HP 8657A SYNTHESIZED SIGNAL GENERATOR

(Including Options 001 and 002)

Operation and Calibration Manual

SERIAL NUMBERS

This manual provides complete information for instruments with serial-number prefixes:

2747U to 2919U or 2747A to 2919A and all *MAJOR* changes that apply to your instrument/modules.

rev.05APR89

NOTE, use this manual only with instruments that have a "U" or "A" in their serial-number prefix.

Second Edition

Operation and Calibration Manual HP Part 08657-90003

Other Documents Available:
Service Manual HP Part 08657-90004
Microfiche Operation and Calibration Manual HP Part 08657-90023
Microfiche Service Manual HP Part 08657-90024

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Table 1-1. *Specifications (1 of 2)*

Frequency

Range (8-digit LED display): 100 kHz to 1040 MHz.
Resolution: 10 Hz.
Display Resolution:
10 Hz for frequencies < 1000 MHz.
100 Hz for ≥ 1000 MHz.
Switching Speed (to be within 100 Hz of final frequency): <130 milliseconds.
Accuracy and Stability: Same as time base used.

Supplemental Characteristics

Frequency Underrange: *To 10 kHz with uncalibrated output and modulation.*

Phase Offset: *Output signal phase is adjustable in 1° nominal increments.*

Timebase Characteristics:

	Standard	Option 001
Aging rate	*±2 ppm/year*	*1×10^{-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)	*Availabel at a level of >0.15 V_{rms} into 50Ω (Output of 10, 5 or 1 MHz is selectable via internal jumper). If 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 50Ω.*	

Spectral Purity

Spurious Signals (≤+7 dBm output levels):
Harmonic: <−30 dBc.
Sub-harmonic: None.
Non-harmonic (CW mode):

Frequency Range	Offset From Carrier	
	5 kHz to 2 MHz	>2 MHz
0.1– 130 MHz	−60 dBc	<−60 dBc
130– 260 MHz	−72 dBc	
260– 520 MHz	−66 dBc	
520–1040 MHz	−60 dBc	

Residual FM (in CW mode):

Frequency Range	Post Detection BW (rms detector)	
	300 Hz to 3 kHz	50 Hz to 15 kHz
0.1– 130 MHz	4 Hz	6 Hz
130– 260 MHz	1 Hz	1.5 Hz
260– 520 MHz	2 Hz	3 Hz
520–1040 MHz	4 Hz	6 Hz

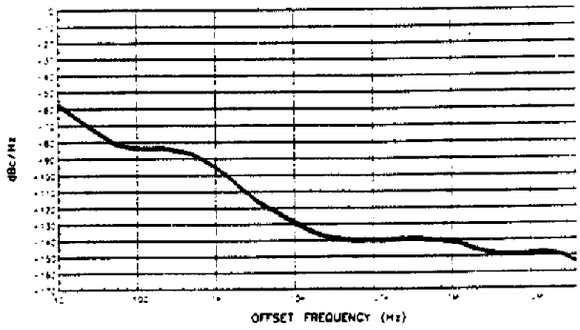
Residual AM (50 Hz to 15 kHz post-detection noise bandwidth, in CW mode): <0.04% AM.

SSB Phase Noise (in CW Mode):

Carrier Frequency	SSB ∅-Noise 20 kHz Offset
0.1 to 130 MHz	<−124 dBc/Hz
130 to 260 MHz	<−136 dBc/Hz
260 to 520 MHz	<−130 dBc/Hz
520 to 1040 MHz	<−124 dBc/Hz

Supplemental Characteristics

Typical SSB Phase Noise at 500 MHz



Output

Level Range (3½-digit LED display): +13 dBm to −143.5 dBm into 50Ω, +10 dBm to −143.5 dBm for frequencies from 100 kHz to 1 MHz.
Resolution: 0.1 dB.
Absolute Level Accuracy[1]: <±1.0 dB, +7 to −127 dBm; <±1.5 dB, >+7 dBm.
Level Flatness (100 kHz to 1040 MHz): <±0.5 dB, output level setting of 0 dBm.
SWR (f_c ≥ 400 kHz): <1.5 for levels <−3.5 dBm.
<2.0 for levels ≤+13 dBm.
Reverse-Power Protection: Protects the signal generator from applications of up to 50 watts of RF power (from a 50Ω source) to 1040 MHz into generator output: DC voltage cannot exceed 50V.

Supplemental Characteristics

Impedance: *50Ω Nominal.*
Output Level Overrange: *To +17 dBm.*
Absolute Level Accuracy:
<±1.5 dB, output levels <−127 dBm.
<±0.5 dB, 25°C ± 10°C, +7 to −127 dBm.

TYPICAL MAXIMUM POWER VS. FREQUENCY
(OUTPUT SET TO +17 dBm)

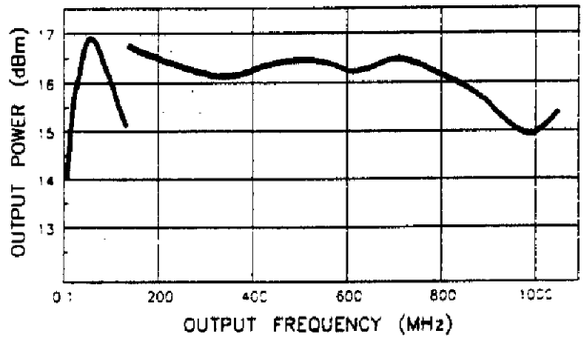


Table 1-1. Specifications (2 of 2)

Amplitude Modulation

AM Depth (2-digit LED display)[2]:
0 to 99%, level ≤+7 dBm, $f_c \geq 400$ kHz[3].
0 to 30%, level ≤+10 dBm, $f_c \geq 400$ kHz[3].
Resolution: 1%.
AM Rate, Internal: 400 Hz and 1 kHz, ±2%.
External: 20 Hz to 40 kHz (1 dB bandwidth, AC coupled).
AM Distortion (internal rates, level ≤7dBm):
0 to 30% AM <1.5% THD plus noise.
31 to 70% AM <3.0% THD plus noise.
71 to 90% AM <4.0% THD plus noise.
Indicator Accuracy (for depths <90% and internal 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 (2-digit LED display)[2]:

Center Frequency	Maximum Peak Deviation	
	AC Mode (the lessor of)	DC Mode
0.1 to 130 MHz	99 kHz or 4000 × rate (Hz)	99 kHz
130 to 260 MHz	50 kHz or 1000 × rate (Hz)	50 kHz
260 to 520 MHz	99 kHz or 2000 × rate (Hz)	99 kHz
520 to 1040 MHz	99 kHz or 4000 × rate (Hz)	99 kHz
FM not specified for $f_c - (\Delta f_{pk})$ <100 kHz		

Resolution: 100 Hz for deviations less than 10 kHz; 1 kHz for deviations ≥10 kHz.
FM Rate:
Internal: 400 Hz and 1 kHz, ±2%.
External: AC Coupled: 5 Hz to 100 kHz, 3 dB BW, 1 kHz reference.
20 Hz to 50 kHz, 1 dB BW, 1 kHz reference.
DC Coupled: DC to 100 kHz, 3 dB BW, 1 kHz reference.
DC to 50 kHz, 1 dB BW, 1 kHz reference.

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

Center Frequency Stability in DC Mode: <10 Hz per hour.
FM Distortion (at internal rates and ≥3 kHz peak deviations)[4]: <0.5% THD plus noise.
Indicator Accuracy (internal rates): <± 5% of setting.
Incidental AM (peak deviations <20 kHz, internal rates and f_c ≥500 kHz): <0.1% AM.

Supplemental Characteristics

External Sensitivity: *1 volt peak for indicated accuracy (1 volt DC when in DC-FM mode).*
External Modulation Input: *Front panel BNC, 600Ω DC-coupled; front panel annunciators indicate application of 1V peak signal, ±5%.*
Modulating Signal Output: *Internal modulating signal is provided at the front panel BNC connector at nominally 1 volt peak into a 600Ω resistive load.*
Simultaneous Modulation:
Internal/External: AM/FM, FM/AM, AM/AM, FM/FM
Internal/Internal, External/External: AM/FM

Remote Programming

Interface: HP-IB (Hewlett-Packard's implementation of IEEE Standard 488).
Interface Functions Implemented: SHØ, AH1, TØ, L2, SRØ, RL1, PPØ, DC1, DTØ, CØ, E1.

General

Operating Temperature Range: 0 to +55°C.
Storage Temperature Range: −55 to +75°C.
Leakage: Conducted and radiated interference is within the requirements of RE02 of MIL STD 461B, and FTZ 1046. Furthermore, RF leakage of <1 μV is induced in a two-turn loop, 2.5 cm in diameter, held 2.5 cm away from the front surface.
Save/Recall/Sequence Storage Registers: 100 non-volatile registers are available that save front panel settings.
Power Requirements: 100 or 120 or 220 or 240 volts (+5%, −10%) from 48 to 440 Hz; 175 VA maximum.
Weight: Net 18.2 kg (40 lb); shipping 23.6 kg (52 lb).
Dimensions: 133H × 425W × 520D mm (5.25 × 16.75 × 20.5 inches).
HP System II module size: 5¼H × 1MW × 17D.

Table 1-2. *Recommended Test Equipment (1 of 3)*

Instrument Type	Critical Specifications	Recommended Model	Use[1]
AM/FM Test Source (required for Measuring Receiver verification)	Range: 10 MHz Residual AM[2] FM Flatness: ±1% (dc to 250 kHz Peak Deviation: to 100 kHz	HP 11715A	P
Audio Source	Level: 0.0 to 1 Vpk into 50 and 600 ohms Frequency: 25 Hz to 40 kHz	HP 8903B	P, A, T
Controller, HP-IB	HP-IB compatibility as defined as IEEE Standard 488 and the identical ANSI Standard MC1.I: SHO, E1, AH1, T4, TEO, LO, LEO, SRO, RLO, PPO, DCO, DTO, and C1, 2. 3, 28.	Use any HP controller and HP-IB interface to implement HP-IB functional checks	T
DC Power Supply	Output: 0-1 V Current: 500 mA	HP 6214A	A
Digital Multimeter	Accuracy: 4 1/2 digit, ±0.05% of reading ±3 Ranges: 20 mV to 30 Vdc and 2 Vac Sensitivity: 100 μV	HP 3466A or HP 3455A (see Table 1-3)	P, A, T
Distortion Analyzer	Distortion Range: <0.1% Range: 25 Hz to 25 kHz	HP 8903A	P,T
Frequency Counter	Range: 10 MHz Resolution: 1 Hz	HP 5328B	A
Frequency Counter	Range: 1040 MHz Resolution: 10 Hz	HP 5328B Option 031	T
Function Generator	Frequency Range: 500 Hz Function: Square wave Output Level: 1 Vp into 600 ohms	HP 3312A	T
Loop Antenna	To ensure measurement accuracy, no substitution is possible. Fabrication depends upon machining and assembling to close tolerances.	HP 08640-60501	P
Measuring Receiver and Sensor Module	Frequency Range: 150 kHz to 990 MHz Input Level: −127 to +13 dBm RF Power: 0.2 dB Tuned RF Level: 0.36 dB RSS Referenced to −10 dBm input	HP 8902A and 11722A (option 003 required for Residual FM Optional Performance Test)	P, A, T

[1] A = Adjustments; P = Performance Tests; T = Troubleshooting.

[2] The residual AM specification of both the HP 8902A Measuring Receiver and HP 11715A AM/FM Test Source are stated in a 50 Hz to 3 kHz bandwidth. In order to assure the validity of the residual AM measurement in the bandwidths stated for the HP 8657A Signal Generator (namely, 50 Hz to 15 kHz) the combined performance of both the HP 8902A and HP 11715A must be verified to be better than 0.022% rms for the 50 Hz to 15 kHz bandwidth.

Table 1–2. *Recommended Test Equipment (2 of 3)*

Instrument Type	Critical Specifications	Recommended Model	Use[3]
Measuring Receiver and Sensor Module (Cont'd)	Amplitude Modulation: Rates[4]: 25 Hz to 25 kHz Depth: to 99% Accuracy: Flatness: ±0.5% Demodulated Output Distortion:0.3% for 50% depth; <0.6% for 90% depth Incidental ΩM: <0.05 radians for 50% depth at 1 kHz rate (50 Hz to 3 kHz bandwidth) Residual AM[5] Frequency Modulation: Rates: 25 Hz to 25 kHz Deviation to 99 kHz Accuracy ±2% at 1 kHz Demodulated Output Distortion: <0.3% Incidental AM[5] Residual FM: <8 Hz rms at 1300 decreasing linearly with frequency to <1 Hz rms for 1000 MHz and below (50 Hz to 3 kHz bandwidth) Audio Distortion: Frequencies: 400 Hz and 1 kHz, ±5% Display Range: < 0.1% Accuracy: ±1 dB of reading	HP 8902A and 17722A ±2% at 1 kHz	P, A, T
Oscilloscope and Probes	Vertical Sensitivity: 100 mV/div (with 54001A 1 GHz Active Probe 54003A 1MΩ input and 10:1 probe 54003-61617 Bandwidth: 50 MHz Time Base: .05 μsec Input: Dual Channel	HP 54100A[6]	A, T
Phase Noise Measurement System	Frequency Range: 0.1to 1040 MHz Offset: 20 kHz Accuracy: ±2 dB Noise Floor: −145 dB	HP 3048A	P

[3] A = Adjustments; P = Performance Tests; T = Troubleshooting.

[4] The incidental AM specification for the Signal Generator is not equivalent to the published specification of the HP 8902A Measuring Receiver. In order to assure the validity of the incidental AM measurement, the incidental AM of the modulation analyzer must be verified to be less than 0.002% for the 300 Hz to 20 kHz peak deviation at internal rates.

[5] The residual AM specification of both the HP 8902A Measuring Receiver and HP 11715A AM/FM Test Source are stated in a 50 Hz to 3 kHz bandwidth. In order to assure the validity of the residual AM measurement in the bandwidths stated for the HP 8657A Signal Generator (namely, 50 Hz to 15 kHz) the combined performance of both the HP 8902A and HP 11715A must be verified to be better than 0.022% rms for the 50 Hz to 15 kHz bandwidth.

[6] See Table 1–4 for an alternate analog oscilloscope listing.

Table 1–2. *Recommended Test Equipment (3 of 3)*

Instrument Type	Critical Specifications	Recommended Model	Use[7]
Reference Source	Frequency: 0.1 to 1040 MHz Level: +13 dBm SSB Phase Noise (20 kHz offset): < −124 dBc/Hz, 0.1 to 130 MHz < −136 dBc/Hz, 130 to 260 MHz < −130 dBc/Hz, 260 tp 520 MHz < −124 dBc/Hz, 520 to 1040 MHz	HP 8657A or HP 8662A	P
Signal Source (optional)	Residual SSB phase noise in 1 Hz Bw (320 MHz ≤ f_c <640 MHz) with an offset from the carrier of: −100 dBc at 10 Hz, −121 dBc at 1 kHz, and −131 dBc at 10 kHz	HP 8662A (for Optional Residual FM Test)	P
Signature Analyzer	Provides preferred method for troubleshooting digital circuitry	HP 5005A	T
Spectrum Analyzer, RF	Frequency Range: 0.1 to 1040 MHz Resolution Bandwidth: <1 kHz to 3 kHz	HP 8568B or HP 8558B/P/853A (see Table 1–4)	P, A, T
SWR Bridge	Frequency Range: 5 MHz to 1040 MHz Impedance: 50 ohms Directivity: >40 dB Test Connector: Type N male	Wiltron 60N50	P
Wideband Amplifier	Gain: 20 or greater Frequency Range: 10 MHz to 1040 MHz Impedance: 50 ohms Connector: Type N	HP 8447D Option 010	P
Termination	Frequency Range: 0.1 to 1040 MHz Termination: 50ohms SWR: <1.05	HP 908A	P

[7] A = Adjustments; P = Performance Tests; T = Troubleshooting.

Table 1–3. *Recommended Accessories*

Adapter	Quantity	Type	Recommended Model	Use[1]
Coaxial	1	BNC(f) to BNC(f)	HP 1250-0080	A, T
Coaxial	1	N(f) to BNC(m)	HP 1250-0077	A
Coaxial	3	N(m) to BNC(f)	HP 1250-0780	P, A, T
Probe	2	SMC(f) to RF Test Point	HP 1250-1598	A, T
RF	2	BNC(f) to SMC(f)	HP 08662-60075	P
RF	1	Connector: UG-21D/U Type N(m)	HP 11500A	P, A, T
RF	2	Connector: UG-21D/U Type N(m)	HP 11500B	P, A, T

[1] A = Adjustments; P = Performance Tests; T = Troubleshooting.

Table 1–4. *Alternate Test Equipment*

Instrument	Recommended Model	Suggested Alternative	Advantages of Alternative
Digital Voltmeter (DVM)	HP 3466A	HP 3455A	HP-IB* Compatible
Frequency Counter	HP 5328B Option 031	HP 5328A Options 001 and 031	HP-IB* Compatible
Oscilloscope	HP 54100A	HP 1740A	Availability
Spectrum Analyzer, RF	HP 8658B	HP 8558B/P/853A or HP 8554B/8552B/141T	Satisfies the requirements for testing the Signal Generator.

* HP-IB is Hewlett-Packard's implementation of IEEE Standard 488 and the identical ANSI Standard MC1.1

Section 4
PERFORMANCE TESTS

4-1. INTRODUCTION

The procedures in this section test the instrument's electrical performance using the specifications of Table 1-1 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 Operator's Checks.

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 1-2, 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

Results of the performance tests may be tabulated on Table 4-2 which is the Performance Test Record. The Performance Test Record located at the end of this section 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

This instrument requires periodic verification of performance. Depending on the use and environmental conditions, the instrument 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 4-1 shows which tests are recommended for various situations. The Operator's Checks in Section 3 should be the first step in all testing situations.

4-6. TEST PROCEDURES

It is assumed that the person performing the following tests understands 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 the operator would set that control so that the analyzer operates correctly.

It is also assumed that the person performing the tests will supply whatever cables, connectors, and adapters are necessary.

Table 4-1. Abbreviated Performance Tests

Testing Situations		Section 3 Functional Checks		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:	Reference Service Sheet No.							
A1	21	X						
A2	21-24	X						
A3A1	9	X		X		FM		
A3	9	X						
A3	10	X		X		FM		
A3	11	X		X				
A3	12	X		X				
A3	13	X		X		FM		
A3	14	X		X		FM		
A3	15	X		X		FM		
A3	16	X		X				
A4	1	X		X				
A4	2	X		X				
A6	4	X		X	X	AM		
A6	5	X		X	X			
A6	8	X						
A7	9	X		X				
A8	3	X		X				
A9	8	X		X	X		X	X
A10	6	X						
A10	7	X			X	X		
A10	8	X						
A11	17-20	X	X		X	X		
A15	25	X						
A16	25	X						
FL1	3	X		X				

Performance Test 1

SPECTRAL PURITY TESTS

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

Specifications

Electrical Characteristics	Performance Limits	Conditions
Spurious Signals:		
Harmonics	< −30 dBc	≤ +7 dBm output levels
Non-harmonics	< −60 dBc	≥ 2 MHz from carrier in CW mode
		> 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	
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 Noise Bandwidth)	< 1 Hz rms	130 to 260 MHz
	< 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 Noise Bandwidth)	< 1.5 Hz rms	130 to 260 MHz
	< 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

Description

Spurious signals are checked using a spectrum analyzer. Residual AM and FM Modulation are checked using a measuring receiver. SSB phase noise is measured using a phase noise measurement system.

Equipment

Spectrum Analyzer ..... HP 8568B or HP 8558A/853A (Harmonics/Spurious Tests)
Measuring Receiver ..... HP 8902A (Option 003 for Optional Residual FM Tests)
Sensor Module ..... HP 11722A
Digital Multimeter ..... HP 3466A
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

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 < −30 dBc, all non-harmonics 2 MHz from the carrier are < −60 dBc, all non-harmonics 5 KHz to 2 MHz from carrier are < −72 dBc, < −66 dBc, < −60 dBc for each frequency band shown in the table, and that there are no sub harmonics as the frequency is incremented from 100 kHz to 1040 MHz.

Spurious Signals	Results	
	Actual	Max.
Harmonics	_____	< −30 dBc
Non-Harmonics (≥ 2 MHz from carrier)	_____	< −60 dBc
5 kHz to 2 MHz from carrier	_____	< − 60 dBc, 0.1 tp 130 MHz
	_____	< −72 dBc, 130 to 260 MHz
	_____	< −66 dBc, 260 to 520 MHz
	_____	< − 60 dBc, 520 to 1040 MHz
Sub-Harmonics	_____	None

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.

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.

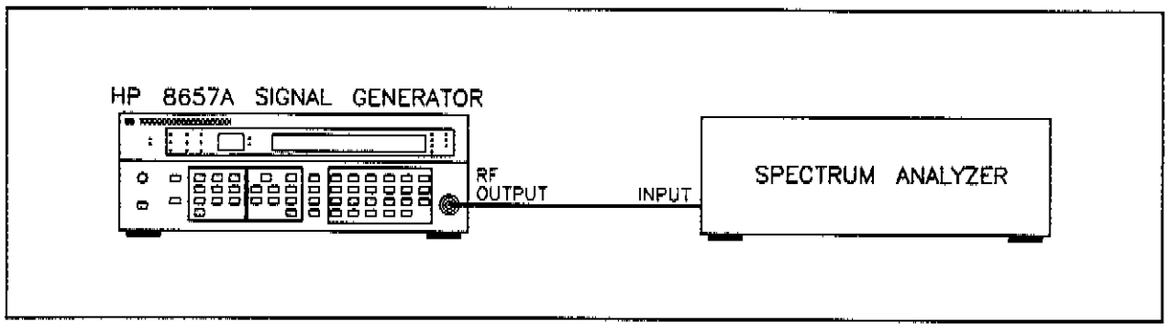


Figure 4-1. *Spurious Signals Test Setup*

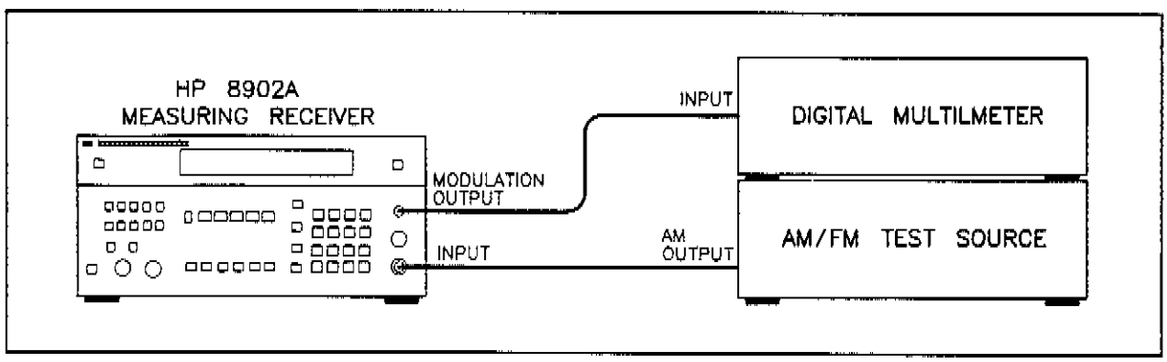


Figure 4-2. *Measuring Receiver Residual AM Verification Test Setup*

Residual AM

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. In order to verify that the residual AM of the measuring receiver is adequate to measure the Signal Generator's residual AM specification, the residual AM of the measuring receiver must be verified to ensure the validity of the measurement. If the Signal Generator's 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 3.28 mV or less.

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 or 0.028%. With an output sensitivity of 10%/V, the corresponding output level is 2.80 mV.

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 <4.00 mVrms.

Actual	Maximum
_____	< 4.00 mVrms

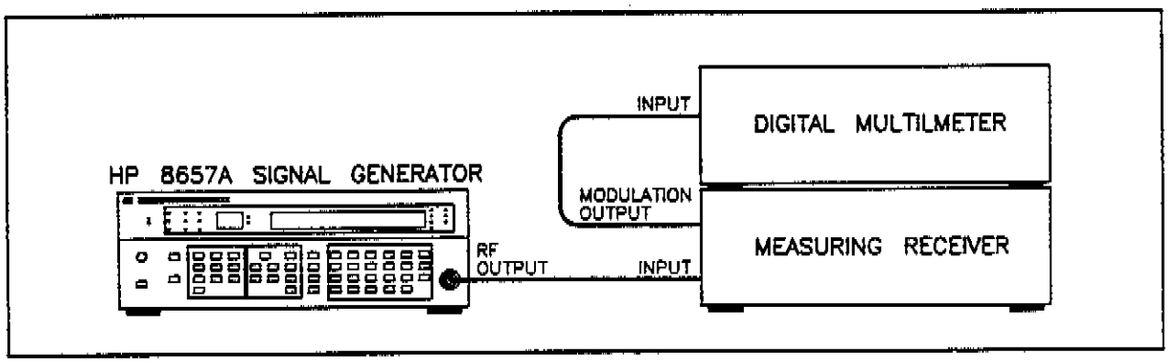


Figure 4-3. Residual AM Test Setup

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 HP 8657A has been repaired or the heterodyne band of frequencies do not pass, the Optional Residual FM Test (steps 10a-13a) 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.

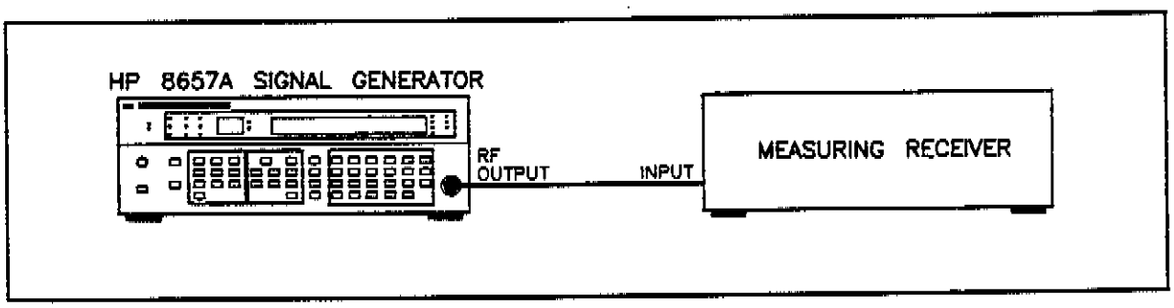


Figure 4–4. Residual FM Test Setup

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 129.99999	300	3	_____	< 4
0.15 to 129.99999	50	15	_____	< 6

Optional Residual FM Test

The Residual FM Test gives confidence that the HP 8657A is passing all its Residual FM specifications. The Residual FM of the HP 8657A can be checked at all frequencies with an HP 8902A Option 003 and an external local oscillator (LO). The residual FM of the external LO must be less than the internal LO of the HP 8902A and the residual FM of the HP 8657A.

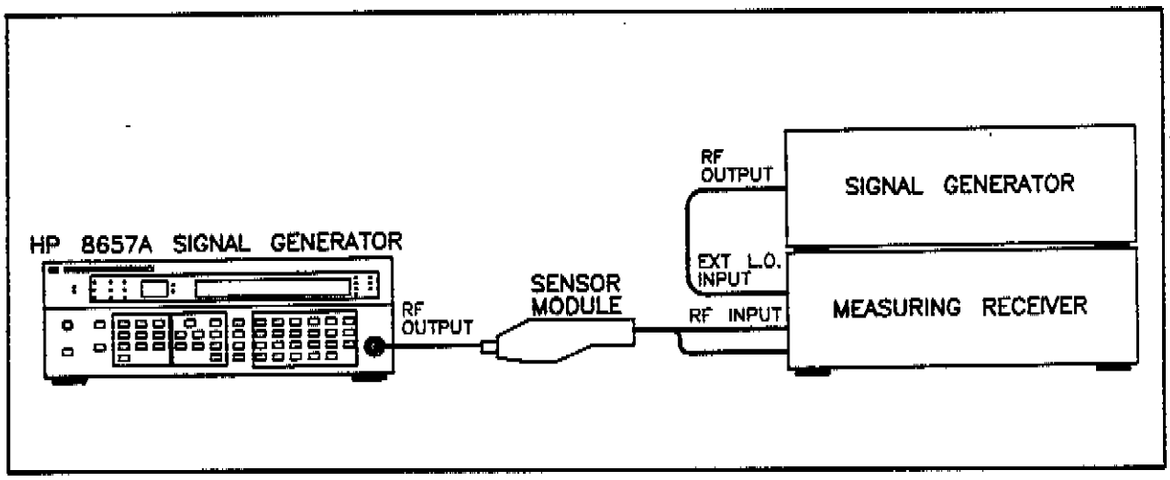


Figure 4–4a. *Residual Test Setup*

10a. Set the measuring receiver as follows:

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

11a. Set the Signal Generator under test as follows:

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

12a. Connect the instruments as shown in Figure 4–4a.

13a. 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.

Optional Residual FM Test Specifications

Signal Generator Frequency (MHz)	Modulation Analyzer Filter		Results (Hz rms)	
	High Pass (Hz)	Low Pass (kHz)	Actual	Max.
0.15 to 130	300	3	_____	< 4
130 to 260	300	3	_____	< 1
260 to 520	300	3	_____	< 2
520 to 1040	300	3	_____	< 4
0.15 to 130	50	15	_____	< 6
130 to 260	50	15	_____	< 1.5
260 to 520	50	15	_____	< 3
520 to 1040	50	15	_____	< 6

SSB PHASE NOISE (1 HZ BANDWIDTH) Can not do.

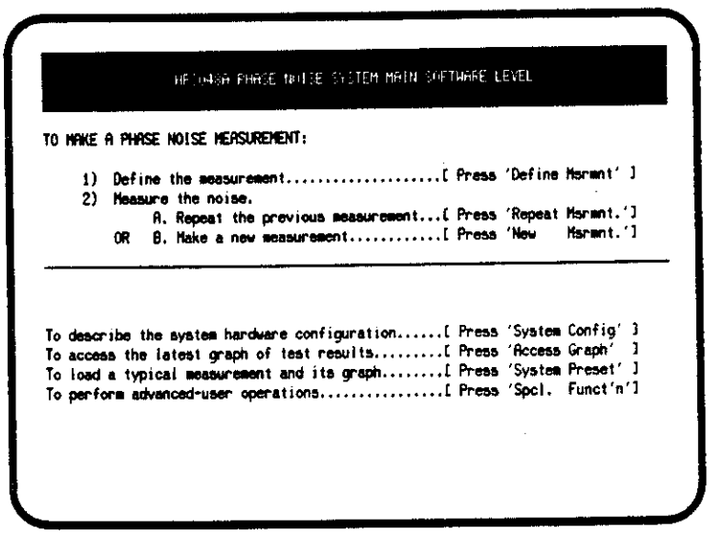
Description

Single-sideband (SSB) phase noise of the HP 8657A is measured at the offset frequency of 20 KHz 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 HP 8657A being tested. If the reference source's phase noise level is equal to the HP 8657A'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 HP 8657A'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 8657A SYSTEM CNTRL. Press the **Done** key when you have completed this operation.

NOTE

The HP 8657A 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 HP 8657A under test. If you are not able to select the HP 8657A as the reference source using the Ref. Source key, then the HP 8657A has not yet been entered into the HP 3048A's Configuration Table. To enter the HP 8657A, 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 HP 8657A and reference source to the HP 3048A as shown. (Note that the reference source is labeled USERS's DUT on the screen. Figure 4-5 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 HP 8657A's setting will be adjusted by the HP 3048A via its HP-IB connection.)

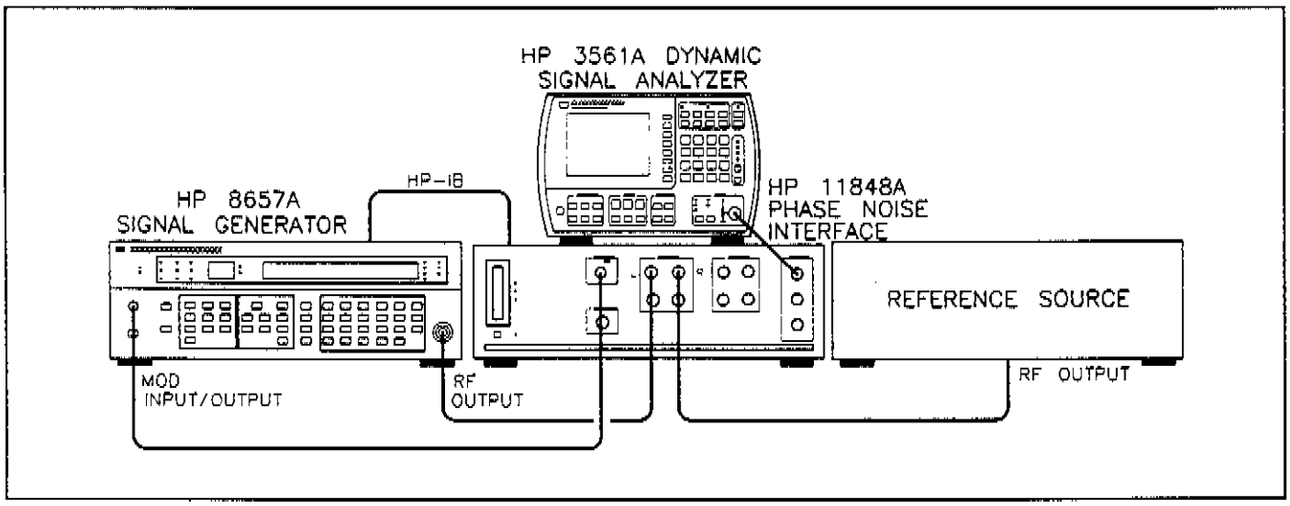


Figure 4–5. *Setup Diagram for SSB Phase Noise Measurement*

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 HP 8657A 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.)

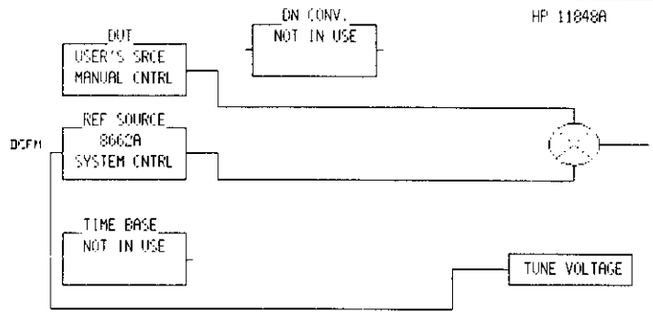
NOTE

If the noise level measured by the HP 3048A exceeds the HP 8657A's specified noise level and the exact noise level of the reference source is not known, the exact level of each source should 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	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

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

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

Performance Test 2

OUTPUT LEVEL ACCURACY AND FLATNESS TESTS

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

Specifications

Electrical Characteristics	Performance Limits	Conditions
Output		
Level Range	+13 dBm to −143.5 dBm +10 dBm to −143.5 dBm	Into 50 ohms 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 form 100 kHz to 1040 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 4-6.

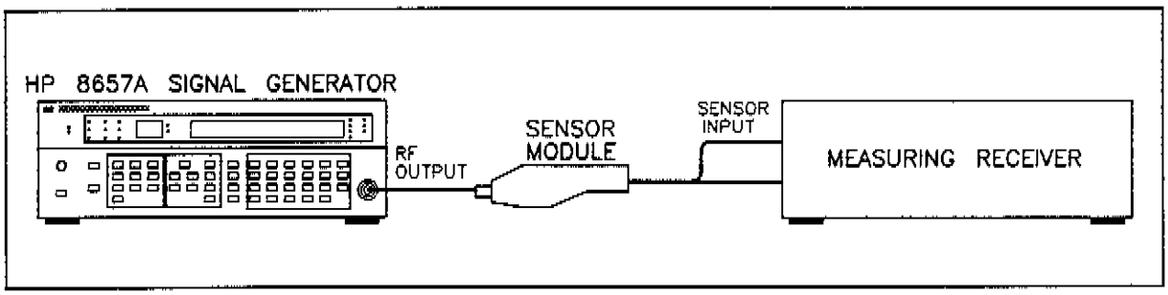


Figure 4-6. *Output Level Accuracy and Flatness Test Setup*

3. Set the measuring receiver as follows:

   Measurement ..... RF POWER
   Display ..... LOG
   Frequency ..... 150 kHz
   Frequency Increment ..... 100 kHz

4. Set the Signal Generator as follows:

   Frequency ..... 150 kHz
   Frequency Increment ..... 100 kHz
   Amplitude ..... 0.0 dBm
   Modulation ..... Off

5. Wait for the power measurement to settle and then select DISPLAY RATIO to set a 0.0 dB. reference.
6. Step the Signal Generator and measuring receiver through the frequency range of 150 kHz to 1040 MHz (use 10 MHz steps above 10 MHz) and record the highest and lowest readings.

   _____ Highest Reading _____ Frequency

   _____ Lowest Reading _____ Frequency

   The amplitude variation should not exceed 1.0 dB. Record the maximum variation (highest reading − lowest reading).

   _____ <1.0 dB

Absolute Level Accuracy

7. Set the Signal Generator as follows:

   Frequency ..... 3 MHz
   Amplitude ..... +13 dBm
   Amplitude Increment ..... 5 dBm
   Modulation ..... Off

8. Set the measuring receiver as follows:

   Measurement ..... RF POWER

9. Begin decrementing the Signal Generator's 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 Frequencies 0.15 to 1040 MHz

Amplitude Setting (dBm)	Minimum (dBm)	Actual (dBm)	Maximum (dBm)
+8.0	+6.5	_____	+9.5
+3.0	+2.0	_____	+4.0
−2.0	−3.0	_____	−1.0
−7.0	−8.0	_____	−6.0
−12.0	−13.0	_____	−11.0
−17.0	−18.0	_____	−16.0
−22.0	−23.0	_____	−21.0
−27.0	−28.0	_____	−26.0
−32.0	−33.0	_____	−31.0
−37.0	−38.0	_____	−36.0
−42.0	−43.0	_____	−41.0
−47.0	−48.0	_____	−46.0
−52.0	−53.0	_____	−51.0
−57.0	−58.0	_____	−56.0
−63.0	−63.0	_____	−61.0
−67.0	−68.0	_____	−66.0
−72.0	−73.0	_____	−71.0
−77.0	−78.0	_____	−76.0
−82.0	−83.0	_____	−81.0
−87.0	−88.0	_____	−86.0
−92.0	−93.0	_____	−91.0
−97.0	−98.0	_____	−96.0
−102.0	−103.0	_____	−101.0
−107.0	−108.0	_____	−106.0
−112.0	−113.0	_____	−111.0
−117.0	−118.0	_____	−116.0
−122.0	−123.0	_____	−121.0
−127.0	−128.0	_____	−126.0

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

Specifications

Electrical Characteristics	Performance Limits	Conditions
Amplitude Modulation		
Depth[1]	0 to 99%	Output levels to < +7 dBm; frequencies from 100 kHz to 1040 MHz.
	0 to 30%	Output levels to +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	+2% (±6% of reading)	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	< 1.5%	0 to 30% AM
(internal rates,	< 3%	31 to 70% AM
levels < +10 dBm)	< 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)

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

Electrical Characteristics	Performance Limits	Conditions
FM Modulation (cont'd)		
Maximum Peak Deviation (Δfpk):[3] (cont'd)		
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)
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)
Indicator Accuracy[3]	±5% of reading	At internal rates.
FM Distortion (Total Harmonic Distortion)[4,5]	<0.5%	≥ 3 kHz peak deviations and at internal rates.
FM Rates:		
Internal	400 and 1 kHz, ±2%	
External	dc to 50 kHz	ac coupled, ±1 dB 20 Hz to 50 kHz.
	dc to 100 kHz	±3 dB.

(3) FM deviation is further limited by the Indicator Accuracy specification.
(4) FM distortion only applies at deviation up to 25 kHz or 130 < fc <260 MHz, and 50 kHz for 260 < fc < 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.
(5) Typically < 0.5% THD for peak deviations > 1 kHz and at internal rates.

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 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 4-7.

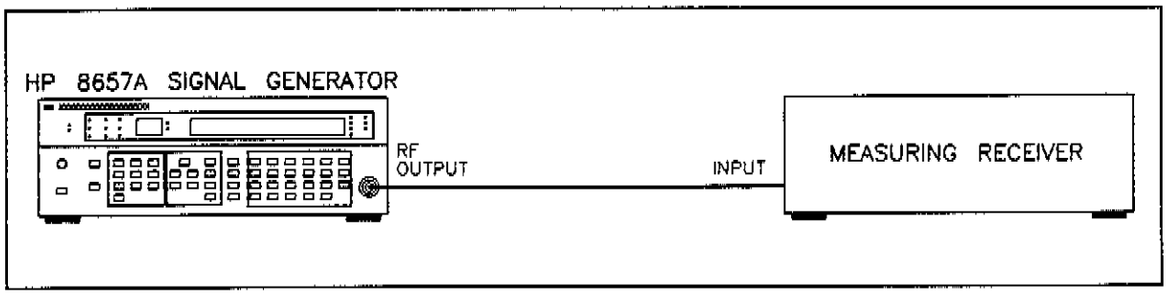


Figure 4-7. *Modulation Test Setup*

2. Set the measuring receiver as follows:

Measurement	AM
Detector	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	+7 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.
5. Repeat step 5 with the Signal Generator set to frequencies of 240 MHz, 400 MHz and 1040 MHz.
6. Select the measuring receiver's 50 Hz high-pass filter. Verify the AM accuracy with the Signal Generator frequency at 100 MHz and internal 400 Hz AM modulation.

MHz	AM Depth	Results		
		Min.	Actual	Max.
100	10%	7.4%	_____	12.6%
	30%	26.2%	_____	33.8%
	70%	63.8%	_____	76.2%
	90%	82.6%	_____	97.4%
240	10%	7.4%	_____	12.6%
	30%	26.2%	_____	33.8%
	70%	63.8%	_____	76.2%
	90%	82.6%	_____	97.4%
400	10%	7.4%	_____	12.6%
	30%	26.2%	_____	33.8%
	70%	63.8%	_____	76.2%
	90%	82.6%	_____	97.4%
1040	10%	7.4%	_____	12.6%
	30%	26.2%	_____	33.8%
	70%	63.8%	_____	76.2%
	90%	82.6%	_____	97.4%

Incidental Phase Modulation

7. Set the measuring receiver as follows:

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

8. Set the Signal Generator as follows:

Frequency ..... 100 kHz
Frequency Increment ..... 100 kHz
Amplitude ..... +7 dBm
Modulation ..... 1 kHz (Int.) AM 30%

9. Step the Signal Generator through the frequency range of 150 kHz to 1040 MHz use 10 MHz steps above 10 MHz) and record the highest reading. The highest reading should not exceed the limit specified.

Signal Generator Frequency		Result	
Min.	Max.	Actual	Max.
150 kHz	1040 MHz	_____	< 0.3 radian peak

AM Distortion

10. Set the measuring receiver as follows:

    Measurement ..... 1 kHz Audio Distortion
    HP Filter ..... 300 Hz
    LP Filter ..... 15 kHz
    Detector ..... Peak+

11. Set the Signal Generator as follows:

    Frequency ..... 10 MHz
    Amplitude ..... +7 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.

13. Repeat step 13 with the Signal Generator set to frequencies of 240 MHz, 400 MHz, and 1040 MHz.

MHz	AM Depth	Results	
		Actual	Max.
100	30%	_____	< 1.5%
	70%	_____	< 3.0%
	90%	_____	< 4.0%
240	30%	_____	< 1.5%
	70%	_____	< 3.0%
	90%	_____	< 4.0%
400	30%	_____	< 1.5%
	70%	_____	< 3.0%
	90%	_____	< 4.0%
1040	30%	_____	< 1.5%
	70%	_____	< 3.0%
	90%	_____	< 4.0%

FM Indicator Accuracy

14. Set the measuring receiver as follows:

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

15. Set the Signal Generator as follows:

    Frequency ..... 100 MHz
    Amplitude ..... +7 dBm
    Modulation ..... 1 kHz (Int) FM 5 kHz

16. 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.

17. 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 4-8.

    b. Set the measuring receiver as follows:

    Measurement ..... Frequency

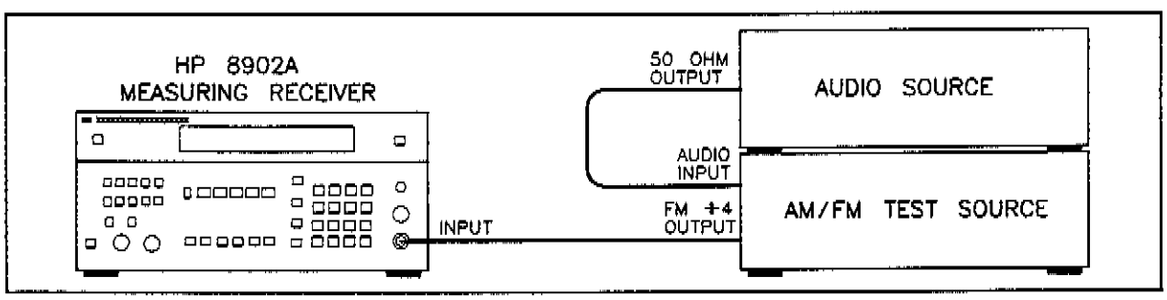


Figure 4-8. *Measuring Receiver Incidental AM Verification Test Setup*

    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.

18. Set the measuring receiver as follows:

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

19. Set the Signal Generator as follows:

Amplitude ..... +7 dBm
Modulation ..... 1 kHz (Int) FM 20 kHz

20. Connect the equipment as shown in Figure 4-7, Modulation Test Setup.

21. 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.

Signal Generator Frequency		Result	
Min.	Max.	Actual	Max.
10 MHz	1040 MHz	_____	< 0.1%

NOTE

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

FM Distortion

22. Set the measuring receiver as follows:

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

23. Set the distortion analyzer as follows:

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

24. Set the Signal Generator as follows:

    Frequency ..... 100.0 MHz
    Amplitude ..... +7 dBm
    Modulation ..... 1 kHz (Int) FM

25. Connect the equipment as shown in Figure 4-7, Modulation Test Setup.

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

27. 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.

FM Deviation		Result	
Min.	Max.	Actual	Max.
3 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

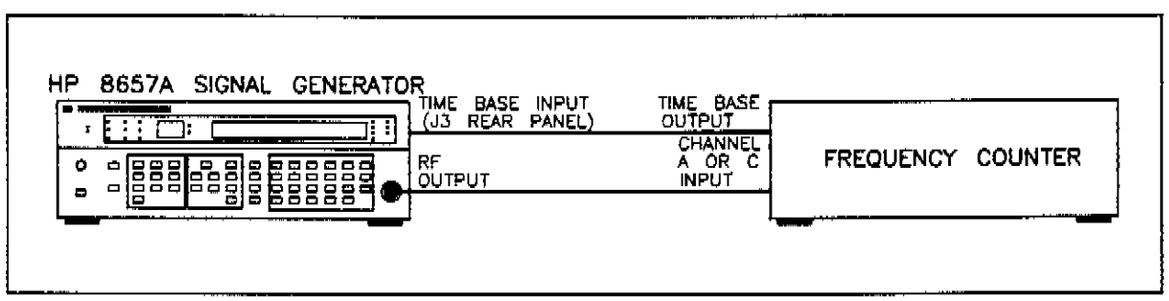


Figure 4-9. *DC FM Test Setup*

Procedure

DC FM Center Frequency Accuracy

28. 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 4–9.

29. Set the frequency counter as follows:

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

30. Set the Signal Generator as follows:

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

31. 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.

Frequency (MHz)	DC FM Deviation(kHz)	Frequency	
		Offset(kHz)	Drift(Hz/Hr)
0.1 to 130	1 to 99	_____ ±500 Hz	_____ ±10
130 to 260	1 to 50	_____ ±125 Hz	_____ ±10
260 to 520	1 to 99	_____ ±250 Hz	_____ ±10
520 to 1040	1 to 99	_____ ±500 Hz	_____ ±10

DC FM Center Frequency Stability

32. Set the Signal Generator FM deviation and frequency as shown in the table above and verify that the frequency drift does not exceed the limits specified.

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 8558B or HP 8568B
50Ω Termination	HP 908A

Procedure

1. Connect equipment as shown in Figure 4-10.

NOTE

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

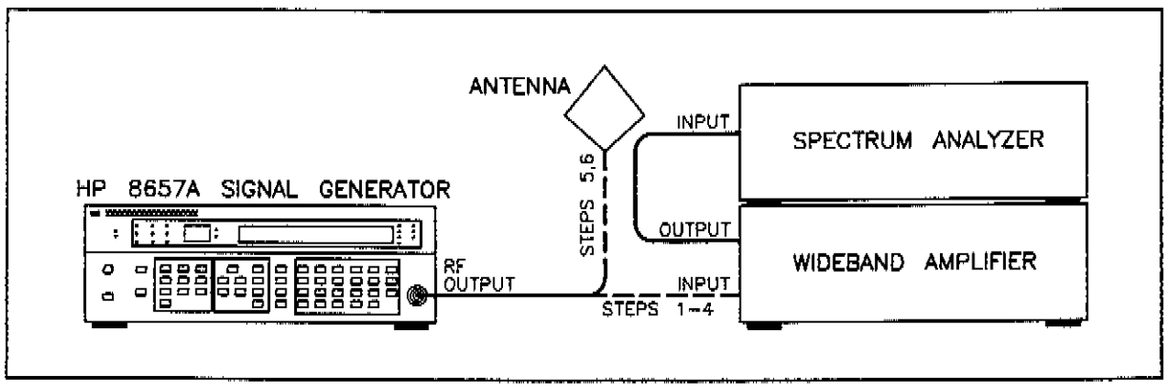


Figure 4-10. *Output Leakage Test Setup*

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 −107 dBm signal from the Signal Generator to 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 spectrum analyzer, 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 26 dB amplifier as shown in Figure 4-10. 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, and 1040 MHz.

   _____ < −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 1040 MHz

Performance Test 5

SWR TEST

- **< −4 dBm (10 dB Attenuator Pad Selected)**
- **> −3 dBm (Attenuator Pads Not Selected)**

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	50 watts	RF power to 1040 MHz into RF OUTPUT, dc voltage cannot exceed 25V.

Description

SWR is verified by comparing the reflected power (frequencies 0.5 to 1040 MHz 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 8657A
Spectrum Analyzer ..... HP 8558B/853A
SWR Bridge ..... Wiltron 60N50
Cables (UG-21D/U type N connectors) ..... HP 11500B (2 Required)

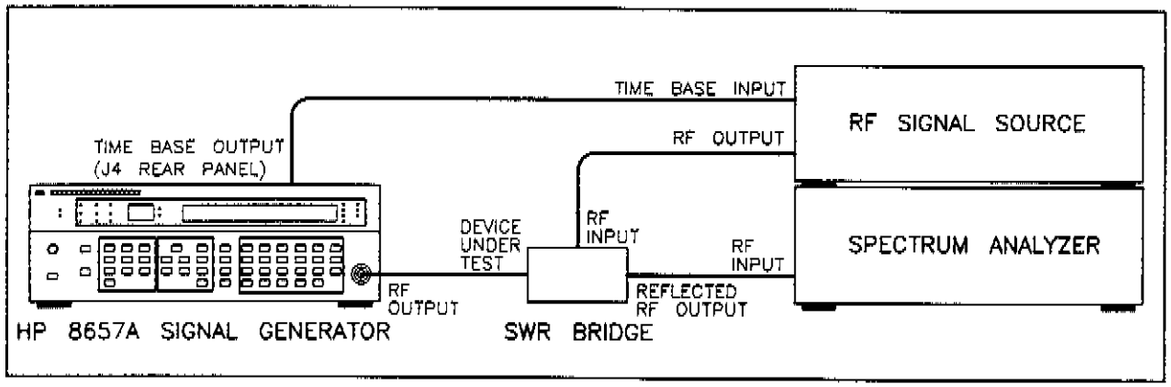


Figure 4–11. SWR Performance Test Setup (Out of Band)

Procedure

≤ −4 dBm (10 dB Attenuator Pad Selected)

1. Set the Signal Generator (HP 8657A) 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 4-11.

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 1040 MHz and 100 MHz from the Signal Generator's frequency.

   _____ 14 dB

SWR Test > −3 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 (HP 8657A) 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 4-11.

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 Blue SHIFT must be pressed to reselect the Phase Decrement function.

18. Read the maximum and minimum 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 1040 MHz 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

PERFORMANCE TEST 1: SPECTRAL PURITY TESTS

Spurious Signals

Spurious Signals	Results	
	Actual	Max.
Harmonics	_____	< −30 dBc
Non-Harmonics (≥ 2 MHz from carrier)	_____	< −60 dBc
5 kHz to 2 MHz from carrier	_____	< − 60 dBc, 0.1 tp 130 MHz
	_____	< −72 dBc, 130 to 260 MHz
	_____	< −66 dBc, 260 to 520 MHz
	_____	< − 60 dBc, 520 to 1040 MHz
Sub-Harmonics	_____	None

Residual AM

The digital multimeter should indicate <4.00 mVrms.

Actual	Maximum
_____	< 4.00 mVrms

PERFORMANCE TEST 1: SPECTRAL PURITY TESTS (CONT'D)

Residual FM Test

Signal Generator Frequency (MHz)	Modulation Analyzer Filter		Results (Hz rms)	
	High Pass (Hz)	Low Pass (kHz)	Actual	Max.
0.15 to 129.99999	300	3	_____	< 4
0.15 to 129.99999	50	15	_____	< 6

Optional Residual FM Test Specifications

Signal Generator Frequency (MHz)	Modulation Analyzer Filter		Results (Hz rms)	
	High Pass (Hz)	Low Pass (kHz)	Actual	Max.
0.15 to 130	300	3	_____	< 4
130 to 260	300	3	_____	< 1
260 to 520	300	3	_____	< 2
520 to 1040	300	3	_____	< 4
0.15 to 130	50	15	_____	< 6
130 to 260	50	15	_____	< 1.5
260 to 520	50	15	_____	< 3
520 to 1040	50	15	_____	< 6

SSB Phase Noise (1 HZ Bandwidth)

Offset from Carrier	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

PERFORMANCE TEST 2: HARMONIC TESTS

Output Level Accuracy and Flatness Tests

Step the Signal Generator and measuring receiver through the frequency range of 150 kHz to 1040 MHz (use 10 MHz steps above 10 MHz) and record the highest and lowest readings.

_____ **Highest Reading** _____ **Frequency**

_____ **Lowest Reading** _____ **Frequency**

The amplitude variation should not exceed 1.0 dB. Record the maximum variation (highest reading − lowest reading).

_____ **<1.0 dB**

Absolute Level Accuracy

RF Output Frequencies 0.15 to 1040 MHz

Amplitude Setting (dBm)	Minimum (dBm)	Actual (dBm)	Maximum (dBm)
+8.0	+6.5	_____	+9.5
+3.0	+2.0	_____	+4.0
−2.0	−3.0	_____	−1.0
−7.0	−8.0	_____	−6.0
−12.0	−13.0	_____	−11.0
−17.0	−18.0	_____	−16.0
−22.0	−23.0	_____	−21.0
−27.0	−28.0	_____	−26.0
−32.0	−33.0	_____	−31.0
−37.0	−38.0	_____	−36.0
−42.0	−43.0	_____	−41.0
−47.0	−48.0	_____	−46.0
−52.0	−53.0	_____	−51.0
−57.0	−58.0	_____	−56.0
−63.0	−63.0	_____	−61.0
−67.0	−68.0	_____	−66.0
−72.0	−73.0	_____	−71.0
−77.0	−78.0	_____	−76.0
−82.0	−83.0	_____	−81.0
−87.0	−88.0	_____	−86.0
−92.0	−93.0	_____	−91.0
−97.0	−98.0	_____	−96.0
−102.0	−103.0	_____	−101.0
−107.0	−108.0	_____	−106.0
−112.0	−113.0	_____	−111.0
−117.0	−118.0	_____	−116.0
−122.0	−123.0	_____	−121.0
−127.0	−128.0	_____	−126.0

PERFORMANCE TEST 3: MODULATION TESTS

AM Indicator Accuracy

MHz	AM Depth	Results		
		Min.	Actual	Max.
100	10%	7.4%	_____	12.6%
	30%	26.2%	_____	33.8%
	70%	63.8%	_____	76.2%
	90%	82.6%	_____	97.4%
240	10%	7.4%	_____	12.6%
	30%	26.2%	_____	33.8%
	70%	63.8%	_____	76.2%
	90%	82.6%	_____	97.4%
400	10%	7.4%	_____	12.6%
	30%	26.2%	_____	33.8%
	70%	63.8%	_____	76.2%
	90%	82.6%	_____	97.4%
1040	10%	7.4%	_____	12.6%
	30%	26.2%	_____	33.8%
	70%	63.8%	_____	76.2%
	90%	82.6%	_____	97.4%

Incidental Phase Modulation

Signal Generator Frequency		Result	
Min.	Max.	Actual	Max.
150 kHz	1040 MHz	_____	< 0.3 radian peak

PERFORMANCE TEST 3: MODULATION TESTS (CONT'D)

AM Distortion

MHz	AM Depth	Results	
		Actual	Max.
100	30% 70% 90%	_____ _____ _____	< 1.5% < 3.0% < 4.0%
240	30% 70% 90%	_____ _____ _____	< 1.5% < 3.0% < 4.0%
400	30% 70% 90%	_____ _____ _____	< 1.5% < 3.0% < 4.0%
1040	30% 70% 90%	_____ _____ _____	< 1.5% < 3.0% < 4.0%

FM Indicator Accuracy

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

Incidental AM

Signal Generator Frequency		Result	
Min.	Max.	Actual	Max.
10 MHz	1040 MHz	_____	< 0.1%

PERFORMANCE TEST 3: MODULATION TESTS (CONT'D)

FM Distortion

FM Deviation		Result	
Min.	Max.	Actual	Max.
3 kHz	99 kHz	_____	<0.5%

DC FM Frequency Accuracy and Stability

Frequency (MHz)	DC FM Deviation(kHz)	Frequency	
		Offset(kHz)	Drift(Hz/Hr)
0.1 to 130	1 to 99	_____ ±500 Hz	_____ ±10
130 to 260	1 to 50	_____ ±125 Hz	_____ ±10
260 to 520	1 to 99	_____ ±250 Hz	_____ ±10
520 to 1040	1 to 99	_____ ±500 Hz	_____ ±10

PERFORMANCE TEST 4: OUTPUT LEAKAGE TESTS

Output Leakage Tests

Connect the one-inch loop antenna to the analyzer through the 26 dB amplifier as shown in Figure 4–10. 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

Repeat step 5 for frequencies of 300, 500, 700, 900, and 1040 MHz.

_____ < −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 1040 MHz

PERFORMANCE TEST 5: SWR TESTS

SWR Tests

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

Repeat steps 3 through 6 with the RF signal source set to any frequency between 5 MHz and 1040 MHz and 100 MHz from the Signal Generator's frequency.

_____ 14 dB

SWR Test > −3 dBm (Attenuator Pads Not Selected)

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

_____ <2.0