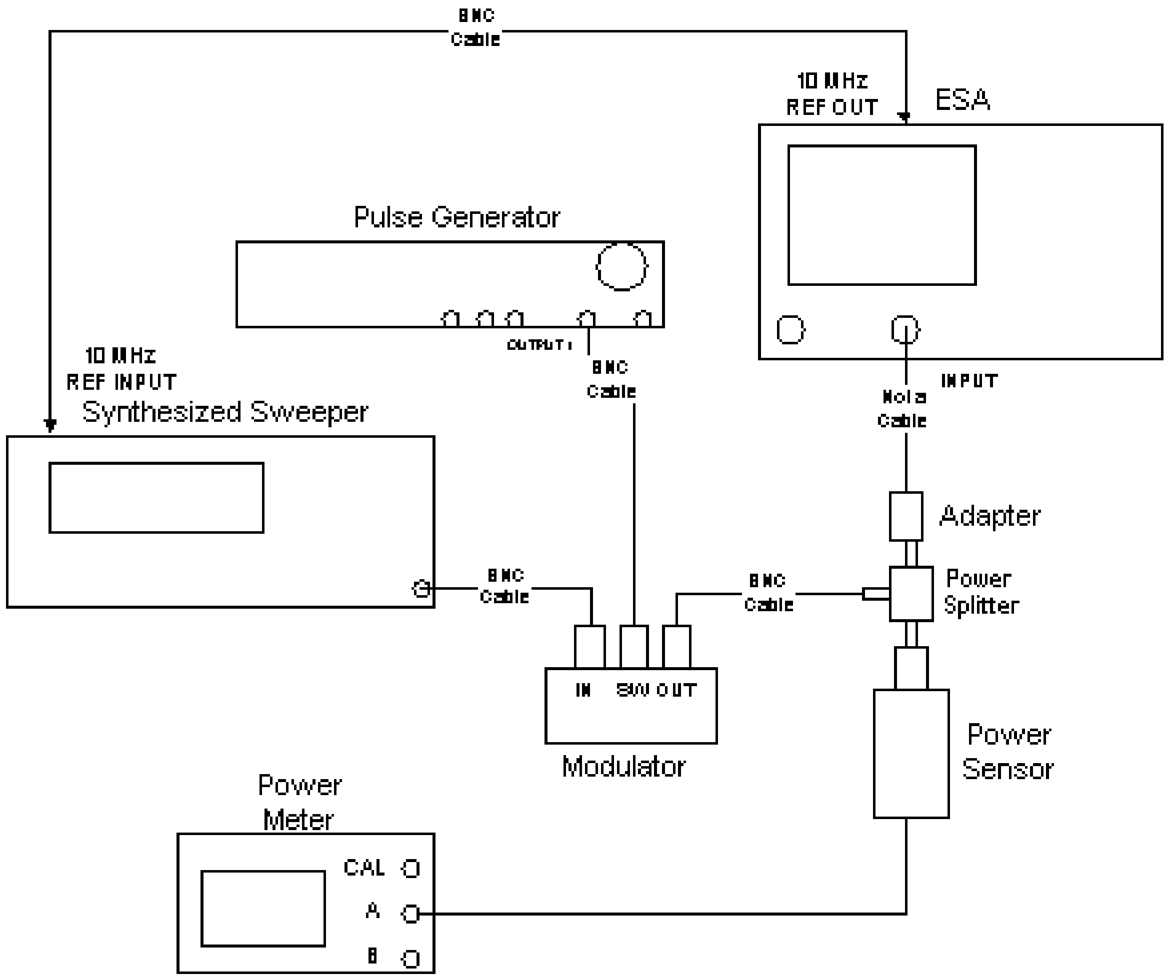
The amplitude correction measurements are made after each pulse mode and line mode measurement. The source amplitude is adjusted to yield the same amplitude as measured when the pulsed RF signal was applied. The power sensor is the amplitude reference for this measurement. The two power sensor measurements (one for pulse mode and one for line mode) are used in the calculation of the impulse bandwidth.

Equipment:

Instrument	Critical Specifications (for this test)	Recommended Model
Signal Sources		
Pulse Generator	Pulse Repetition Frequency: 150 kHz Pulse Width: 50 ns PRF Accuracy: <±0.1% Amplitude: -1.7V to +2.0V	8110A w/ 81103A and 81106A
Synthesized Sweeper	Frequency:250 MHz ± 5 MHz Amplitude: -60 dBm to 0 dBm Amplitude Resolution: 0.02 dB	83630B Option 001
Meters		
Power Meter	Dual Channel	E4419A
Low Power Power Sensor	Frequency Range: 250 MHz ± 5 MHz Amplitude Range: -60 dBm to –30 dBm	8481D
Miscellaneous Devices		
30 dB Reference Attenuator	For use with HP 8481D	11708A
Power Splitter	Frequency: 250 MHz ± 5 MHz	11667A

Pulse Modulator	Frequency: 250 MHz ± 5 MHz On/Off Ratio: > 70 dB Switching Speed: 2ns Insertion Loss: 5 dB, nominal	0955-0533, or TeleTech SC35B
Cables		
Cable, BNC (4 required)	120cm (48 in.) BNC cable	10503A
Adapters		
APC 3.5(f) to Type N(f)		1250-1745
Type N (m) to BNC (f) (2 required)		1250-0780
Type N (m) to Type N (m)		1250-0788

Test Setup


BNC Cable
10 MHz REF OUT
ESA
Pulse Generator
OUTPUT
BNC Cable
10 MHz REF INPUT
Synthesized Sweeper
INPUT
Cable
Adapter
BNC Cable
BNC Cable
Power Splitter
IN
SW OUT
Modulator
Power Sensor
Power Meter
CAL
A
B

GSM- Phase and Frequency Error

(option BAH only)

Specification:

Phase Error

Peak <+/- 2.1 deg

RMS <+/- 1.1 deg

Frequency Error < +/- 10 Hz

Description:

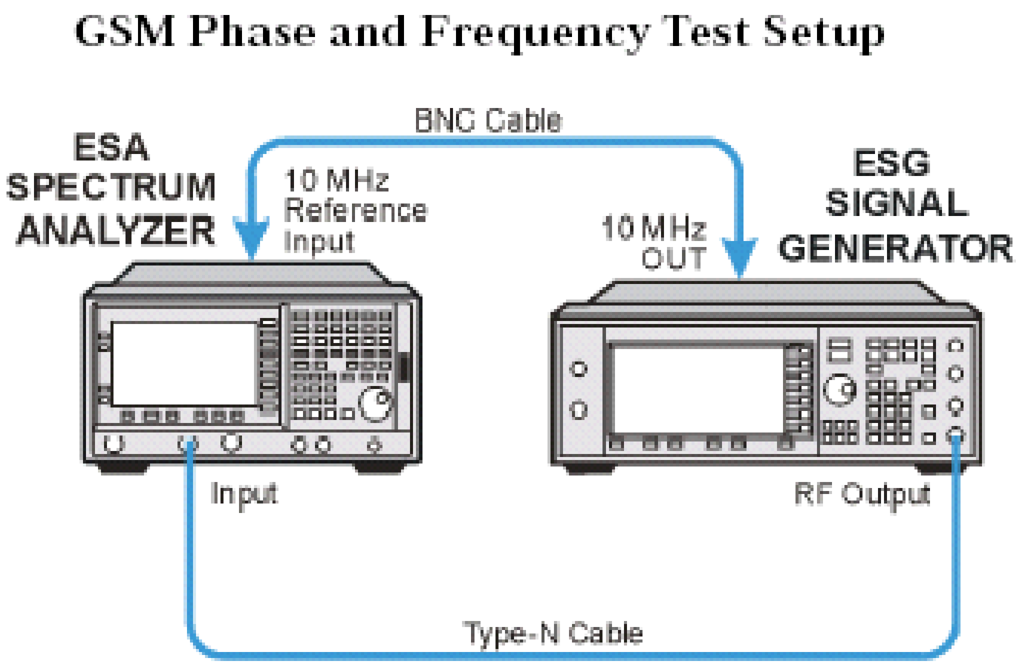
This test verifies UUT's ability to measure Phase and Frequncy error in the GSM personality BAH. GSM phase and frequency error is measure by generating an GSM forward link carrier with a single time slot active. The Phase and Frequency error is measured with the ESA series spectrum analyzer with options BAH and B7E and the performance is verified. Option B7D is a required option for B7E. This test is repeated at different frequencies and amplitude signal levels.

Equipment:

Instrument	Critical Specifications (for this test)	Recommended Model
Signal Sources		

Economy Signal Generator with GSM capability		E4433B with options 1E5, UN8

Test Setup



PREVIOUS [Impulse Bandwidth Accuracy](#) [COMMS - Frequency Response](#) NEXT

TOP

Comms Frequency Response

Specification

There is no specification for Comms Frequency Response. The data from this test is added to the data measured in the Comms Absolute Power Accuracy test to yield the cdmaOne Channel Power Accuracy, cdmaOne Receive Channel Power Accuracy, and GSM Transmit Power Accuracy values.

Description:

This test measures the ESA's amplitude error 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 source's power level is adjusted at 50 MHz to place the displayed signal at the ESA's center horizontal graticule line. The power meter is then set to measure dB relative to the power at 50 MHz. At each new source frequency and ESA center frequency, the source's power level 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.

For improved amplitude accuracy in the PCS and Cellular bands a power splitter is characterized using a second 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 ESA.

This procedure also tests frequency response with the optional preamplifier (Option 1DS) turned on if the analyzer is equipped with Option 1DS. When testing the preamplifier, it is necessary to re-characterize the power splitter/buried sensor combination.

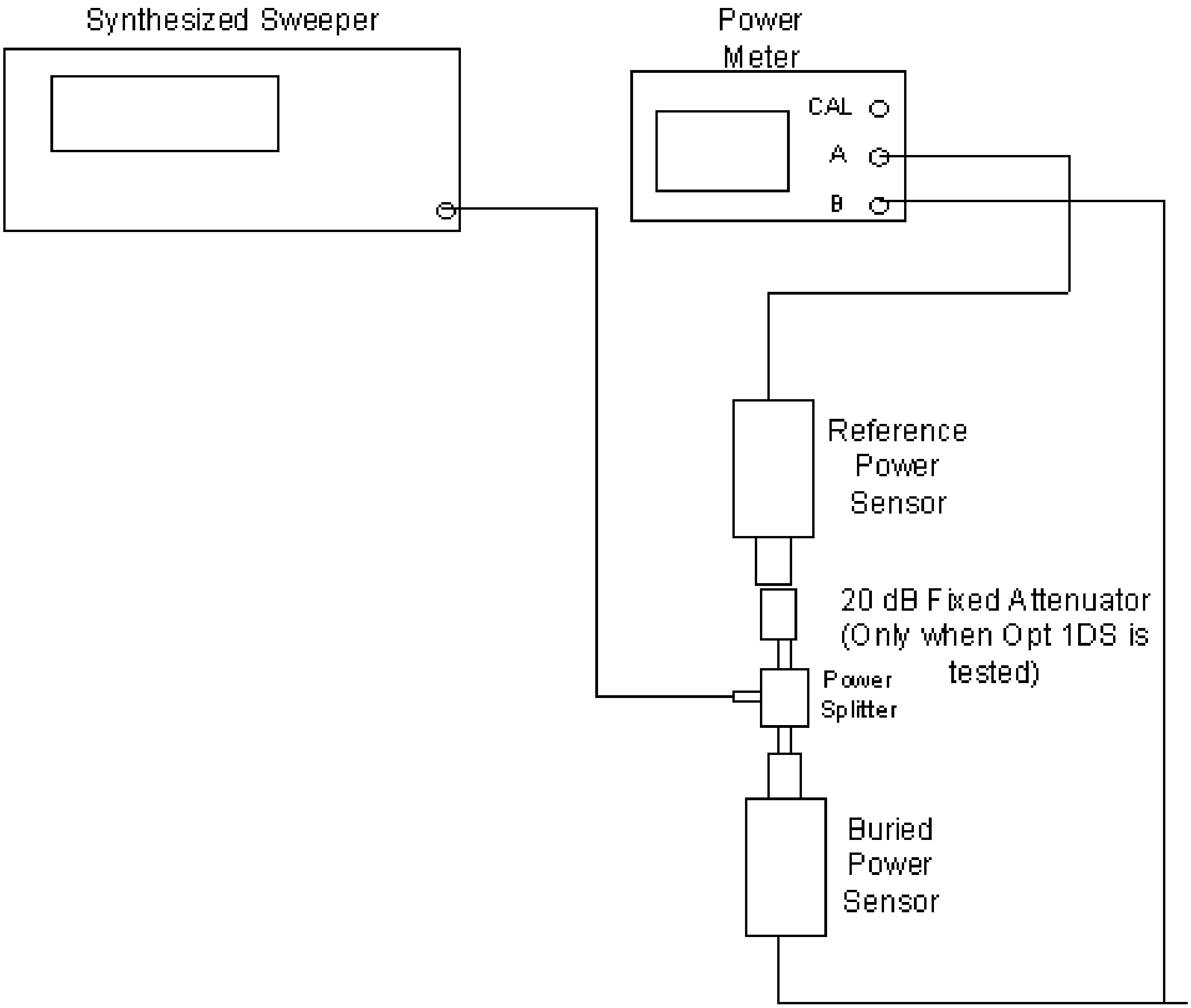
The related adjustment for this performance test is "Frequency Response".

Instrument	Critical Specifications (for this test)	Recommended Model
Signal Sources		
Synthesized Sweeper	Amplitude: -12 dBm to +5 dBm	83620B
Meters		
Power Meter	Channels: 2	E4419A
Power Sensor	Amplitude: -15 dBm to 0 dBm Frequency: 800 MHz to 2000 MHz	8482A (2 required)
Miscellaneous Devices		
Power Splitter	Insertion Loss: 6 dB (nominal) Output Tracking: 800 MHz to 2 GHz: <0.20 dB Equivalent Output SWR: 800 MHz to 2 GHz: <1.1:1 Frequency: 9 kHz to 3.0 GHz (ESA 3 GHz)	11667A
Cables		

20 dB Fixed Attenuator	Frequency: 800 MHz to 2 GHz Nominal Attenuation: 20 dB VSWR: <1.2:1 at < 2 GHz Connectors: Type N(m), Type N(f)	8491A Opt 020
Type N Cable	Frequency: 800 MHz to 2 GHz Connectors: Type N(m) Length: 183cm (72 in)	11500A
Cable, BNC	120cm (48 in.) BNC cable	10503A (2 required)
APC 3.5 Cable	Frequency: 9 kHz to 26.5 GHz Connectors: APC 3.5 (m) Length: >92 cm (36 in)	8120-4921
Adapters		
APC 3.5(f) to APC 3.5(f)		1250-1749
Type N(m) to Type N(m)		1250-1475
Type N(m) to BNC(f)		1250-1476
BNC Tee (f,m,f)		1250-0781

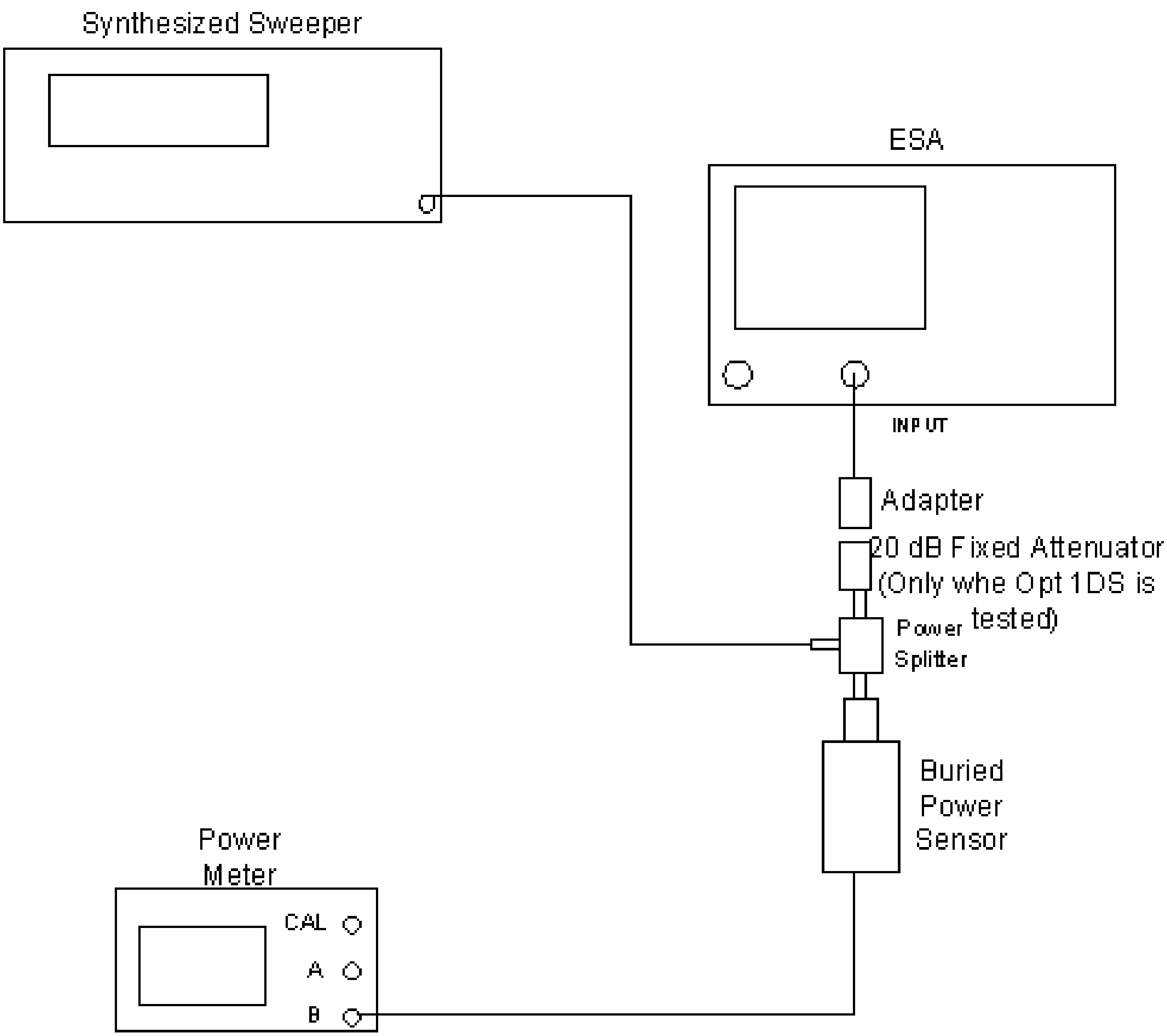
Test Setup

Characterization



Synthesized Sweeper
Power Meter
CAL
A
B
Reference Power Sensor
20 dB Fixed Attenuator (Only when Opt 1DS is tested)
Power Splitter
Buried Power Sensor

Test



PREVIOUS GSM - Phase and Frequency Error

COMMS - Absolute Amplitude Accuracy NEXT

TOP

Comms Absolute Amplitude Accuracy at 50 MHz

(Options BAC or BAH)

Related Specification:

GSM Transmit Power

cdmaOne Channel Power

cdmaOne Spur Close

cdmaOne Receive Channel Power

cdmaOne Receiver Spurious

Related Adjustment:

IF Amplitude Adjustment

Test Description:

This test measures the absolute amplitude of the ESA spectrum analyzer at numerous input amplitudes, attenuator settings and reference levels. The test also measures the amplitude accuracy with the preamp On when Option 1DS is present. The measured performance, when added to the absolute frequency response over a 20 to 30 degC temperature range, yields the Comms Absolute Amplitude Accuracy. The absolute frequency response is tested separately. Refer to the Comms Frequency Response performance test. The frequency response is not specified in the Cellular or PCS bands, therefore the Comms Frequency Response test must be completed first and the worksheet data will be used with the results of

the comms amplitude accuracy at 50 MHz to yield the Comms Absolute Amplitude Accuracy in the Cellular and PCS bands.

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. This is done at +15 dBm as well as 0 dBm. The attenuators are used to adjust the signal levels applied to the ESA from the initial signal amplitude. The amplitude measured by the ESA is compared to the actual signal level and the amplitude error is calculated.

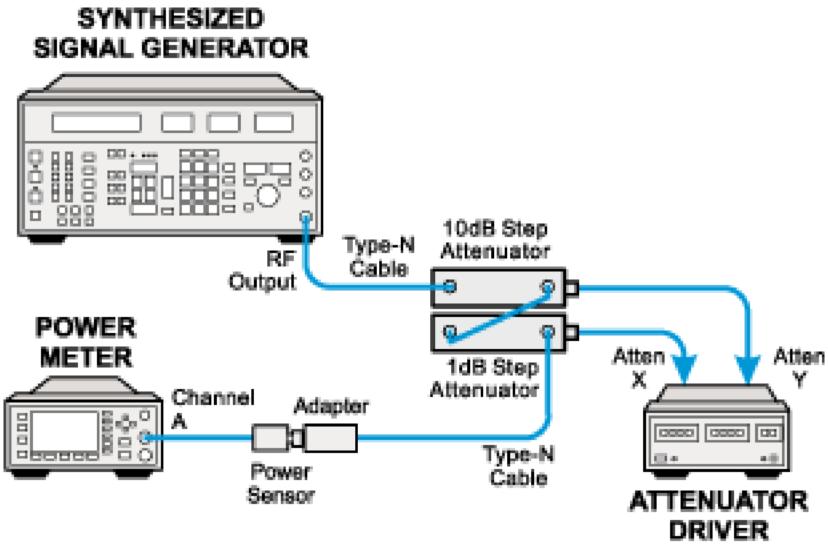
Required Equipment:

Instrument	Recommended Model
Signal Sources	
Synthesized Signal Generator	8663A
Meters	
Power Meter	E4419A
Power Sensor	8482A
Attenuators	
10 dB Step Attenuator	8496A/G
1 dB Step Attenuator	8494A/G
Attenuator Interconnection Kit	11716A

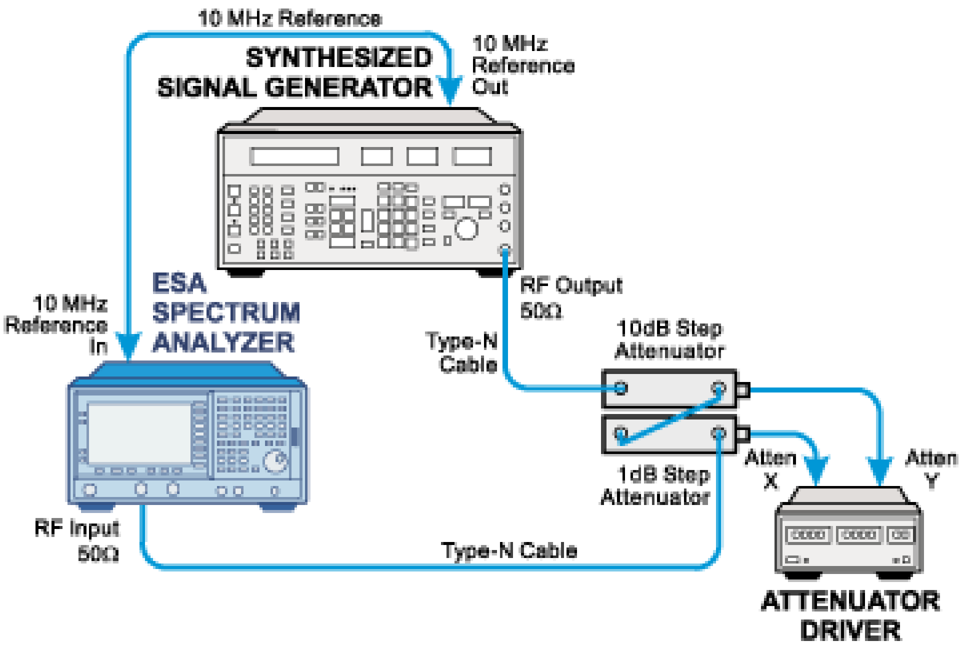
Attenuator Driver (if programmable step attenuators are used)	11713A
Miscellaneous Devices	
Cables	
(2) 62cm (24in) (m)	11500C
Cable, BNC	10503A
Adapters	
Type N(f) to APC 3.5(f) (Option BAB only)	1250-0745
Type N(f) to Type N(f)	1250-1472

Test Setup

Part 1



Part 2



PREVIOUS [COMMMS - Frequency Response]

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Agilent ESA Series Performance Verification Software