This manual provides documentation for the following Analyzers:
N9010A EXA
Notices

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Information on preventing analyzer damage can be found at:

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Table of Contents

1. Functional Tests
   Functional Test Versus Performance Verification ........................................... 8
   Contents of this Document .............................................................................. 9
   Before Performing a Functional Test ............................................................... 10
   Test Equipment ............................................................................................... 11

2. Displayed Average Noise Level (DANL)
   Procedure ....................................................................................................... 16

3. Frequency Readout Accuracy
   Procedure ....................................................................................................... 21

4. Amplitude Accuracy at 50 MHz
   Procedure ....................................................................................................... 25
   Testing Preamp Option (P03) ......................................................................... 27
   Procedure ....................................................................................................... 27

5. Frequency Response (Flatness)
   Procedure ....................................................................................................... 31

6. Frequency Response (Flatness), Preamp On
   Procedure ....................................................................................................... 35

7. Scale Fidelity
   Procedure ....................................................................................................... 39
1 Functional Tests

Functional tests are tests of various instrument parameters that give a high degree of confidence that the analyzer is operating correctly. They are recommended as a check of analyzer operation for incoming inspection or after a repair. Measurement uncertainty analysis is not available for functional tests, and the analyzer is checked against limits that are wider than the published specifications. The functional tests are designed to test an analyzer operating within the temperature range defined by the analyzer specifications using a minimum set of test equipment. If a test does not pass, performance verification tests must be run to determine whether a problem exists.
Functional Test Versus Performance Verification

Functional tests use a minimum set of test equipment to check a much smaller range of parameters (and a limited number of data points for each parameter) than do performance verification tests. Functional tests use limits that are wider than the published specifications; measurement uncertainty analysis is not available for functional tests.

**NOTE**

If a functional test does not pass, you must run performance verification tests to determine whether a problem exists.

Performance verification tests span a wide range of instrument parameters and provide the highest level of confidence that the instrument conforms to published specifications. These tests can be time consuming and require extensive test equipment.
Contents of this Document

This chapter includes the following:

- “Before Performing a Functional Test” on page 10 (what to do first).
- “Test Equipment” on page 11 (a list of the equipment required for all of the tests).

Subsequent chapters describe the following Functional Tests:

- “Displayed Average Noise Level (DANL)” on page 15
- “Frequency Readout Accuracy” on page 19
- “Amplitude Accuracy at 50 MHz” on page 23
- “Amplitude Accuracy at 50 MHz” on page 23
- “Frequency Response (Flatness)” on page 29
- “Frequency Response (Flatness), Preamp On” on page 33
- “Scale Fidelity” on page 37

Each functional test includes:

- Test limits (pass/fail criteria)
- A description of the test
- The equipment required for the test
- A figure showing how to connect the equipment
- Step-by-step instructions
- One or more tables in which to record the measurement results
Before Performing a Functional Test

1. Ensure that you have the proper test equipment.

2. Switch on the unit under test (UUT) and let it warm up (in accordance with warm-up requirements in the instrument specifications).

3. Allow sufficient warm-up time for the required test equipment (refer to individual instrument documentation for warm-up specifications).

4. Ensure that the analyzer’s frequency reference is set to Internal:
   a. Press the Input/Output, More, Freq Ref In keys.
   b. If the Freq Ref In softkey does not show Internal, press the Freq Ref In softkey and select Internal.

5. Following instrument warm-up, perform the auto align routine:
   Press System, Alignments, Align Now, All.

**NOTE**
Functional test accuracy depends on the precision of the test equipment used. Ensure that all of the test equipment is calibrated before running a functional test.
Functional Tests
Test Equipment

The table below summarizes the test equipment needed to perform all of the functional tests. Alternate equipment model numbers are given in case the recommended equipment is not available. If neither the recommended nor the alternative test equipment are available, substitute equipment that meets or exceeds the critical specifications listed.

<table>
<thead>
<tr>
<th>Analyzer Option</th>
<th>Item</th>
<th>Critical Specifications</th>
<th>Recommended Keysight Model</th>
<th>Alternate Keysight Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adapters</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>3.5 mm (f) to 3.5mm (f)</td>
<td>Frequency: 10 MHz to 26.5 GHz&lt;br&gt;VSWR: &lt; 1.1:1</td>
<td>83059B</td>
<td>1250-1749</td>
</tr>
<tr>
<td>All</td>
<td>BNC (f) to SMA (m)</td>
<td>Frequency: 40 MHz</td>
<td>1250-1200</td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>Type N (f) to Type N (f)</td>
<td>Frequency: 10 MHz to 18 GHz&lt;br&gt;VSWR: &lt; 1.05:1</td>
<td>1250-1472</td>
<td>1250-0777</td>
</tr>
<tr>
<td>All</td>
<td>Type N (m) to 3.5 mm (m)</td>
<td>Frequency: 10 MHz to 18 GHz&lt;br&gt;VSWR: &lt; 1.1:1</td>
<td>1250-1743</td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>Type N (m) to 3.5 mm (f)</td>
<td>Frequency: 10 MHz to 18 GHz&lt;br&gt;VSWR: &lt; 1.1:1</td>
<td>1250-1744</td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>Type N (f) to 3.5 mm (f)</td>
<td>Frequency: 10 MHz to 18 GHz&lt;br&gt;VSWR: &lt; 1.1:1</td>
<td>1250-1745</td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>Type N (m) to BNC (f)</td>
<td>Frequency: 10 MHz to 1 GHz&lt;br&gt;VSWR: &lt; 1.05:1</td>
<td>1250-1476</td>
<td></td>
</tr>
<tr>
<td><strong>Attenuators</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>10 dB Step Attenuator</td>
<td>Frequency: 50 MHz&lt;br&gt;Range: 0 to 70 dB</td>
<td>8495A</td>
<td>8496A</td>
</tr>
<tr>
<td>All</td>
<td>10 dB Fixed Attenuator (2 required)</td>
<td>Frequency: 50 MHz&lt;br&gt;VSWR: &lt; 1.2:1</td>
<td>8493C Option 010</td>
<td>8493A Option 010 or 8493B Option 010</td>
</tr>
<tr>
<td>Pxx</td>
<td>30 dB Fixed Attenuator</td>
<td>Accuracy: &lt; 0.05 dB @ 50 MHz</td>
<td>11708A</td>
<td></td>
</tr>
<tr>
<td><strong>Cables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>3.5 mm (1 meter)</td>
<td>Frequency: 10 MHz to 26.5 GHz&lt;br&gt;VSWR: &lt; 1.4:1&lt;br&gt;Loss: &lt; 2.0 dB</td>
<td>11500E</td>
<td>8120-4921</td>
</tr>
<tr>
<td>All</td>
<td>Cable, BNC (3 required)</td>
<td>120 cm (48 in.) BNC cable</td>
<td>10503A</td>
<td></td>
</tr>
</tbody>
</table>
### Functional Tests

#### Test Equipment

<table>
<thead>
<tr>
<th>Analyzer Option</th>
<th>Item</th>
<th>Critical Specifications</th>
<th>Recommended Keysight Model</th>
<th>Alternate Keysight Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>BBA</td>
<td>Cable, BNC</td>
<td>120 cm (48 in.) BNC cable Flatness (250 kHz to 40 MHz) &lt; 0.5 dB</td>
<td>10503A</td>
<td></td>
</tr>
<tr>
<td>BBA</td>
<td>Cable, BNC</td>
<td>BNC male 23 cm (9 in) max</td>
<td>10502A</td>
<td></td>
</tr>
</tbody>
</table>

#### Signal Source

<table>
<thead>
<tr>
<th>Item</th>
<th>Critical Specifications</th>
<th>Recommended Keysight Model</th>
<th>Alternate Keysight Model</th>
</tr>
</thead>
</table>
| Synthesizer Sweeper | **Frequency:** 10 MHz to 26.5 GHz  
**Harmonic level:** < −40 dBc  
**Amplitude range:** 10 to −20 dBm  
**Frequency Accuracy:** 0.02% | PSG³ | 83630B, 83640B, 83650B |

<table>
<thead>
<tr>
<th>Item</th>
<th>Critical Specifications</th>
<th>Recommended Keysight Model</th>
<th>Alternate Keysight Model</th>
</tr>
</thead>
</table>
| Signal Generator | **Frequency:** 250 kHz to 40 MHz  
**Amplitude:** ~−10 dBm  
**Flatness:** < ±0.75 dB | E4438C | 33250A |

#### Power Meter

<table>
<thead>
<tr>
<th>Item</th>
<th>Critical Specifications</th>
<th>Recommended Keysight Model</th>
<th>Alternate Keysight Model</th>
</tr>
</thead>
</table>
| Power Meter | **Power Reference Accuracy:** ±1.2%  
Compatible with power sensor | E4418B | E4419B |
| Power Sensor | **Frequency Range:** 50 MHz to 3.66 GHz  
**Amplitude Range:** −70 to −10 dBm | 8481D | 8487D 8485D |
| Low Power Sensor | **Frequency Range:** 50 MHz to 3.6 GHz  
**Amplitude Range:** −70 to −10 dBm | 8481D | 8485D 8487D |

#### Oscilloscope

<table>
<thead>
<tr>
<th>Item</th>
<th>Critical Specifications</th>
<th>Recommended Keysight Model</th>
<th>Alternate Keysight Model</th>
</tr>
</thead>
</table>
| Keysight Oscilloscope | **Cutoff Frequency:** 50 MHz  
**Rejection at 65 MHz:** > 40 dB  
**Rejection at 75 MHz:** > 60 dB  
**Rejection at 80 MHz:** > 60 dB  
**Frequency:** 10 MHz to 26.5 GHz | 54800B | |

#### Miscellaneous Equipment

<table>
<thead>
<tr>
<th>Item</th>
<th>Critical Specifications</th>
<th>Recommended Keysight Model</th>
<th>Alternate Keysight Model</th>
</tr>
</thead>
</table>
| Filter, 50 MHz Low Pass | **Cutoff Frequency:** 50 MHz  
**Rejection at 65 MHz:** > 40 dB  
**Rejection at 75 MHz:** > 60 dB  
**Rejection at 80 MHz:** > 60 dB  
**Frequency:** 10 MHz to 26.5 GHz | 0955-0306 | |
| Power Splitter, 3.5 mm | **Nominal Insertion Loss:** 6 dB  
**Tracking Between Ports:** < 0.25 dB | 11667B | |
### Functional Tests

#### Test Equipment

<table>
<thead>
<tr>
<th>Analyzer Option</th>
<th>Item</th>
<th>Critical Specifications</th>
<th>Recommended Keysight Model</th>
<th>Alternate Keysight Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>503, 507, 513</td>
<td>Power Splitter</td>
<td><strong>Nominal Insertion Loss</strong>: 6 dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Tracking Between Ports</strong>: &lt; 0.25 dB</td>
<td>11667A</td>
<td>11667B</td>
</tr>
<tr>
<td>All</td>
<td>Termination, 50Ω</td>
<td>Type N (m) Connector</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Frequency</strong>: 30 Hz to 26.5 GHz</td>
<td>909A Option 012</td>
<td></td>
</tr>
<tr>
<td>BBA</td>
<td>Termination, 50Ω</td>
<td>BNC male</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Frequency</strong>: 250 kHz to 40 MHz</td>
<td>11593A</td>
<td></td>
</tr>
</tbody>
</table>

2 Displayed Average Noise Level (DANL)

Test Limits (with 0 dB input attenuation)

See Table 2-1 for values.

The Displayed Average Noise Level (DANL) of the signal analyzer is measured across a 10 kHz frequency span at several center frequencies. The analyzer input is terminated into a 50Ω load. A test is performed to assure the measurement is not performed in the presence of a residual response. The measurement is then averaged, and the result is normalized to a 1 Hz bandwidth.

<table>
<thead>
<tr>
<th>Item</th>
<th>Critical Specifications (for this test)</th>
<th>Recommended Keysight Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Termination, 50Ω Type-N(m)</td>
<td>Frequency: DC to 18 GHz</td>
<td>909A Option 012</td>
</tr>
</tbody>
</table>

Figure 2-1 DANL Test Setup
Procedure

1. Configure the equipment as shown in Figure 2-1
2. Press Mode, Spectrum Analyzer, Mode Preset on the analyzer.
3. Set up the signal analyzer by pressing:
   - FREQ Channel, Center Freq, 10, MHz
   - Input/Output, RF Input, RF Coupling, select DC
   - SPAN X Scale, Span, 10, kHz
   - AMPTD Y Scale, –70, dBm
   - AMPTD Y Scale, Attenuation, Mech Atten, 0, dB
   - BW, Res BW, 1, kHz
   - BW, Video BW, 100, Hz
   - Meas Setup, Average/Hold, Number, 20, Enter
   - Trace/Detector, Trace Average
   - Single
4. Press Restart, then wait for Average/Hold to display 20/20.
6. Rotate the knob and set the display line at the average amplitude of the displayed noise floor by visual inspection.
7. Confirm that the measurement is performed on the analyzer noise floor and not on a residual response within the displayed 10 kHz span.

**NOTE**
Ignore the residual response if one appears when taking the measurement.

8. Enter the value of the display line as the Measured Average Noise Level at 10 MHz column in Table 2-1.
9. Normalize the measured value to a 1 Hz BW by adding 30 dB to the measured value.

**NOTE**
The 30 dB value is added because the formula used to calculate the value of the noise power in a 1 Hz BW when measured with a 1 kHz BW is:

\[ \text{Normalized Noise} = 10 \log \left( \frac{\text{BW}_2}{\text{BW}_1} \right) \]

where \( \text{BW}_2 \) is the 1 kHz BW we measure and \( \text{BW}_1 \) is 1 Hz BW to which we want to normalize.

Therefore, \( 10 \log (1000) = 30 \text{ dB} \), so the noise floor will be 30 dB lower in a 1 Hz BW.

10. Enter the normalized value of the displayed average noise level in Table 2-1.
11. The value of the normalized displayed average noise should be less than the specification value.

12. Change the analyzer center frequency to the next value listed in Table 2-1. Press: FREQ Channel, Center Freq, [Table 2-1 Value], GHz

13. Repeat step 7 through step 12 to fill in the remainder of Table 2-1 for your analyzer frequency range.

Table 2-1 Displayed Average Noise Level (DANL) Results

<table>
<thead>
<tr>
<th>Center Frequency</th>
<th>Measured Average Noise Level (dBm)</th>
<th>Normalized Average Noise Level/(1 Hz BW) (dBm)</th>
<th>Test Limits (dBm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 MHz</td>
<td></td>
<td></td>
<td>−145</td>
</tr>
<tr>
<td>2 GHz</td>
<td></td>
<td></td>
<td>−145</td>
</tr>
<tr>
<td>6 GHz</td>
<td></td>
<td></td>
<td>−143</td>
</tr>
<tr>
<td>13 GHz</td>
<td></td>
<td></td>
<td>−142</td>
</tr>
<tr>
<td>20 GHz</td>
<td></td>
<td></td>
<td>−136</td>
</tr>
<tr>
<td>26.5 GHz</td>
<td></td>
<td></td>
<td>−133</td>
</tr>
</tbody>
</table>
Displayed Average Noise Level (DANL)
Procedure
3 Frequency Readout Accuracy

**Test Limits**

Frequency Readout Accuracy is equivalent to the following equation:

\[
\pm (0.25\% \times \text{span} + 5\% \times \text{RBW} + 2 \text{ Hz} + 0.5 \times \text{horizontal resolution})
\]

See results table for actual values.

The frequency readout accuracy is measured in several spans and center frequencies that allow both internal analyzer synthesizer modes and prefilter bandwidths to be tested. Frequency reference error is eliminated by using the same frequency standard for the analyzer and signal source.

<table>
<thead>
<tr>
<th>Item</th>
<th>Critical Specification (for this test)</th>
<th>Recommended Keysight Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adapter, Type-N(m), to 3.5 mm(f)</td>
<td>Frequency: 10 MHz to 1.51 GHz</td>
<td>1250-1744</td>
</tr>
<tr>
<td></td>
<td>VSWR: &lt; 1.1:1</td>
<td></td>
</tr>
<tr>
<td>Adapter, 3.5 mm(f) to 3.5 mm(f)</td>
<td>Frequency: 10 MHz to 1.51 GHz</td>
<td>83059B</td>
</tr>
<tr>
<td></td>
<td>VSWR: &lt; 1.1:1</td>
<td></td>
</tr>
<tr>
<td>Cable, 3.5 mm, 1 meter</td>
<td>Frequency: 10 MHz to 1.51 GHz</td>
<td>11500E</td>
</tr>
<tr>
<td></td>
<td>VSWR: &lt; 1.4:1</td>
<td></td>
</tr>
<tr>
<td>Cable, BNC, 120 cm</td>
<td>Frequency: 10 MHz</td>
<td>10503A</td>
</tr>
<tr>
<td>Synthesized Sweeper</td>
<td><strong>Frequency</strong>: 10 MHz to 1.51 GHz</td>
<td>PSG</td>
</tr>
</tbody>
</table>
Figure 3-1 Frequency Readout Accuracy Test Setup

SYNTHESIZED SWEEPER

SIGNAL ANALYZER

BNC Cable

10 MHz Ref Out

Ext Ref In

ADAPTER

ADAPTER

3.5 mm Cable
Frequency Readout Accuracy

Procedure

1. Configure the equipment as shown in Figure 3-1. Confirm the analyzer's built-in auto alignment has been performed within the past 24 hours.

2. On the synthesized sweeper, press **PRESET**, then set the controls as follows:
   
   **FREQUENCY**, 1505, MHz
   **POWER LEVEL**, –10, dBm

3. Set up the signal analyzer by pressing:
   
   **Mode**, Spectrum Analyzer
   **Mode Preset**
   **Input/Output**, More, Freq Ref In, External
   **FREQ Channel**, Center Freq, 1505, MHz
   **SPAN X Scale**, Span, 2990, MHz
   **Trace/Detector**, More, Detector, Sample Single

4. Press **Restart**.

   Press **Peak Search** on the analyzer. If the instrument is functioning correctly, the marker reading in the active function block will be between the values listed in Table 3-1. Record the marker value in the Marker Frequency Readout column in Table 3-1.

5. On the signal analyzer, change the span and center frequency as listed in Table 3-1.

6. Change the synthesized sweeper frequency to match the center frequency of the analyzer.

7. Repeat step 4 through step 6 until the Marker Frequency Readout column of Table 3-1 is complete.

Table 3-1  Frequency Readout Accuracy Results

<table>
<thead>
<tr>
<th>Span (MHz)</th>
<th>Center Frequency (MHz)</th>
<th>Minimum</th>
<th>Marker Frequency Readout</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>2990</td>
<td>1505</td>
<td>1495.9 MHz</td>
<td></td>
<td>1514.1 MHz</td>
</tr>
<tr>
<td>127.2</td>
<td>1505</td>
<td>1504.56 MHz</td>
<td></td>
<td>1505.44 MHz</td>
</tr>
<tr>
<td>54.1</td>
<td>1505</td>
<td>1504.8122 MHz</td>
<td></td>
<td>1505.1878 MHz</td>
</tr>
<tr>
<td>7.95</td>
<td>1505</td>
<td>1504.97240 MHz</td>
<td></td>
<td>1505.0276 MHz</td>
</tr>
<tr>
<td>0.106</td>
<td>1505</td>
<td>1504.999630 MHz</td>
<td></td>
<td>1505.00370 MHz</td>
</tr>
<tr>
<td>1.98</td>
<td>517.59</td>
<td>517.58316 MHz</td>
<td></td>
<td>517.59684 MHz</td>
</tr>
<tr>
<td>1.98</td>
<td>832.50</td>
<td>832.49316 MHz</td>
<td></td>
<td>832.50684 MHz</td>
</tr>
</tbody>
</table>
Frequency Readout Accuracy
Procedure
### Functional Tests

#### 4. Amplitude Accuracy at 50 MHz

**Test Limits**

Amplitude Accuracy should remain within ±1.20 dB of the measured source value across the range of source levels and changes in resolution bandwidth. The Preamp (option P03) should remain within ±1.3 dB of measured values.

A synthesized sweeper is used as the signal source for the test. The source amplitude is varied using the signal source amplitude control. The attenuation and resolution bandwidth are varied on the signal analyzer. The source amplitude is measured by the power meter and signal analyzer at each setting, and the values compared. The difference between each pair of measurements indicates the amplitude accuracy.

<table>
<thead>
<tr>
<th>Item</th>
<th>Critical Specifications</th>
<th>Recommended Keysight Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adapter</td>
<td>Type-N(m), to 3.5 mm(m)</td>
<td>1250-1743</td>
</tr>
<tr>
<td>Adapter</td>
<td>3.5 mm(f) to 3.5 mm(f)</td>
<td>83059B</td>
</tr>
<tr>
<td>Attenuator, 30 dB</td>
<td><strong>Accuracy</strong>: &lt; 0.5 dB at 50 MHz</td>
<td>11708A</td>
</tr>
<tr>
<td>Cable</td>
<td>3.5 mm, 1 meter</td>
<td>11500E</td>
</tr>
<tr>
<td>Cable</td>
<td>BNC, 120 cm</td>
<td>10503A</td>
</tr>
<tr>
<td>Power Meter</td>
<td>Compatible with power sensor</td>
<td>E4418B</td>
</tr>
<tr>
<td>Power Sensor</td>
<td><strong>Amplitude Range</strong>: −25 dBm to 10 dBm</td>
<td>8485A</td>
</tr>
<tr>
<td>Power Splitter</td>
<td>3.5 mm (f) connectors</td>
<td>11667B</td>
</tr>
<tr>
<td></td>
<td>6 dB loss</td>
<td></td>
</tr>
<tr>
<td>Synthesized Sweeper</td>
<td><strong>Typical Temperature Stability</strong>: 0.01 dBC/°C</td>
<td>PSG</td>
</tr>
</tbody>
</table>
Figure 4-1  Amplitude Accuracy Test Setup

- POWER METER
- SYNTHESIZED SWEEPER
- SIGNAL ANALYZER
- 30 dB PAD
- 11667B POWER SPLITTER
- POWER SENSOR
- BNC Cable
- APC 3.5 mm Cable
- 10 MHz Ref Out
- Ext Ref In
Amplitude Accuracy at 50 MHz

**Procedure**

1. Zero and calibrate the power meter.

2. Configure equipment as shown in Figure 4-1, with the power splitter connected directly to the signal analyzer input through the adapter.

**CAUTION**

To minimize stress on the test equipment connections, support the power sensor.

3. If the auto alignment for the analyzer has not been performed within the past 24 hours, press System, Alignments, Align Now, All to perform the auto alignment routine.

4. Press Mode, Spectrum Analyzer, Mode Preset on the analyzer.

5. Set up the synthesized sweeper by pressing:
   - CW, 50, MHz
   - Power Level, -4, dBm
   - RF (On)

6. Set up the signal analyzer by pressing:
   - Input/Output, More, Freq Ref In, External
   - FREQ Channel, Center Freq, 50, MHz
   - SPAN X Scale, 2, MHz
   - AMPTD Y Scale, Attenuation, Mech Atten, 10, dB
   - Input/Output, RF Input, RF Coupling, select DC
   - Sweep/Control, Sweep Setup, Swp Time Rules, SA - Accuracy Meas Setup, Average/Hold Number, 20, Enter
   - Trace/Detector, Trace Average
   - Single

7. Perform the following steps for each row listed in Table 4-1:
   
   **a.** Set the synthesized sweeper amplitude to the value listed in the Nominal Source Amplitude column in Table 4-1
   
   **b.** Set the Mech Atten as indicated in the Attenuation column in Table 4-1
   
   **c.** Set the Span as listed in the Span column of Table 4-1
   
   **d.** Record the source amplitude, as measured by the power meter, in the Power Meter Amplitude column of Table 4-1
   
   **e.** On the signal analyzer, press Restart.
   
   **f.** Wait for the signal analyzer to finish averaging.
   
   **g.** Press Peak Search.
h. Record the signal amplitude, as measured by the analyzer in the Measured Amplitude column of Table 4-1.

i. Calculate the signal amplitude accuracy error using the following equation, and record the results under the Amplitude Accuracy Error column:

\[
\text{Amplitude Accuracy Error} = \text{Meas_amp} - \text{Power_meter}
\]

Table 4-1 Amplitude Accuracy Results

<table>
<thead>
<tr>
<th>Nominal Source Amplitude (dBm)</th>
<th>Attenuation (dB)</th>
<th>Span (MHz)</th>
<th>Measured Amplitude Meas_amp (dBm)</th>
<th>Power Meter Amplitude Power_meter (dBm)</th>
<th>Amplitude Accuracy Error (dB)</th>
<th>Test Limit (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>−4</td>
<td>10</td>
<td>2</td>
<td></td>
<td></td>
<td>±1.20 dB</td>
<td></td>
</tr>
<tr>
<td>−9</td>
<td>10</td>
<td>1</td>
<td></td>
<td></td>
<td>±1.20 dB</td>
<td></td>
</tr>
<tr>
<td>−14</td>
<td>10</td>
<td>0.5</td>
<td></td>
<td></td>
<td>±1.20 dB</td>
<td></td>
</tr>
<tr>
<td>−4</td>
<td>20</td>
<td>0.1</td>
<td></td>
<td></td>
<td>±1.20 dB</td>
<td></td>
</tr>
<tr>
<td>−14</td>
<td>20</td>
<td>0.1</td>
<td></td>
<td></td>
<td>±1.20 dB</td>
<td></td>
</tr>
<tr>
<td>−4</td>
<td>30</td>
<td>0.1</td>
<td></td>
<td></td>
<td>±1.20 dB</td>
<td></td>
</tr>
<tr>
<td>−14</td>
<td>30</td>
<td>0.1</td>
<td></td>
<td></td>
<td>±1.20 dB</td>
<td></td>
</tr>
</tbody>
</table>
Amplitude Accuracy at 50 MHz
Testing Preamp Option (P03)

Testing Preamp Option (P03)

Instruments containing Option P03 must have the preamp function turned on and tested.

Procedure

1. On the analyzer, press **AMPTD Y Scale, More, Internal Preamp, Low Band**.
2. Connect the equipment as shown in Figure 4-1 on page 24, using a 30 dB Pad between the adaptor and the signal analyzer input.
3. Set the synthesized sweeper amplitude to the value listed in the Nominal Source Amplitude column in Table 4-2.
4. Set the signal analyzer input attenuation to 0 dB.
5. Set the Span as listed in Table 4-2.
6. Record the source amplitude, as measured by the power meter, in the Power Meter Amplitude column of Table 4-2.
7. On the signal analyzer, press **Restart**.
8. Wait for the analyzer to finish averaging.
9. Press **Peak Search**.
10. Record the signal amplitude as measured by the analyzer in the measured amplitude column of Table 4-2.
11. Calculate the signal amplitude accuracy using the following equation:

\[
\text{Amplitude Accuracy Error} = \text{Meas}_\text{amp} + 30 \text{ dB} - \text{Power}\_\text{meter}
\]

12. Record the results under the Amplitude Accuracy Error column of Table 4-2.

<table>
<thead>
<tr>
<th>Nominal Source Amplitude (dBm)</th>
<th>Low-band Preamp</th>
<th>Res BW (kHz)</th>
<th>Span (kHz)</th>
<th>Measured Amplitude Meas_amp (dBm)</th>
<th>Power Meter Amplitude Power_meter (dBm)</th>
<th>Amplitude Accuracy Error (dB)</th>
<th>Test Limit (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-13</td>
<td>ON</td>
<td>1</td>
<td>106</td>
<td></td>
<td></td>
<td></td>
<td>±1.30 dB</td>
</tr>
</tbody>
</table>
Amplitude Accuracy at 50 MHz
Testing Preamp Option (P03)
5  Frequency Response (Flatness)

Test Limits

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Limit Relative to 50 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 kHz to 3.6 GHz</td>
<td>±1.7 dB</td>
</tr>
<tr>
<td>&gt; 3.6 GHz to 7.0 GHz</td>
<td>±3.0 dB</td>
</tr>
<tr>
<td>&gt; 7.0 GHz to 13.6 GHz</td>
<td>±3.5 dB</td>
</tr>
<tr>
<td>&gt; 13.6 GHz to 26.5 GHz</td>
<td>±4.2 dB</td>
</tr>
</tbody>
</table>

The frequency response test measures the signal analyzer’s amplitude error as a function of the tuned frequency. Measurements are made ranging from 50 MHz to the maximum frequency range of your analyzer. The signal source amplitude is measured with a power meter to eliminate error due to source flatness. The measured value is normalized to 50 MHz.

<table>
<thead>
<tr>
<th>Item</th>
<th>Critical Specifications (for this test)</th>
<th>Recommended Keysight Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adapter, Type N(m) to 3.5 mm(m)</td>
<td>Frequency: 10 MHz to 18 GHz</td>
<td>1250-1743</td>
</tr>
<tr>
<td></td>
<td>VSWR: &lt; 1.1:1</td>
<td></td>
</tr>
<tr>
<td>Adapter, 3.5 mm(f) to 3.5 mm(f)</td>
<td>Frequency: 10 MHz to 26.5 GHz</td>
<td>83059B</td>
</tr>
<tr>
<td></td>
<td>VSWR: &lt; 1.1:1</td>
<td></td>
</tr>
<tr>
<td>Cable, 3.5 mm, 1 meter</td>
<td>Frequency: 10 MHz to 26.5 GHz</td>
<td>11500E</td>
</tr>
<tr>
<td></td>
<td>VSWR: &lt; 1.4:1</td>
<td></td>
</tr>
<tr>
<td>Cables, BNC 120 cm</td>
<td>Frequency: 10 MHz</td>
<td>10503A</td>
</tr>
<tr>
<td>Power Meter</td>
<td>Compatible with power sensor</td>
<td>E4418B</td>
</tr>
<tr>
<td>Power Sensor</td>
<td>Frequency Range: 50 MHz to 26.5 GHz</td>
<td>8485A</td>
</tr>
</tbody>
</table>
Frequency Response (Flatness)

<table>
<thead>
<tr>
<th></th>
<th>Critical Specifications (for this test)</th>
<th>Recommended Keysight Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Splitter</td>
<td><strong>Frequency Range</strong>: 50 MHz to 26.5 GHz</td>
<td>11667B</td>
</tr>
<tr>
<td></td>
<td><strong>Tracking between ports</strong>: &lt; 0.25 dB</td>
<td></td>
</tr>
<tr>
<td>Synthesized Sweeper</td>
<td><strong>Frequency Range</strong>: 50 MHz to 26 GHz</td>
<td>PSG</td>
</tr>
</tbody>
</table>

Figure 5-1  Frequency Response Test Setup
Frequency Response (Flatness)

Procedure

1. Zero and calibrate the power meter and power sensor as described in the power meter operation manual.

2. Configure the equipment as shown in Figure 5-1.

NOTE Connect the power splitter to the signal analyzer input using the appropriate adapter. Do not use a cable.

3. Assure the signal analyzer’s built-in auto alignment has been performed within the last 24 hours.


5. Set up the synthesized sweeper by pressing:
   - CW, 50, MHz
   - Power level, –4, dBm

6. Set up the signal analyzer by pressing:
   - Input/Output, More, Freq Ref In, External
   - FREQ Channel, Center Freq, 50, MHz
   - SPAN X Scale, Span, 50, kHz
   - AMPTD Y Scale, Ref Level, 0, dBm

7. Adjust the synthesized sweeper output power for a power meter reading of –10 dBm ±0.1 dB.


9. Press the Peak Search key on the signal analyzer to position the marker on the peak of the signal.

10. Refer to Table 5-1, “Frequency Response (Flatness) Results.” Enter the amplitude of the signal displayed on the signal analyzer into the MeasAmp column of Table 5-1.

11. Enter the power meter reading into the PowerMeter column of Table 5-1.

12. Tune the synthesized sweeper and signal analyzer to the next frequency listed in Table 5-1.

13. Enter the power sensor calibration factor into the power meter.

14. For frequencies 3.6 GHz and above, press AMPTD Y Scale, then Presel Center to center the preselector filter for an optimum amplitude measurement.

15. Repeat step 7 through step 14 and complete the remainder of Table 5-1 for the frequency range of your analyzer.
Frequency Response (Flatness)

Procedure

16. Compute the measurement error \( \text{MeasError} = \text{MeasAmp} - \text{PowerMeter} \).

17. Compute the flatness error normalized to 50 MHz:
\[
(\text{MeasError} - \text{MeasError} @ 50 \text{ MHz})
\]

18. Enter the computed flatness error value into the Flat\text{Norm} column of Table 5-1.

19. Compare the value of Flat\text{Norm} to the test limit.

Table 5-1 Frequency Response (Flatness) Results

<table>
<thead>
<tr>
<th>Center Frequency</th>
<th>Analyzer Amplitude Meas\text{amp}</th>
<th>Power Meter Measurement Power\text{meter}</th>
<th>Meas Error Meas\text{error}</th>
<th>Flatness Normalized to 50 MHz Flat\text{Norm}</th>
<th>Flatness Error Test Limits (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 MHz</td>
<td></td>
<td></td>
<td>0</td>
<td></td>
<td>Ref</td>
</tr>
<tr>
<td>1 GHz</td>
<td></td>
<td></td>
<td>±1.7 dB</td>
<td></td>
<td>±1.7 dB</td>
</tr>
<tr>
<td>2 GHz</td>
<td></td>
<td></td>
<td>±1.7 dB</td>
<td></td>
<td>±1.7 dB</td>
</tr>
<tr>
<td>3 GHz</td>
<td></td>
<td></td>
<td>±1.7 dB</td>
<td></td>
<td>±1.7 dB</td>
</tr>
<tr>
<td>3.5 GHz</td>
<td></td>
<td></td>
<td>±1.7 dB</td>
<td></td>
<td>±1.7 dB</td>
</tr>
<tr>
<td>4 GHz</td>
<td></td>
<td></td>
<td>±3.0 dB</td>
<td></td>
<td>±3.0 dB</td>
</tr>
<tr>
<td>6 GHz</td>
<td></td>
<td></td>
<td>±3.0 dB</td>
<td></td>
<td>±3.0 dB</td>
</tr>
<tr>
<td>8 GHz</td>
<td></td>
<td></td>
<td>±3.5 dB</td>
<td></td>
<td>±3.5 dB</td>
</tr>
<tr>
<td>9 GHz</td>
<td></td>
<td></td>
<td>±3.5 dB</td>
<td></td>
<td>±3.5 dB</td>
</tr>
<tr>
<td>11 GHz</td>
<td></td>
<td></td>
<td>±3.5 dB</td>
<td></td>
<td>±3.5 dB</td>
</tr>
<tr>
<td>13 GHz</td>
<td></td>
<td></td>
<td>±3.5 dB</td>
<td></td>
<td>±3.5 dB</td>
</tr>
<tr>
<td>14 GHz</td>
<td></td>
<td></td>
<td>±4.2 dB</td>
<td></td>
<td>±4.2 dB</td>
</tr>
<tr>
<td>17 GHz</td>
<td></td>
<td></td>
<td>±4.2 dB</td>
<td></td>
<td>±4.2 dB</td>
</tr>
<tr>
<td>20 GHz</td>
<td></td>
<td></td>
<td>±4.2 dB</td>
<td></td>
<td>±4.2 dB</td>
</tr>
<tr>
<td>23 GHz</td>
<td></td>
<td></td>
<td>±4.2 dB</td>
<td></td>
<td>±4.2 dB</td>
</tr>
<tr>
<td>26 GHz</td>
<td></td>
<td></td>
<td>±4.2 dB</td>
<td></td>
<td>±4.2 dB</td>
</tr>
</tbody>
</table>
6 Frequency Response (Flatness), Preamp On

Test Limits

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Limit Relative to 50 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 kHz to 3.6 GHz</td>
<td>±2.2 dB</td>
</tr>
</tbody>
</table>

The frequency response test, with preamplifier on, measures the signal analyzer's amplitude error as a function of the tuned frequency. Measurements are made ranging from 50 MHz to the maximum frequency range of the preamp. The signal source amplitude is measured with a power meter to eliminate error due to source flatness. The measured value is normalized to 50 MHz.

<table>
<thead>
<tr>
<th>Item</th>
<th>Critical Specifications (for this test)</th>
<th>Recommended Keysight Model</th>
</tr>
</thead>
</table>
| Adapter, Type N(m) to 3.5 mm(m) | Frequency: 10 MHz to 18 GHz  
VSWR: < 1.1:1 | 1250-1743 |
| Adapter, 3.5 mm(f) to 3.5 mm(f) | Frequency: 10 MHz to 26.5 GHz  
VSWR: < 1.1:1 | 83059B |
| Cable, 3.5 mm, 1 meter | Frequency: 10 MHz to 26.5 GHz  
VSWR: < 1.4:1 | 11500E |
| Cables, BNC 120 cm | Frequency: 10 MHz | 10503A |
| Power Meter | Compatible with power sensor | E4418B |
| Attenuator, 30 dB Fixed | Frequency: 50 MHz  
Accuracy: ±0.05 dB | 11708A |
| Power Sensor | **Frequency Range**: 50 MHz to 3.6 GHz  
**Amplitude Range**: −65 dBm to −55 dBm | 8481D |
### Critical Specifications (for this test) | Recommended Keysight Model
---|---
Power Splitter | Frequency Range: 50 MHz to 26.5 GHz, Tracking between ports: < 0.25 dB | 11667B
Synthesized Sweeper | Frequency Range: 50 MHz to 26.5 GHz | PSG

**Figure 6-1  Frequency Response Test Setup**

![Test Setup Diagram](image-url)
Procedure

1. Zero and calibrate the power meter and power sensor as described in the power meter operation manual.
2. Configure the equipment as shown in Figure 6-1.

**NOTE**
Connect the power splitter to the signal analyzer input using the appropriate adapter. Do not use a cable.

3. Assure the signal analyzer’s built-in auto alignment has been performed within the last 24 hours.
5. Set up the synthesized sweeper by pressing:
   
   CW, 50, MHz
   Power level, −54, dBm

6. Set up the signal analyzer by pressing:
   
   Input/Output, More, Freq Ref In, External
   FREQ Channel, Center Freq, 50, MHz
   SPAN X Scale, Span, 50, kHz
   AMPTD Y Scale, More, Internal Preamp, “Low Band”
   AMPTD Y Scale, Attenuation, Mech Atten, 0, dB
   AMPTD Y Scale, Ref Level, −55, dBm

7. Adjust the synthesized sweeper output power for a power meter reading of −60 dBm ±0.1 dB.
8. On the signal analyzer, press *Single*.
9. Press the *Peak Search* key on the signal analyzer to position the marker on the peak of the signal.

10. Refer to Table 6-1, “Frequency Response (Flatness) Results.” Enter the amplitude of the signal displayed on the signal analyzer into the MeasAmp column of Table 6-1.

11. Enter the power meter reading into the PowerMeter column of Table 6-1.

12. Tune the synthesized sweeper and signal analyzer to the next frequency listed in Table 6-1.

13. Enter the power sensor calibration factor into the power meter.

14. Repeat step 7 through step 13 and complete the remainder of Table 6-1 for the frequency range of your preamp.

15. Compute the measurement error (MeasError = MeasAmp − PowerMeter).
Frequency Response (Flatness), Preamp On
Procedure

16. Compute the flatness error normalized to 50 MHz:
   \[(\text{Meas Error} - \text{Meas Error} @ 50 \text{ MHz})\]

17. Enter the computed flatness error value into the Flat\text{Norm} column of Table 6-1.

18. Compare the value of Flat\text{Norm} to the test limit.

Table 6-1 Frequency Response (Flatness) Results

<table>
<thead>
<tr>
<th>Center Frequency</th>
<th>Analyzer Amplitude Measamp</th>
<th>Power Meter Measurement Powermeter</th>
<th>Meas Error Measerror</th>
<th>Flatness Normalized to 50 MHz Flat\text{Norm}</th>
<th>Flatness Error Test Limits (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 MHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ref</td>
</tr>
<tr>
<td>1 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>±2.2 dB</td>
</tr>
<tr>
<td>2 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>±2.2 dB</td>
</tr>
<tr>
<td>3 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>±2.2 dB</td>
</tr>
<tr>
<td>3.5 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>±2.2 dB</td>
</tr>
</tbody>
</table>
7 Scale Fidelity

Test Limits
The scale fidelity error will be \( \leq 1.0 \, \text{dB} \) with \( \leq -10 \, \text{dBm} \) at the mixer.

This test checks the scale fidelity of the instrument by maintaining a constant reference level and measuring signals of different amplitudes over most of the display range. This test sets the input attenuator to 10 dB and the Reference Level to 0 dBm. The external attenuator is set to 0 dB, and the amplitude of the source is adjusted to set the displayed signal at the reference level.

The instrument’s internal marker is used to measure the reference amplitude. The Marker Delta function is activated and the RF input is reduced using the external precision step attenuator. Signal input levels from 0 dBm to \(-50 \, \text{dBm}\) are measured.

<table>
<thead>
<tr>
<th>Item</th>
<th>Critical Specifications (for this test)</th>
<th>Recommended Keysight Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adapter, Type-N(m), to 3.5 mm(f)</td>
<td>Frequency: 10 MHz to 18 GHz VSWR: (&lt; 1.1:1)</td>
<td>1250-1745</td>
</tr>
<tr>
<td>Adapter, 3.5 mm(f) to 3.5 mm(f)</td>
<td>Frequency: 10 MHz to 26.5 GHz VSWR: (&lt; 1.1:1)</td>
<td>83059B</td>
</tr>
<tr>
<td>Attenuator, 10 dB Step</td>
<td>Range: 0-50 dB Frequency: 50 MHz Accuracy: (\pm 0.25 , \text{dB})</td>
<td>8495A</td>
</tr>
<tr>
<td>Attenuator, 10 dB fixed (2 required)</td>
<td>Frequency: 50 MHz VSWR: (&lt; 1.2:1)</td>
<td>8493C, option 010</td>
</tr>
<tr>
<td>Cable, 3.5 mm, 1 meter (2 required)</td>
<td>Frequency: 10 MHz to 26.5 GHz VSWR: (&lt; 1.4:1)</td>
<td>11500E</td>
</tr>
<tr>
<td>Cable, BNC 120 cm</td>
<td>Frequency: 10 MHz</td>
<td>10503A</td>
</tr>
<tr>
<td>Synthesized Sweeper</td>
<td>Output Level Accuracy: 0 to (-15 , \text{dBm}): (\pm 1.0 , \text{dB})</td>
<td>PSG</td>
</tr>
</tbody>
</table>
NOTE

Averaging is used for all measurements to improve repeatability and reduce measurement uncertainty.
Procedure

1. Configure the equipment as shown in Figure 7-1.

2. Preset the Source and press Mode, Spectrum Analyzer, Mode Preset on the analyzer.

3. Set up the synthesized sweeper by pressing:
   - Frequency, 50, MHz
   - Amplitude, +5, dBm
   - RF On/Off, On

4. Set up the signal analyzer by pressing:
   - Input/Output, More, Freq Ref In, External FREQ Channel, Center Freq, 50, MHz
   - SPAN X Scale, Span, 1, MHz
   - AMPTD Y Scale, Ref Level, 0, dBm
   - Meas Setup, Average/Hold Number, 10, Enter
   - Trace/Detector, Trace Average
   - Peak Search

5. Set the external 10 dB step attenuator to 0 dB.

6. Adjust the amplitude on the signal source until the marker amplitude on the analyzer reads –15 dBm ±0.2 dB.

7. On the analyzer, press the Single, Restart to trigger a 10 sweep average.

8. On the analyzer, activate the Marker Delta function by pressing Peak Search, Marker Delta.

9. Perform the following steps for each attenuator setting listed in the table below:
   a. Select the next External attenuator setting.
   b. Press the Restart key to trigger a 10 sweep average.
   c. Enter the delta marker value into Table 7-1.
   d. Check delta marker reading against the test limits.
## Table 7-1  Scale Fidelity Results

<table>
<thead>
<tr>
<th>External Attenuator Setting</th>
<th>Minimum (dB)</th>
<th>Marker Delta Value (dB)</th>
<th>Maximum (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>N/A</td>
<td>Reference</td>
<td>N/A</td>
</tr>
<tr>
<td>10</td>
<td>-11.0</td>
<td></td>
<td>-9.0</td>
</tr>
<tr>
<td>20</td>
<td>-21.0</td>
<td></td>
<td>-19.0</td>
</tr>
<tr>
<td>30</td>
<td>-31.0</td>
<td></td>
<td>-29.0</td>
</tr>
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Index

A
amplitude accuracy test 23
  option 1DS 27
amplitude linearity test 37

D
DANL test 15
displayed average noise level. See DANL 15

E
equipment
  functional tests 11
  warm-up time 10

F
frequency readout accuracy test 19
frequency response
  (flatness) test 29
frequency response (flatness) test
  preamp on 33
functional testing
  performance verification 8
functional tests
  before performing 10
  equipment list 11
  introduction 7
  vs performance verification tests 8
  warm-up time 10
  See also individual functional tests 7

P
performance verification tests vs functional tests 8

T
tests. See functional tests