Section 4
PERFORMANCE TESTS

4-1. INTRODUCTION

The procedures in this section test the Signal Generator electrical performance using the specification tables in Section 1 as the performance standards. All tests can be performed without access to the interior of the instrument. A simpler operational test is included in Section 3 under User Confidence Tests.

NOTE

If the performance tests are to be considered valid, the following conditions must be met:

a. *The Signal Generator must have a 30-minute warmup.*
b. *The line voltage must be 100, 120, 220, or 240 Vac (+5%, −10%) from 48 to 440 Hz. The Voltage Selector Cam must be in the proper position. Refer to Figure 2-1.*
c. *The ambient temperature must be 0 to 55° C for the Level Accuracy and Flatness Test.*

4-2. EQUIPMENT REQUIRED

Equipment required for the performance tests is listed in Table 1-4, Recommended Test Equipment. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model(s).

4-3. PERFORMANCE TEST RECORD

You can record the results of the performance tests in the Performance Test Record, located at the end of this section. The Test Record lists all of the tested specifications and their acceptable limits. The results recorded at incoming inspection can be used for comparison in periodic maintenance and troubleshooting and after repairs or adjustments.

4-4. CALIBRATION CYCLE

The Signal Generator requires periodic verification of performance. Depending on the use and environmental conditions, the Signal Generator should be checked using the following performance tests at least once each year.

4-5. ABBREVIATED PERFORMANCE TESTING

In most cases, it is not necessary to perform all of the tests in this section. Table 4-1a and Table 4-1b show which tests are recommended for various situations. The User Confidence Tests in Section 3 should be the first step in all testing situations.

8656B 100 KHz to 990 MHz ±2ppm/year (50 MHz)
8657B 100 kHz to 2060 MHz ±2ppm/year Std Opt 001, 1×10^{-9} (45day warmup)

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4–6. TEST PROCEDURES

It is assumed that if you are performing the following tests, that you know how to operate the specified test equipment. Equipment settings, other than those for the Signal Generator, are stated in general terms. For example, a test might require that a spectrum analyzer's resolution bandwidth be set to 100 Hz; however, the time per division setting would not be specified and you would set that control so that the analyzer operates correctly.

It is also assumed that you will supply whatever cables, connectors, and adapters are necessary.

Table 4–1a. Abbreviated Performance Tests for HP 8656B and HP 8657A

Testing Situations	Section 3 Confidence Tests		Performance Test Number and Name				
			1	2	3	4	5
	Basic	HP-IB	Spectral Purity	Output Level Accuracy And Flatness	Modulation	Output Leakage	SWR
Incoming Inspection or Overall Performance Verification	X	X	X	X	X	X	X
After Complete Adjustment	X		X	X	X	X	X
After Repairs to Assembly:							
A1	X						
A2	X						
A3A1	X		X		FM		
A3	X						
A3	X		X		FM		
A3	X		X				
A3	X		X				
A3	X		X		FM		
A3	X		X		FM		
A3	X		X		FM		
A3	X		X				
A4	X		X				
A4	X		X				
A6	X		X	X	AM		
A6	X		X	X			
A8	X		X				
A9	X		X	X		X	X
A10	X						
A11	X			X	X		
A15	X						
A16	X						
FL1	X		X				

Table 4–1b. Abbreviated Performance Tests for HP 8657B

Testing Situations	Section 3 Confidence Tests		Performance Test Number and Name				
			1	2	3	4	5
	Basic	HP-IB	Spectral Purity	Output Level Accuracy And Flatness	Modulation	Output Leakage	SWR
Incoming Inspection or Overall Performance Verification	X	X	X	X	X	X	X
After Complete Adjustment	X		X	X	X	X	X
After Repairs to Assembly:							
A1	X						
A2	X						
A3A1	X		X		FM		
A3	X						
A3	X		X		FM		
A3	X		X				
A3	X		X				
A3	X		X		FM		
A3	X		X		FM		
A3	X		X		FM		
A3	X		X				
A4	X		X				
A4	X		X				
A6	X		X	X	AM		
A6	X		X	X			
A8	X		X				
A10	X		X	X	PULSE		X
A11	X				AM/FM		
A12	X		X	X	X		X
A13	X	X		X	X		
A14	X						
A15	X						
A16	X						
FL1	X		X				

Performance Test 1

SPECTRAL PURITY TESTS

- Spurious Signals
- Residual AM
- Residual FM
- SSB Phase Noise (1 Hz Bandwidth)

HP 8656B Specifications

Electrical Characteristics	Performance Limits	Conditions
Spurious Signals:		
Harmonics	< −30 dBc	≤ +7 dBm output levels 0.1 to 990 MHz
Non-harmonics	< −60 dBc	> 5 kHz from carrier in CW mode 0.1 to 990 MHz
Sub-harmonics	None	
Residual Modulation CW Mode:		
AM (0.5 to 15 kHz Post Detection Noise Bandwidth)	− 30 dBc	0.1 to 990 MHz
FM (0.3 to 3 kHz Post Detection Noise Bandwidth)	< 7 Hz rms < 2 Hz rms < 4 Hz rms < 7 Hz rms	0.1 to 123.5 MHz 123.5 to 247 MHz 247 to 494 MHz 494 to 990 MHz
FM (0.05 to 15 kHz Post Detection Noise Bandwidth)	< 15 Hz rms < 4 Hz rms < 8 Hz rms < 15 Hz rms	0.1 to 123.5 MHz 123.5 to 247 MHz 247 to 494 MHz 494 to 990 MHz
SSB Phase Noise		20 kHz offset from carrier
	< −114 dBc/Hz < −126 dBc/Hz < −120 dBc/Hz < −114 dBc/Hz	0.1 to 123.5 MHz 123.5 to 247 MHz 247 to 494 MHz 494 to 990 MHz

HP 8657A Specifications

Electrical Characteristics	Performance Limits	Conditions
Spurious Signals:		
Harmonics		≤ +7 dBm output levels
	< −30 dBc	0.1 to 1040 MHz
Non-harmonics		> 5 kHz to 2 MHz from carrier in CW mode
	< −60 dBc	0.1 to 130 MHz
	< −72 dBc	130 to 260 MHz
	< −66 dBc	260 to 520 MHz
	< −60 dBC	520 to 1040 MHz
Sub-harmonics	None	0.1 to 1040 MHz
Residual Modulation CW Mode:		
AM	< 0.04%	0.1 to 1040 MHz
(0.5 to 15 kHz Post Detection Noise Bandwidth)		
FM	< 4 Hz rms	0.1 to 130 MHz
(0.3 to 3 kHz Post Detection	< 1 Hz rms	130 to 260 MHz
Noise Bandwidth)	< 2 Hz rms	260 to 520 MHz
	< 4 Hz rms	520 to 1040 MHz
FM	< 6 Hz rms	0.1 to 130 MHz
(0.05 to 15 kHz Post Detection	< 1.5 Hz rms	130 to 260 MHz
Noise Bandwidth)	< 3 Hz rms	260 to 520 MHz
	< 6 Hz rms	520 to 1040 MHz
SSB Phase Noise		20 kHz offset from carrier
	< −124 dBc/Hz	0.1 to 130 MHz
	< −136 dBc/Hz	130 to 260 MHz
	< −130 dBc/Hz	260 to 520 MHz
	< −124 dBc/Hz	520 to 1040 MHz

HP 8657B Specifications

Electrical Characteristics	Performance Limits	Conditions
Spurious Signals:		
Harmonics		≤ +7 dBm output levels
	< –30 dBc	0.1 to 1030 MHz
	< –25 dBc	1030 to 2060 MHz
Non-harmonics		> 5 kHz to 2 MHz from carrier in CW mode
	< –63 dBc	0.1 to 130 MHz
	< –75 dBc	130 to 260 MHz
	< –66 dBc	260 to 520 MHz
	< –63 dBC	520 to 1030 MHz
	< –57 dBC	1030 to 2060 MHz
		≥ 2 MHz from carrier in CW mode
	< –60 dBC	0.1 to 1030 MHz
	< –54 dBC	1030 to 2060 MHz
Sub-harmonics	None	0.1 to 1030 MHz
	< –40 dBC	1030 to 1800 MHz
	< –35 dBC	1800 to 2060 MHz
Residual Modulation CW Mode:		
AM (0.5 to 15 kHz Post Detection Noise Bandwidth)	< 0.04%	0.1 to 2060 MHz
FM (0.3 to 3 kHz Post Detection Noise Bandwidth)	< 4 Hz rms	0.1 to 130 MHz
	< 1 Hz rms	130 to 260 MHz
	< 2 Hz rms	260 to 520 MHz
	< 3 Hz rms	520 to 1040 MHz
	< 6 Hz rms	1040 to 2060 MHz
FM (0.05 to 15 kHz Post Detection Noise Bandwidth)	< 6 Hz rms	0.1 to 130 MHz
	< 1.5 Hz rms	130 to 260 MHz
	< 3 Hz rms	260 to 520 MHz
	< 4 Hz rms	520 to 1040 MHz
	< 8 Hz rms	1040 to 2060 MHz
SSB Phase Noise		20 kHz offset from carrier
	< –124 dBc/Hz	0.1 to 130 MHz
	< –136 dBc/Hz	130 to 260 MHz
	< –130 dBc/Hz	260 to 520 MHz
	< –124 dBc/Hz	520 to 1040 MHz
	< –118 dBc/Hz	1040 to 2060 MHz

Description

Spurious signals are checked using a spectrum analyzer. Residual AM and FM Modulation are checked to 1300 MHz using a measuring receiver. SSB phase noise of the HP 8657A and HP 8657B is measured to 1600 MHz using a phase noise measurement system. SSB phase noise of the HP 8656B is measured by mixing the RF output of the Signal Generator and a Reference Signal in a double balanced mixer to eliminate the carrier and translate the noise spectrum to a low frequency where it can be viewed on a spectrum analyser. The output of the mixer is viewed on a spectrum analyser.

Equipment

Spectrum Analyzer ..... HP 8562B or HP 8555A/8552B/141T (Harmonics/Spurious Tests)
Measuring Receiver ..... HP 8902A (Option 003 for Optional Residual FM Tests)
Sensor Module ..... HP 11722A
Digital Multimeter ..... HP 3466A
Oscilloscope ..... HP 54501A
AM/FM Test Source ..... HP 11715A
Cable (UG-21D/U type N connectors) ..... HP 11500B
Cable (UG-88C/U BNC and dual banana plug connectors) ..... HP 11001-60001
Synthesized Signal Generator/(LO for Optional Residual FM Test) ..... HP 8662A
Phase Noise Measurement System ..... HP 3048A

Procedure

Spurious Signals Test

1. Set the spectrum analyzer as follows:

   Center Frequency ..... 100 kHz
   Frequency Span ..... 30 kHz
   Resolution Bandwidth ..... 300 Hz
   Reference Level ..... +7 dBm

2. Set the Signal Generator as follows:

   Frequency ..... 100 kHz
   Frequency Increment ..... 100 kHz
   Amplitude ..... +7 dBm
   Modulation ..... Off

NOTE

The Reference Level of both the Signal Generator and the Spectrum Analyser should be +4 dBm if the HP 8657B you are using is fitted with Pulse Modulation. Pulse Modulation is available as an option on the HP 8657B only.

3. Connect the RF OUTPUT of the Signal Generator to the input of the spectrum analyzer as shown in Figure 4-1. Verify that all harmonics are within the specifications shown in the following table.

Spurious Signals	Results			
	Actual	HP 8656B	HP 8657A	HP 8657B
Harmonics	_____	< –30 dBc	< –30 dBc	< –30 dBc (0.1 to 1030MHz) < –25 dBc (1030 to 2060MHz)
Non-Harmonics (≥ 2 MHz from carrier)	_____	< –60 dBc	< –60 dBc	< –60 dBc (0.1 to 1030MHz < –54 dBc (1030 to 2060 MHz)
5 kHz to 2 MHz from carrier	_____	< –60 dBc	< –60 dBc (0.1 to 130MHz)	< –63 dBc (0.1 to 130MHz)
	_____		< –72 dBc (130 to 260MHz) < –66 dBc (260 to 520MHz) < –60 dBc, 520 to 1040MHz	< –75 dBc (130 to 260MHz) < –66 dBc (260 to 520MHz) < –63 dBc (520 to 1030MHz) < –57 dBc (1030 to 2060 MHz)
Sub-Harmonics	_____	None	None	None, 0.1 to 1030 MHz < –40 dBc (1030 to 1800 MHz) < –35 dBc (1800 to 2060 MHz)

NOTE

Adjust the Center Frequency, Frequency Span, and Resolution Bandwidth controls as required.

Change the frequency increment from 100 kHz to 10 MHz at 10 MHz, if desired.

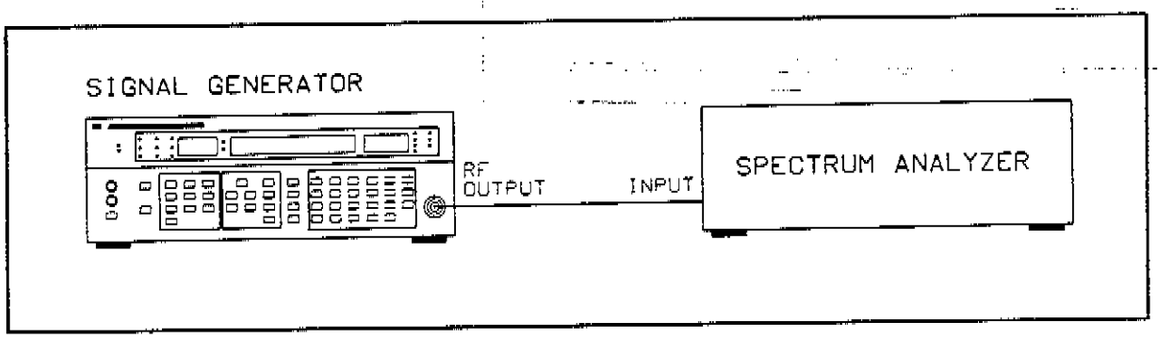


Figure 4–1. Spurious Signals Test Setup

Residual AM

4. Verify the residual AM of the measuring receiver as follows:

   a. Connect the modulation output of the measuring receiver to the input of the digital multimeter and the AM output of the AM/FM test source to the input of the measuring receiver as shown in Figure 4-2. Nothing should be connected to the audio input of the AM/FM test source.

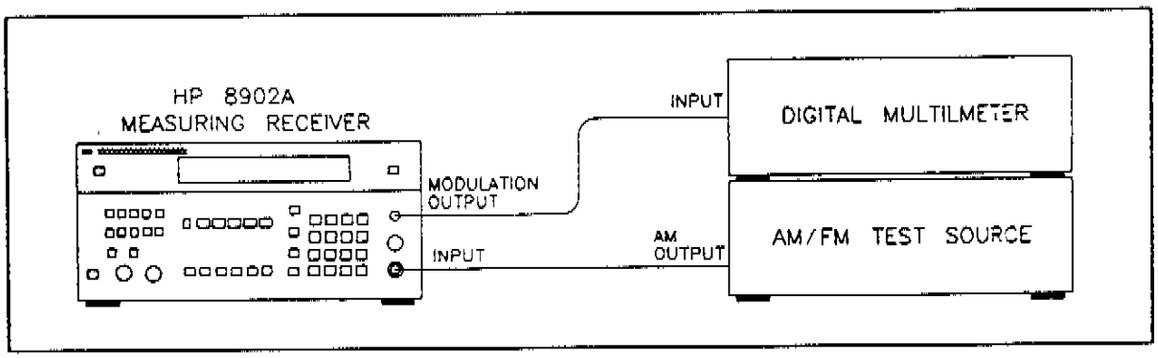


Figure 4–2. Measuring Receiver Residual AM Verification Test Setup

NOTE

The residual AM specification of the Signal Generator is not equivalent to the published specification of the HP 8902A Measuring Receiver. To make a valid residual AM measurement, the residual AM of the measuring receiver should be at least 3 dB better than the specification being tested. The residual AM of the Measuring Receiver must be verified to be adequate to measure the Signal Generator residual AM specification to ensure the validity of the measurement. If residual AM is measured frequently, it is not necessary to verify the residual AM of the measuring receiver each time; however, it is recommended that it be verified monthly to ensure an accurate measurement.

b. Set the measuring receiver as follows:

Measurement ..... Frequency

c. Set the AM/FM test source as follows:

Test Mode ..... FM

d. Tune the carrier frequency on the AM/FM test source for a measuring receiver reading of 12.5 ±0.1 MHz.

e. Set the digital multimeter as follows:

Function ..... Vac
Range ..... 200 mV

f. Set the measuring receiver as follows:

Measurement ..... AM
HP Filter ..... 50 Hz
LP Filter ..... 15 kHz

g. The digital multimeter should indicate 1.77 mV or less for an HP 8656B and 3.28 mV or less for an HP 8657A or HP 8657B.

NOTE

To make a valid residual AM measurement, the residual AM of the measuring receiver should be at least 3 dB better than the specification being tested.

5. Set the measuring receiver as follows:

Measurement	AM
Detector	Peak+
HP Filter	50 Hz
LP Filter	15 kHz
FM De-Emphasis	Off

6. Set the Signal Generator as follows:

Frequency	Any
Amplitude	0.0 dBm
Modulation	Off

7. Set the digital multimeter as follows:

Function	Vac
Range	200 mV

8. Connect the RF OUTPUT of the Signal Generator to the input of the measuring receiver and the modulation output of the measuring receiver to the input of the digital multimeter as shown in Figure 4-3.

9. The digital multimeter should indicate <1.77 mVrms for an HP 8656B and <3.28 mVrms for an HP 8657A or HP 8657B.

Actual	Maximum
_____	< 1.77 mVrms
_____	< 3.28 mVrms

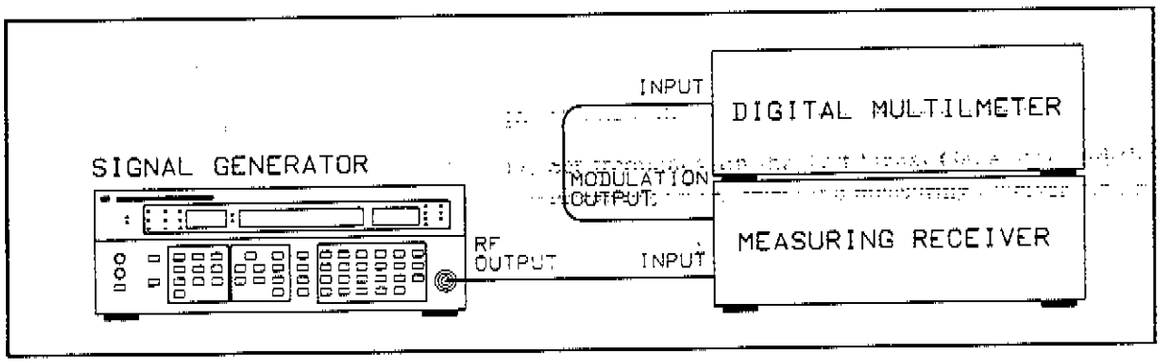


Figure 4–3. Residual AM Test Setup

Residual FM

NOTE

A standard HP 8902A can be used to verify the residual FM specifications in the heterodyne band of frequencies. Tests performed at these frequencies will verify that in all probability, the instrument meets its specifications. If the Signal Generator has been repaired or the heterodyne band of frequencies do not pass, the Optional Residual FM Test (steps 14-18) should be performed.

10. Set the measuring receiver as follows:

    Measurement ..... FM
    Detector ..... RMS
    FM De-Emphasis ..... Off
    Automatic Operation ..... Selected

11. Set the Signal Generator under test as follows:

    Frequency ..... Any From Chart
    Amplitude ..... 0.0 dBm
    Modulation ..... Off

12. Connect the RF OUTPUT of the Signal Generator under test to the input of the measuring receiver as shown in Figure 4-4.

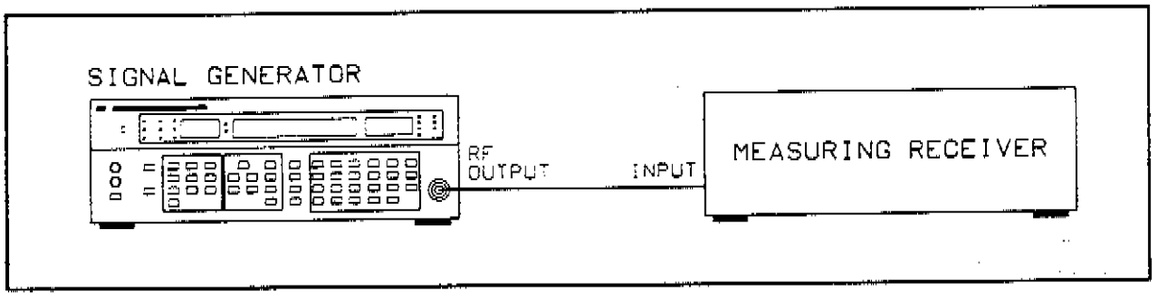


Figure 4–4. Residual FM Test Setup

13. Set the Signal Generator frequency and select the measuring receiver high-pass and low-pass filters as indicated in the following table. Verify that the measured results do not exceed the limits specified.

Signal Generator Frequency (MHz)	Modulation Analyzer Filter		Results (Hz rms)	
	High Pass (Hz)	Low Pass (kHz)	Actual	Max.
0.15 to 123.00000	300	3	_____	< 4
0.15 to 123.00000	50	15	_____	< 6

Optional Residual FM Test

The Residual FM Test gives confidence that the Signal Generator is passing all its Residual FM specifications. The Residual FM of the Signal Generator can be checked at all frequencies to 1300 MHz with an HP 8902A Option 003 and an external local oscillator (LO). The residual FM of the external LO must be less than the residual FM of the Signal Generator under test.

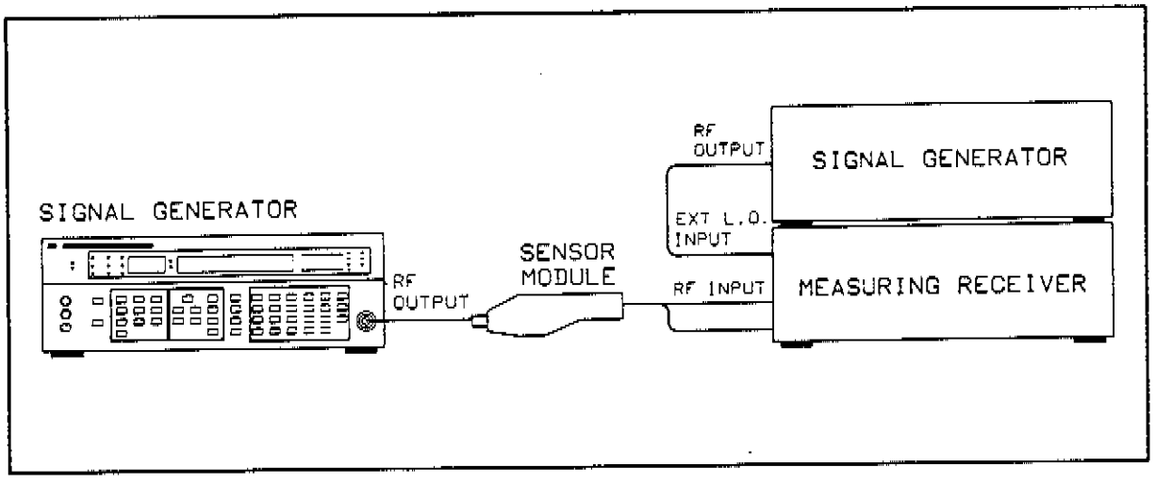


Figure 4–5. Optional Residual Test Setup

14. Set the measuring receiver as follows:

    Measurement ..... FM
    Detector ..... RMS
    FM De-Emphasis ..... Off
    Automatic Operation ..... Selected

15. Set the Signal Generator under test and the LO Signal Generator as follows:

    Frequency ..... Any From Chart
    Amplitude ..... 0.0 dBm
    Modulation ..... Off

16. Connect the test equipment as shown in Figure 4-5.

17. Set frequency on the Test Signal Generator and the LO Signal Generator as is shown in the following table. Select the measuring receiver high-pass filter for 300 Hz and the low-pass filter for 3 kHz. Verify that the measured results do not exceed the limits specified.

Optional Residual FM Test Specifications

Test Signal Generator Frequency (MHz)	LO Signal Generator Frequency (MHz)	Results (Hz rms)					
		HP 8656B		HP 8657A		HP 8657B	
		Actual	Max	Actual	Max	Actual	Max
120	121.5	____	7	____	4	____	4
150	151.5	____	2	____	1	____	1
300	301.5	____	4	____	2	____	2
600	601.5	____	7	____	4	____	3
1300	1301.5	N/A	N/A	N/A	N/A	____	6

18. Set frequency on the Test Signal Generator and the LO Signal Generator as is shown in the following table. Select the measuring receiver high-pass filter for 50 Hz and the low-pass filter for 15 kHz. Verify that the measured results do not exceed the limits specified.

Optional Residual FM Test Specifications

Test Signal Generator Frequency (MHz)	LO Signal Generator Frequency (MHz)	Results (Hz rms)					
		HP 8656B		HP 8657A		HP 8657B	
		Actual	Max	Actual	Max	Actual	Max
120	121.5	____	15	____	6	____	6
150	151.5	____	4	____	1.5	____	1.5
300	301.5	____	8	____	3	____	3
600	601.5	____	15	____	6	____	4
1300	1301.5	N/A	N/A	N/A	N/A	____	8

HP 8656B SSB PHASE NOISE (1 HZ BANDWIDTH)

Description

SSB phase noise is measured at Signal Generator RF Output frequencies from 200 KHz to 500 MHz (frequency range of the mixer) by mixing RF output and a reference in a double balanced mixer. The RF OUTPUT reference is set in quadrature (90x apart) so the mixer output is a dc component, and a high frequency component. The high frequency component is filtered out leaving the dc, which is proportional to the phase noise. The Signal Generator frequency is offset from the reference frequency by 20 KHz to set a reference on the spectrum analyzer. The Signal Generator frequency is then set to the reference frequency and amplitude to 0 dBm. The SSB phase noise is measured at the 20 KHz offset.

NOTE

This test measures the total SSB Phase Noise of both Generators. Therefore, the reference generator must have SSB Phase Noise less than or equal to the specifications for the Generator under test.

1. Connect the equipment as shown in figure 4-6.

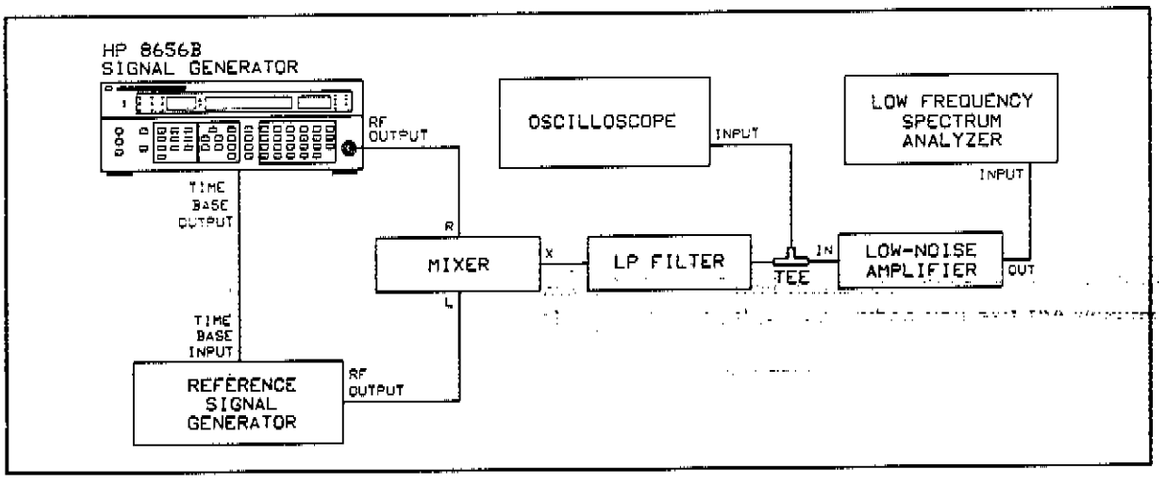


Figure 4–6. HP 8656B SSB Phase Noise Measurement Set-up

NOTE

The following symbols are used in the procedure.

f_{RF} = the RF output frequency where SSB phase noise will be measured.

f_{off} = the frequency offset from f_{RF} where SSB phase noise will be measured.

2. Set the reference generator frequency to f_{RF} and output level to +13 dBm. Set the Signal Generator under test to f_{RF} + f_{off} and output level to -50 dBm.
3. On the 8568A spectrum analyzer, set the REFERENCE LEVEL to -20 dBm, FREQUENCY SPAN to 1 kHz and view the signal at f_{off}.
4. Set the 8568A spectrum analyzer's reference level so the signal is 9 dB below the spectrum analyzer reference (-6 dB converts measured reading to SSB phase noise and -3 dB corrects for equal SSB phase noise RF sources).
5. Set the Signal Generator under test to f_{RF} and 0 dBm output Amplitude.
6. Set the frequency increment of the Signal Generator under test to 10 Hz.
7. Set the oscilloscope as follows:
   INPUT ..... CHAN A
   VOLTS/DIV ..... 0.1, dc
   DISPLAY ..... CHAN A
   TRIGGER ..... CHAN A
   TIME/DIV ..... 10 mSEC
8. Press the Signal Generator frequency Increment UP key and view the signal on the oscilloscope. The signal is a low frequency signal moving around ground level. Stop the signal at ground level (within 50 mV of ground) by pressing the frequency Increment DOWN key. The key sequence to increment the frequency UP and DOWN may have to be executed several times to stop the signal within 50 mV of ground. This sets the two input signals to the mixer in phase quadrature.
9. Set the spectrum analyzer to measure SSB Phase Noise in a 1 Hz bandwidth, select SHIFT (M) NORMAL keys, and to Video Averaging, select SHIFT (G) VIDEO BW, 1, 2, Hz keys.
10. The SSB Phase Noise is read directly from the spectrum analyzer display, -XXX dB in 1 Hz bandwidth plus the following correction:
    a. Take the difference between -50 dB and the spectrum analyzer reference.
    b. Add this difference to the spectrum analyzer -XXX dB in 1 Hz bandwidth to correct for the change in the attenuator setting of the Signal Generator under test.
11. Measured SSB Phase Noise should be at or below the specified value.

Offset from Carrier	HP 8656B SSB Phase Noise		Carrier Frequency (MHz)
	Min.	Actual	
20 kHz	–114 dBc/Hz	_____	0.1 to 123.5
	–126 dBc/Hz	_____	123.5 to 247
	–120 dBc/Hz	_____	247 to 494
	–114 dBc/Hz	_____	494 to 990

HP 8657A/57B SSB PHASE NOISE (1 HZ BANDWIDTH)

NOTE

This method of measuring Phase Noise is to be used on the **HP 8657A** *or* **HP 8657B** *only.*

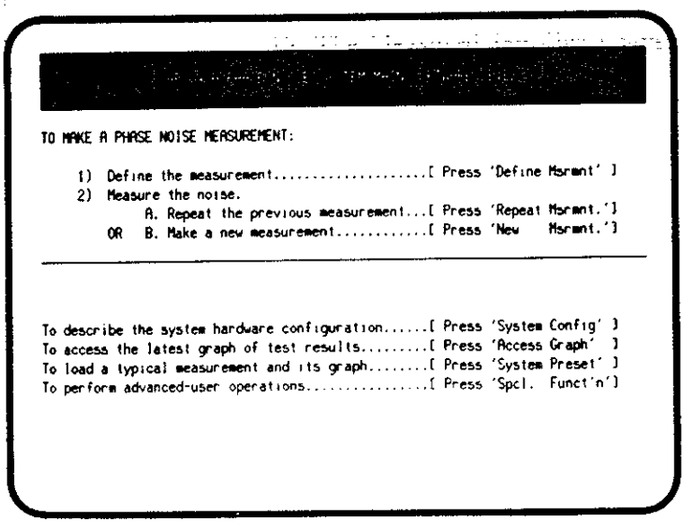
Description

Single-sideband (SSB) phase noise of the Signal Generator is measured at the offset frequency of 20 KHz and output frequencies to 1600 MHz by the HP 3048A Phase Noise System using its Phase Lock Loop measurement type. The system software provides both the measurement program and the BASIC operating system for the controller. This procedure provides the steps for entering the specific measurement parameters required for this test.

NOTE

This test measures the total SSB phase noise of both generators. This test assumes that the noise level of the reference source you are using is lower than or equal to the noise level of the Signal Generator being tested. If the reference source's phase noise level is equal to the Signal Generator's, the actual noise level for both sources is 3 dB below the level measured by the HP 3048A.

1. The HP 3048's BASIC operating system and system software must be loaded, the Signal Generator's HP-IB address entered, and system operation verified before this test is run. Refer to the HP 3048A Phase Noise Measurement System Operating Manual, Appendix A for the required procedures.
2. If you are not at the HP 3048A's Main Software Level, press the **Done** or **Abort** Softkey. The Main Software Level menu provides access to each of the HP 3048's main functions. You will always return to this menu when you exit the selected function.



Defining the Measurement

3. Press the **Define Msrmt** Softkey to display the Measurement Definition Menu.
4. Press the **Test Files** softkey.
5. Position the curser at the file labeled HP EXAMPLE RF SYNTHESIZER (8662/3 DCFM).
6. Press the **Load File** key. After the HP 3048A has completed the file loading sequence, press the **Done** key.

NOTE

This example file contains many of the measurement parameters required for this test. Table 4-2 lists the paramaters that have been loaded from this file. The following steps will guide you through the process of making the necessary changes to the parameters to meet the specific requirements of this test.

7. Press the **Instr Params** key. Enter a carrier frequency of 640 E+6 Hz. Enter a Detector/Disc. Input frequency of 640 E+6 Hz. Enter a VCO Tuning Constant of 1 E+3 Hz/volt. Enter the Voltage Tuning Range of VCO as 5 volts. The remaining entries do not need to be changed. Press the **Done** key.
8. Press the **Calibr Process** key. Press the **Tuning Const** key to select Compute from expected T. Constant. Press the **Done** key.
9. Press the **Source Control** key. Press the **Ref. Source** key as needed to select 8657B SYSTEM CNTRL. Press the **Done** key when you have completed this operation.

NOTE

The Signal Generator under test is configured as the reference source in this display to enable the HP 3048A to control it using control routines built into the HP 3048A's software. The measurement results will still reflect the noise level of the Signal Generator under test. If you are not able to select the Signal Generator as the reference source using the Ref. Source key, then the Signal Generator has not yet been entered into the HP 3048A's Configuration Table. To enter the Signal Generator, return to the Main Software Menu and press the **System Config** *key.*

10. Press the **Define Graph** key. Enter an appropriate graph title for your test. Press the **Done** key to exit this menu, and then press the **Done** key again to return to the Main Software level.

Beginning the Measurement

11. Press the **New Msrmnt** key to begin the phase noise measurement.
12. When the hardware connect diagram appears in the display, connect the Signal Generator and reference source to the HP 3048A as shown. (Note that the reference source is labeled USERS's DUT on the screen. Figure 4-7 also shows the cable connections for this measurement.)
13. Adjust the reference source's center frequency to 640 MHz and its amplitude to 0 dBm. (The Signal Generator's setting will be adjusted by the HP 3048A via its HP-IB connection.)

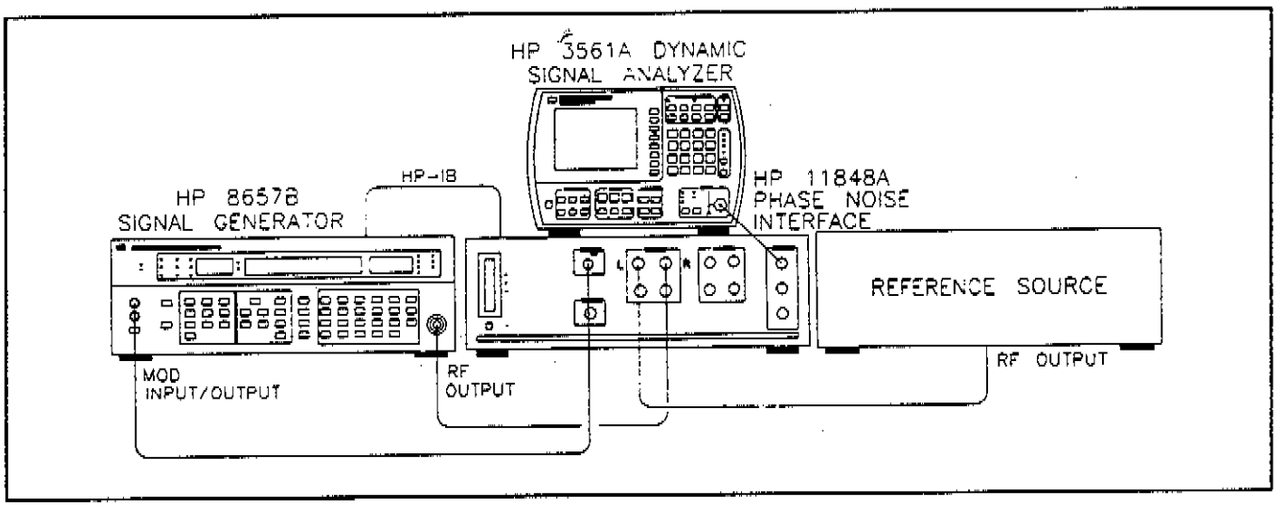


Figure 4–7. Setup Diagram for SSB Phase Noise Measurement

14. After you have connected the cables, press the **Proceed** key to run the measurement. (If you wish to measure the phase noise level of the Signal Generator at other center frequency settings after this test is completed, change the center frequency on the reference source to the desired frequency. Enter the desired frequency as the carrier frequency and detector/disc input frequency in the Source and Interface Parameter Entry menu.)

NOTE

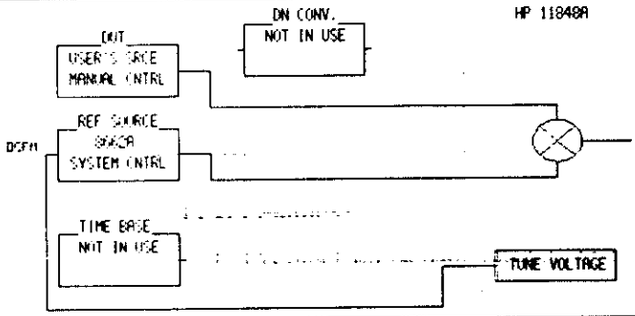
If the noise level measured by the HP 3048A exceeds the Signal Generator's specified noise level and the exact noise level of the reference source is not known, the exact level of each source should be determined by measuring each source against a third signal source and comparing the measurement results for all three measurements.

15. The Measured SSB Phase Noise should be at or below the specified value.

Offset from Carrier	HP 8657A SSB Phase Noise		Carrier Frequency (MHz)
	Min.	Actual	
20 kHz	–124 dBc/Hz	_____	0.1 to 129
	–136 dBc/Hz	_____	130 to 260
	–130 dBc/Hz	_____	260 to 520
	–124 dBc/Hz	_____	520 to 1040

Offset from Carrier	HP 8657B SSB Phase Noise		Carrier Frequency (MHz)
	Min.	Actual	
20 kHz	–124 dBc/Hz	_____	0.1 to 129
	–136 dBc/Hz	_____	130 to 260
	–130 dBc/Hz	_____	260 to 520
	–124 dBc/Hz	_____	520 to 1040
	–118 dBc/Hz	_____	1040 to 1600

Table 4–2. Parameter Data Loaded from HP Example RF Synthesizer (HP 8662/3 DCFM file)

Parameters	Data
Measurement Type **Frequency Range** Start Freq. Stop Freq. Averages	Phase Noise Using a Phase Lock Loop 1 Hz 100 E + 3 Hz 4
Source Parameters Carrier Frequency Detector/Discr. Input Frequency VCO Tuning Constant Center Voltage of VCO Tuning Curve Voltage Tuning Range of VCO VCO Tune-Port Input Resistance Internal Phase Detector	 500 E + 6 Hz 500 E + 6 Hz 25 E + 3 Hz/V 0 Volts ±2 Volts 600 ohms 5 MHz to 1600 MHz
Phase Detector Constant VCO Tuning Constant PLL Suppression	Measure the Detector Constant Measure the VCO Tuning Constant Will be verified
Source Control	
Define Graph Title Minimum X Maximum X Minimum Y Maximum Y Graph Type	 RF SYNTHESIZER VERSUS HP 8662/3A USING DC FM. 1 Hz 100 E + 3 Hz −170 0 Single Sideband Phase Noise (dBc/Hz)

Performance Test 2

OUTPUT LEVEL ACCURACY AND FLATNESS TESTS

- **Level Flatness**
- **Absolute Level Accuracy**

HP 8656B Specifications

Electrical Characteristics	Performance Limits	Conditions
Output		
Level Range (into 50 ohms)	+13 dBm to −127 dBm	100 kHz to 990 MHz
Resolution	0.1 dB	
Absolute Level Accuracy(1)	≤ ±1.0 dB	Output levels of +7 dBm to −124 dBm frequencies from 123.5 to 990 MHz
	< ±1.5 dB	100kHz to 123.5 MHz and output levels > +7dBm or < −124 dBm; frequencies 100kHz to 990 MHz
Level Flatness	≤ ±1.0 dB	Output level setting of 0.0 dBm; frequencies from 100 kHz to 990 MHz

(1) Absolute level accuracy includes allowances for detector linearity, temperature, flatness, attenuator accuracy, and measurement errors.

HP 8657A Specifications

Electrical Characteristics	Performance Limits	Conditions
Output		
Level Range (into 50 ohms)	+13 dBm to −143.5 dBm +10 dBm to −143.5 dBm	1 MHz to 1040 MHz 100 kHz to 1 MHz
Resolution	0.1 dB	
Absolute Level Accuracy(1)	≤ ±1.0 dB	Output levels of +7 dBm to −127 dBm
	< ±1.5 dB	> +7 dBm
Level Flatness	≤ ±0.5 dB	Output level setting of 0.0 dBm; frequencies from 100 kHz to 1040 MHz

(1) Absolute level accuracy includes allowances for detector linearity, temperature, flatness, attenuator accuracy, and measurement errors.

HP 8657B Specifications

Electrical Characteristics	Performance Limits	Conditions
Output		
Level Range (into 50 ohms)	+13 dBm to −143.5 dBm +10 dBm to −143.5 dBm	100 kHz to 2060 MHz Opt 003
Resolution	0.1 dB	
Absolute Level Accuracy(1)	≤ ±1.0 dB	Output levels of +3.5 dBm to −127 dBm
	< ±1.5 dB	> +3.5 dBm
Level Flatness	≤ ±0.5 dB	Output level setting of 0.0 dBm; frequencies from 100 kHz to 2060 MHz

(1) Absolute level accuracy includes allowances for detector linearity, temperature, flatness, attenuator accuracy, and measurement errors.

Description

Output level accuracy and flatness are verified using a measuring receiver and a sensor module.

Equipment

Measuring Receiver ..... HP 8902A
Sensor Module ..... HP 11722A

Procedure

Level Flatness

1. Connect the sensor module to the measuring receiver. Zero and calibrate the sensor module and measuring receiver.
2. Connect the sensor module to the Signal Generator as shown in Figure 4-8.

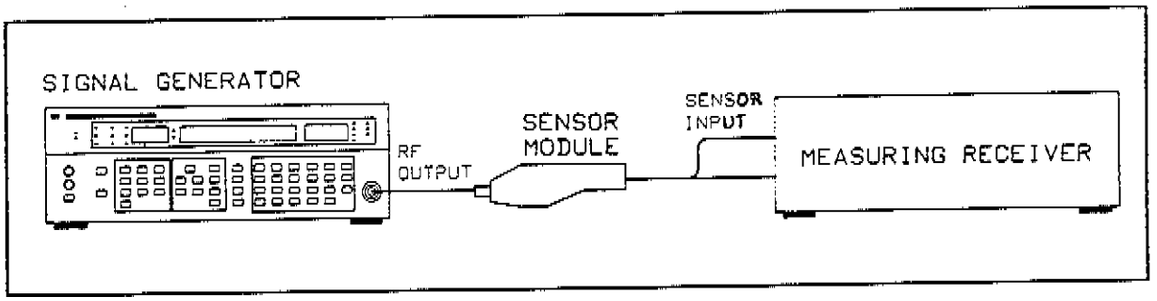


Figure 4–8. Output Level Accuracy and Flatness Test Setup

3. Set the measuring receiver as follows:

Measurement	RF POWER
Display	LOG
Frequency	100 kHz

4. Set the Signal Generator as follows:

Frequency	100 kHz
Amplitude	0.0 dBm
Modulation	Off

5. Wait for the power measurement to settle and then select DISPLAY RATIO on the measuring receiver to set a 0.0 dB. reference.

6. Set a Frequency Increment value on the Measuring Receiver and Signal Generator according to the frequency band of the measurements. Frequency Increment on the measuring receiver is set by entering the numeric value in kHz and pressing the kHz (up or down) keys. Upon entering that value the measuring receiver will also change the center frequency by that amount, the Signal Generator should be stepped to match. Dependant on the Signal Generator model under test, use increments of 100 kHz (100 kHz to 1 MHz), 1 MHz (1 MHz to 10 MHz), 10 MHz (10 MHz to 100 MHz), 100 MHz (100 MHz to 2000 MHz), and 60 MHz (2000 MHZ to 2060 MHz).

7. Step the Signal Generator and measuring receiver through the frequency range. Ranges are:

- 100 kHz to 990 MHz for an HP 8656B
- 100 kHz to 1040 MHz for an HP 8657A
- 100 kHz to 2060 MHz for an HP 8657B

Record the highest and lowest power levels and their frequencies and calculate the maximum variation.

_____ Highest Reading _____ Frequency

_____ Lowest Reading _____ Frequency

The amplitude variation should not exceed 2.0 dB for the HP 8656B and 1.0 dB for the HP 8657A/8657B. Record the maximum variation (highest reading – lowest reading).

_____ <2.0 dB (HP 8656B only)

_____ <1.0 dB (HP 8657A/8657B only)

8. Step the Signal Generator and measuring receiver through the following frequency ranges:

Model	Range A	Range B
HP 8656B	3 MHz to 123.5 MHz	123.5 MHz to 990 MHz
HP 8657A	3 MHz to 123.5 MHz	123.5 MHz to 1040 MHz
HP 8657B	3 MHz to 123.5 MHz	123.5 MHz to 2060 MHz

Record the highest and lowest reading from both ranges to be used in the Absolute Level Accuracy test below.

HP 8656B only

_____ Highest Reading (Range A) _____ Test Frequency 1

_____ Lowest Reading (Range A) _____ Test Frequency 2

_____ Highest Reading (Range B) _____ Test Frequency 3

_____ Lowest Reading (Range B) _____ Test Frequency 4

HP 8657A or HP 8657B only

_____ Overall Highest Reading (Ranges A & B) _____ Test Frequency 3

_____ Overall Lowest Reading (Ranges A & B) _____ Test Frequency 4

Absolute Level Accuracy

9. Set the Signal Generator as follows:

Frequency ..... From Step 8
Amplitude ..... +13 dBm
Amplitude Increment ..... 5 dBm
Modulation ..... Off

10. Set the measuring receiver as follows:

Measurement ..... RF POWER

11. Absolute Level Accuracy must be tested on the Signal Generator using the frequencies from step 8. Begin decrementing the Signal Generator amplitude in 5 dB steps. At each step, the measuring receiver reading must be within the tolerances shown in the following Table, RF Output Frequencies. Step the amplitude down to −2 dBm. Change the measuring receiver's measurement to TUNED RF LEVEL. If RECAL or UNCAL is displayed press and release the CALIBRATE key. Continue to step the amplitude down to −127 dBm; and each time RECAL is displayed press and release the CALIBRATE key.

RF Output Test Frequency 1 _____ *RF Output Test Frequency 3* _____
RF Output Test Frequency 2 _____ *RF Output Test Frequency 4* _____

All Models	HP 8656B Only (100 kHz to 123.5 MHz)				HP 8656B (> 123.5 MHz), HP 8657A, HP 8657B			
Amplitude Setting (dBm)	Minimum (dBm)	Maximum (dBm)	Actual (dBm)		Minimum (dBm)	Maximum (dBm)	Actual (dBm)	
			Freq 1	Freq 2			Freq 3	Freq 4
+13.0[1]	+11.5	+14.5			+11.5	+14.5		
+8.0	+6.5	+9.5			+6.5	+9.5		
+3.0	+1.5	+4.5			+2.0	+4.0		
−2.0	−3.5	−0.5			−3.0	−1.0		
−7.0	−8.5	−5.5			−8.0	−6.0		
−12.0	−13.5	−10.5			−13.0	−11.0		
−17.0	−18.5	−15.5			−18.0	−16.0		
−22.0	−23.5	−20.5			−23.0	−21.0		
−27.0	−28.5	−25.5			−28.0	−26.0		
−32.0	−33.5	−30.5			−33.0	−31.0		
−37.0	−38.5	−35.5			−38.0	−36.0		
−42.0	−43.5	−40.5			−43.0	−41.0		
−47.0	−48.5	−45.5			−48.0	−46.0		
−52.0	−53.5	−50.5			−53.0	−51.0		
−57.0	−58.5	−55.5			−58.0	−56.0		
−62.0	−63.5	−60.5			−63.0	−61.0		
−67.0	−68.5	−65.5			−68.0	−66.0		
−72.0	−73.5	−70.5			−73.0	−71.0		
−77.0	−78.5	−75.5			−78.0	−76.0		
−82.0	−83.5	−80.5			−83.0	−81.0		
−87.0	−88.5	−85.5			−88.0	−86.0		
−92.0	−93.5	−90.5			−93.0	−91.0		
−97.0	−98.5	−95.5			−98.0	−96.0		
−102.0	−103.5	−100.5			−103.0	−101.0		
−107.0	−108.5	−105.5			−108.0	−106.0		
−112.0	−113.5	−110.5			−113.0	−111.0		
−117.0	−118.5	−115.5			−118.0	−116.0		
−122.0	−123.5	−120.5			−123.0	−121.0		
−127.0	−128.5	−125.5			−128.0[2]	−126.0[2]		
−127.0					−128.5[3]	−125.5[3]		

[1] +13.0 dBm does not apply to HP 8657B with Pulse Modulation installed.
[2] HP 8657A and HP 8657B only.
[3] HP 8656B only < − 124.0 dBm.

Performance Test 3

MODULATION TESTS

- **AC Modulation**
  - AM Indicator Accuracy
  - Incidental Phase Modulation
  - AM Distortion
  - FM Indicator Accuracy
  - Incidental AM
  - FM Distortion
- **DC Modulation**
  - DC FM Center Frequency Accuracy
  - DC FM Center Frequency Stability
- **Pulse Modulation (HP 8657B only)**
  - ON OFF Ratio
  - Rise/Fall Time

HP 8656B Specifications

Electrical Characteristics	Performance Limits	Conditions
Amplitude Modulation		
Depth[1]	0 to 99%	Output levels ≤ +7 dBm; frequencies from 100 kHz to 990 MHz
	0 to 30%	Output levels ≤ +10 dBm; frequencies from 100 kHz to 990 MHz
Resolution	1%	
Incidental Phase Modulation	< 0.3 radian peak	30% AM depth and internal rates
Indicator Accuracy[1]	± (4% of setting + 2%)	Depths < 90% and internal rates and levels ≤ +7 dBm
AM Rates:		
Internal	400 and 1 kHz, ± 3%	
External	20 Hz to 40 kHz	1 dB bandwidth, ac coupled
AM Distortion (internal rates)	< 1.5%	0 to 30% AM
	< 3%	31 to 70% AM
	< 4%	71 to 90% AM
FM Modulation		
Maximum Peak Deviation (Δfpk):[2]		
Rates ≥ 25 Hz (ac mode)	99 kHz	0.1 to 123.5 MHz (fc)
Rates ≥ 50 Hz (ac mode)	50 kHz	123.5 to 247 MHz (fc)
Rates ≥ 50 Hz (ac mode)	99 kHz	247 to 494 MHz (fc)
Rates ≥ 25 Hz (ac mode)	99 kHz	494 to 990 MHz (fc)

(1) AM Depth is further limited by the Indicator Accuracy specification.
(2) FM deviation is further limited by the Indicator Accuracy specification.

HP 8656B Specifications (Continued)

Electrical Characteristics	Performance Limits	Conditions
FM Modulation (Cont'd)		
Maximum Peak Deviation (Δfpk):[2] (Cont'd)		
Rates < 25 Hz (ac mode)	4000 × Rate Hz	0.1 to 123.5 MHz (fc)
Rates < 50 Hz (ac mode)	1000 × Rate Hz	123.5 to 247 MHz (fc)
Rates < 50 Hz (ac mode)	2000 × Rate Hz	247 to 494 MHz (fc)
Rates < 25 Hz (ac mode)	4000 × Rate Hz	494 to 990 MHz (fc)
Rates (dc mode)	99 kHz	0.1 to 123.5 MHz (fc)
	50 kHz	123.5 to 247 MHz (fc)
	99 kHz	247 to 494 MHz (fc)
	99 kHz	494 to 990 MHz (fc)
Center Frequency Accuracy (dc mode)	± 500 Hz	0.1 to 123.5 MHz (fc)
	± 125 Hz	123.5 to 247 MHz (fc)
	± 250 Hz	247 to 494 MHz (fc)
	± 500 Hz	494 to 990 MHz (fc)
Stability (dc mode)	< 10 Hz/hour	
Resolution	0.1 kHz	Deviations < 10 kHz
	1 kHz	Deviations ≥ 10 kHz
Incidental AM		< 20 kHz peak deviation and internal rates:
	< 0.1%	> 500 kHz (fc)
	< 1.0%	200 to 500 kHz (fc)
	< 5.0%	< 200 kHz (fc)
Indicator Accuracy[2]	± 5% of reading	At internal rates
FM Distortion (Total Harmonic Distortion)[3,4]	< 0.5%	≥ 3 kHz peak deviations and at internal rates
FM Rates:		
Internal	400 and 1 kHz, ± 3%	
External	dc to 50 kHz	ac coupled, ± 1 dB 20 Hz to 50 kHz
	dc to 100 kHz	± 3 dB

(2) FM deviation is further limited by the Indicator Accuracy specification.

(3) FM distortion only applies at deviations up to 25 kHz for 123.5 < f_c < 247 MHz, and 50 kHz for 247 < f_c < 494 MHz. Typical total FM distortion (harmonic and non-harmonic) is less that 1.5% for all specified deviations and external rates of dc to 100 kHz.

(4) Typically < 0.5% THD for peak deviations > 1 kHz and at internal rates.

HP 8657A Specifications

Electrical Characteristics	Performance Limits	Conditions
Amplitude Modulation		
Depth[1]	0 to 99%	Output levels ≤ +7 dBm; frequencies from 100 kHz to 1040 MHz
	0 to 30%	Output levels ≤ +10 dBm; frequencies from 100 kHz to 1040 MHz
Resolution	1%	
Incidental Phase Modulation	< 0.3 radian peak	30% AM depth and internal rates.
Indicator Accuracy[1]	± (6% of setting + 2%)	Depths < 90% and internal rates and levels ≤ +7 dBm.
AM Rates:		
Internal	400 and 1 kHz, ± 3%	
External	20 Hz to 40 kHz	1 dB bandwidth, ac coupled
AM Distortion (internal rates)	< 1.5%	0 to 30% AM
	< 3%	31 to 70% AM
	< 4%	71 to 90% AM
FM Modulation		
Maximum Peak Deviation (Δfpk):[2]		
Rates ≥ 25 Hz (ac mode)	99 kHz	0.1 to 130 MHz (fc)
Rates ≥ 50 Hz (ac mode)	50 kHz	130 to 260 MHz (fc)
Rates ≥ 50 Hz (ac mode)	99 kHz	260 to 520 MHz (fc)
Rates ≥ 25 Hz (ac mode)	99 kHz	520 to 1040 MHz (fc)
Rates < 25 Hz (ac mode)	4000 × Rate Hz	0.1 to 130 MHz (fc)
Rates < 50 Hz (ac mode)	1000 × Rate Hz	130 to 260 MHz (fc)
Rates < 50 Hz (ac mode)	2000 × Rate Hz	260 to 520 MHz (fc)
Rates < 25 Hz (ac mode)	4000 × Rate Hz	520 to 1040 MHz (fc)
Rates (dc mode)	99 kHz	0.1 to 130 MHz (fc)
	50 kHz	130 to 260 MHz (fc)
	99 kHz	260 to 520 MHz (fc)
	99 kHz	520 to 1040 MHz (fc)
Center Frequency Accuracy (dc mode)	± 500 Hz	0.1 to 130 MHz (fc)
	± 125 Hz	130 to 260 MHz (fc)
	± 250 Hz	260 to 520 MHz (fc)
	± 500 Hz	520 to 1040 MHz (fc)

(1) AM Depth is further limited by the Indicator Accuracy specification.
(2) FM deviation is further limited by the Indicator Accuracy specification.

HP 8657A Specifications (Continued)

Electrical Characteristics	Performance Limits	Conditions
FM Modulation (Cont'd)		
Maximum Peak Deviation (Δfpk):[2] (Cont'd)		
Stability (dc mode)	< 10 Hz/hour	
Resolution	0.1 kHz 1 kHz	Deviations < 10 kHz Deviations ≥ 10 kHz
Incidental AM	< 0.1%	< 20 kHz peak deviation and internal rates: ≥ 500 kHz (fc)
Indicator Accuracy[2]	± 5% of reading	At internal rates
FM Distortion (Total Harmonic Distortion)[3,4]	< 0.5%	≥ 3 kHz peak deviations and at internal rates
FM Rates:		
Internal	400 and 1 kHz, ± 2%	
External	dc to 50 kHz dc to 100 kHz	ac coupled, ± 1 dB 20 Hz to 50 kHz ± 3 dB

(2) FM deviation is further limited by the Indicator Accuracy specification.
(3) FM distortion only applies at deviations up to 25 kHz for 130 < f_c < 260 MHz, and 50 kHz for 260 < f_c < 520 MHz. Typical total FM distortion (harmonic and non-harmonic) is less that 1.5% for all specified deviations and external rates of dc to 100 kHz.
(4) Typically < 0.5% THD for peak deviations > 1 kHz and at internal rates.

HP 8657B Specifications

Electrical Characteristics	Performance Limits	Conditions
Amplitude Modulation		
Depth[1,2]	0 to 100%	Output levels ≤ +7 dBm; frequencies from 400 kHz to 2060 MHz
	0 to 30%	Output levels ≤ +10 dBm; frequencies from 400 kHz to 2060 MHz
Resolution	1%	
Incidental Phase Modulation	< 0.3 radian peak	30% AM depth and internal rates.
Indicator Accuracy[1]	± (6% of setting + 2%)	Depths < 90% and internal rates and levels ≤ +7 dBm.
AM Rates		
Internal	400 and 1 kHz, ± 2%	
External	20 Hz to 40 kHz	1 dB bandwidth, ac coupled
AM Distortion, 1 kHz internal rate	< 1.5%	0 to 30% AM frequencies <1030
Levels ≥ 7 dBm	< 3%	31 to 70% AM frequencies <1030
	< 4%	71 to 90% AM frequencies <1030
	< 4%	0 to 30% AM frequencies >1030
	< 4%	31 to 70% AM frequencies >1030
	< 7%	71 to 90% AM frequencies >1030
FM Modulation		
Maximum Peak Deviation (Δfpk):[3]		
20 Hz to 50 kHz	200 kHz	0.1 to 130 MHz (fc)
1 dB Bandwidth	50 kHz	130 to 260 MHz (fc)
	100 kHz	260 to 520 MHz (fc)
	200 kHz	520 to 1040 MHz (fc)
	400 kHz	1040 to 2060 MHz (fc)
	4000 × Rate Hz	0.1 to 130 MHz (fc)
	1000 × Rate Hz	130 to 260 MHz (fc)
	2000 × Rate Hz	260 to 520 MHz (fc)
	4000 × Rate Hz	520 to 1040 MHz (fc)
	8000 × Rate Hz	1040 to 2060 MHz (fc)
Rates (dc mode)	200 kHz	0.1 to 130 MHz (fc)
	50 kHz	130 to 260 MHz (fc)
	100 kHz	260 to 520 MHz (fc)
	200 kHz	520 to 1040 MHz (fc)
	400 kHz	1040 to 2060 MHz (fc)
Center Frequency Accuracy (dc mode)	± 500 Hz	0.1 to 130 MHz (fc)
	± 125 Hz	130 to 260 MHz (fc)
	± 250 Hz	260 to 520 MHz (fc)
	± 500 Hz	520 to 1040 MHz (fc)
	± 1000 Hz	1040 to 2060 MHz (fc)

(1) AM Depth is further limited by the Indicator Accuracy specification.
(2) When Opt. 003 is installed, output level in AM is reduced by 3 dB when f_c is <1030 MHz.
(3) FM deviation is further limited by the Indicator Accuracy specification.

HP 8657B Specifications (Continued)

Electrical Characteristics	Performance Limits	Conditions
FM Modulation (Cont'd)		
Maximum Peak Deviation (Δfpk):[3] (Cont'd)		
Stability (dc mode)	< 10 Hz/hour	
Resolution	0.1 kHz	Deviations < 100 kHz, fc <1030 MHz
	1 kHz	Deviations ≥ 100 kHz, fc <1030 MHz
	0.2 kHz	Deviations < 100 kHz, fc >1030 MHz
	2 kHz	Deviations ≥ 100 kHz, fc >1030 MHz
Incidental AM		< 20 kHz peak deviation and internal rates:
	< 0.1%	500 kHz to 1030 MHz
	< 0.5%	1030 MHz to 2060 MHz
Indicator Accuracy[3]	± 5% of reading	At internal 1kHz rate
FM Distortion (Total Harmonic Distortion)[4]	< 0.5%	≥ 6 kHz peak deviations and at internal 1kHz rate
FM Rates:		
Internal	400 and 1 kHz, ± 2%	
External	20 Hz to 50 kHz	ac coupled, ± 1 dB.
	5 Hz to 100 kHz	± 3 dB.
External	dc to 50 kHz	dc coupled, ± 1 dB.
	dc to 100 kHz	± 3 dB.
Pulse Modulation		
ON/OFF Ratio:		
	> 70 dB	< 1030 MHz:
	> 95 dB	≥ 1030 MHz:
Rise/Fall Time:	< 35 ns	< 1030 MHz
	< 50 ns	≥ 1030 MHz

[3] FM deviation is further limited by the Indicator Accuracy specification.

[4] FM distortion only applies at deviation at 1/2 maximum, f_c <520 MHz. Typical total FM distortion (harmonic and non-harmonic) is less that 1.5% for all specified deviations and external rates of dc to 100 kHz.

AC MODULATION

Description

AC modulation specifications are verified by measuring the specified parameters with a measuring receiver. Distortion is verified by measuring the demodulated output from the measuring receiver with a distortion analyzer.

Equipment

Measuring Receiver ..... HP 8902A
Sensor Module ..... HP 11722A
Audio Analyzer and Source ..... HP 8903B
AM/FM Test Source ..... HP 11715A
Cable (UG-21D/U type N connectors) ..... HP 11500B
Cable (UG-88C/U BNC and dual banana plug connectors ..... HP 11001-60001

Procedure

AM Indicator Accuracy

1. Connect the RF OUTPUT of the Signal Generator to the input of the measuring receiver as shown in Figure 4-9.

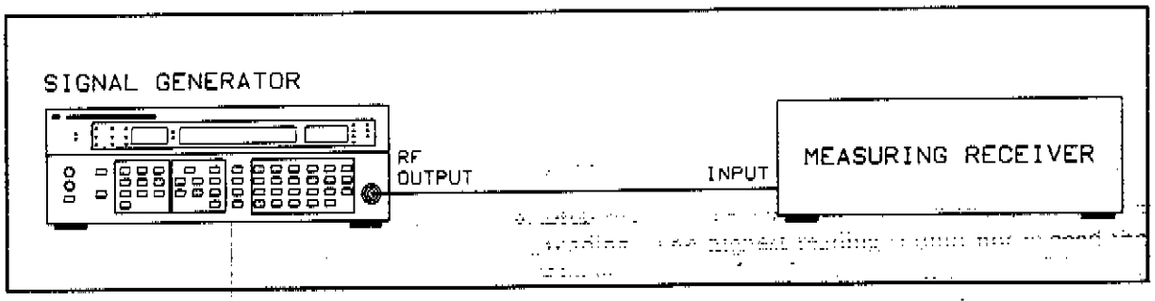


Figure 4–9. Modulation Test Setup

2. Set the measuring receiver as follows:

Measurement ..... AM
Detector ..... Peak+ and Peak -
HP Filter ..... 300 Hz
LP Filter ..... 15 kHz
FM De-Emphasis ..... Off
Automatic Operation ..... Selected

3. Set the Signal Generator as follows:

Frequency ..... 100 MHz
Amplitude (HP 8656B/8657A) ..... +7 dBm
Amplitude (HP 8657B) ..... +4 dBm
Amplitude (HP 8657B (with Pulse Modulation installed)) ..... +1 dBm
Modulation ..... 1 kHz (Int.) AM 10%

4. Set the AM depth to the values listed in the following table and verify that the measured results are within the limits specified.

MHz	AM Depth	Results				
		Min.		Actual	Max.	
		HP 8656B	HP8657A HP8657B		HP 8656B	HP 8657A HP8657B
100	10% 30% 70% 90%	7.6% 26.8% 65.2% 84.4%	7.4% 26.2% 63.8% 82.6%	_____ _____ _____ _____	12.4% 33.2% 74.8% 95.6%	12.6% 33.8% 76.2% 97.4%
240	10% 30% 70% 90%	7.6% 26.8% 65.2% 84.4%	7.4% 26.2% 63.8% 82.6%	_____ _____ _____ _____	12.4% 33.2% 74.8% 95.6%	12.6% 33.8% 76.2% 97.4%
400	10% 30% 70% 90%	7.6% 26.8% 65.2% 84.4%	7.4% 26.2% 63.8% 82.6%	_____ _____ _____ _____	12.4% 33.2% 74.8% 95.6%	12.6% 33.8% 76.2% 97.4%
990	10% 30% 70% 90%	7.6% 26.8% 65.2% 84.4%	7.4% 26.2% 63.8% 82.6%	_____ _____ _____ _____	12.4% 33.2% 74.8% 95.6%	12.6% 33.8% 76.2% 97.4%
1030 (HP 8657A & HP 8657B only)	10% 30% 70% 90%	N/A	7.4% 26.2% 63.8% 82.6%	_____ _____ _____ _____	N/A	12.6% 33.8% 76.2% 97.4%
1040 (HP 8657A & HP 8657B only)	10% 30% 70% 90%	N/A	7.4% 26.2% 63.8% 82.6%	_____ _____ _____ _____	N/A	12.6% 33.8% 76.2% 97.4%
1300 (HP 8657B only)	10% 30% 70% 90%	N/A	7.4% 26.2% 63.8% 82.6%	_____ _____ _____ _____	N/A	12.6% 33.8% 76.2% 97.4%

5. Select the measuring receiver's 50 Hz high-pass filter. Set the AM depth to the values listed in the following table and verify that the measured results are within the limits specified with the Signal Generator frequency at 100 MHz and internal 400 Hz AM modulation.

MHz	AM Depth	Results				
		Min.		Actual	Max.	
		HP 8656B	HP8657A HP8657B		HP 8656B	HP 8657A HP 8657B
100	10%	7.6%	7.4%	_____	12.4%	12.6%
	30%	26.8%	26.2%	_____	33.2%	33.8%
	70%	65.2%	63.8%	_____	74.8%	76.2%
	90%	84.4%	82.6%	_____	95.6%	97.4%

Incidental Phase Modulation

6. Set the measuring receiver as follows:

Measurement ..... Phase Modulation
HP Filter ..... 300 Hz
LP Filter ..... 15 kHz
Detector ..... Peak+

7. Set the Signal Generator as follows:

Frequency ..... 150 kHz
Frequency Increment ..... 150 kHz
Amplitude (HP 8656B/8657A) ..... +7 dBm
Amplitude (HP 8657B) ..... +4 dBm
Amplitude (HP 8657B with Pulse Modulation installed) ..... +1 dBm
Modulation ..... 1 kHz (Int.) AM 30%

8. Step the Signal Generator through the frequency range from 150 kHz and record the highest reading. The highest reading should not exceed the limit specified. Dependant on the Signal Generator model under test, use increments of 50 kHz (150 kHz to 200 kHz), 100 kHz (200 kHz to 1 MHz), 1 MHz (1 MHz to 10 MHz), 10 MHz (10 MHz to 100 MHz), 100 MHz (100 MHz to 2000 MHz), and 60 MHz (2000 MHZ to 2060 MHz).

Model	Frequency		Result	
	Min.	Max.	Actual	Max.
HP 8656B	150 kHz	990 MHz	_____	< 0.3 radian peak
HP 8657A	150 kHz	1040 MHz	_____	< 0.3 radian peak
HP 8657B	150 kHz	1300 MHz	_____	< 0.3 radian peak

AM Distortion

9. Set the Measuring Receiver as follows:

Measurement ..... AM
HP Filter ..... 300 Hz
LP Filter ..... 15 kHz
Detector ..... Peak+ and Peak-

10. Set the Audio Analyzer as follows:

    Measurement ..... Distortion

11. Set the Signal Generator as follows:

    Frequency ..... 10 MHz
    Amplitude (HP 8656B/8657A) ..... +7 dBm
    Amplitude (HP 8657B) ..... +4 dBm
    Amplitude (HP 8657B (with Pulse Modulation installed)) ..... +1 dBm
    Modulation ..... 1 kHz (Int.) AM 30%

12. Set the AM depth to the values listed in the following table and verify that the measured results do not exceed the limits specified.

MHz	AM Depth	Results			
		Actual	Max.		
			HP 8656B	HP 8657A	HP 8657B
100	30% 70% 90%	_____ _____ _____	< 1.5% < 3.0% < 4.0%	< 1.5% < 3.0% < 4.0%	< 1.5% < 3.0% < 4.0%
240	30% 70% 90%	_____ _____ _____	< 1.5% < 3.0% < 4.0%	< 1.5% < 3.0% < 4.0%	< 1.5% < 3.0% < 4.0%
400	30% 70% 90%	_____ _____ _____	< 1.5% < 3.0% < 4.0%	< 1.5% < 3.0% < 4.0%	< 1.5% < 3.0% < 4.0%
990	30% 70% 90%	_____ _____ _____	< 1.5% < 3.0% < 4.0%	< 1.5% < 3.0% < 4.0%	< 1.5% < 3.0% < 4.0%
1030	30% 70% 90%	_____ _____ _____	N/A	< 1.5% < 3.0% < 4.0%	< 4.0% < 4.0% < 7.0%
1040	30% 70% 90%	_____ _____ _____	N/A	< 1.5% < 3.0% < 4.0%	< 4.0% < 4.0% < 7.0%
1300	30% 70% 90%	_____ _____ _____	N/A	N/A	< 4.0% < 4.0% < 7.0%

FM Indicator Accuracy

13. Set the measuring receiver as follows:

    Measurement ..... FM
    Detector ..... Peak+
    HP Filter ..... 300 Hz
    LP Filter ..... 3 kHz

14. Set the Signal Generator as follows:

    Frequency ..... 100 MHz
    Amplitude (HP 8656B/8657A) ..... +7 dBm
    Amplitude (HP 8657B) ..... +4 dBm
    Amplitude (HP 8657B (with Pulse Modulation installed)) ..... +1 dBm
    Modulation ..... 1 kHz (Int) FM 5 kHz

15. Set FM deviation to the values listed in the following table and verify that the measured results are within the limits specified.

FM Deviation for 100 MHz	Results		
	Min.	Actual	Max.
5.0 kHz	4.75 kHz	_____	5.25 kHz
30.0 kHz	28.50 kHz	_____	31.50 kHz
70.0 kHz	66.50 kHz	_____	73.50 kHz
99.0 kHz	94.05 kHz	_____	103.95 kHz

Incidental AM

The incidental AM specification of the Signal Generator is not equivalent to the published specification of the HP 8902A Measuring Receiver. To make a valid incidental AM measurement, the incidental AM of the measuring receiver must be four times better than the specification being tested. In order to verify that the incidental AM of the measuring receiver is adequate to measure the Signal Generator's incidental AM specification, the incidental AM of the measuring receiver must be verified to ensure the validity of the measurement. If the Signal Generator's incidental AM is measured frequently, it is not necessary to verify the incidental AM of the measuring receiver each time; however, it is recommended that it be verified monthly to ensure an accurate measurement.

16. Verify the incidental AM of the measuring receiver as follows:

    a. Connect the FM divide-by-4 output of the AM/FM test source to the input of the measuring receiver and the 50 ohm output of the test oscillator to the audio input of the AM/FM test source, as shown in Figure 4-10.

    b. Set the measuring receiver as follows:

       Measurement ..... Frequency

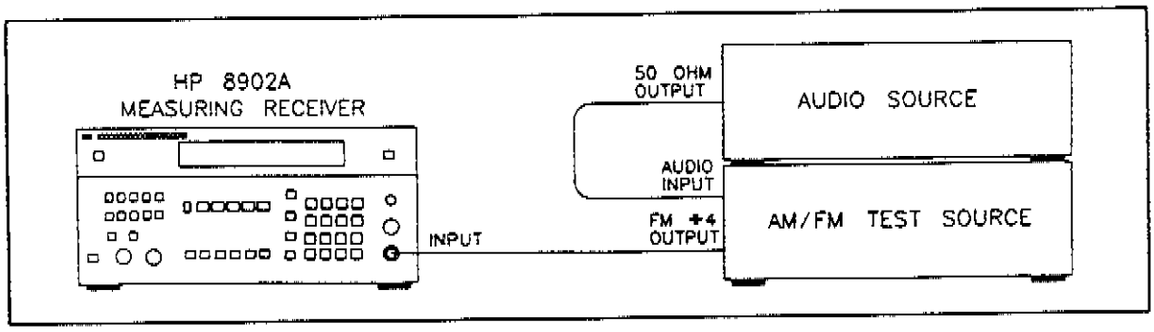


Figure 4–10. Measuring Receiver Incidental AM Verification Test Setup

c. Set the AM/FM test source as follows:

Test Mode ..... FM

d. Tune the carrier frequency on the AM/FM test source for a measuring receiver reading of 100 MHz ±0.1 MHz.

e. Set the test oscillator as follows:

Frequency ..... 1 kHz
Output Attenuator ..... −10 dBm
Amplitude Course ..... Fully ccw

f. Set the measuring receiver as follows:

Measurement ..... FM
Detector ..... Peak+
HP Filter ..... 300 Hz
LP Filter ..... 3 kHz

g. Increase the output of the test oscillator by rotating the Amplitude Coarse control clockwise until the measuring receiver indicates 20.0 kHz ±0.1 kHz peak deviation.

h. Set the measuring receiver as follows:

Measurement ..... AM

i. The modulation must be < 0.02% AM to test the incidental AM of the Signal Generator.

17. Set the measuring receiver as follows:

Measurement ..... AM
Detector ..... Peak+
HP Filter ..... 300 Hz
LP Filter ..... 3 kHz

18. Set the Siganl Generator as follows:

Amplitude (HP 8656B/8657A) ..... +7 dBm
Amplitude (HP 8657B) ..... +4 dBm
Amplitude (HP 8657B (with Pulse Modulation installed)) ..... +1 dBm
Modulation ..... 1 kHz (Int) FM 20 kHz

19. Connect the equipment as shown in Figure 4-9, Modulation Test Setup.

20. Set the Signal Generator frequency to a value within the range specified in the following table and verify that the measured result does not exceed the limit specified.

Model	Frequency		Result	
	Min.	Max.	Actual	Max.
HP 8656B	10 MHz	990 MHz	_____	< 0.1%
HP 8657A	10 MHz	1040 MHz	_____	< 0.1%
HP 8657B	10 MHz	1030 MHz	_____	< 0.1%
	1030 MHz	1300 MHz	_____	< 0.5%

NOTE

Below 10 MHz, the incidental AM of the Signal Generator is less than that of the measuring receiver.

FM Distortion

21. Set the measuring receiver as follows:

Measurement ..... FM
Detector ..... Peak+
HP Filter ..... 300 Hz
LP Filter ..... 3 kHz

22. Set the distortion analyzer as follows:

Function ..... Distortion
Analyzer Input Select ..... Distortion
Frequency ..... 1 kHz

23. Set the Signal Generator as follows:

Frequency (HP 8656B) ..... 100.0 MHz
Frequency (HP 8657A and HP 8657B) ..... 150.0 MHz
Amplitude ..... +4 dBm
Modulation ..... 1 kHz (Int) FM

24. Connect the equipment as shown in Figure 4-9, Modulation Test Setup.

25. Verify that the measured Total Harmonic Distortion does not exceed 0.5%.

26. Set the Signal Generator FM deviation to a value within the range specified in the following table and verify that the measured result does not exceed the limit specified.

Model	FM Deviation		Result	
	Min.	Max.	Actual	Max.
HP 8656B	3 kHz	99 kHz	_____	<0.5%
HP 8657A	6 kHz	99 kHz	_____	<0.5%
HP 8657B	6 kHz	99 kHz	_____	<0.5%

NOTE

At peak deviations less than 3 kHz, residual FM and other type of FM distortion become a greater portion of the distortion reading. If the distortion falls within tolerance at or above 3 kHz, it may be safely assumed that the Signal Generator meets the test requirements.

DC MODULATION

Description

DC FM specifications are verified by measuring the RF OUTPUT frequency offset with a frequency counter.

Equipment

Frequency Counter ..... HP 5328B OPT 31

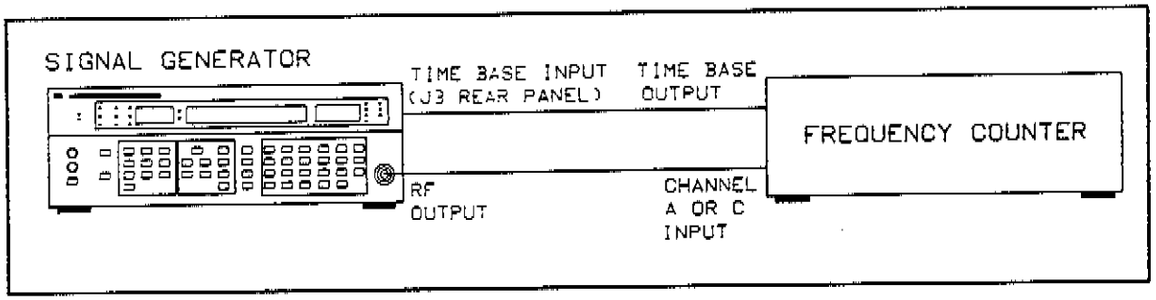


Figure 4–11. DC FM Test Setup

Procedure

DC FM Center Frequency Accuracy and Stability

27. Connect the RF OUTPUT from the Signal Generator to the INPUT of the frequency counter, and connect the Signal Generator TIME BASE INPUT to the Frequency counter TIME BASE OUTPUT as shown in Figure 4-11.

28. Set the frequency counter as follows:

    INPUT ..... CHANNEL A
    TRIGGER ..... CHANNEL A

29. Set the Signal Generator as follows:

    Frequency ..... 100 MHz
    Amplitude ..... 0 dBm
    Modulation ..... DC FM

30. Set the Signal Generator FM deviation to a value for the frequency range specified in the following table. Verify that the measured frequency does not exceed the limits specified.

Model	Frequency (MHz)	DC FM Deviation (kHz)	Accuracy	Stability
			Offset (kHz)	Drift (Hz/Hr)
HP 8656B	0.1 to 123.5	1 to 99	_____ ± 500 Hz	_____ ± 10
	123.5 to 247	1 to 50	_____ ± 125 Hz	_____ ± 10
	247 to 494	1 to 99	_____ ± 250 Hz	_____ ± 10
	494 to 990	1 to 99	_____ ± 500 Hz	_____ ± 10
HP 8657A and HP 8657B	0.1 to 130	1 to 99	_____ ± 500 Hz	_____ ± 10
	130 to 269	1 to 50	_____ ± 125 Hz	_____ ± 10
	260 to 520	1 to 99	_____ ± 250 Hz	_____ ± 10
HP 8657A	520 to 1040	1 to 99	_____ ± 500 Hz	_____ ± 10
HP 8657B	520 to 1030	1 to 99	_____ ± 500 Hz	_____ ± 10
	1030 to 2060	1 to 99	_____ ± 1000 Hz	_____ ± 10

PULSE MODULATION (HP 8657B ONLY)

NOTE

Pulse Modulation is available as an option on the **HP 8657B.**

Description

The output of the HP 8657B is coupled to an oscilloscope and the Rise/Fall Time of the RF pulses is measured. The ouput of the HP 8657B is then coupled to a spectrum analyzer and the On/Off Level Ratio of the RF pulses is measured.

Equipment

Oscilloscope ..... HP 54100A
Oscilloscope Probe ..... HP 54002A
Pulse Generator ..... HP 8116A
Spectrum Analyzer ..... HP 8562B

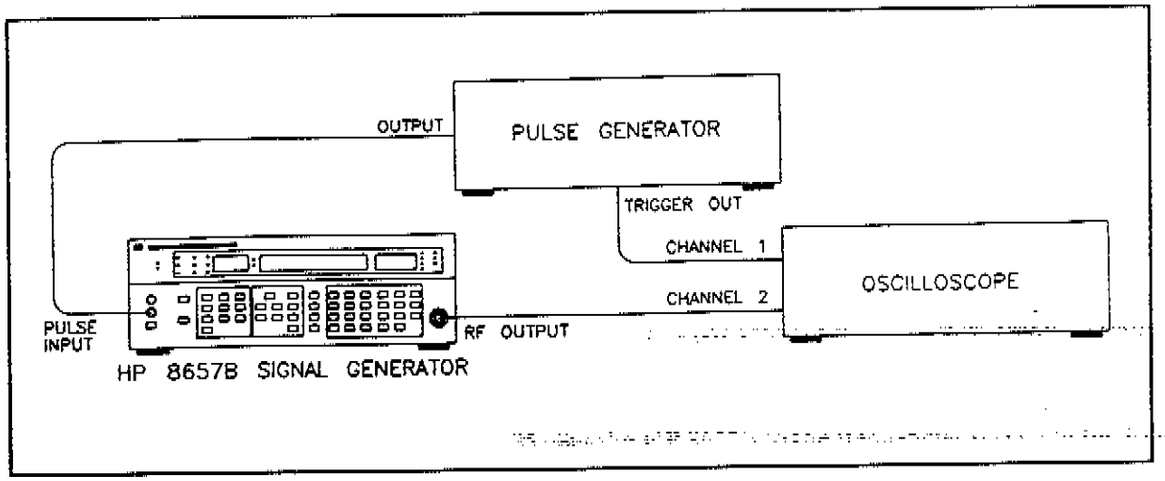


Figure 4–12. Modulation Test Setup

Procedure

31. Connect the equipment as shown in Figure 4-12.

32. Set the HP 8657B as follows:

Frequency ..... See Table
Amplitude ..... 0 dBm
Modulation ..... Pulse

33. Set the Pulse Generator as follows:

Mode	Normal
Function	Pulse
Frequency	50 kHz
Amplitude	1 Volt
Amplitude Offset	1 Volt
Pulse Width	10 usec
Output Disable	Off (LED Off)

34. Set the Oscilloscope as follows:

Timebase

Sec/Div	10 ns
Delay	100 ns
Delay Reference	Center

Trigger

Mode	Edge
Source	Chan 2
Trigger Level	1.25 V
Slope	Pos

Display

Mode	Normal
Display Time (Persistence)	2 sec
Split Screen	Off
Graticle	Grid

Channel 1

Mode	Normal
Display	On
Volts/Div	100 mV
Offset	0 V

Channel 2

Mode	Normal
Display	Off
Volts/Div	500 mV
Offset	1.25 V

Delta V

VMarkers	On/Chan1
Marker 1 Position	0 Volt (To Start)
Marker 2 Position	To Maximum Settled Level

After positioning markers to initial position, press 10%-90%

Delta T

TMarkers	On
Start Marker (see Figure 11)	At 10% Level Pulse Crossing
Stop Marker (see Figure 11)	At 90% Level Pulse Crossing

Pulse Modulation Rise and Fall Time (Using an Oscilloscope)

NOTE

Figure 4-11 shows the RF Pulse as displayed on the oscilloscope. The Delta V markers are the approximate 10 and 90% Levels of the pulse envelope. The reading Δt is the Rise Time.

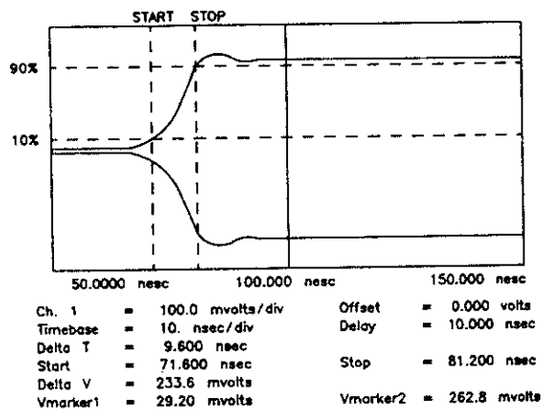


Figure 4–13. Oscilloscope Display

NOTE

If the oscilloscope does not have adequate bandwidth at the higher frequencies, proceed with the following steps using a crystal detector.

35. Set the HP 8657B to the frequencies shown in the following Table. For each frequency measure the 10% to 90% Rise Time of the RF Pulse. The Delta V and Delta T Markers will require repositioning after each frequency change. To measure Fall Time will require a Shift Delay of +10 usec minimum on the oscilloscope to view the trailing edge of the pulse (including markers). Refer to Figure 4-13 for an example of the oscilloscope measurement display. The Rise and Fall Time should be within the limits shown in the Table.

Frequency MHz	Results		
	Rise Time Actual	Fall Time Actual	Max
100	_____	_____	<35 ns
300	_____	_____	<35 ns
500	_____	_____	<35 ns
1100	_____	_____	<50 ns

Pulse Modulation Rise and Fall Time (Using a Crystal Detector)

Additional Equipment

Crystal Detector (Negative) ..... HP 423A
Crystal Detector (Positive) ..... HP 423A Opt. 003
Power Splitter ..... HP 11667A
15 MHz Low Pass Filter (2 Required) ..... (See Figure 4-15)

36. Connect the equipment as shown in Figure 4-14. Low Pass Filters can be constructed using the schematic in Figure 4-15.

37. Set the HP 8657B to the frequencies shown in the Table. For each frequency measure the 10 % and 90 % Rise and Fall Times of the RF Pulse. The waveform on the oscilloscope now is the peak-detected envelope . The Rise and Fall Time should be within the limits shown in the Table. The oscilloscope setups are the same as in step 34.

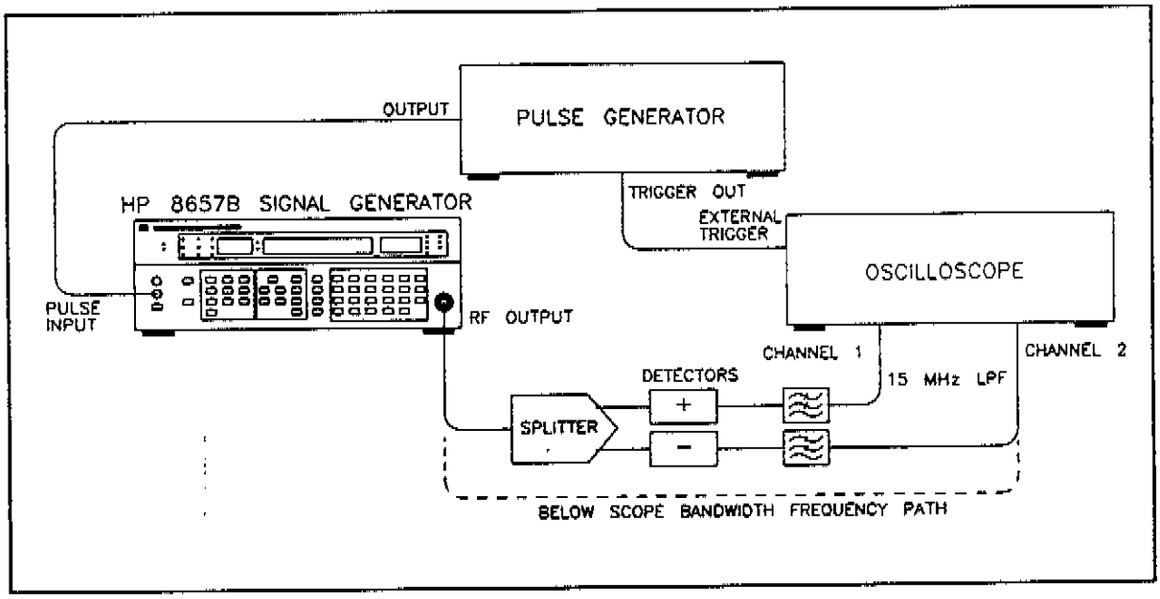


Figure 4–14. Rise/Fall Time Test Setup with Peak Detectors

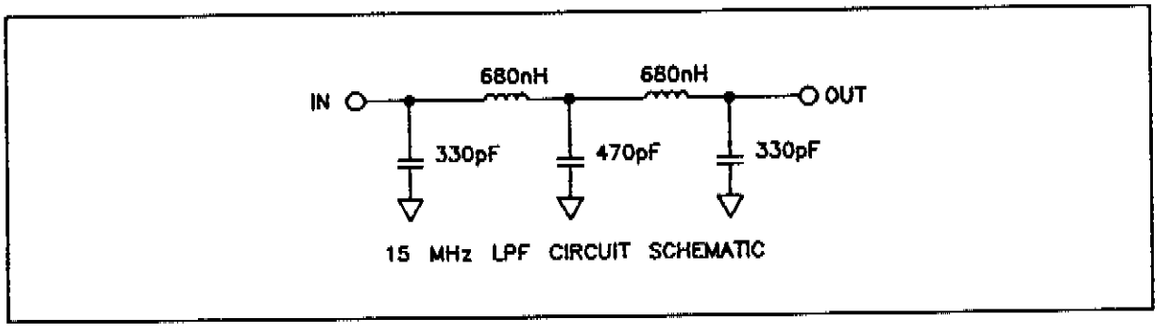


Figure 4–15. Schematic for 15 MHz Low Pass Filters

Pulse Modulation ON/OFF Ratio

38. Set the HP 8657B as follows:

Frequency	See Table
Amplitude	0 dBm
Modulation	Pulse

39. Connect the equipment as shown in Figure 4-16.

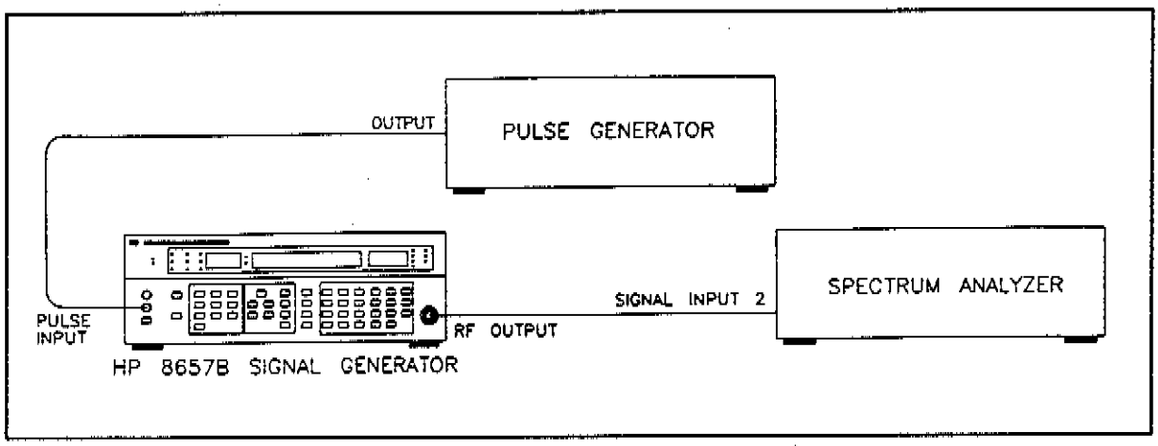


Figure 4–16. Pulse On/Off Ratio Test Setup

40. Set the pulse generator as follows:

Mode	Normal
Frequency	100 Hz
Duty Cycle	50%
Amplitude	1 Volt
Offset	1 Volt

41. Set the spectrum analyzer as follows:

Center Frequency	See Table
Resolution BW	10 kHz
Video BW	1 MHz
Frequency Span	0 Hz
Reference Level	0 dBm
Reference Level/div	10 dB/div
Trigger	Video

42. Set the HP 8657B's frequency and the spectrum analyzer's center frequency to the frequencies shown in the following Table. For each frequency measure the change in amplitude as the HP 8657B is pulsed on and off. The amplitude should drop at least 70 dB for frequencies below 1030 MHz and 95 dB for frequencies above 1030 MHz as the HP 8657B is pulsed on and off.

Frequency MHz	Results	
	On/Off Ratio Actual	Min
100	_____	>70 dB
300	_____	>70 dB
500	_____	>70 dB
1100	_____	>95 dB

Performance Test 4

OUTPUT LEAKAGE TESTS

Specification

Leakage limits are within those specified in MIL STD 461B, and FTZ 1115. Furthermore, less than 1.0 μV is induced in a two-turn, 2.5 cm (1 inch) diameter loop held 2.5 cm (1 inch) away from the front surface and measured into a 50Ω receiver.

Description

Output leakage is verified by holding a loop antenna 2.5 cm (1 inch) from the front surface of the Signal Generator and measuring the resulting signal with a spectrum analyzer.

The loop antenna is suspended in a molding so that when the molding is in contact with a surface, the loop antenna is one inch from the surface.

NOTE

The use of a screen room may be necessary to reduce external radiated interference.

Equipment

One-Inch Loop Antenna	HP 08640-60501
26 dB Amplifier	HP 8447D
Spectrum Analyzer	HP 8562B
50Ω Termination	HP 908A

Procedure

1. Connect equipment as shown in Figure 4-17, for the signal path shown as 1-4 below.

NOTE

To avoid disturbing the antenna's field and causing measurement error, grasp the antenna at the end that has the BNC connector.

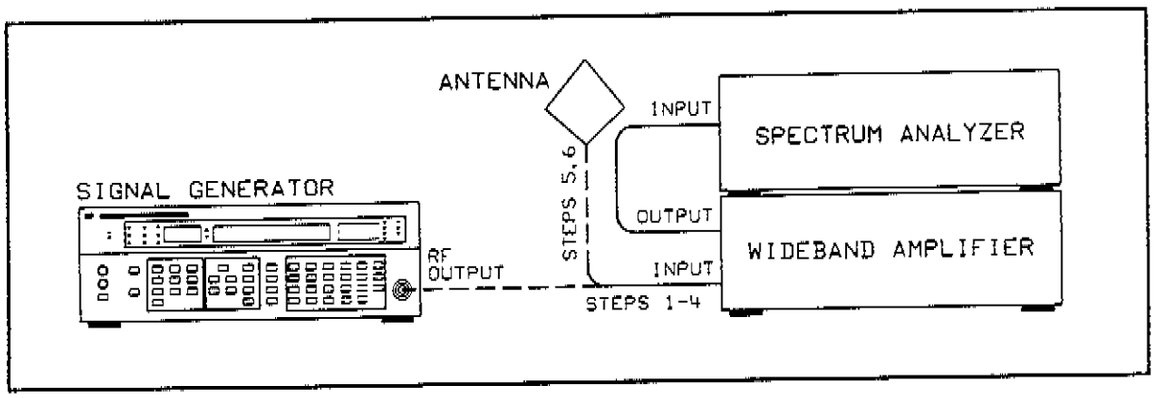


Figure 4–17. Output Leakage Test Setup

2. Set the Signal Generator as follows:

   Frequency ..... 100 MHz
   Amplitude ..... −107 dBm
   Modulation ..... Off

3. Set the spectrum analyzer as follows:

   Center Frequency ..... 100 MHz
   Input Attenuation ..... −40 dB
   Reference Level ..... −20 dBm
   Frequency Span ..... 20 MHz
   Resolution Bandwidth ..... 10 kHz

4. View the signal on the spectrum analyzer and adjust the reference level controls of the spectrum analyzer to set the amplified −107 dBm signal from the Signal Generator to a reference graticule line on the spectrum analyzer display. Set the video filter to further separate the signal from the noise. Disconnect the Signal Generator from the amplifier, and connect a 50 ohm termination to the Signal Generator's RF OUTPUT connector.

5. Connect the one-inch loop antenna to the analyzer through the amplifier as shown in Figure 4−17, for the signal path shown as 5,6. Hold the end of the loop antenna cylinder in contact with the front surfaces of the Signal Generator. All signals and noise should be below the reference graticule line (i.e.,below −107 dBm).

   _____ < −107 dBm (<1.0 μV) at 100 MHz

6. Repeat step 5 for frequencies of 300, 500, 700, 900, 990, 1030 (except HP 8656B), 1040 (except HP 8656B), 2060 MHz (HP 8657B only).

   _____ < −107 dBm (<1.0 μV) at 300 MHz
   _____ < −107 dBm (<1.0 μV) at 500 MHz
   _____ < −107 dBm (<1.0 μV) at 700 MHz
   _____ < −107 dBm (<1.0 μV) at 900 MHz
   _____ < −107 dBm (<1.0 μV) at 990 MHz
   _____ < −107 dBm (<1.0 μV) at 1030 MHz
   _____ < −107 dBm (<1.0 μV) at 1040 MHz
   _____ < −107 dBm (<1.0 μV) at 2060 MHz

Performance Test 5

SWR TEST (HP 8656B AND HP 8657A ONLY)

NOTE

The SWR specification is a supplemental characteristic for the HP 8657B. The specification in the table below is for the HP 8656B and HP 8657A.

Specification

Electrical Characteristics	Performance Limits	Conditions
SWR:		
RF OUTPUT	< 2.0, −9.6 dB Return Loss	≥ −3.5 dBm
	< 1.5, −14 dB Return Loss	< −3.5 dBm
Impedance	50 ohms nominal	
Reverse Power (HP 8656B)	25 watts	RF power to 990 MHz into RF OUTPUT, dc voltage cannot exceed 25V.
Reverse Power (HP 8657A)	50 watts	RF power to 1040 MHz into RF OUTPUT, dc voltage cannot exceed 50V.

Description

SWR is verified by comparing the reflected power (frequencies 0.5 to 990 MHz for an HP 8656B or 0.5 to 1040 MHz for an HP 8657A from an RF signal source) to a reference that represents 100% return loss. The reference level is determined by disconnecting the SWR bridge from the Signal Generator under test, and connecting a short to the SWR bridge (100% reflected power) to the spectrum analyzer. The reference is established on the spectrum analyzer display. The SWR bridge is then connected to the Signal Generator under test, and return loss for the frequency is displayed on the spectrum analyzer. The output frequency of Signal Generator under test must be set 100 MHz from the frequency of the RF signal source.

Equipment

RF Signal Source ..... HP 8657B
Spectrum Analyzer ..... HP 8562B
SWR Bridge ..... Wiltron 60N50
Cables (UG-21D/U type N connectors) ..... HP 11500B (2 Required)

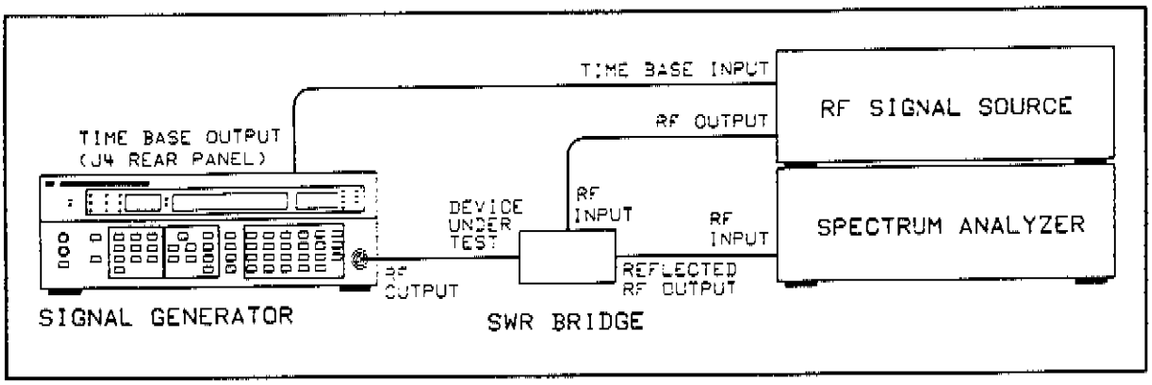


Figure 4–18. SWR Performance Test Setup (Out of Band)

Procedure

≤ −3.5 dBm (10 dB Attenuator Pad Selected)

1. Set the Signal Generator as follows:

   Frequency ..... 0.1 MHz
   Modulation ..... Off
   Amplitude ..... −10 dBm

2. Set the spectrum analyzer as follows:

   Frequency Span ..... 100 MHz
   Resolution Bandwidth ..... 300 kHz
   Reference Level ..... 0 dBm
   Center Frequency ..... 100 MHz

3. Set the RF signal source as follows:

   Output Level ..... +10 dBm
   Frequency ..... 100 MHz

4. Connect the equipment as shown in Figure 4-18.

5. With the SWR bridge disconnected from the Signal Generator under test, and a short connected to the SWR bridge, set the reference level on the spectrum analyzer for a 100% reflected signal.

6. Connect the SWR bridge to the Signal Generator's RF OUTPUT connector. The difference, in dB, of the level on the display and the reference is the return loss of the Signal Generator's RF OUTPUT connector. The return loss must be >14 dB.

   _____ 14 dB

7. Repeat steps 3 through 6 with the RF signal source set to any frequency between 5 MHz and 990 MHz (for an HP 8656B) or 1040 MHz (for an HP 8657A) and 100 MHz from the Signal Generator's frequency.

   _____ 14 dB

SWR Test > −3.5 dBm (Attenuator Pads Not Selected)

SWR, without any attenuation, is verified by the following procedure. Set the amplitude of the Signal Generator under test and turn off the RF signal source. Then the amplitude of the reflected signal from the RF source is set to an equal level with the Device Under Test port shorted. The maximum and minimum voltages in dB are read from the spectrum analyzer to compute the SWR using the equation listed below.

8. Set the Signal Generator as follows:

   Frequency ..... 100 MHz
   Modulation ..... Off
   Amplitude ..... −2 dBm

9. Set the spectrum analyzer as follows:

   Frequency Span ..... 0 Hz
   Resolution Bandwidth ..... 3 MHz
   Reference Level ..... 0 dBm
   Center Frequency ..... 100 MHz
   Scale ..... LOG 2dB/Div

10. Set the RF signal source as follows:

    Amplitude ..... −127 dBm
    Modulation ..... Off
    Frequency ..... 100 MHz
    RF ..... Off

11. Connect the equipment as shown in Figure 4-18.
12. With the SWR bridge connected to the Signal Generator under test, and the amplitude of the RF signal source turned off, set a reference on the spectrum analyzer. Tune the frequency of the spectrum analyzer for maximum level on the display.
13. Disconnect the SWR bridge from the Signal Generator under test and connect a short to the Device Under Test port.
14. Set the amplitude of the RF signal source to +13 dBm.
15. Set the amplitude of the RF signal source to the same level on the spectrum analyzer as set in step 12.
16. Remove the short from the SWR bridge, and connect the SWR bridge to the Signal Generator under test.
17. Press and release the Blue SHIFT key. Press and hold the Phase Decrement DOWN key (frequency decrement DOWN key). The level on the spectrum analyzer changes as the phase changes.

NOTE

Each time the Phase Decrement key is released, the SHIFT key must be pressed to reselect the Phase Decrement function.

18. Read the maximum and minimum power levels from the spectrum analyzer and substitute their value in the following equation and solve for the SWR of the Signal Generator.

    _____ <2.0

19. Repeat steps 8 through 18 for each frequency between 5 and 990 MHz (for an HP 8656B) or 1040 MHz (for an HP 8657A) at which SWR is to be checked.

$$SWR = \frac{1+\rho}{1-\rho} = \frac{E_{max}}{E_{min}}$$

$$E_{max} = A + \rho A$$

$$E_{min} = A - \rho A$$

$$SWR = \frac{E_{max}/A}{E_{min}/A} = \frac{E_{max}}{E_{min}}$$

$$20\ log\ E_{max} = E_{max} dB$$

$$20\ log\ E_{min} = E_{min} dB$$

$$20\ log\ SWR = 20\ log \frac{(E_{max})}{(E_{min})}$$

$$20\ log\ SWR = 20\ log E_{max} - 20\ log E_{min}$$

$$20\ log\ SWR = E_{max}\ dB - E_{min}\ dB$$

$$SWR = 10^{\frac{E_{max}\ dB - E_{min}\ dB}{20}}$$

Performance Test Record

SPECTRAL PURITY TESTS

Spurious Signals

Spurious Signals	Results			
	Actual	HP 8656B	HP 8657A	HP 8657B
Harmonics	_____	< –30 dBc	< –30 dBc	< –30 dBc (0.1 to 1030MHz) < –25 dBc (1030 to 2060MHz)
Non-Harmonics (≥ 2 MHz from carrier)	_____ _____	< –60 dBc	< –60 dBc	< –60 dBc (0.1 to 1030MHz < –54 dBc (1030 to 2060 MHz)
5 kHz to 2 MHz from carrier	_____	< –60 dBc	< –60 dBc (0.1 to 130MHz)	< –63 dBc (0.1 to 130MHz)
	_____ _____ _____ _____		< –72 dBc (130 to 260MHz) < –66 dBc (260 to 520MHz) < –60 dBc, 520 to 1040MHz	< –75 dBc (130 to 260MHz) < –66 dBc (260 to 520MHz) < –63 dBc (520 to 1030MHz) < –57 dBc (1030 to 2060 MHz)
Sub-Harmonics	_____ _____ _____	None	None	None, 0.1 to 1030 MHz < –40 dBc (1030 to 1800 MHz) < –35 dBc (1800 to 2060 MHz)

Residual AM

The digital multimeter should indicate <1.77 mVrms for an HP 8656B.
The digital multimeter should indicate <3.28 mVrms for an HP 8657A or HP8657B.

Actual	Maximum
_____	< 1.77 mVrms
_____	< 3.28 mVrms

Residual FM

Signal Generator Frequency (MHz)	Modulation Analyzer Filter		Results (Hz rms)	
	High Pass (Hz)	Low Pass (kHz)	Actual	Max.
0.15 to 123.00000	300	3	_____	< 4
0.15 to 123.00000	50	15	_____	< 6

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HP 8657B
specifications

SPECIFICATIONS describe the instruments warranted performance and apply after a 30 minute warm-up. All SPECIFICATIONS are valid over the signal generator's entire Operating/Environmental Range unless otherwise noted.

SUPPLEMENTAL CHARACTERISTICS (shown in italics) are intended to provide additional information useful in applying the instrument by giving typical (expected), but not warranted performance.

FREQUENCY

Range (10-digit LED display):
100 kHz to 2060 MHz.
Resolution: 1 Hz.
Switching Speed (to be within 1 dB of level and within 100 Hz of carrier frequency):
<35 ms.[1-pg12] *(30 ms typical at 25°C)*
Accuracy and Stability: Same as timebase used.

SUPPLEMENTAL CHARACTERISTICS

Frequency Underrange: *To 10 kHz with uncalibrated output and modulation.*
Phase Offset: *Output signal phase is adjustable in 1 degree increments.*
Timebase Characteristics:

	Standard	*Option 001*
Aging Rate	*±2 ppm/year*	*1.0×10^{-9}/day after 45 days*
Temperature (0-55°C)	*±10 ppm*	*7×10^{-9}*
Line Voltage	—	*2×10^{-9} (+5%,-10%)*
Frequency	*50 MHz*	*10 MHz*
Timebase Reference Signal (Rear Panel)	*Available at a level of >0.15 V_{rms} into 50 Ω (Output of 10, 5, or 1 MHz is selectable via internal jumper). If an external reference is used, output will be the same frequency.*	
External Reference Input (Rear Panel)	*Accepts any 10, 5, or 1 MHz (±0.002%) frequency standard at a level >0.15 V_{rms} into 50 Ω.*	

SPECTRAL PURITY

Spurious Signals (≤+7 dBm output levels):[1-pg12]

Type of Spurious	Frequency (MHz)		
	0.1-1030	1030-1800	1800-2060
Harmonic	<-30 dBc	<-25 dBc	<-25 dBc
Sub-harmonic	None	<-40 dBc	<-35 dBc

Nonharmonic Spurious:

Carrier Frequency	Carrier Offset	
	>5 kHz (Typical)	>2 MHz
0.1 to 130	*<-63 dBc*	<-60 dBc
130 to 260	*<-75 dBc*	<-60 dBc
260 to 520	*<-66 dBc*	<-60 dBc
520 to 1030	*<-63 dBc*	<-60 dBc
1030 to 2060	*<-57 dBc*	<-54 dBc

Residual FM in Hz rms (in CW mode):

Post Detection Bandwidth	Frequency Range (MHz)				
	0.1-130	130-260	260-520	520-1040	1040-2060
0.3 - 3 kHz	<4 Hz	<1 Hz	<2 Hz	<3 Hz	<6 Hz
0.05 - 15 kHz	<6 Hz	<1.5 Hz	<3 Hz	<4 Hz	<8 Hz
Typical Residual FM:					
0.3 - 3 kHz	<2 Hz	<0.5 Hz	<0.5 Hz	<1 Hz	<2 Hz
0.3 - 3 kHz (CCITT)	<1.25 Hz	<0.25 Hz	<0.25 Hz	<0.5 Hz	<1.0 Hz
0.05 - 15 kHz	<3 Hz	<1 Hz	<1 Hz	<1.5 Hz	<3 Hz

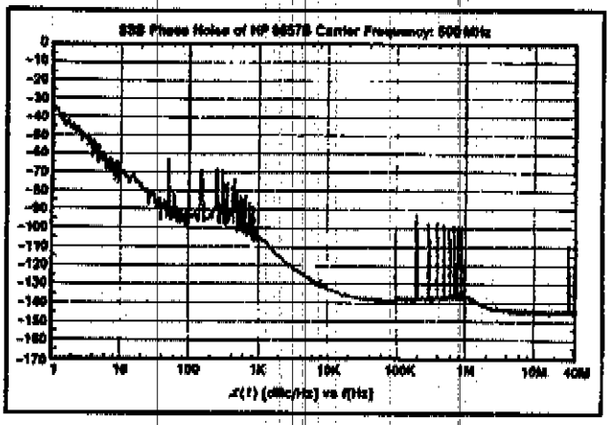
Residual AM (50 Hz to 15 kHz post-detection noise bandwidth, in CW mode): <0.04% AM.

SSB Phase Noise (in CW Mode):

Carrier Frequency	SSB ϕ-Noise 20 kHz offset	*Typical 20 kHz offset*
0.1 to 130 MHz	<-124 dBc/Hz	*<-130 dBc/Hz*
130 to 260 MHz	<-136 dBc/Hz	*<-140 dBc/Hz*
260 to 520 MHz	<-130 dBc/Hz	*<-136 dBc/Hz*
520 to 1040 MHz	<-124 dBc/Hz	*<-130 dBc/Hz*
1040 to 2060 MHz	<-118 dBc/Hz	*<-123 dBc/Hz*

SUPPLEMENTAL CHARACTERISTICS

Typical SSB Phase Noise at 500 MHz

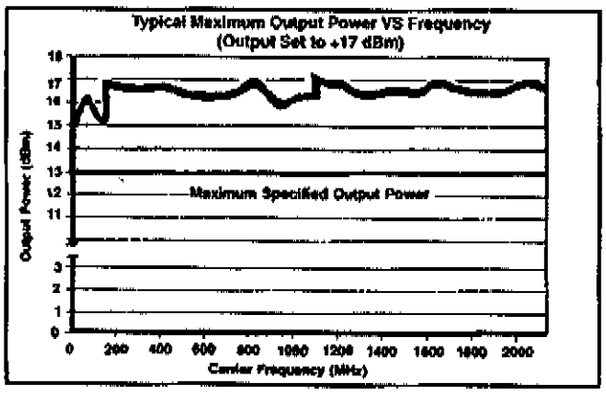


OUTPUT

Level Range (3 1/2-digit LED display): +13 dBm to –143.5 dBm into 50Ω.[2-pg12]
Resolution: 0.1 dB.
Absolute Level Accuracy:[3-pg12]
< ±1.0 dB (+3.5 to –127 dBm),
< ±1.5 dB (level >+3.5 dBm).
Level Flatness (100 kHz to 2060 MHz):
±0.5 dB, output level setting of 0 dBm.
Reverse-Power Protection: Protects the signal generator from applications of up to 50 watts of RF power (from a 50Ω source) to 2060 MHz into generator output; DC voltage cannot exceed 25 V.

SUPPLEMENTAL CHARACTERISTICS

Attenuator Repeatability: *0.01 dB*
Impedance: *50 Ω Nominal.*
Absolute level Accuracy: *1.5 dB, output levels ≤ –127 dBm.*
SWR: *<1.5 for levels ≤ –6.5 dBm.*
<2.0 for levels ≤ +13 dBm.
Typical Output Level Overrange:



AMPLITUDE MODULATION

AM Depth (f_c >400 kHz):[4-pg12]
0 to 100%, level ≤ +7 dBm.
0 to 30%, level ≤ +10 dBm.
Resolution: 1%.
AM Rate,
Internal: 400 Hz and 1 kHz, ± 2%.
External: 20 Hz to 40 kHz (1 dB bandwidth)
20 Hz to 100 kHz (3 dB bandwidth) Typical.
AM Distortion (at 400 Hz and 1 kHz rates, levels ≤ +7 dBm):

AM Depth	f_c<1030	f_c>1030
0 to 30 % AM	1.5%	4%
31 to 70 % AM	3.0%	4%
71 to 90 % AM	4.0%	7%

Indicator Accuracy (for depths < 90%, 400 Hz and 1 kHz rates and levels ≤ +7 dBm):
±(2% + 6% of setting).

Incidental Phase Modulation (at 30% AM depth, internal rates): < 0.3 radians peak.

FREQUENCY MODULATION

Maximum FM Peak Deviation:

Center Frequency	Maximum Peak Deviation	
	AC Mode (the lesser of)	DCMode
0.1 to 130 MHz	200 kHz or 4000 x rate (Hz)	200 kHz
130 to 260 MHz	50 kHz or 1000 x rate (Hz)	50 kHz
260 to 520 MHz	100 kHz or 2000 x rate (Hz)	100 kHz
520 to 1040 MHz	200 kHz or 4000 x rate (Hz)	200 kHz
1040 to 2060 MHz	400 kHz or 8000 x rate (Hz)	400 kHz
FM not specified when peak deviation is > (f_c –100 KHz)		

FM Setting Resolution:

FM Deviation	Carrier Frequency	
	f_c <1040 MHz	f_c >1040 MHz
< 20 kHz	100 Hz	200 Hz
> 20kHz	200 Hz	400 Hz

FM Rate,
Internal: 400 Hz and 1 kHz, ±2%.
External: (referenced to 1 kHz)
dc/5 Hz to 100 kHz, 3 dB bandwidth.
dc/20 Hz to 50 kHz, 1 dB bandwidth.

Center Frequency Accuracy in dc Mode:

Carrier Frequency	Center Frequency Accuracy
0.1 to 130 MHz	± 500 Hz
130 to 260 MHz	± 125 Hz
260 to 520 MHz	± 250 Hz
520 to 1040 MHz	± 500 Hz
1040 to 2060 MHz	± 1000 Hz

Center Frequency Stability in dc Mode:
<10 Hz per hour drift *(typ <3 Hz per hour).*
FM Distortion (at 400 Hz and 1 kHz rates):
<0.5% THD plus noise at deviations shown in the following table.

Center Frequency	Deviation
0.1 to 130 MHz	3 to 100 kHz
130 to 260 MHz	3 to 25 kHz
260 to 520 MHz	3 to 50 kHz
520 to 1040 MHz	3 to 100 kHz
1040 to 2060 MHz	6 to 200 kHz

Cell ID #
164 6635

HP 8657B
specifications

Indicator Accuracy (400 Hz and 1 kHz rates):
< 5% of setting
Incidental AM (peak dev. <20 kHz, 400 Hz and 1 kHz rates). <0.5% AM f_c > 1030 MHz
< 0.1% AM, f_c >500 kHz.

SUPPLEMENTAL CHARACTERISTICS

FM Distortion: *Worst case distortion at all specified deviations, rates, and carrier frequencies is 1.5%.*
External Sensitivity:
1 volt peak for indicated accuracy
(1 volt dc when in dc-FM mode).
External Modulation Input:
Front panel BNC, 600 Ω dc-coupled; front panel annunciators indicate 1 V peak signal ± 5%.
Modulating Signal Output: *Internal modulating signal is provided at the front panel BNC connector at nominally 1 volt peak into a 600 Ω resistive load.*
Simultaneous Modulation:
Internal/External: AM/FM, FM/AM, AM/AM, FM/FM, AM/FM/Pulse. [5,6,7]
Internal/Internal, External/External: AM/FM

PULSE MODULATION[5,6,7]

ON/OFF Ratio: >70 dB, $f_c \geq 130$ MHz.
>95 dB, $f_c \geq 1030$ MHz.
Rise/Fall Time: < 35 nanoseconds, $f_c \geq 130$ MHz
< 50 nanoseconds, $f_c \geq 1030$ MHz

HP 8657B OPTION H60

If what you need is pulse modulation to 1 GHz and don't want to pay for 2 GHz coverage the HP 8657B Option H60 provides pulse modulation standard and frequency coverage from 100 kHz to 1040 MHz. All specifications are the same as the HP 8657B with Option 003, up to 1040 MHz.

SUPPLEMENTAL CHARACTERISTICS:

Typical Rise/Fall Time: *10 ns, f_c <1030 MHz;*
18 ns, f_c > 1030 MHz.
Maximum Repetition Rate: *DC - 30 MHz.*
Level Accuracy: *± 1.0dB absolute level accuracy in Pulse Mode.*
Duty Cycle: *0 - 100%. (limited by rise/fall time)*
Pulse Modulation Input: *BNC, high impedance (internally selectable to 50 ohms), can be driven directly by TTL.*
Maximum Input Level: *± 15 V.*
Nominal Input Threshold: *1.6 V.*
Video Feedthrough: *<15%.*
Pulse Time Delay: [6,7]
Off to On: 47 nanoseconds
On to Off: 34 nanoseconds

REMOTE PROGRAMMING

Interface: HP-IB (Hewlett-Packard's implementation of IEEE Standard 488).
Interface Functions Implemented: SH0, AH1, T0, L2, SR0, RL1, PP0, DC1, DT0, C0, E1.

GENERAL

Operating Temperature Range: 0 to +55°C.
Storage Temperature Range: -40 to +71°C.
Leakage: Conducted and radiated interference is within the requirements of CE03 (except broadband conducted below 70 kHz) and RE02 of MIL STD 461B, and FTZ 1115. Furthermore, RF leakage of less than 1.0 µV is induced in a two-turn loop, 2.5 cm in diameter, held 2.5 cm away from the front surface. (Typical leakage is <0.05 µV for levels <-40 dBm.)
Save/Recall/Sequence Storage Registers: 100 non-volatile registers are available to save front panel settings.
Rear Panel SEQ Input Level: TTL low to recall next storage register contents.
Power Requirements: 100 or 120 or 220 or 240 volts (±10%) from 48 to 440 Hz; 200 VA maximum.
Weight: Net 20.5 kg (45 lb); shipping 26.0 kg (57 lb).
Dimensions: 133H x 425W x 574D mm (5.25 x 16.75 x 22.6 inches.)
HP System II module size: 5 1/4H x 1MW x 17 D.

[1] Spurious specifications apply for output levels ≤+4 dBm and f_c <1030 MHz when pulse modulation is installed.
[2] Maximum output power is +10 dBm with pulse modulation installed at f_c <1030 MHz.
[3] Absolute level accuracy includes allowances for detector linearity, temperature, flatness, attenuator accuracy and measurement uncertainty.
[4] When pulse modulation is installed, maximum specified output level in AM is reduced by 3 dB when f_c <1030 MHz.
[5] Pulse modulation specifications apply for carriers >130 MHz and levels ≤+7 dBm (frequency switching speed typically increases by 30 ms with pulse modulation on). Additionally, AM is unspecified with pulse modulation turned on at $f_c \geq 1030$ MHz.
[6] Time delay between a change in input pulse and carrier response.
[7] Add 5 ms when switching to $f_c \geq 1030$ MHz.