

# **Calibration Guide**

## **Agilent Technologies**

### **ESG Family Signal Generators**

**Serial Number Prefixes:**

(Affix Label Here)



Part No. E4400-90325

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# Contents

## 1. Equipment Required

Required Equipment .....	1-2
--------------------------	-----

## 2. Operation Verification

Verification Procedures .....	2-2
-------------------------------	-----

## 3. Service Software

Required Test Equipment .....	3-2
Installing the ESG_B or ESG_APDP Service Software .....	3-3
Uninstalling the Software .....	3-5
ESG Family Support Software Administration .....	3-6
Running the Service Support Software .....	3-20

## 4. Performance Tests

Support Software .....	4-3
1. Internal FM Accuracy and Distortion .....	4-9
2. Internal AM Accuracy and Distortion .....	4-10
3. Phase Modulation Accuracy and Distortion .....	4-12
4. FM Frequency Response .....	4-13
5. AM Frequency Response .....	4-14
6. Phase Modulation Frequency Response .....	4-16
7. DCFM Frequency Offset Relative to CW .....	4-17
8. Residual FM (ESG-A and ESG-D only) .....	4-18
9. Harmonic, Subharmonic, and Nonharmonic Spurious Signals .....	4-20
10. Power Level Accuracy .....	4-21
11. Timebase Aging Rate (ESG-AP, ESG-DP or Option 1E5 only) .....	4-24
12. Digital Modulation Level Accuracy .....	4-27
13. Internal Digital Modulation Quality .....	4-28
14. Custom I/Q RF Modulation Quality (Option UN8 only) .....	4-29
15. I/Q Modulation Quality (Options UN3, UN4 & UN8) .....	4-31
16. Pulse Modulation On/Off Ratio .....	4-32
17. Burst Modulation On/Off Ratio (ESG-D only) .....	4-33
18. CDMA Adjacent Channel Power (Option UN5 only) .....	4-34
19. Alternate Timeslot Power Settling Time (Option UNA only) .....	4-35
20. Pulse Rise/Fall Time (Option 1E6 only) .....	4-36
21. Measuring Phase Noise and Residual FM (ESG-AP and ESG-DP Series Signal Generators) .....	4-37
22. Dual Arbitrary Waveform Generator Check (Option UND only) .....	4-42
23. GSM Loopback BER Check (Option 300 only) .....	4-44
24. Frac-N Check (ESG-AP, ESG-DP only) .....	4-45
25. Sampler/YO Driver Check (ESG-AP, ESG-DP only) .....	4-45
Performance Test Records .....	4-46

## 5. Adjustments

Adjustment Relationships .....	5-2
Internal Reference Oscillator Adjustment .....	5-4
Analog Bus ADC Calibration .....	5-5
Pretune Calibration (ESG-AP and ESG-DP only) .....	5-6

---

# Contents

Internal Source Calibration .....	5-7
VCO Bias Potentiometer Adjustment .....	5-8
Lock Angle Potentiometer Adjustment .....	5-9
KV versus Frequency Calibration .....	5-10
AM Audio Path Offset Calibration .....	5-11
Timebase DAC Calibration .....	5-12
FM Scale DAC Offset Calibration .....	5-13
FM Path Offset Calibration .....	5-14
FM In-Band DAC Offset Calibration .....	5-15
FM Inverting Amplifier Offset Calibration .....	5-16
FM 1/2 Path Ratio Gain Calibration .....	5-17
Modulation Source Relative Gain Compression Calibration .....	5-18
FM Out-of-Band Calibration (ESG-A and ESG-D only) .....	5-19
FM Delay Potentiometer Adjustment (ESG-A and ESG-D only) .....	5-20
Wide Bandwidth Phase Modulation Calibration (ESG-A and ESG-D only) .....	5-21
FM/PM Out-of-Band Calibration (ESG-AP and ESG-DP only) .....	5-22
FM/PM YO Frequency Compensation Calibration (ESG-AP and ESG-DP only) .....	5-23
DCFM Calibration .....	5-24
Low Frequency (LF) Output Calibration .....	5-25
External Input Peak Detector Calibration .....	5-26
Burst Modulator Calibration (ESG-D only) .....	5-27
Burst Audio Path Gain Calibration .....	5-28
Prelevel Calibration, Digital .....	5-29
Prelevel Calibration, Analog (ESG-A only) .....	5-30
Gain Adjust Calibration .....	5-31
Low Noise Floor Gain Adjust (ESG-AP and ESG-DP only) .....	5-32
ALC Modulation Driver Bias Calibration .....	5-33
VBLO Mixer Bias Calibration .....	5-34
Power Level Accuracy .....	5-35
Level Meter Calibration .....	5-38
ALC Modulation Flatness Calibration .....	5-39
AM Gain Calibration .....	5-40
I/Q Gain/Offset/Quadrature Calibration (ESG-D only) .....	5-41
I/Q Impairment Adjustment (ESG-D only) .....	5-42
Baseband Generator I/Q Gain and Offset Adjustment (ESG-A and ESG-D Options UN3 and UN4 only) .....	5-43

## 6. Maintenance and Service

Preventive Maintenance Procedures .....	6-2
Returning a Signal Generator for Service .....	6-2
Sales and Service Offices .....	6-3

## 7. Safety and Regulatory

Safety Notes .....	7-2
Instrument Markings .....	7-3
General Safety Considerations .....	7-4
Statement of Compliance .....	7-5
Electrostatic Discharge .....	7-6

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**Contents**

Warranty .....7-7

Assistance .....7-8

Certification .....7-9



# **1 Equipment Required**

This chapter contains a list of all the recommended equipment required to perform the performance tests and adjustments for the ESG Family Signal Generators.

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## Required Equipment

- **HP/Agilent 8902A Measuring Receiver<sup>1</sup> Option 010**

FM accuracy:  $\pm 2\%$  of reading  $\pm 1$  digit

AM accuracy:  $\pm 2\%$  of reading  $\pm 1$  digit

Range: 250 kHz to 1300 MHz

Filters: 300 Hz high pass and  
15 kHz and 3 kHz low pass

Detectors: Peak+

- **HP/Agilent 54750A Digitizing Oscilloscope**

Bandwidth: 20 GHz

- **HP/Agilent 54751/2A Oscilloscope Plug-in**

Two 20 GHz bandwidth channels

- **HP/Agilent 54610B Digital Oscilloscope<sup>1</sup>**

Bandwidth: 500 MHz

- **HP/Agilent 5071A Primary Frequency Standard**

Frequency: 10 MHz

Stability:  $> 1 \times 10^{-10}$ /year

- **HP/Agilent 8903B Options 051, 010 Audio Analyzer<sup>1</sup>**

Distortion accuracy:  $\pm 1$  dB

Residual distortion:  
–80 dB at 80 kHz BW

30 kHz low pass filter

AC level accuracy:  $\pm 4\%$

- **HP/Agilent 89441A Options AY7, AYA, AY9, UFG or UTH, and AYH Vector Signal Analyzer<sup>1,2</sup>**  
(No Substitution)

- **HP/Agilent 8563E Option E35 Spectrum Analyzer** (No Substitution)

Capable of W-CDMA ACP  
measurements from 1.2 to 3.0 GHz

**Option E35 Comprises:**

- HP/Agilent 8563E Option H35 Spectrum Analyzer
- HP/Agilent 8563E Option K35 Adjacent Channel Power Ratio Test Set for W-CDMA

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**NOTE** HP/Agilent 8563E Option K37 combines the Option K35 test set with firmware ROM chips to upgrade existing HP/Agilent 8560 E-series analyzers.

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- **HP/Agilent 8563E Options 001, 007 Spectrum Analyzer<sup>1</sup>**

Frequency range: 100 kHz to 4000 MHz

Relative level accuracy (harmonic and spurious measurements)  $\pm 2$  dB

Displayed average noise level (1 Hz BW)  
–110 dBm at 100 kHz,  
–130 dBm at 1 to 10 MHz, and  
–134 dBm at 0.01 to 4 GHz

1 Hz digital resolution BW filter  
(required for power accuracy)

RF input VSWR: 1:1.5

External timebase input

Second IF output

- **HP/Agilent 8663A Signal Generator<sup>1</sup>**

Frequency Range: 11.5 to 2500 MHz

Output level: +16 dBm

Meets HP/Agilent 8663A  
single-sideband phase noise  
specifications

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1. Equipped with GPIB  
2. Used only with ESG-D models



- **HP/Agilent 8904A Function Generator<sup>1</sup>**  
Frequency range (sinewave):  
0 Hz to 600 kHz  
AC Amplitude (sinewave only):  
Range: 0 to 10 Vp-p into a 50Ω load  
Flatness (>630 mVp-p into 50Ω):  
±0.1% (±0.009 dB), 0.1 Hz to 100 kHz
- **HP/Agilent 53132A Option 050 Universal Counter<sup>1</sup>**  
Frequency range: 4 GHz  
Resolution: 0.1 Hz  
External timebase input
- **HP/Agilent 33120A Option 001 Arbitrary Waveform Generator<sup>1</sup> (2)**  
*(No Substitution)*
- **HP/Agilent 438A Power Meter<sup>1</sup>**  
Instrumentation accuracy: ±0.5%  
Power reference accuracy: 0.9%
- **HP/Agilent 8482A Power Sensor**  
Frequency range: 100 kHz to 4000 MHz  
Power range: -30 dBm to +13 dBm  
Maximum SWR:  
100 kHz to 300 kHz: 1:1.6,  
300 kHz to 1 MHz: 1:1.12,  
1 MHz to 2 GHz: 1:1.1,  
2 GHz to 4 GHz: 1:1.3  
Calibration factor accuracy (RSS):  
≤ 1.6%
- **HP/Agilent E3615A Power Supply**  
Minimum Power: 15V  
Minimum Current: 325 mA
- **MD/MDC-174 Mixer**  
Frequency range: 0.001 to 2.8 GHz
- **MD/MDC-164 Mixer**  
Frequency range: 0.5 to 9 GHz
- **HP/Agilent 3458A Digital Multimeter<sup>1</sup>**  
dc Volts: 0.1 to 100 V  
Input resistance: 10Ω to 1 KΩ
- **HP/Agilent 8491A/B Option 006 Attenuator**  
Attenuation: 6 dB
- **HP/Agilent 8491A/B Option 010 Attenuator**  
Attenuation: 10 dB
- **HP/Agilent 8491A/B Option 020 Attenuator**  
Attenuation: 20 dB
- **Personal Computer** (included in HP/Agilent E5500A/B)  
Running MS Windows® 3.1/95/98 or Windows NT®
- **HP LaserJet 5L Printer**  
MS Windows supported
- **HP 82341C GPIB Interface Card with SICL HP I/O Library Installed**  
*(No Substitution)*
- **Agilent Technologies E4400-60073 Digital Test Card** *(No Substitution)*
- **HP/Agilent 8495G Programmable Step Attenuator**  
Attenuation: 0 to 70 dB  
Frequency range: dc to 4 GHz
- **HP/Agilent 11713A Step Attenuator Driver**
- **HP/Agilent E5500A/B Phase Noise Measurement System<sup>2, 3</sup>**  
Frequency range: 0 to 4 GHz

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1. Equipped with GPIB  
2. Includes Personal Computer  
3. Required for ESG-AP/DP only

## **Low Noise Amplifiers for Power Level Accuracy Adjustment and Performance Test**

The power level accuracy adjustment and performance test both use low noise amplifiers. They are required to maintain separation between a low-level signal and the signal analyzer noise floor. The following amplifiers meet the requirements of making this measurement.

A +15 Vdc external supply is required for each of the amplifiers. An HP/Agilent E3615A, 0 to 20 V power supply can power all recommended amplifiers simultaneously.

### **100 kHz to 10 MHz Low Noise Amplifier**

#### **Critical Specifications**

Frequency Range: 100 kHz to 10 MHz

Noise Figure: 1.5 dB

Gain: 50 dB

1 dB Compression Minimum: +5 dBm

External Power Supply Required: +15 Vdc @ 25 mA

#### **Possible Part Number and Supplier**

Part Number: W50ATC

Supplier: Advanced Control Components  
20 Meridian Road  
Eatontown, NJ 07724

### **30 MHz to 2 GHz Low Noise Amplifier**

#### **Configuration**

Two amplifiers are cascaded to obtain the necessary requirements. The specifications listed below are the combined specifications of the cascaded amplifiers.

#### **Critical Specifications**

Frequency Range: 10 MHz to 2 GHz

Noise Figure: 1.8 dB

Gain: > 56 dB

1 dB Compression Minimum: +10 dBm

External Power Supply Required: +15 Vdc @ 300 mA

#### **Possible Part Number and Supplier**

Part Number: AFS3-00010300-18-5P-4 (2 required)

Supplier: MITEQ Inc.  
100 Davids Drive  
Hauppauge, NY 11788

## **2 Operation Verification**

This chapter provides procedures that will either ensure that the signal generator is operating correctly or will help to point to problem areas if it is not. Operation verification does not ensure performance to specifications, but should provide a level of confidence that the signal generator is operating correctly within a minimum amount of time. Operation verification is appropriate for incoming inspection, after repair when a full calibrated performance is not required, or whenever the integrity of the signal generator is in question.

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## Verification Procedures

Perform the following procedures in the order they are presented. The tables referenced by the tests are located in the back of the chapter where they can be copied easily.

1. Power On the Signal Generator on page 2-2
2. Check for Error Messages on page 2-3
3. Frequency Range and Accuracy Check on page 2-3
4. Power Level Accuracy Check on page 2-4
5. FM Accuracy Check on page 2-7
6. AM Accuracy Check on page 2-8
7. I/Q Modulation Check (ESG-D Only) on page 2-9

## Equipment Required

- HP/Agilent 5350A Frequency Counter
- HP/Agilent 438A Power Meter
- HP/Agilent 8482A Power Sensor
- HP/Agilent 8563E Spectrum Analyzer
- HP/Agilent 8491A/B Option 006 Attenuator (6 dB)
- HP/Agilent 8491A/B Option 010 Attenuator (10 dB)
- HP/Agilent 8902A Measuring Receiver

### 1. Power On the Signal Generator

This procedure verifies that the signal generator powers up and that the internal instrument check identifies no errors. The internal check evaluates the correctness of operation and returns an error message if a problem is detected.

1. Turn power on to the signal generator by pressing the power switch. The green LED will light. Let the signal generator warm up for one hour.

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<b>NOTE</b>	For ESG-AP or ESG-DP signal generators, or those with Option 1E5, <code>ERROR 514, Reference Oven Cold</code> occurs whenever the signal generator is first connected to AC line power. The <code>OVEN COLD</code> annunciator and the <code>ERR</code> annunciator both turn on. The <code>OVEN COLD</code> annunciator automatically clears after approximately 5 minutes. The error queue <i>cannot</i> be cleared, however, until the <code>OVEN COLD</code> annunciator has turned off.
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2. Cycle the power to the signal generator. The green LED should again be lit and the signal generator will perform a check.

## 2. Check for Error Messages

1. When the display is lit, check to see if the **ERR** annunciator is turned on.
2. If the **ERR** annunciator is turned on, review the error messages in the queue by pressing **Utility > Error Info > View Next Error Message**. The first error message in the queue will be shown in the text area of the display. Refer to the error messages guide for information about the error message.

If there is more than one error message (each message will be designated as 1 of *n*), continue pressing the **View Next Error Message** softkey until you have seen all of the messages.

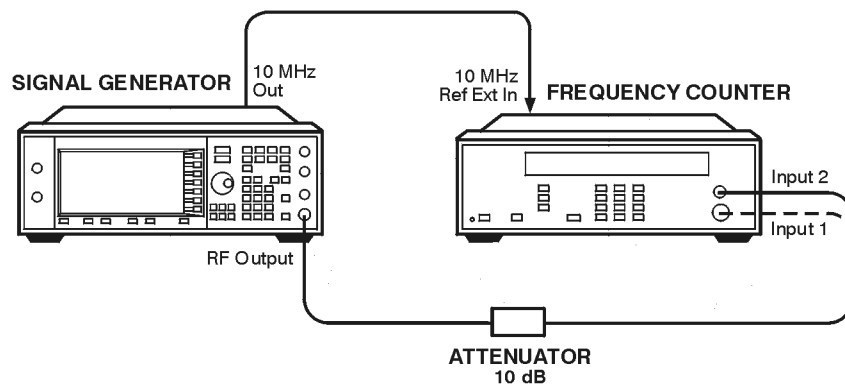
3. When you have resolved all of the error messages, press **Clear Error Queue(s)** to delete the messages. Cycle the power on the signal generator and then restart this procedure (Check for Error Messages) at step 1.

## 3. Frequency Range and Accuracy Check

Frequency range is tested by determining the frequency accuracy relative to the timebase at the frequency limits.

### Connect the Test Equipment

**Figure 2-1 Frequency Range and Accuracy Equipment Setup**



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### Configure the Signal Generator

1. Preset the signal generator to normal (factory-defined) preset conditions.
2. Press **Mod On/Off**. The **MOD OFF** annunciator is displayed.
3. For frequencies < 10 MHz:
  - a. Press **Amplitude**. Enter 10 using the numeric keypad and press the **dBm** terminator softkey.
  - b. Press **RF On/Off**. The **RF ON** annunciator is displayed.

4. For frequencies  $\geq 10$  MHz:

- a. Press **Amplitude**. Enter 0 using the numeric keypad and press the dBm terminator softkey.
- b. Check that the RF ON annunciator is displayed. If not, press **RF On/Off**.

### Configure the Frequency Counter

1. For frequencies  $< 10$  MHz use Input 2. Press 1 M $\Omega$ .
2. For frequencies  $\geq 10$  MHz and  $\leq 500$  MHz use Input 2. Press 50 $\Omega$ .
3. For frequencies  $> 500$  MHz use Input 1. Press **AUTO**.

---

**NOTE** Set the gate time of  $> 5$  seconds for maximum counter accuracy. Verify that the counter is phase-locked to the 10 MHz external reference.

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### Measure the Frequency Accuracy

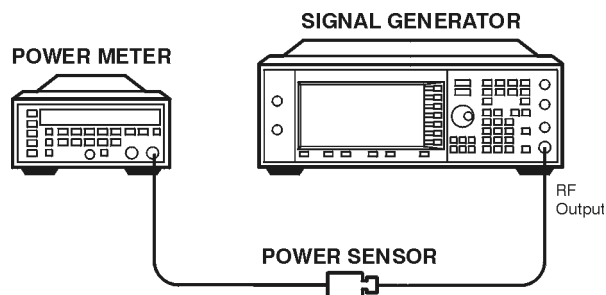
1. Set the signal generator to the frequencies shown in [Table 2-1, "Frequency Accuracy,"](#) on page 2-10 (to the maximum frequency of your signal generator).
2. Record the measured frequency in [Table 2-1](#) and compare it to the corresponding limits.

## 4. Power Level Accuracy Check

Performing this check will provide a high level of confidence that the signal generator's power level circuitry is functioning correctly. This check does *not* test the signal generator to warranted specifications. Test points have been reduced and the limits are degraded in order to minimize measurement time and take into account a broad range of measurement uncertainties. To have the signal generator tested to warranted specifications, a complete power level accuracy performance test is required. If the complete performance test is needed and you are unable to perform it, contact your nearest Agilent Technologies service center for information concerning calibration.

### Connect the Test Equipment for Setup 1

**Figure 2-2 Power Level Accuracy Equipment Setup 1**



wk7107a

## Configure the Signal Generator

1. Preset the signal generator to normal (factory-defined) preset conditions.
2. Press **Frequency**. Enter 277 using the numeric keypad and press the **kHz** terminator softkey.
3. Press **Amplitude**. Enter 13 using the numeric keypad and press the **dBm** terminator softkey.
4. Press **Mod On/Off**. The **MOD OFF** annunciator is displayed.
5. Press **RF On/Off**. The **RF ON** annunciator is displayed.

## Configure the Power Meter

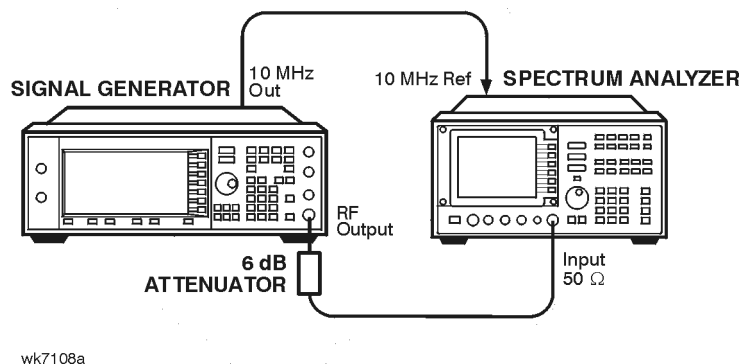
1. Zero and calibrate the power meter to the sensor's reference calibration factor.
2. Set the power meter to measure absolute log power (dBm).

## Measure the Power Level Accuracy

1. Set the power levels and frequencies for the signal generator (to the maximum frequency of your signal generator). Refer to the appropriate table in the following list:
  - [Table 2-2, "Power Level Accuracy Setup 1 \(Signal Generators without Option 1E6\),"](#) on page 2-11
  - [Table 2-3, "Power Level Accuracy Setup 1 \(Signal Generators with Option 1E6\),"](#) on page 2-13.
2. Set the power sensor's calibration factor for each frequency.
3. Record the measured power level in the appropriate table ([Table 2-2](#) or [Table 2-3](#)) and compare it to the corresponding limits.

## Connect the Test Equipment for Setup 2

**Figure 2-3 Power Level Accuracy Equipment Setup 2**



## Configure the Signal Generator

1. Press **Frequency**. Enter 277 using the numeric keypad and press the **kHz** terminator softkey.
2. Press **Amplitude**. Enter -15 using the numeric keypad and press the **dBm** terminator softkey.

## Configure the Spectrum Analyzer

1. Preset the spectrum analyzer.
2. Set the analyzer to external 10 MHz reference.
3. Set the center frequency to 277 kHz.
4. Set the frequency span to 100 Hz. (This will result in a 1 Hz resolution bandwidth with a digital filter.)

## Measure the Power Level Accuracy

1. Connect the signal generator's RF OUTPUT through the 6 dB attenuator to the spectrum analyzer's RF input.
2. Transfer the power level results for each frequency at -15 dBm from the Measured Power column in [Table 2-2](#) or [Table 2-3](#) as appropriate, to the Power Meter Reading for -15 dBm column in [Table 2-4](#), "Power Level Accuracy Setup 2 (All Signal Generators)," on page 2-15.
3. On the spectrum analyzer, select **Marker Normal Mode** and then select the **Peak Search** function. This activates the marker and sets it to the signal peak.
4. On the spectrum analyzer, ensure that the marker is at the signal peak and use the **MKR->** menu to set the marker to the reference level. If necessary, select **Peak Search** to ensure that the marker is at the signal peak.
5. With the marker at signal peak, select the **Marker Delta** function. This will set the marker to measure relative amplitude from a reference of 0 dB. If the marker does not read 0 dB, press **Marker Normal > Peak Search > Marker Delta** until the marker reads 0 dB.
6. Decrease the signal generator amplitude in 10 dB steps as shown in [Table 2-4](#). At each 10 dB step, select **Peak Search** to ensure that the marker is at the signal peak.
7. Measure the power levels shown in the Power Level Setting (dBm) column of [Table 2-4](#) for the current frequency, and record the values in the Spectrum Analyzer Marker (dB) column.
8. Return the spectrum analyzer reference level and the signal generator amplitude to -15 dBm. Set the signal generator frequency and the spectrum analyzer's center frequency to the next frequency listed in [Table 2-4](#) and repeat the process from step 3. Continue until all of the frequencies have been measured and recorded (to the maximum frequency of your signal generator).



## Calculate the Actual Power Level

1. Calculate and record the Actual Power Level, in [Table 2-4](#), as the sum of the Power Meter Reading for  $-15$  dBm and the Spectrum Analyzer Marker (dB) value.

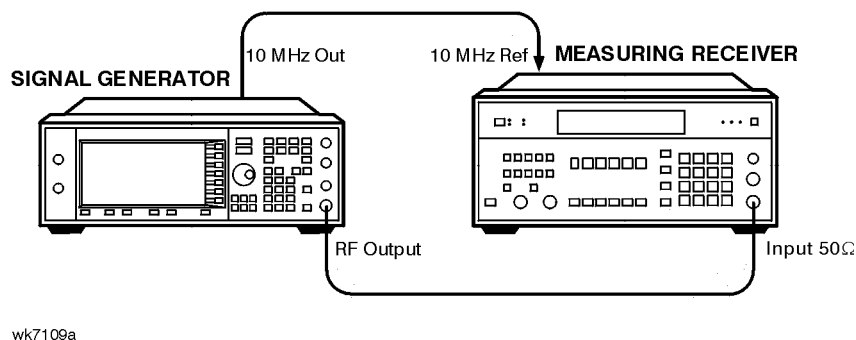
For example:

- Power Meter Reading for  $-15$  dBm at 2.516 MHz =  $-14.95$  dBm
  - Spectrum Analyzer Marker (dB) at 2.516 MHz and Power Level Setting at  $-85$  dBm =  $-70.17$  dB
  - Actual Power Level at 2.516 MHz and  $-85$  dBm:  $(-14.95) + (-70.17) = -85.12$  dBm
2. Compare the calculated Actual Power Level value to the corresponding limits.

## 5. FM Accuracy Check

### Connect the Test Equipment

**Figure 2-4 FM Accuracy Equipment Setup**



### Configure the Signal Generator

1. Preset the signal generator to normal (factory-defined) preset conditions.
2. Press **FM/ΦM** > **FM Off On**. The **FM** annunciator is displayed.
3. Press **FM Rate**. Enter 1 using the numeric keypad and press the **kHz** terminator softkey.
4. Press **FM Dev**. Enter 100 using the numeric keypad and press the **kHz** terminator softkey.
5. Press **Amplitude**. Enter 7 using the numeric keypad and press the **dBm** terminator softkey.
6. Check that the **MOD ON** annunciator is displayed. If it is not, press **Mod On/Off**.
7. Press **RF On/Off**. The **RF ON** annunciator is displayed.

## Configure the Measuring Receiver

1. Reset the measuring receiver.
2. Set the measuring receiver to FM mode.
3. Turn on Peak+ detector.
4. Turn on the 300 Hz high-pass filter.
5. Turn on the 3 kHz low-pass filter.

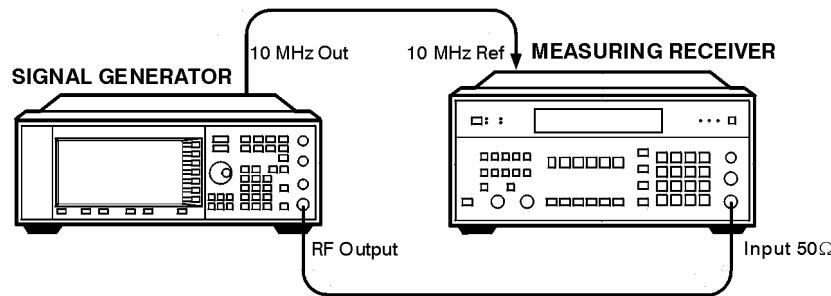
## Measure the Deviations

1. Set the signal generator to the frequencies shown in [Table 2-5, “FM Accuracy,”](#) on page 2-19.
2. Record the deviations measured and compare them to the limits shown in [Table 2-5](#).

## 6. AM Accuracy Check

### Connect the Test Equipment

**Figure 2-5 AM Accuracy Equipment Setup**



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## Configure the Signal Generator

1. Preset the signal generator to normal (factory-defined) preset conditions.
2. Press **AM > AM Off On**. The **AM** annunciator is displayed.
3. Press **AM Rate**. Enter 1 using the numeric keypad and press the **kHz** terminator softkey.
4. Press **Amplitude**. Enter 7 using the numeric keypad and press the **dBm** terminator softkey.
5. Check that the **MOD ON** annunciator is displayed. If it is not, press **Mod On/Off**.
6. Press **RF On/Off**. The **RF ON** annunciator is displayed.

## Configure the Measuring Receiver

1. Reset the measuring receiver.
2. Set the measuring receiver to AM mode.
3. Turn on Peak+ detector.
4. Turn on the 300 Hz high-pass filter.
5. Turn on the 3 kHz low-pass filter.

## Measure the Deviations

1. Set the signal generator to the frequencies and depths shown in [Table 2-6, “AM Accuracy,”](#) on page 2-19.
2. Record the AM depths measured and compare them to the limits shown in [Table 2-6](#).

## 7. I/Q Modulation Check (ESG-D Only)

1. Preset the signal generator to normal (factory-defined) preset conditions.
2. Press **I/Q > I/Q Calibration**. Check that **Full** is highlighted on the **Calibration Type User Full** softkey. If not, press **Calibration Type User Full**.
3. Press **Execute Cal** to begin an I/Q calibration for the signal generator's full frequency range. The message **I/Q Calibration in Progress** is displayed until the calibration is complete.

## Test Tables

**Table 2-1 Frequency Accuracy**

Frequency (MHz)	Limits		
	Lower (Hz)	Measured (Hz)	Upper (Hz)
0.25	249 999.		250 001.
0.5	499 999.		500 001.
1	999 999.		1 000 001.
10	9 999 999.		10 000 001.
50	49 999 999.		50 000 001.
100	99 999 999.		100 000 001.
500	499 999 999.		500 000 001.
1000	999 999 999.		1 000 000 001.
2000	1 999 999 999.		2 000 000 001.
3000	2 999 999 999.		3 000 000 001.
4000	3 999 999 999.		4 000 000 001.

**Table 2-2 Power Level Accuracy Setup 1 (Signal Generators without Option 1E6)**

<b>Frequency Setting</b>	<b>Power Level Setting (dBm)</b>	<b>Lower Limit (dBm)</b>	<b>Measured Power (dBm)</b>	<b>Upper Limit (dBm)</b>
277 kHz	+13	12.2		13.8
	+7	6.5		7.5
	0	-0.5		0.5
	-5	-5.5		-4.5
	-15	-15.5		-14.5
2.516 MHz	+13	12.2		13.8
	+7	6.5		7.5
	0	-0.5		0.5
	-5	-5.5		-4.5
	-15	-15.5		-14.5
270.1 MHz	+13	12.2		13.8
	+7	6.5		7.5
	0	-0.5		0.5
	-5	-5.5		-4.5
	-15	-15.5		-14.5
510.1 MHz	+13	12.2		13.8
	+7	6.5		7.5
	0	-0.5		0.5
	-5	-5.5		-4.5
	-15	-15.5		-14.5
990.1 MHz	+13	12.2		13.8
	+7	6.5		7.5
	0	-0.5		0.5
	-5	-5.5		-4.5
	-15	-15.5		-14.5
1350.1 MHz	+10	9.2		10.8
	+7	6.5		7.5
	0	-0.5		0.5

Frequency Setting	Power Level Setting (dBm)	Lower Limit (dBm)	Measured Power (dBm)	Upper Limit (dBm)
	-5	-5.5		-4.5
	-15	-15.5		-14.5
1950.1 MHz	+10	9.2		10.8
	+7	6.5		7.5
	0	-0.5		0.5
	-5	-5.5		-4.5
	-15	-15.5		-14.5
2310.1 MHz	+10	8.8		11.2
	+7	6.1		7.9
	0	-0.9		0.9
	-5	-5.9		-4.1
	-15	-15.9		-14.1
2985.1 MHz	+10	8.8		11.2
	+7	6.1		7.9
	0	-0.9		0.9
	-5	-5.9		-4.1
	-15	-15.9		-14.1
3225.1 MHz	+7	6.1		7.9
	0	-0.9		0.9
	-5	-5.9		-4.1
	-15	-15.9		-14.1
4000 MHz	+7	6.1		7.9
	0	-0.9		0.9
	-5	-5.9		-4.1
	-15	-15.9		-14.1

**Table 2-3 Power Level Accuracy Setup 1 (Signal Generators with Option 1E6)**

<b>Frequency Setting</b>	<b>Power Level Setting (dBm)</b>	<b>Lower Limit (dBm)</b>	<b>Measured Power (dBm)</b>	<b>Upper Limit (dBm)</b>
277 kHz	+9	8.2		9.8
	+3	2.5		3.5
	0	-0.5		0.5
	-5	-5.5		-4.5
	-15	-15.5		-14.5
2.516 MHz	+9	8.2		9.8
	+3	2.5		3.5
	0	-0.5		0.5
	-5	-5.5		-4.5
	-15	-15.5		-14.5
270.1 MHz	+9	8.2		9.8
	+3	2.5		3.5
	0	-0.5		0.5
	-5	-5.5		-4.5
	-15	-15.5		-14.5
510.1 MHz	+9	8.2		9.8
	+3	2.5		3.5
	0	-0.5		0.5
	-5	-5.5		-4.5
	-15	-15.5		-14.5
990.1 MHz	+9	8.2		9.8
	+3	2.5		3.5
	0	-0.5		0.5
	-5	-5.5		-4.5
	-15	-15.5		-14.5
1350.1 MHz	+6	5.2		6.8
	+3	2.5		3.5
	0	-0.5		0.5

Frequency Setting	Power Level Setting (dBm)	Lower Limit (dBm)	Measured Power (dBm)	Upper Limit (dBm)
	-5	-5.5		-4.5
	-15	-15.5		-14.5
1950.1 MHz	+6	5.2		6.8
	+3	2.5		3.5
	0	-0.5		0.5
	-5	-5.5		-4.5
	-15	-15.5		-14.5
2310.1 MHz	+6	4.8		7.2
	+3	2.1		3.9
	0	-0.9		0.9
	-5	-5.9		-4.1
	-15	-15.9		-14.1
2985.1 MHz	+6	4.8		7.2
	+3	2.1		3.9
	0	-0.9		0.9
	-5	-5.9		-4.1
	-15	-15.9		-14.1
3225.1 MHz	+3	2.1		3.9
	0	-0.9		0.9
	-5	-5.9		-4.1
	-15	-15.9		-14.1
4000 MHz	+3	2.1		3.9
	0	-0.9		0.9
	-5	-5.9		-4.1
	-15	-15.9		-14.1



**Table 2-4 Power Level Accuracy Setup 2 (All Signal Generators)**

<b>Frequency Setting</b>	<b>Power Level Setting (dBm)</b>	<b>Power Meter Reading for -15 dBm</b>	<b>Spectrum Analyzer Marker (dB)</b>	<b>Lower Limit (dBm)</b>	<b>Actual Power Level (dBm)</b>	<b>Upper Limit (dBm)</b>
277 kHz	-15		0 (Ref)	N/A	N/A	N/A
	-25			-26		-24
	-35			-36		-34
	-45			-46		-44
	-55			-56		-54
	-65			-66		-64
	-75			-76		-74
	-85			-86		-84
2.516 MHz	-15		0 (Ref)	N/A	N/A	N/A
	-25			-26		-24
	-35			-36		-34
	-45			-46		-44
	-55			-56		-54
	-65			-66		-64
	-75			-76		-74
	-85			-86		-84
270.1 MHz	-15		0 (Ref)	N/A	N/A	N/A
	-25			-26		-24
	-35			-36		-34
	-45			-46		-44
	-55			-56		-54
	-65			-66		-64
	-75			-76		-74
	-85			-86		-84
510.1 MHz	-15		0 (Ref)	N/A	N/A	N/A
	-25			-26		-24
	-35			-36		-34
	-45			-46		-44

Frequency Setting	Power Level Setting (dBm)	Power Meter Reading for -15 dBm	Spectrum Analyzer Marker (dB)	Lower Limit (dBm)	Actual Power Level (dBm)	Upper Limit (dBm)
	-55			-56		-54
	-65			-66		-64
	-75			-76		-74
	-85			-86		-84
990.1 MHz	-15		0 (Ref)	N/A	N/A	N/A
	-25			-26		-24
	-35			-36		-34
	-45			-46		-44
	-55			-56		-54
	-65			-66		-64
	-75			-76		-74
	-85			-86		-84
1350.1 MHz	-15		0 (Ref)	N/A	N/A	N/A
	-25			-26		-24
	-35			-36		-34
	-45			-46		-44
	-55			-56		-54
	-65			-66		-64
	-75			-76		-74
	-85			-86		-84
1950.1 MHz	-15		0 (Ref)	N/A	N/A	N/A
	-25			-26		-24
	-35			-36		-34
	-45			-46		-44
	-55			-56		-54
	-65			-66		-64
	-75			-76		-74
	-85			-86		-84

<b>Frequency Setting</b>	<b>Power Level Setting (dBm)</b>	<b>Power Meter Reading for -15 dBm</b>	<b>Spectrum Analyzer Marker (dB)</b>	<b>Lower Limit (dBm)</b>	<b>Actual Power Level (dBm)</b>	<b>Upper Limit (dBm)</b>
2310.1 MHz	-15		0 (Ref)	N/A	N/A	N/A
	-25			-26		-24
	-35			-36		-34
	-45			-46		-44
	-55			-56		-54
	-65			-66		-64
	-75			-76		-74
	-85			-86		-84
2985.1 MHz	-15		0 (Ref)	N/A	N/A	N/A
	-25			-26		-24
	-35			-36		-34
	-45			-46		-44
	-55			-56		-54
	-65			-66		-64
	-75			-76		-74
	-85			-86		-84
3225.1 MHz	-15		0 (Ref)	N/A	N/A	N/A
	-25			-26		-24
	-35			-36		-34
	-45			-46		-44
	-55			-56		-54
	-65			-66		-64
	-75			-76		-74
	-85			-86		-84
4000 MHz	-15		0 (Ref)	N/A	N/A	N/A
	-25			-26		-24
	-35			-36		-34
	-45			-46		-44
	-55			-56		-54

<b>Frequency Setting</b>	<b>Power Level Setting (dBm)</b>	<b>Power Meter Reading for -15 dBm</b>	<b>Spectrum Analyzer Marker (dB)</b>	<b>Lower Limit (dBm)</b>	<b>Actual Power Level (dBm)</b>	<b>Upper Limit (dBm)</b>
	-65			-66		-64
	-75			-76		-74
	-85			-86		-84

**Table 2-5 FM Accuracy**

Frequency (MHz)	Deviation (kHz)	Limits (kHz)		
		Lower	Measured	Upper
500.001	100 kHz	96.48		103.52
750	100 kHz	96.48		103.52
1000	100 kHz	96.48		103.52

**Table 2-6 AM Accuracy**

Frequency (MHz)	Depth (%)	Limits (%)		
		Lower	Measured	Upper
200	30	27.5		32.5
200	90	84.5		95.5
300	30	27.5		32.5
300	90	84.5		95.5
501	30	27.5		32.5
501	90	84.5		95.5
750	30	27.5		32.5
750	90	84.5		95.5
1000	30	27.5		32.5
1000	90	84.5		95.5



## 3 Service Software

The ESG Family Support Software contains the program and supporting files necessary to run the automated performance tests and adjustments for your signal generator. This chapter lists the equipment required to run the software, and gives instructions for installing, administering, using and un-installing the software. For a description of the individual performance tests and adjustments, refer to [Chapter 4, “Performance Tests,”](#) and [Chapter 5, “Adjustments.”](#)

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## Required Test Equipment

The following equipment is required to run the software:

- Personal computer with the following specifications:
  - 386/33 MHz CPU, or better
  - 8 Mbytes of RAM
  - Hard drive with at least 350 Mbytes free
  - 16-color VGA monitor
  - 3.5-inch disk drive
- MS Windows 3.x, MS Windows 95, or MS Windows NT.
- 2 Button Mouse (optional)
- Printer, MS Windows-supported (for test results documentation)
- HP 82341C/D GPIB Interface Card
  - HP SICL Libraries must be installed and configured.

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<b>NOTE</b>	No other MS Windows programs may be running during installation. Close any MS Windows programs that are currently running prior to starting the installation.
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## Installing the ESG\_B or ESG\_APDP Service Software

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NOTE	If you are installing the ESG_B or ESG_APDP Service Software onto a computer which already has service software <i>older</i> than version A.03.00, you must first remove the old version before installing the new software.
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Follow this procedure to install the ESG\_B or ESG\_APDP Service Software on your personal computer.

1. Insert “Disk 1” into the disk drive.
2. To display the Run dialog box:
  - For MS Windows 95 or Windows NT: Select the Start button, then select Run ... from the pop-up menu.
  - For MS Windows version 3.x: Open the Program Manager, then select Run ... from the File drop-down menu.

3. From the Run dialog box, type `a:setup` and select the OK button.

The Setup window is displayed as it loads files for the installation. Once these files are loaded, the ESG Service Software’s Welcome screen is displayed.

4. Continue with the setup by selecting the Next button.
5. The ESG Service Software’s Important Information window is displayed. It contains information that is vital to installing and using the software. In addition, any new information may also be shown on this screen. *Stop and read this information* before continuing with the software installation!

6. Continue with the setup by selecting the Next button.

The Choose Destination Location window is displayed. The default location for installing the software is `C:\HP_SVC\ESG_B` (or `C:\HP_SVC\ESG_APDP`). Use this as the software’s destination folder.

7. Continue with the setup by selecting the Next button.

The ESG Service Software’s Select Program Folder window is displayed. This installation procedure will install the service software icons into a program folder. You can enter a new folder name in the Program Folders text field or select a folder from the Existing Folders field. It is recommended to use “ESG\_B Service Software” (or “ESG\_APDP Service Software”) for the folder name.

NOTE	This documentation refers to the folder name as “ESG_B Service Software.” If you use another name for the folder, be aware of this difference.
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8. Continue with the setup by selecting the **Next** button.

The ESG Service Software's, Start Copying Files window is displayed. This window shows the destination directory and the folder name settings. To change these settings, select the **Back** button until the appropriate window is displayed.

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<b>NOTE</b>	This is the last point that you can cancel the installation. If you select the <b>Next</b> button, the installation proceeds until the software is completely installed.
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9. Select the **Next** button to go ahead with the installation process.

The graphic on the left of the screen shows the status of each file as it is copied to the destination directory, the status of each disk that is being copied, and the status of the overall memory of the destination. The graphic in the center of the screen keeps you updated on the destination folder, the files that are being copied, and the progress of the installation.

When the contents of the disk have been copied to their destination, you are notified to insert each of the next disks by the **Setup Needs the Next Disk** dialog box.

10. Insert the next disk, as instructed, and select the **OK** button.

When the installation is complete, the **Setup Complete** window is displayed. You will be asked to select whether you want to view the **README** file or the **INFO** file. (You already read the **INFO** file when you started the installation.)

11. Select the **README** file and then select the **Finish** button.

The text editor will display the file. To close this file select the **File** pull down menu and then select **Exit**.

12. Select the **Yes, I want to restart my computer now** radio button. Ensure that the last disk has been removed and then choose the **Finish** button to restart MS Windows.

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<b>NOTE</b>	The MS Windows program must be restarted before you can use the software. When you select restart, the computer reboots.
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If you do not want to restart MS Windows at this time, select the **No, I will restart my computer later** radio button. If you select restart, the computer reboots and you can start using the software.

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## Uninstalling the Software

- MS Windows 95 or Windows NT:
  1. Display the Control Panel program group by pressing Start > Settings > Control Panel.
  2. Select the Add/Remove Programs icon.
  3. From the Install/Uninstall Tab in the Add/Remove Programs properties dialog box:
    - a. Select ESG\_B, then select the Add/Remove button.
    - b. Select ESG Service Software, then select the Add/Remove button.
  4. If the Details button is displayed, the program is removed but the path has not been removed. Click the Details button and note the path. Then click OK.
  5. Display the MS Windows Explorer dialog box by selecting Start > Programs > Windows Explorer.
  6. Select the path that you previously noted, and if you are not using these files for another purpose, select Delete from the Files drop-down menu to delete the path.
- MS Windows version 3.x:
  1. From the Program Manager, click on program group (HP Service Support was the program's default title) to highlight the program group name.
  2. From the File drop-down menu, select Delete.
  3. From the File Manager, select the subdirectory where the program is stored. (The program's default subdirectory was hp\_svc.)
  4. From the File drop-down menu, select Delete.

---

## ESG Family Support Software Administration

The following section shows you how to administer and run the ESG Family Support Software. The software's administrative functions allow for the addition or removal of all necessary test equipment, software drivers, and test procedures. This would include additional software drivers (as they are released) to extend the range of tests and equipment supported by the ESG family test set, or maintenance releases of the current drivers.

### Software Configuration

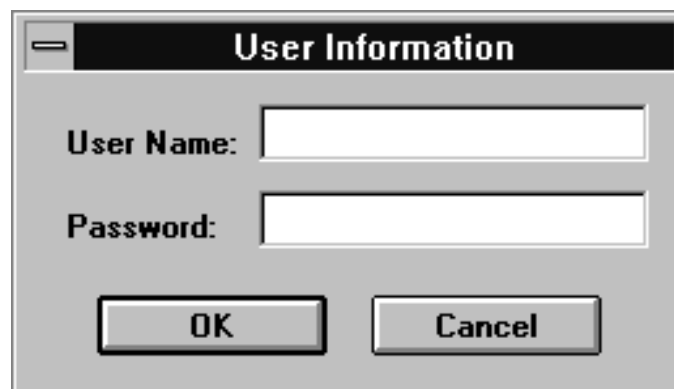
Follow the instructions below to configure the software to run in either User Mode or Administration Mode.

Start the software using the steps appropriate for the version of MS Windows that is installed on your PC.

- For MS Windows version 3.x:
  1. Open the Program Manager window.
  2. Open the HP Service Support program group.
  3. Open the HP Service Software icon.
- For MS Windows 95 or Windows NT:
  1. Select Start.
  2. Select HP Service Software for PC's.
  3. Select HP Service Software.

The service support software has two configurations: User and Administration. The following sections explain the difference between the two configurations.

**Figure 3-1      The User Information Window**

A screenshot of a Windows-style dialog box titled "User Information". The dialog box has a title bar with a standard minimize button. Inside, there are two text input fields. The first is labeled "User Name:" and the second is labeled "Password:". Below the input fields are two buttons: "OK" and "Cancel". The dialog box has a light gray background and a thin black border.

## The User Configuration

Logging on in User Configuration only allows access to the instrument's performance tests and adjustments. Refer to [“Starting the Software”](#) on page 3-20.

## The Administration Configuration

Logging on in Administration Configuration supports all administrative functions, including the addition of new equipment and the installation of test procedures and device drivers.

## Administering the Service Support Software

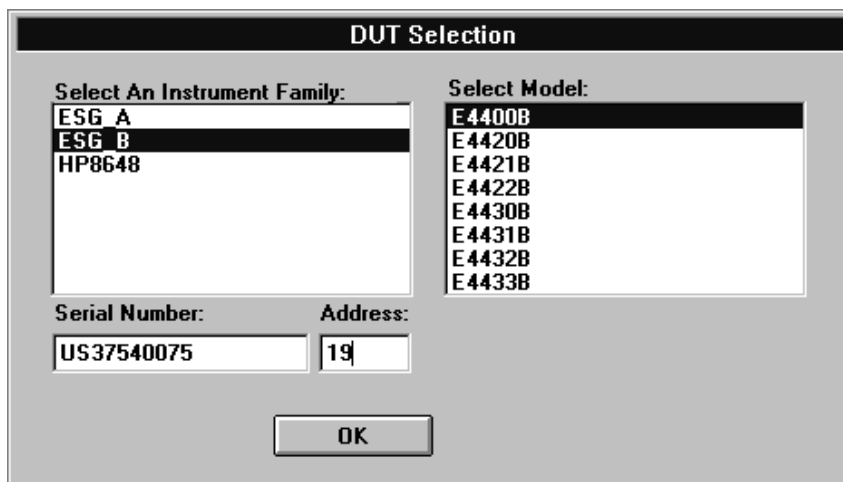
A dialog box titled "User Information" with a standard Windows-style title bar. It contains two text input fields. The first field is labeled "User Name:" and contains the text "Admin". The second field is labeled "Password:" and contains seven asterisks "\*\*\*\*\*". Below the fields are two buttons: "OK" and "Cancel".

User Information	
User Name:	Admin
Password:	*****
<div>OK Cancel</div>	

1. Refer to the illustration above and fill in the fields in the User Information window:
  - a. In the User Name field, type in the word Admin. (Case sensitive.)
  - b. In the Password field, type in the word Falcon. (Case sensitive.)
2. Click OK. (Cancel closes the software application.)

## Identifying the DUT

When the DUT Selection dialog box is displayed:

A dialog box titled "DUT Selection" with a standard Windows-style title bar. It contains two list boxes. The first list box is labeled "Select An Instrument Family:" and contains three items: "ESG A", "ESG B" (which is highlighted), and "HP8648". The second list box is labeled "Select Model:" and contains eight items: "E4400B", "E4420B", "E4421B", "E4422B", "E4430B", "E4431B", "E4432B", and "E4433B". Below the list boxes are two text input fields. The first field is labeled "Serial Number:" and contains the text "US37540075". The second field is labeled "Address:" and contains the text "19". Below the fields is a single button labeled "OK".

DUT Selection	
Select An Instrument Family:	Select Model:
ESG A	E4400B
ESG B	E4420B
HP8648	E4421B
	E4422B
	E4430B
	E4431B
	E4432B
	E4433B
Serial Number:	Address:
US37540075	19
<div>OK</div>	

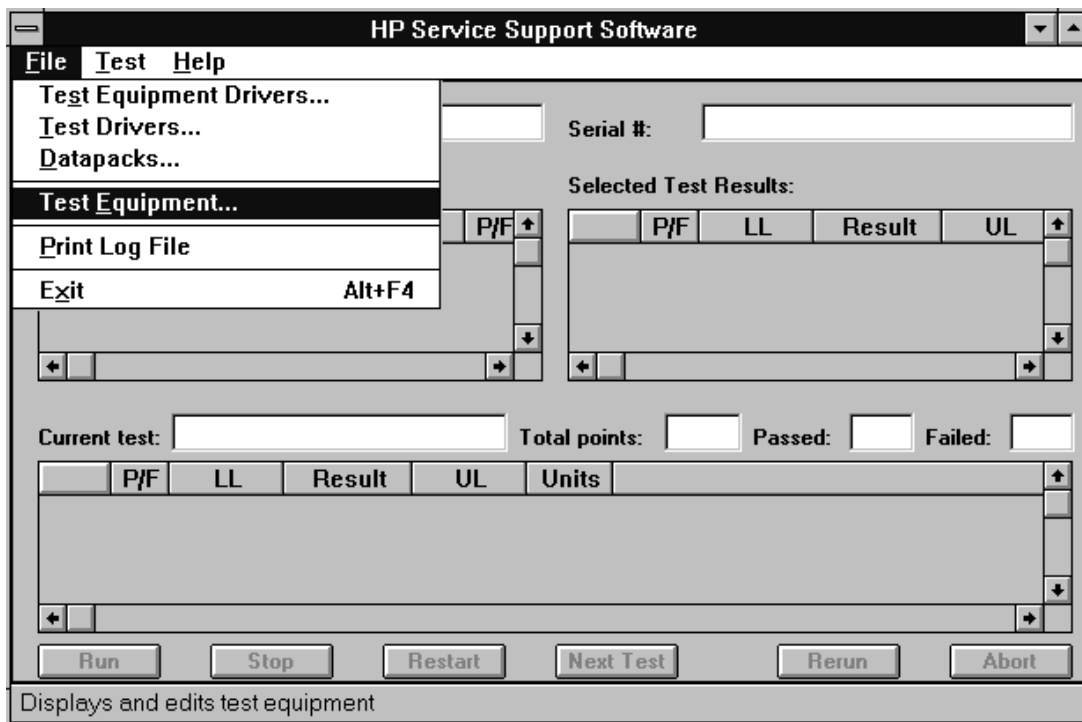
1. Make sure that ESG\_B is selected in the Select an Instrument Family list.
2. In the Select Model list, select the instrument model of the DUT to be adjusted or tested.
3. In the Serial Number box, enter the complete serial number of the DUT.
4. In the Address box, enter the two-digit GPIB address of the DUT. (To display the address on the signal generator, press **Utility > GPIB/RS-232**. The **GPIB Address** softkey shows the current address.)
5. Select the OK button.
6. The Select Test Equipment and Tests window appears on the display. Close this window.

## Adding Test Equipment

Before any performance tests can be run, information regarding your specific test equipment must be entered into the software's database. This information includes the serial numbers, calibration dates, GPIB address, and traceability data for each individual component. Only equipment which has been entered into the system will be available for the test equipment selection process during the test setup. To add test equipment, follow the instructions below:

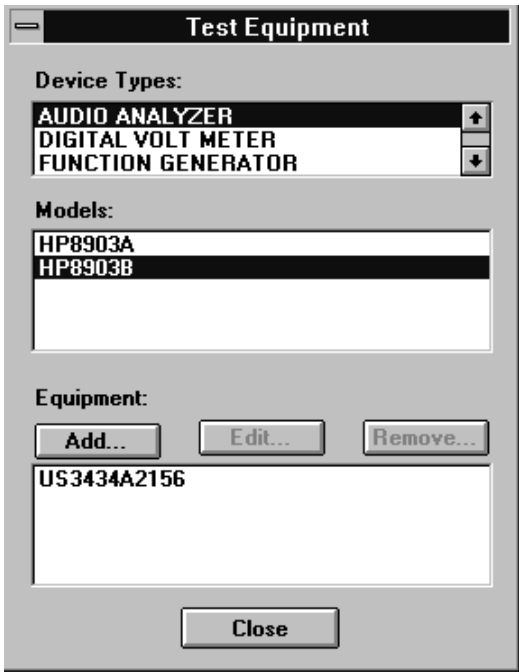
1. Refer to [Figure 3-2](#). In the File drop-down menu, select Test Equipment.

**Figure 3-2 Test Equipment in the File Drop-Down Menu**



2. Refer to [Figure 3-3](#). In the Test Equipment dialog box, select the Device Type for the new equipment you are adding.

**Figure 3-3      Adding Test Equipment Using the Test Equipment Menu**



- 3. Select the model of the device.
- 4. Click Add.
- 5. In the New Test Equipment window (refer to [Figure 3-4](#)), enter the following parameters into the appropriate box:
  - Serial Number**      of the new equipment.
  - GPIB Address**      of the new equipment. This address must be in the range of 0 through 31 and it should not conflict with any other instrument address already present in the test setup.

NOTE	The power sensor must be assigned GPIB address –1 (negative 1).
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- Cal Due Date**      the projected calibration due date of the new equipment.
- Trace Number**      the calibration tracking number. This is the last required item.
- Calibration Type**      (optional) is used only when special calibration data is associated with the device being added, and only as a function setup by the factory for equipment requiring specific calibration data. The only devices currently requiring this feature are power sensors.

Table 3-1 is an example of the calibration information required to ensure accuracy for measurements using the power sensor. This window is accessed for data entry by selecting the words CAL DATA from the Calibration Type field in the Edit or New Test Equipment window, [Figure 3-4](#).

**Table 3-1 An Example of Calibration Data for Power Sensors**

Frequency (MHz)	Calibration Factor (%)
0.1000	97.6
0.3000	98.9
1.0	99.1
3.0	99.4

**Figure 3-4 Adding the Equipment Information Using the New Test Equipment Window**

6. Click OK.

---

**NOTE** The serial number of the test equipment added will be displayed in the Equipment field of the Test Equipment dialog box (Figure 3-3).

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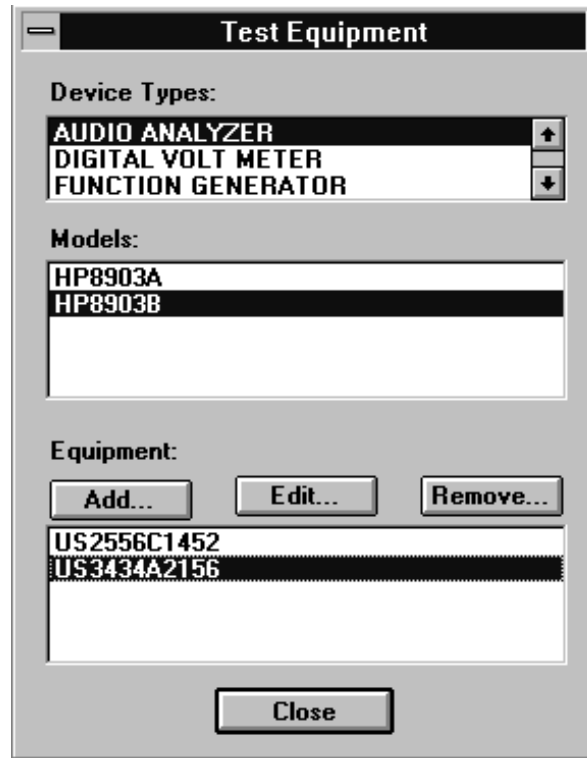
## Removing Test Equipment

Removal of test equipment is accomplished using the Test Equipment dialog box. Refer to Figure 3-5.

1. Select the Device Type of the test equipment to be removed.



**Figure 3-5 Removing and Editing Test Equipment Using the Test Equipment Window**



2. Select the model of the test equipment to be removed from the Models field.
3. Select the serial number of the test equipment to be removed from the Equipment field.
4. Click Remove.
5. Click Close.

### Editing Test Equipment

Editing test equipment parameters is accomplished using the Test Equipment dialog box. Refer to [Figure 3-5](#).

1. Select the Device Type of the test equipment to be edited.
2. Select the model of the test equipment to be edited from the Models field.
3. Select the serial number of the test equipment to be edited.
4. Click Edit. The Edit Test Equipment window will appear. Change the field parameters as necessary.
5. Click OK to save the changes and close the window.
6. Click Close in the Test Equipment window.

## Adding Device Drivers

Follow these instructions to add test equipment device drivers to the program:

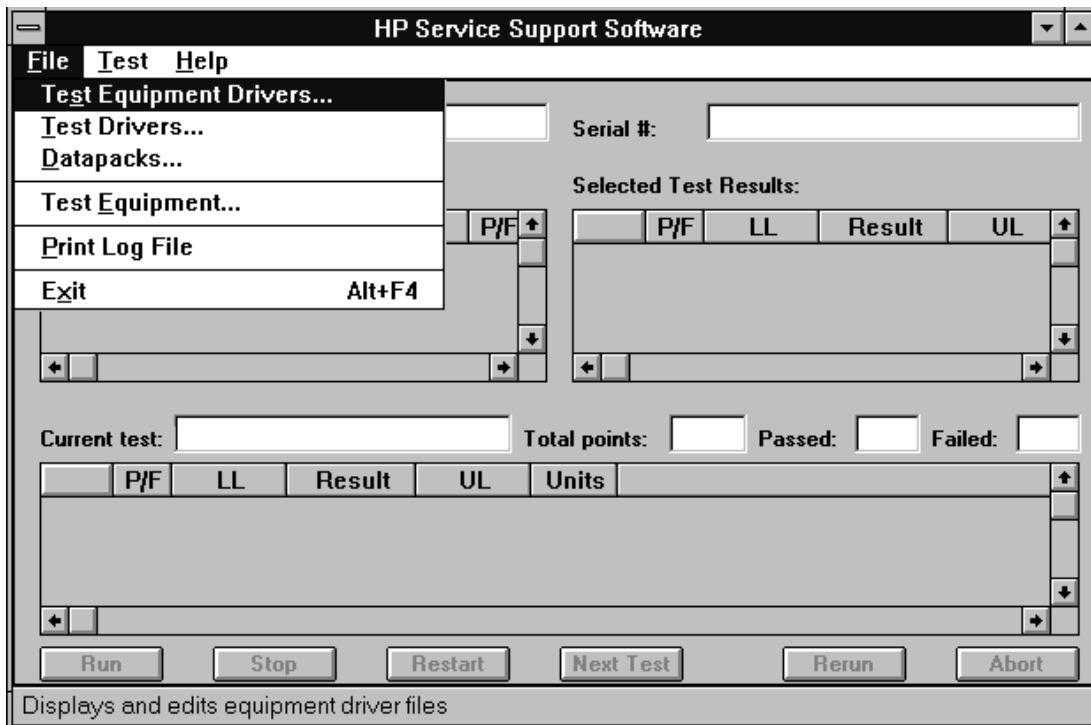
---

**CAUTION** This and the following procedures: Adding/Removing Device (Test Equipment) Drivers, Adding/Removing Test Drivers, and Adding/Removing Datapacks are included for informational purposes. These procedures should only be used when instructions are provided describing which drivers or datapacks need replacement or removal.

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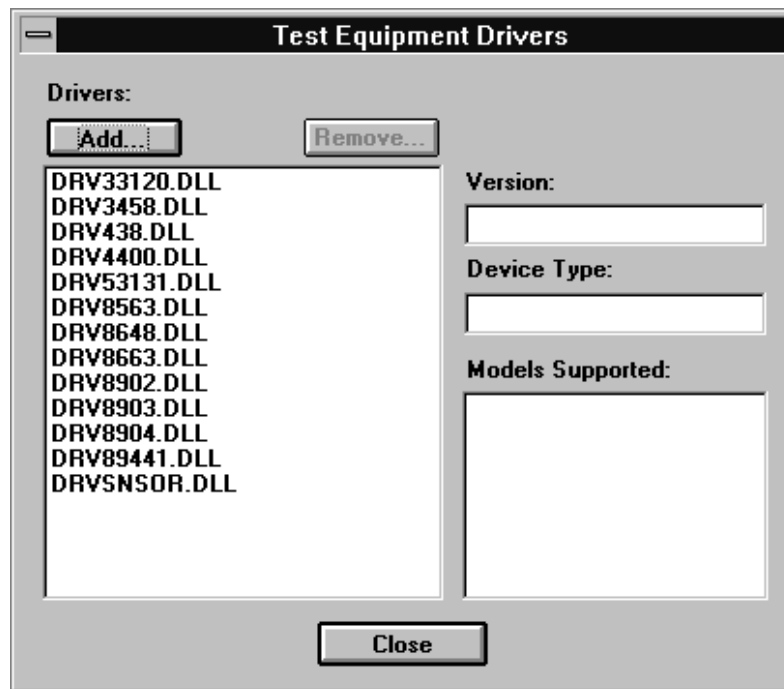
1. Log into the software normally until the Select Test Equipment and Tests window is displayed.
2. Click the Cancel button to close the Select Test Equipment and Tests window.
3. Refer to [Figure 3-6](#). In the File drop-down menu, select Test Equipment Drivers.

**Figure 3-6 Test Equipment Drivers in the File Drop-Down Menu**

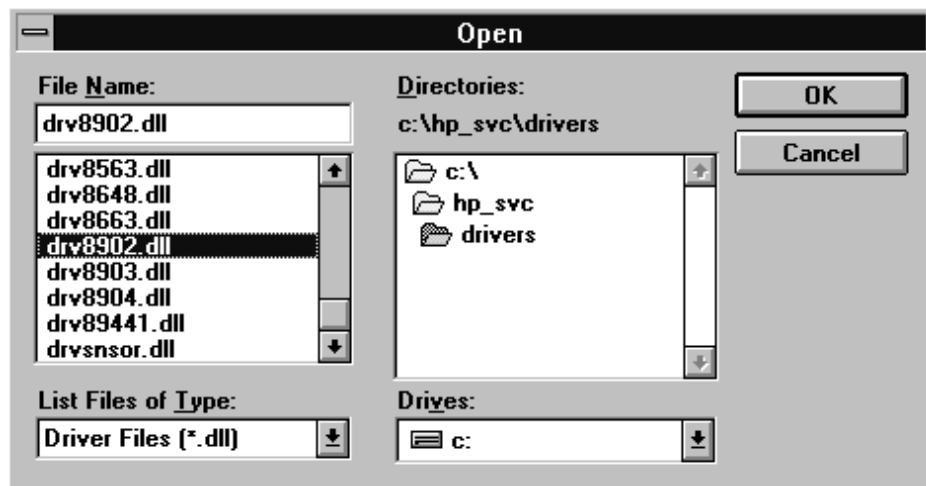


This selection allows for the addition or removal of software drivers for the test equipment being used to verify the performance of the DUT.

4. To add a device driver to the existing list of test equipment drivers, click Add ([Figure 3-7](#)).

**Figure 3-7 Adding a Device Driver Using the Test Equipment Drivers Window**

5. Refer to [Figure 3-8](#). Using the standard file search procedure, select the driver that you are adding and click OK.

**Figure 3-8 Using the Open Dialog Box to Search for a Device Driver File to Add**

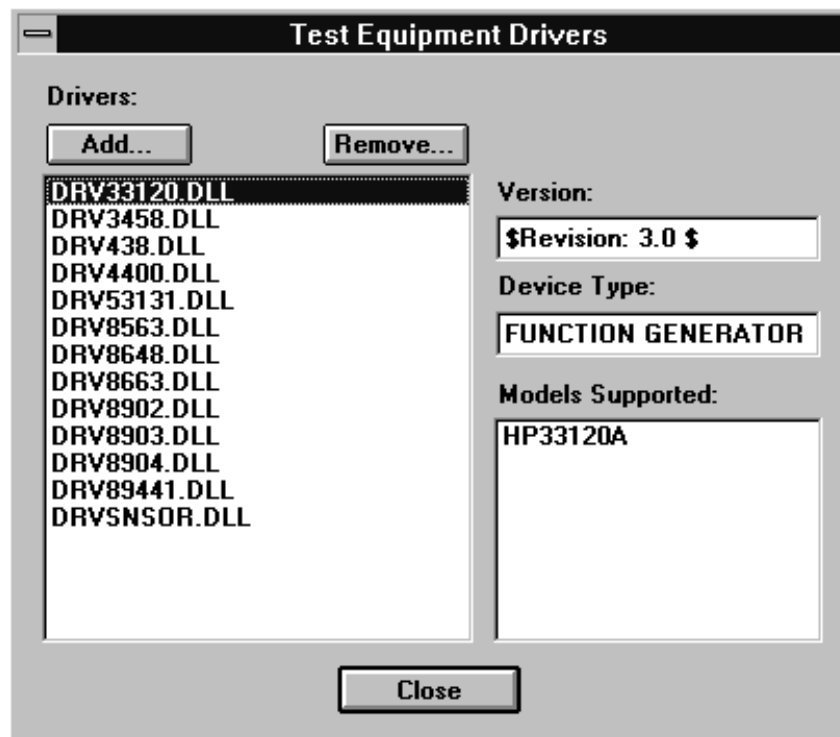
The selected driver should now be displayed in the Test Equipment Drivers dialog box, as seen in [Figure 3-9](#).

## Removing Device Drivers

Removing device drivers is accomplished using the Test Equipment Drivers dialog box. Refer to [Figure 3-9](#).

1. Select the driver (.dll) file to be removed.

**Figure 3-9 Removing a Device Driver Using the Test Equipment Drivers Window**



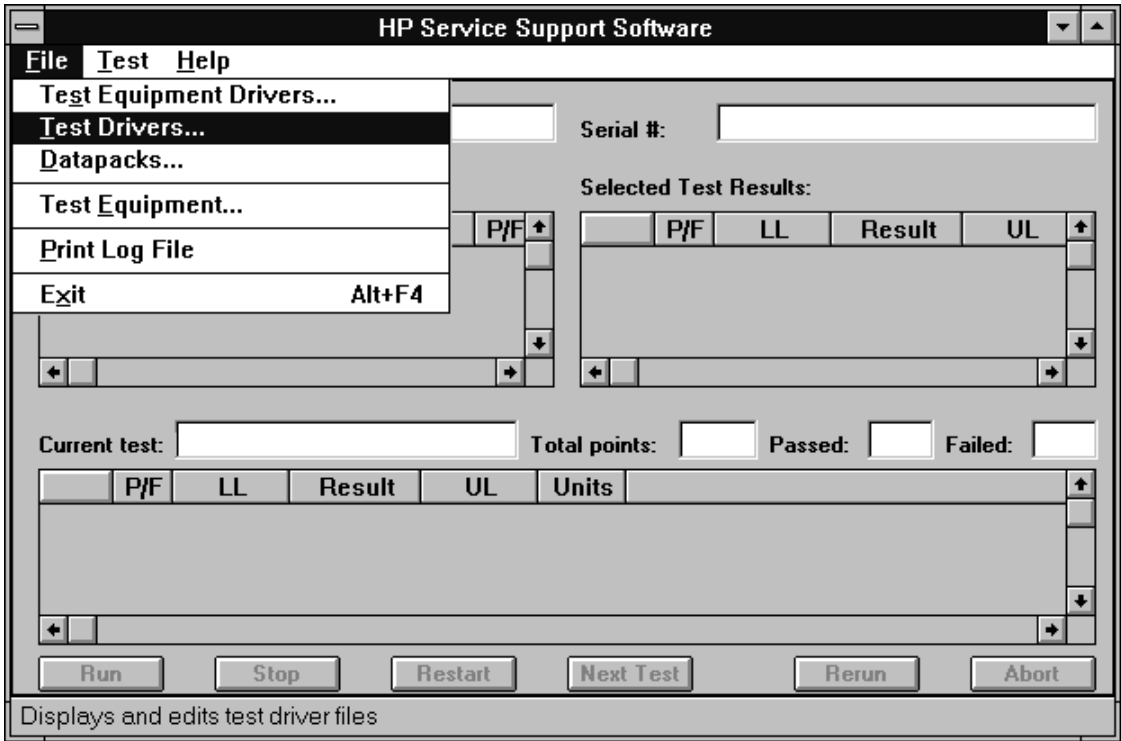
2. Ensure that the information displayed in the Version, Device Type, and Models Supported fields reflects the correct information for the selected driver being removed.
3. Click Remove.
4. Click Close.

## Adding Test Drivers

Adding software drivers is accomplished using the Test Drivers window.

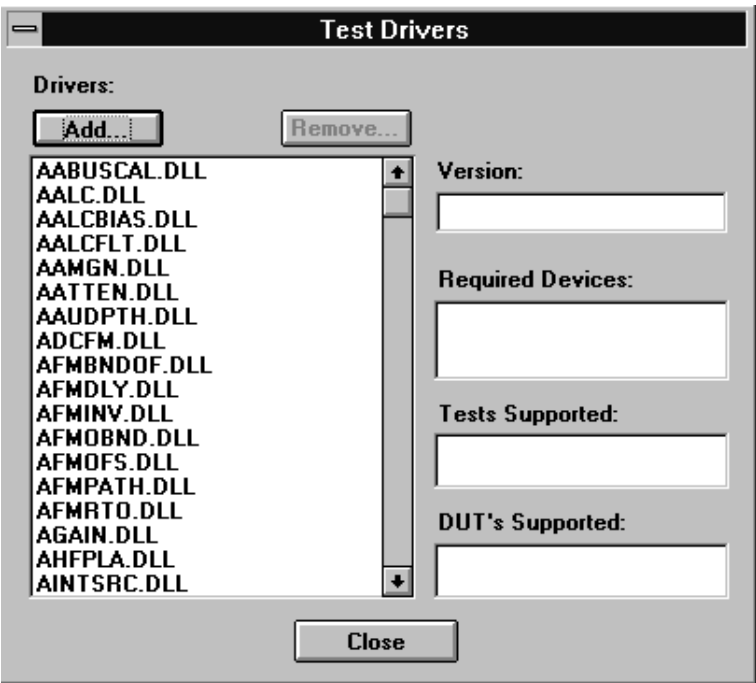
1. Refer to [Figure 3-10](#). In the File drop-down menu, select Test Drivers.

Figure 3-10 Test Drivers in the File Drop-Down Menu



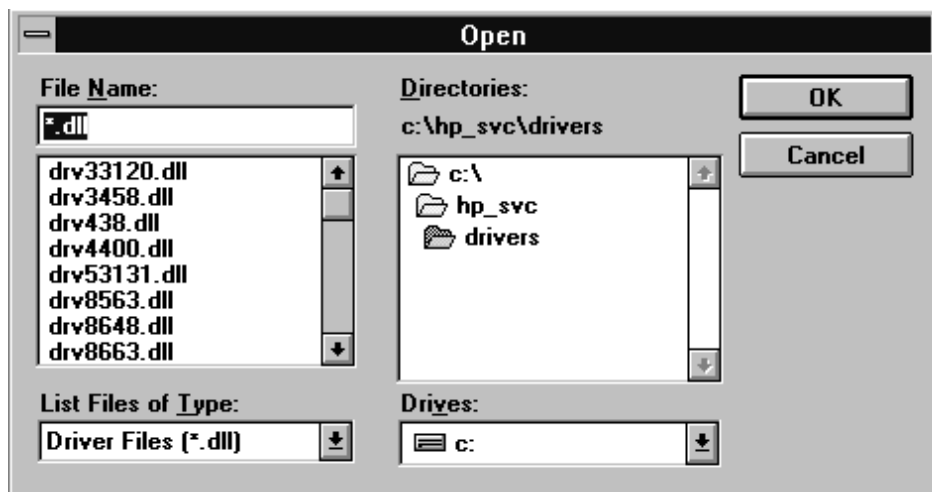
- 2. Refer to [Figure 3-11](#). To add a test driver to the existing list of test drivers, click Add.

Figure 3-11 Adding a Test Driver Using the Test Drivers Window



3. Refer to [Figure 3-12](#). Using the standard file search procedure, select the test driver that you are adding and click OK.

**Figure 3-12 Using the Open Dialog Box to Search for a Test Driver File to Add**



The selected driver should now be displayed in the Test Drivers dialog box, as seen in [Figure 3-11](#).

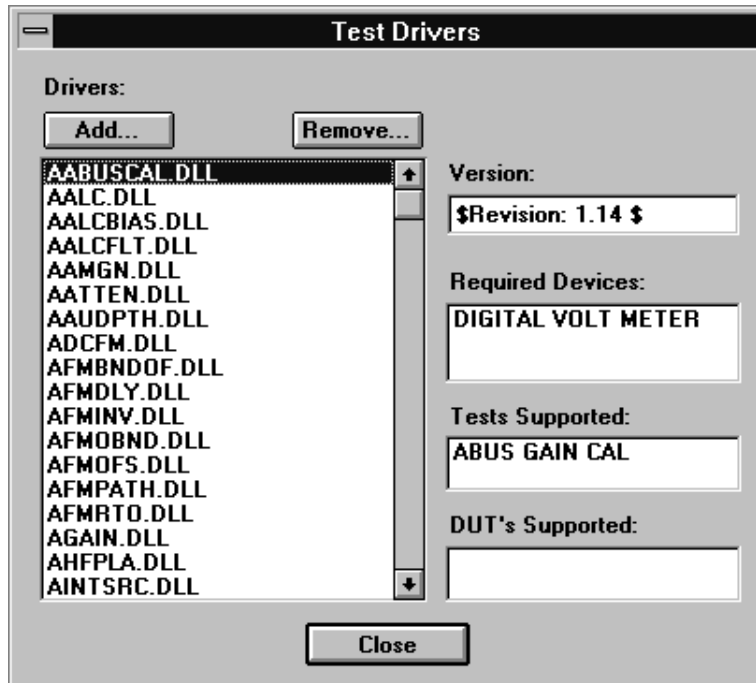
4. Click Close ([Figure 3-11](#)).

## Removing Test Drivers

Removing test drivers is accomplished using the Test Drivers dialog box. Refer to [Figure 3-13](#).

1. Select the driver (.dll) file to be removed.

**Figure 3-13 Removing a Test Driver Using the Test Drivers Window**



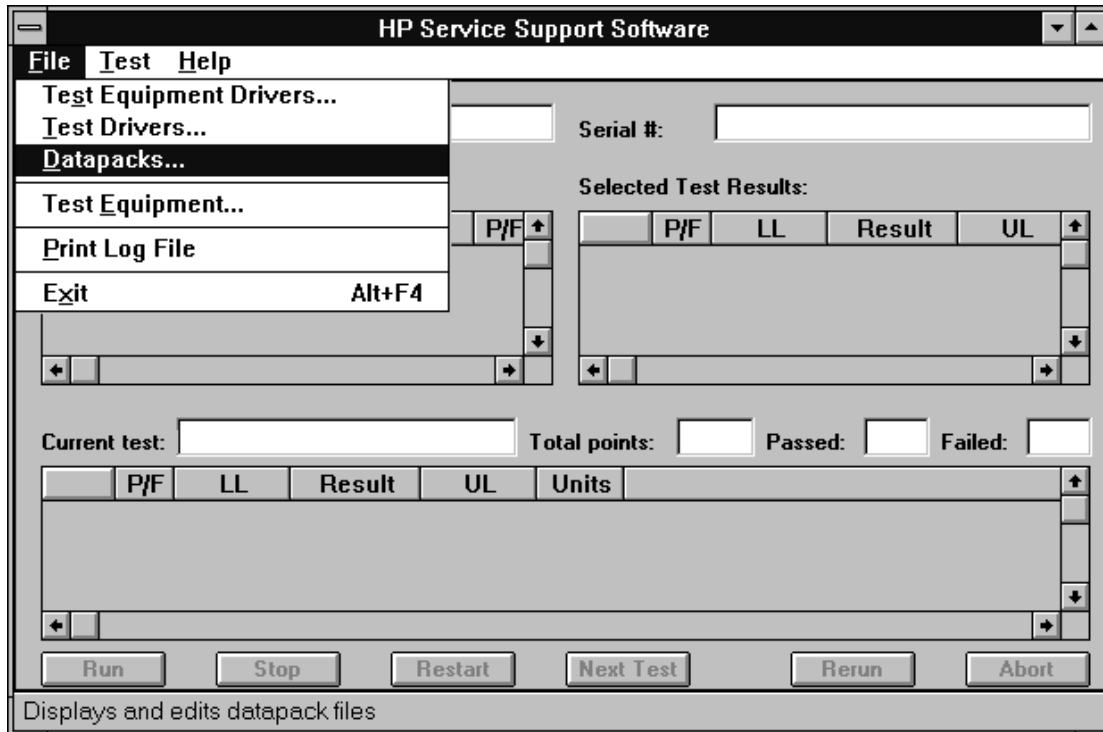
2. Ensure that the information displayed in the Version, Required Devices, and Tests Supported fields reflects the correct information for the selected driver being removed.
3. Click Remove.
4. Click Close.

## Adding Datapacks

Adding datapacks for test procedures is accomplished using the Datapacks dialog box.

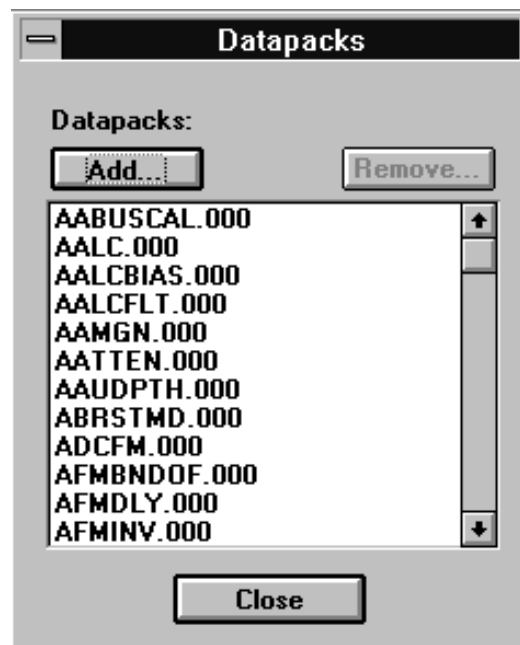
1. Refer to [Figure 3-14](#). In the File drop-down menu, select Datapacks.

**Figure 3-14 Datapacks in the File Drop-Down Menu**



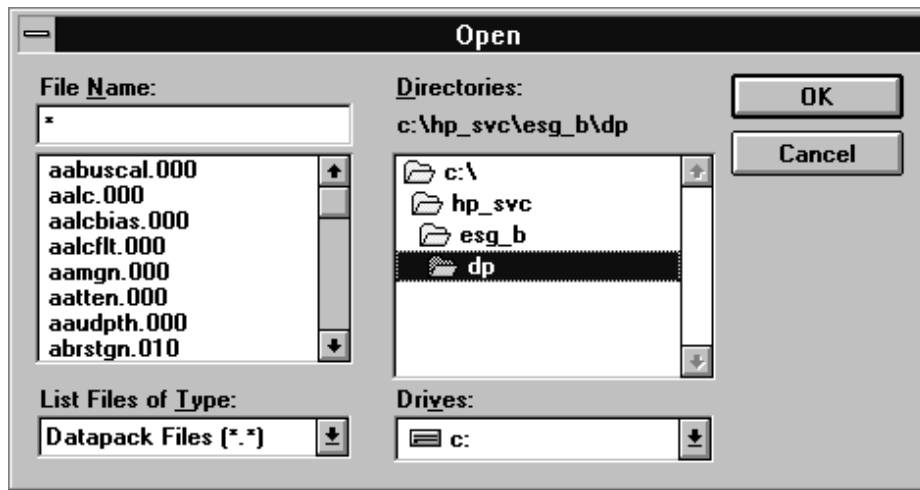
2. Refer to [Figure 3-15](#). To add a datapack to the existing list of datapacks, click Add.

**Figure 3-15 Adding a Datapack Using the Datapacks Window**



3. Refer to [Figure 3-16](#). Using the standard file search procedure, select the datapack that you are adding and click OK.



**Figure 3-16 Using the Open Dialog Box to Search for a Datapack File to Add**

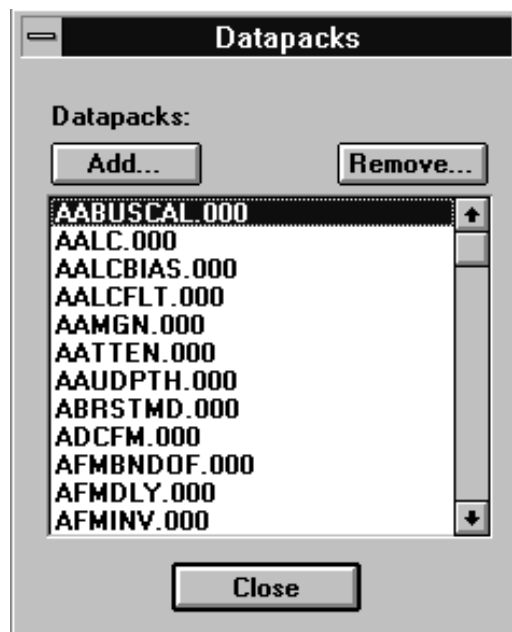
The selected driver should now be displayed in the Datapacks dialog box, as seen in [Figure 3-15](#).

4. Click Close ([Figure 3-15](#)).

## Removing Datapacks

Removing datapacks is accomplished using the Datapacks dialog box. Refer to [Figure 3-17](#).

1. Select the datapack (.000) file to be removed.

**Figure 3-17 Removing a Datapack Using the Datapacks Window**

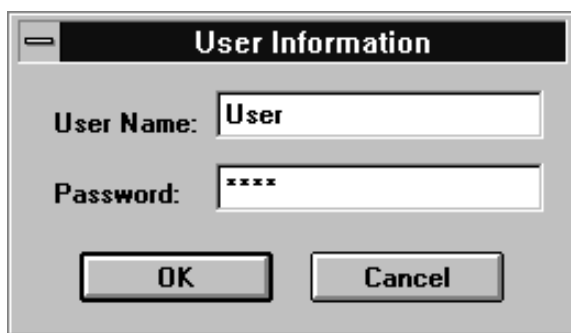
2. Click Remove.
3. Click Close.

---

## Running the Service Support Software

### Starting the Software

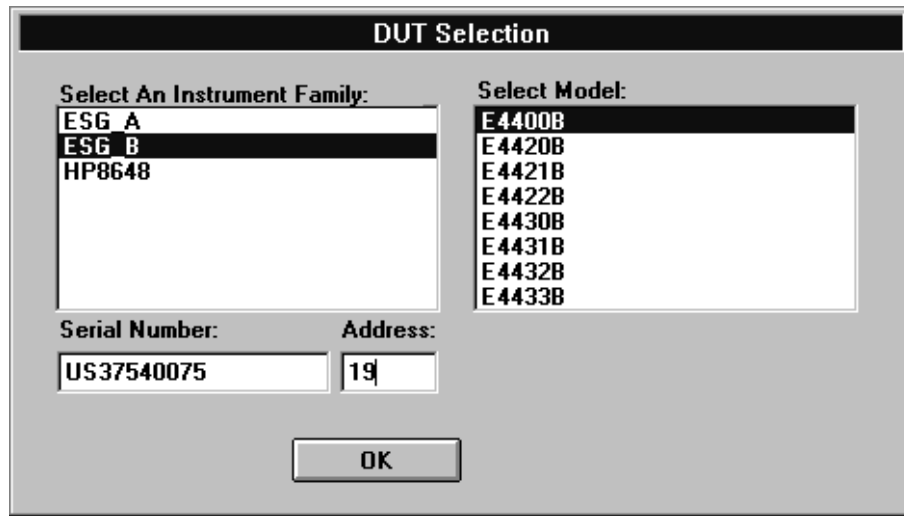
1. Start the software using the steps appropriate for the version of MS Windows that is installed on your PC.
  - For MS Windows 95:
    - a. Select Start.
    - b. Select HP Service Support for PC's.
    - c. Select HP Service Software.
  - For MS Windows version 3.x:
    - a. Open the Program Manager window.
    - b. Open the HP Service Support program group.
    - c. Select the HP Service Support icon.
2. Once the User Information dialog box is displayed, enter the user name and the password.



- a. In the User Name box, enter User. (Case sensitive.)
- b. In the Password box, enter User. (Case sensitive.)
- c. Click OK.

## Identifying the DUT

When the DUT Selection dialog box is displayed,



The DUT Selection dialog box is shown with the following fields and options:

- Select An Instrument Family:** A list box containing "ESG A", "ESG B" (selected), and "HP8648".
- Select Model:** A list box containing "E4400B", "E4420B", "E4421B", "E4422B", "E4430B", "E4431B", "E4432B", and "E4433B".
- Serial Number:** A text box containing "US37540075".
- Address:** A text box containing "19".
- OK** button.

1. Make sure that ESG\_B is selected in the Select An Instrument Family list.
2. In the Select Model list, select the signal generator model of the DUT to be adjusted or tested.
3. In the Serial Number box, enter the complete serial number of the DUT.
4. In the Address box, enter the two-digit GPIB address of the DUT. (To display the address on the signal generator, press **Utility** > **GPIB/RS-232**. The **GPIB Address** softkey shows the current address.)
5. Select the OK button.

## Selecting Performance Tests or Adjustments and the Test Equipment

When the Select Test Equipment and Tests window is displayed,

The screenshot shows the 'Select Test Equipment and Tests' dialog box. It has a title bar and two main panes. The left pane, 'TEST SELECTION', contains radio buttons for 'Performance Tests' (selected) and 'Adjustments'. Below is a list of test names: 'AM ACCURACY', 'AM DISTORTION', 'AM FREQUENCY RESPONSE', 'DCFM FREQUENCY OFFSET' (highlighted), 'DIG. MOD. RF QUALITY', and 'FM ACCURACY'. There are 'Select All' and 'Unselect' buttons. The right pane, 'TEST EQUIPMENT SELECTION', has a 'Device Type' dropdown menu with 'AUDIO ANALYZER', 'DIGITAL VOLT METER', and 'FUNCTION GENERATOR'. Below is a 'Model' text box. Further down are 'Required Test Equipment' and 'Available Test Equipment' sections, each with a list box. Below these are 'Selected Tests' and 'Selected Test Equipment' sections, each with 'Add', 'Remove', and 'Clear' buttons. At the bottom are 'OK' and 'Cancel' buttons.

1. Select either the Performance Tests radio button to display the list of automated performance tests or the Adjustments radio button to display the list of automated adjustments.
2. From the list of performance tests or adjustments, select the tests or adjustments that will be performed on the DUT. Select a test name by clicking on it (the DCFM FREQUENCY OFFSET test will be selected for the sections following). The selected test will be highlighted.

Select all of the performance tests or adjustments by selecting the Select All button. Unselect all of the selected tests or adjustments by choosing the Unselect button.

As each test or adjustment is selected, the test equipment required to perform the test or adjustment is listed in the Required Test Equipment box. As each test or adjustment is removed from the list, the test equipment required to perform the test or adjustment is removed from the list. Only the test equipment for the highlighted tests is displayed in the list.

3. Once the test is highlighted, identify all test equipment listed in the Required Test Equipment box. To identify test equipment:
  - a. Select the type of device from the Device Type list.
  - b. Select the model number from the Model list for the device.
  - c. Select the device's serial number from the Available Test Equipment list.
  - d. Select the Add button to add the device to the list in the Selected Test Equipment box.

The following buttons are available for the Selected Test Equipment box:

<b>Add</b>	Copies the tests and adjustments highlighted in the Available Test Equipment box to the Selected Test Equipment box.
<b>Remove</b>	Removes the highlighted test equipment from the Selected Test Equipment box.
<b>Clear</b>	Removes all of the test equipment from the Selected Test Equipment box.

---

<b>NOTE</b>	If necessary, the test equipment GPIB address can be changed after it is added to the Selected Test Equipment box. Change the GPIB address by pressing the right arrow on the keyboard until the GPIB address selection in the Selected Test Equipment box is selected. (The GPIB address is selected when it has a dark box around the selection.) Then, type the new GPIB address and press Enter to change the address.
-------------	--

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- e. Repeat the previous steps for each test equipment instrument.
4. Once the test equipment has been identified, select the Add button located above the Selected Tests box to add each of the highlighted performance tests or adjustments. The tests or adjustments that were highlighted are now displayed in the list in the Selected Tests box.

The following buttons are available for the Selected Tests box:

<b>Add</b>	Copies the tests and adjustments highlighted in the list of tests and adjustments to the Selected Tests box.
<b>Remove</b>	Removes the highlighted tests and adjustments from the Selected Tests box.
<b>Clear</b>	Removes all of the tests and adjustments from the Selected Tests box.

- If the appropriate tests or adjustments are listed in the Selected Tests box and the appropriate test equipment is listed in the Selected Test Equipment box, select the OK button.

**Select Test Equipment and Tests**

**TEST SELECTION**  
☒ Performance Tests ☐ Adjustments  
 AM ACCURACY  
 AM DISTORTION  
 AM FREQUENCY RESPONSE  
**DCFM FREQUENCY OFFSET**  
 DIG. MOD. RF QUALITY  
 FM ACCURACY  
 Select All Unselect

**TEST EQUIPMENT SELECTION**  
 Device Type:  
 SPECTRUM ANALYZER  
**UNIVERSAL COUNTER**  
 VEC. SIG. ANALYZER  
 Model:  
 HP53131A  
**HP53132A**

**Required Test Equipment:**  
 UNIVERSAL COUNTER

**Available Test Equipment:**

Serial Number	Cal Due Date
US2345D7689	1199

**Selected Tests:**  
 Add Remove Clear  
 DCFM FREQUENCY OFFSET

**Selected Test Equipment:**  
 Add Remove Clear

Model	Serial Number
HP53132A	US2345D7689

OK Cancel

## Defining the Location where the Test Results are Saved

- When the Save As dialog box is displayed, select the File Name box and enter the file name into which you would like to save the test results.

**Save As**

File Name:  
 dcfm.log

Directories:  
 c:\hp\_svc\esg\_b\log

Save File as Type:  
 Result Files (\*.log)

Drives:  
 c:

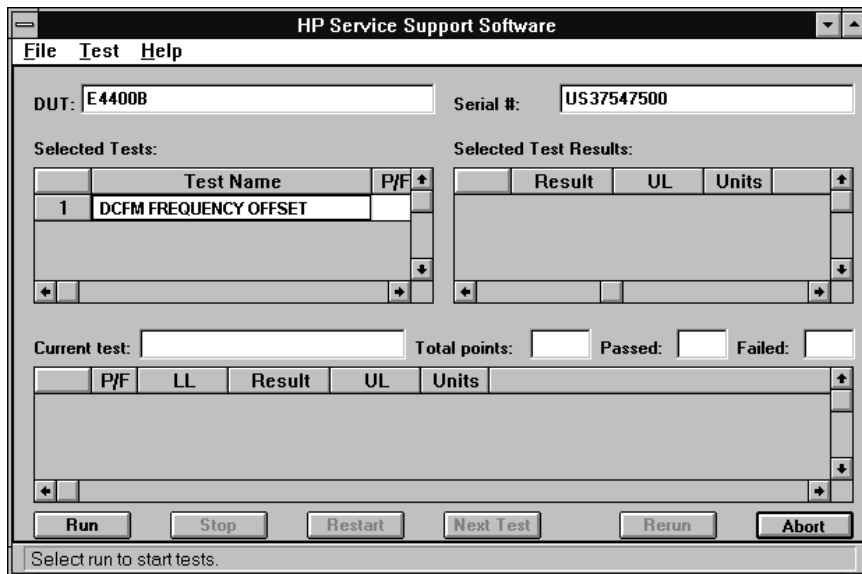
OK Cancel

The results file name suffix is .log. The results are saved automatically to the .log file. You may select the directory into which you would like to save the file by changing the drive and folder in this window. This file is a text file and can be viewed using many text editors. Notepad, a standard accessory in MS Windows, is an example of a text editor that can be used to view text files.

2. Once you have selected the drive, folder, and assigned a file name, select the OK button to save these settings for when the tests are complete.

## Running the Tests and Adjustments

Once the HP Service Support Software window is displayed:



1. Select the Run button to start the automated tests or adjustments displayed in the Selected Tests box.

The software steps through the tests or adjustments sequentially.

2. Follow the instructions displayed on the PC.

A description for each automated performance test or adjustment can be found in [Chapter 4, "Performance Tests,"](#) and [Chapter 5, "Adjustments."](#)

## Reviewing the Test and Adjustment Results

Once the tests have finished running, you will want to review the results of the tests. The HP Service Support Software window displays the DUT model number and serial number, the selected tests, the results of the selected test, and the current test information. Six buttons, which are used to control the testing, are also displayed.

HP Service Support Software

File Test Help

DUT: E4400B Serial #: US37547500

Selected Tests:

	Test Name	P/F
1	DCFM FREQUENCY OFFSET	

Selected Test Results:

	P/F	LL	Result	UL

Current test: DCFM FREQUENCY OFFSET Total points: 14 Passed: 6 Failed: 0

	P/F	LL	Result	UL	Units	MEASUREMENTS;RF FREQ ;DEVI
4	P	**	**	**	**	CAL_DCFM;500;1
5	P	0.000	0.000	0.100	%	MEAS;500;1
6	P	**	**	**	**	CAL_DCFM;1000;1

Run Stop Restart Next Test Rerun Abort

Running sequentially through selected tests.

The Selected Tests box displays the name of the selected tests, the pass/fail status (P/F) of each test that has been run, the total number of points that each test checks, and the number of points that passed and failed for each test. The pass/fail status indicates a failure if any point in that test fails.

The Selected Test Results box shows the results of the test that is highlighted in the Selected Tests box. The Selected Test Results box shows the pass/fail status (P/F), the lower limits (LL), the measured value (Result), the upper limits (UL), and the measured units (for example, kHz, mV, or dBm) for each test point checked by the performance tests and some adjustments. “\*\*” indicates values not displayed by the adjustments.

The Current test box shows the results of the test that is currently running. The Current test box shows the pass/fail status (P/F), the lower limits (LL), the measured value (Result), the upper limits (UL), and the measured units (for example, kHz, mV, or dBm) for each test point checked by the performance tests and some adjustments. “\*\*” indicates values not displayed by the adjustments.

The following buttons are also displayed on the HP Service Support Software window. These buttons are used to control the testing. Only the buttons that are appropriate are active. For example, if the test is already in progress, the Run button would not be active.

**Run** Start running the highlighted test when initially starting the testing. Also used to start testing at the same point where the test was stopped.

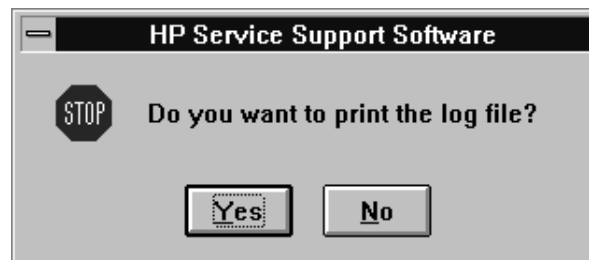
**Stop** Stop the test that is currently running. The test stops after making the next measurement.



<b>Restart</b>	Rerun a test that was running when the testing was stopped. This restarts the test from the beginning.
<b>Next Test</b>	Quit running the current test and give it a Fail status. Then, continue testing with the next test.
<b>Rerun</b>	Restart the testing at the beginning of the first test.
<b>Abort</b>	Quit testing. Abort all tests.

## Printing the Test and Adjustment Results

Once the tests are complete, a dialog box is displayed that asks if you want to print the log file.



The log file is the file in which the test (or adjustment) results are stored. Select the Yes button to print the test results using the printer connected to LPT1. Choosing the No button allows you to exit the program without printing the test results.

There are two other methods of printing the test results.

The first method is selecting the Print Log File selection from the File drop-down menu. The software asked you to define the computer path and file name when the tests were performed. The default directory is the “log” subdirectory of the destination directory where you installed the software. (C:\HP\_SVC\EGS\_B\ was the default destination directory.)

The second alternative method of printing is opening the file in a text editor and printing the file in the text editor.

## Exiting the Software

Exit the software by selecting Exit from the file drop-down menu.

Pressing Alt-F4 on the keyboard is an alternate method of exiting the software.



## **4 Performance Tests**

Unless stated otherwise, the procedures in this chapter enable you to test the electrical performance of the signal generator to its specifications.

### Calibration Cycle

This instrument requires periodic verification of performance. Under normal use and environmental conditions, the instrument should be calibrated every two years. Normal use is defined as about 2,000 hours of use per year.

### Performance Test Records

Unless stated differently, the ESG Family Support Software can print a test record that contains the results of the automated performance tests. For each of the two manual performance tests, “Timebase Aging Rate (ESG-AP, ESG-DP or Option 1E5 only)” and “Measuring Phase Noise and Residual FM (ESG-AP and ESG-DP Series Signal Generators),” a performance test record is located at the end of this chapter so it can be photocopied for use.

### Recommended Test Equipment

The recommended test equipment table, located in [Chapter 1, “Equipment Required,”](#) is the complete list of equipment required to perform the procedures in this chapter. Test equipment is also listed with each test and is shown in the test setup. However, to avoid clutter in the figures, the controller required to run the support software is not shown in the test setup for each automated test. The controller must be connected via GPIB to all of the test equipment in the currently selected automated tests. For performance tests, other equipment can be substituted for the recommended models if it meets or exceeds the critical specifications listed in [Chapter 1, “Equipment Required.”](#) For the adjustment procedures, no equipment substitutions are available.

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## Support Software

The ESG Family Support Software runs performance tests and where applicable, generates reports of the results for the tests. The following manual tests are *not* listed in the software:

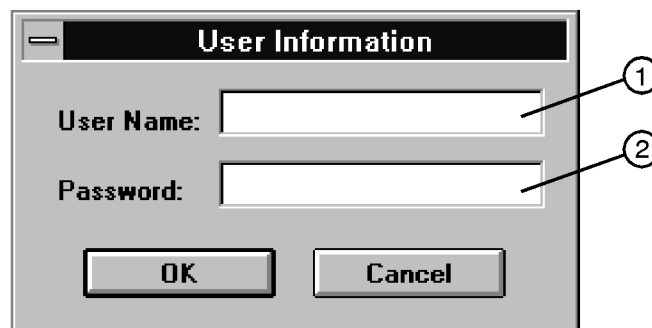
- Timebase Aging Rate (ESG-AP, ESG-DP or Option 1E5 only)
- Measuring Phase Noise and Residual FM (ESG-AP and ESG-DP Series Signal Generators)

This chapter shows how to run the software to test and verify the performance of a signal generator. [Chapter 3, “Service Software,”](#) explains how to set up the software for a particular set of test instruments and interfaced components in a test environment.

## Running the Performance Tests

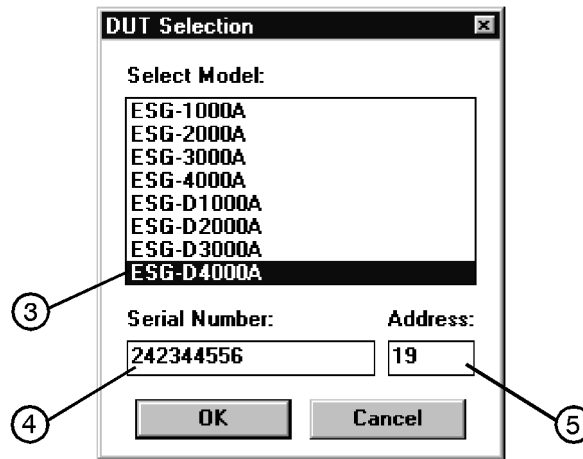
1. Load the support software into the personal computer. Refer to [Chapter 3, “Service Software,”](#) for installation instructions.
2. Click on the installed support software icon.
3. Fill in the fields in the User Information window ([Figure 4-1](#)):
  - a. In the User Name field (item 1), enter User. (Case sensitive.)
  - b. In the Password field (item 2), enter User. (Case sensitive.)
4. Click OK.

**Figure 4-1**      **The User Information Window**



5. In the DUT (Device Under Test) Selection Window ([Figure 4-2](#)):
  - a. In the Select Model list (item 3), choose the correct model number of your signal generator.
  - b. In the Serial Number box (item 4), enter the complete serial number of the DUT.
  - c. In the Address box (item 5), enter the two-digit GPIB address of the signal generator. (To display the address on the signal generator, press **Utility > GPIB/RS-232 > GPIB Address**. The **GPIB Address** softkey shows the current address.)
6. Click OK.

**Figure 4-2 The DUT Selection Window**



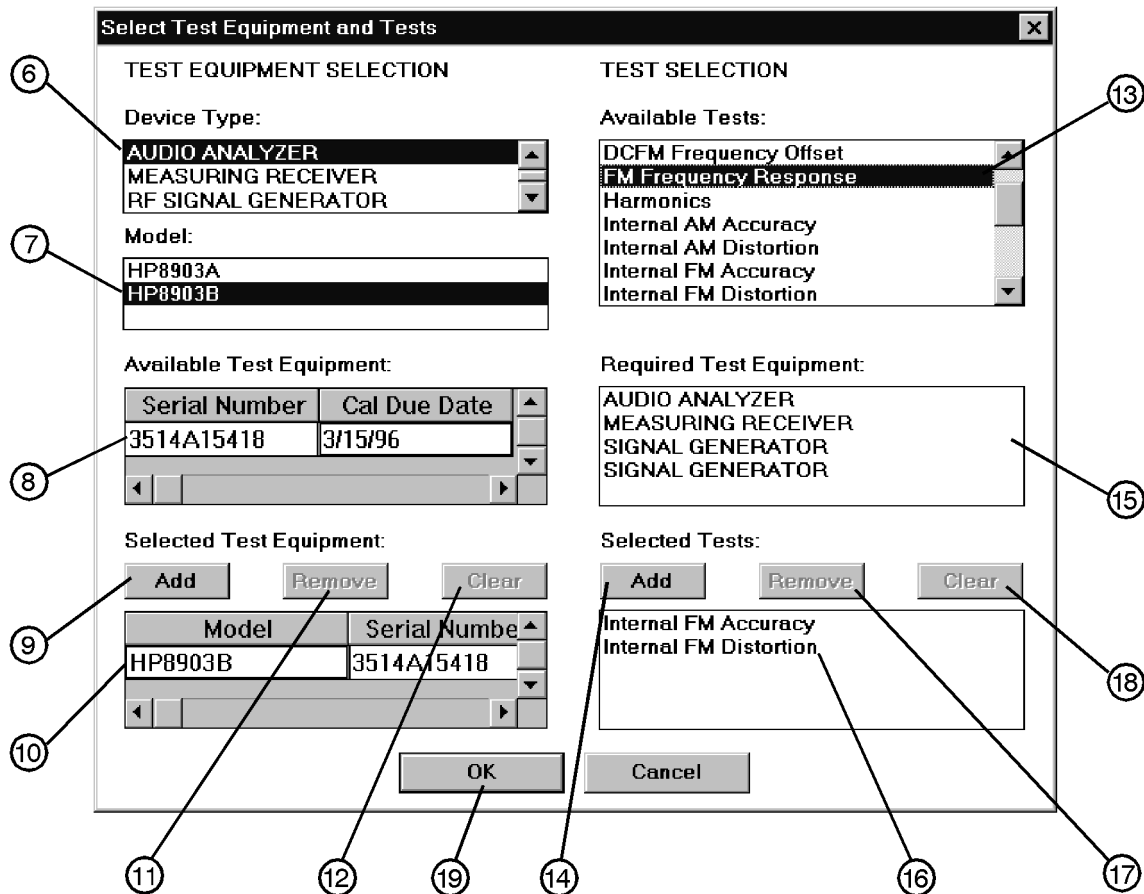
wk759a

7. In the Select Test Equipment and Tests window (Figure 4-3), create a list of test equipment that will verify the signal generator's performance:
  - a. In the Device Type list (item 6), select a device type that you want to add to the equipment list.
  - b. In the Model list (item 7), select the model of the device type that you want to add to the equipment list.
  - c. In the Available Test Equipment box (item 8), select the serial number of an instrument. There may be more than one instrument available for any model. Make sure that the instrument calibration due date has not passed. If the due date has passed, use another available instrument. Also, alert your system administrator that the instrument is due for calibration.
  - d. Click Add (item 9) to add the instrument to the test equipment list.
  - e. Continue adding test equipment to the list by repeating these steps.

---

<b>NOTE</b>	<p>You can correct mistakes while you are entering instruments in the test equipment list:</p> <ul style="list-style-type: none"> <li>• To delete a single entry in the equipment list, click on the unwanted selection in the Selected Test Equipment box and then click Remove (item 11).</li> <li>• To delete the entire list of equipment, click Clear (item 12).</li> </ul>
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**Figure 4-3 The Select Test Equipment and Tests Window**

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8. Create a list of performance tests that you want the software to run (Figure 4-3):

- a. In the Available Tests list (item 13), select a performance test.
- b. Click Add (item 14) to add the test to the list of tests that the software will run.

You can view the Required Test Equipment list (item 15) for a performance test by clicking on the test title in the Available Tests (item 13) box.

- c. Continue adding performance tests to the list by repeating these steps.

**NOTE** You can correct mistakes while you are entering tests in the performance test list:

- To delete a single entry in the test list, select the unwanted test in the Selected Tests box (item 16) and then click Remove (item 17).
- To delete the entire list of equipment, click Clear (item 18).

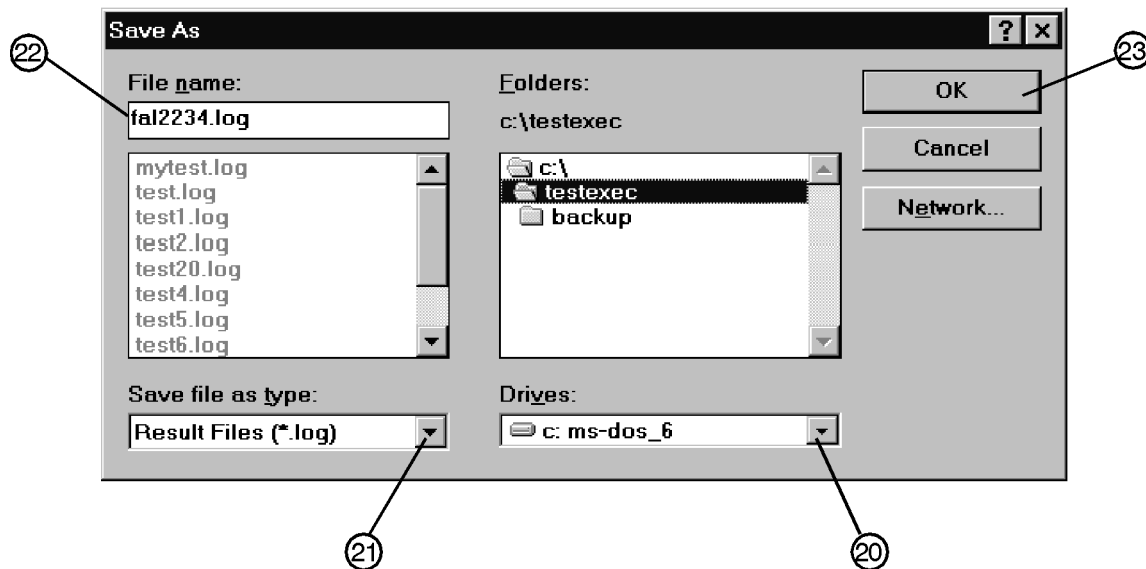
9. When you are done, click OK (item 19).

10. To save the test results to a file, make the following selections (Figure 4-4):

- a. Click on the Drives window (item 20) and select the drive where you want to save the test results.
- b. Click on the Save file as type window (item 21) and select the file type for saving the test results.
- c. Click on the File name window (item 22) and type in a name for the test results file.

11. Click OK (item 23).

**Figure 4-4 The Save As Window**



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12. In the Main Test and Results window (Figure 4-5), verify that the selected DUT (item 24), serial number (item 24), and selected tests (item 25) are correct. Then click Run.

The selected performance tests are listed in the order in which they will run. You cannot change this order.

During the testing sequence the window shows the following information:

- the model and serial number of the signal generator under test (item 24)
- the list of selected performance tests with the current test highlighted (item 25)
- the performance test currently running (item 26)
- the data points taken (item 27)
- the total number of data points that will be measured during the test (item 28)
- the number of points that have currently passed the test (item 29)
- the number of points that have currently failed the test (item 30)
- the lower limits (LL) (item 31) and upper limits (UL) (item 32) for each test point
- the measured results (item 33) and the pass/fail (P/F) (item 34) indication

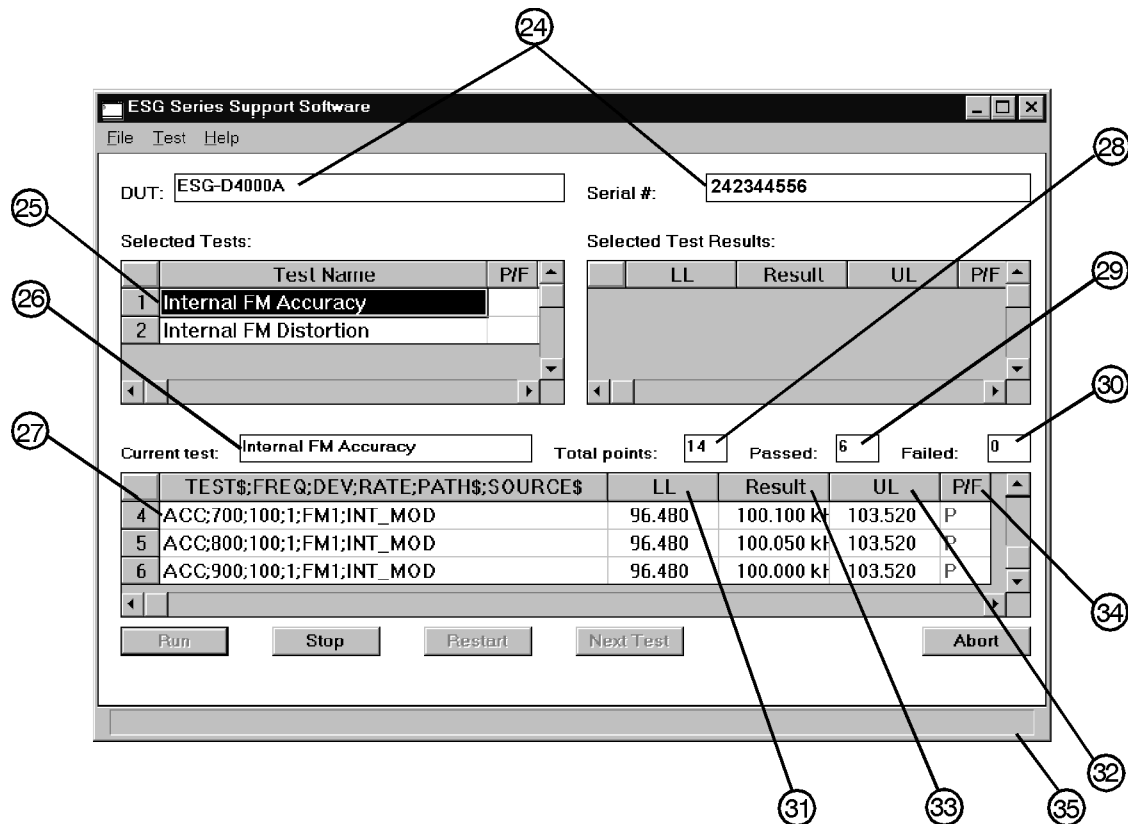


You can scroll the results window, vertically and horizontally. You can also click on the following buttons during the test sequence:

- Run** Start running the highlighted test when initially starting the testing. Also used to start testing at the same point where the test was stopped.
- Stop** Stop the test that is currently running. The test stops after making the next measurement.
- Restart** Rerun a test that was running when the testing was stopped. This restarts the test from the beginning.
- Next Test** Quit running the current test and give it a Fail status. Then, continue testing with the next test.
- Rerun** Restart the testing at the beginning of the first test.
- Abort** Quit testing. Abort all tests.

To begin a performance test sequence with a new DUT, click File and New Session. This allows you to reselect the DUT, the equipment list, and the performance test list.

**Figure 4-5 The Main Test and Results Window**



wk761a

13. When the software has run all of the selected performance tests, the status bar indicates that the tests are completed (item 35).

## **Printing the Performance Test Results**

1. To print all the results of the entire test sequence, click File and Print.

## **Exiting the Support Software Program**

1. To exit the performance tests program, click File and Exit.

## 1. Internal FM Accuracy and Distortion

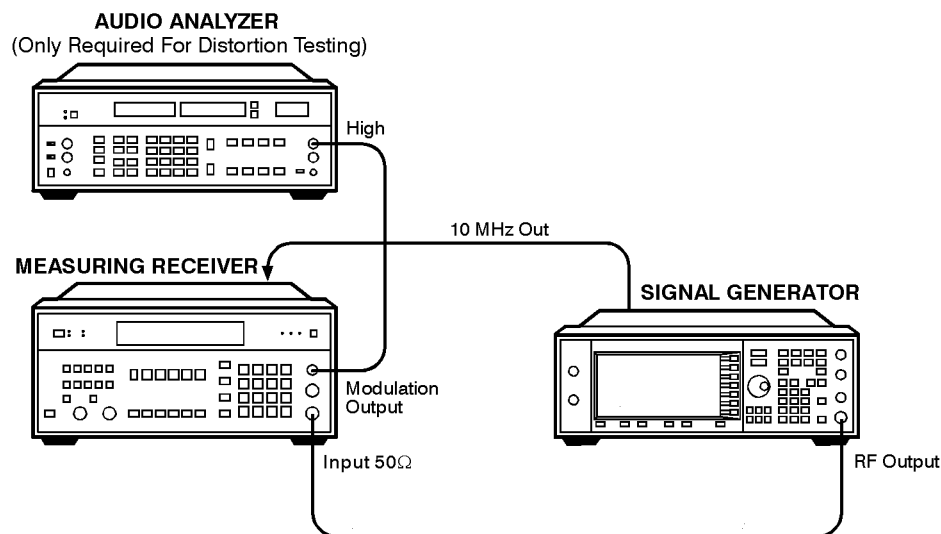
These automated tests verify the FM accuracy and distortion specifications. Accuracy is verified directly with a measuring receiver, and distortion is verified by measuring the demodulated output of the measuring receiver, using the audio analyzer. The audio analyzer provides a more accurate verification with better resolution, as opposed to the measuring receiver alone.

### Recommended Equipment

- HP/Agilent 8902A Measuring Receiver Option 010
- HP/Agilent 8903B Audio Analyzer

### Equipment Setup

**Figure 4-6** Internal FM Accuracy and Distortion Tests Setup



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## 2. Internal AM Accuracy and Distortion

These automated tests verify the AM accuracy and distortion specifications.

For frequencies at or below 1300 MHz, accuracy is verified directly with a measuring receiver, and distortion is verified by measuring the demodulated output from the measuring receiver with an audio analyzer. The audio analyzer provides a more accurate verification with better resolution than using the measuring receiver alone.

For frequencies above 1300 MHz, the RF output from the signal generator is mixed with the output from another signal generator (local oscillator) to produce a suitable input frequency for the measuring receiver.

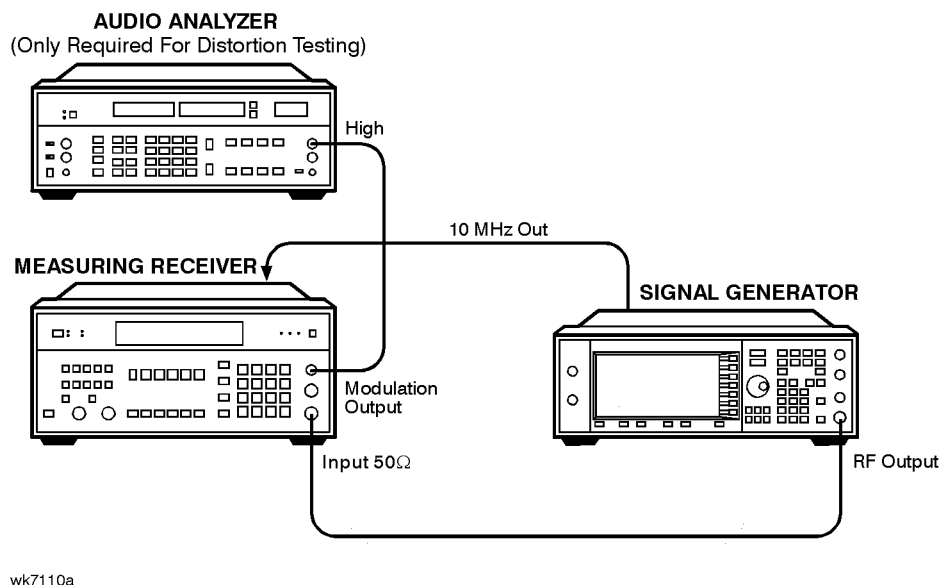
For a frequency of 4 GHz, verification is accomplished by covering two different frequency spans through the use of two mixers.

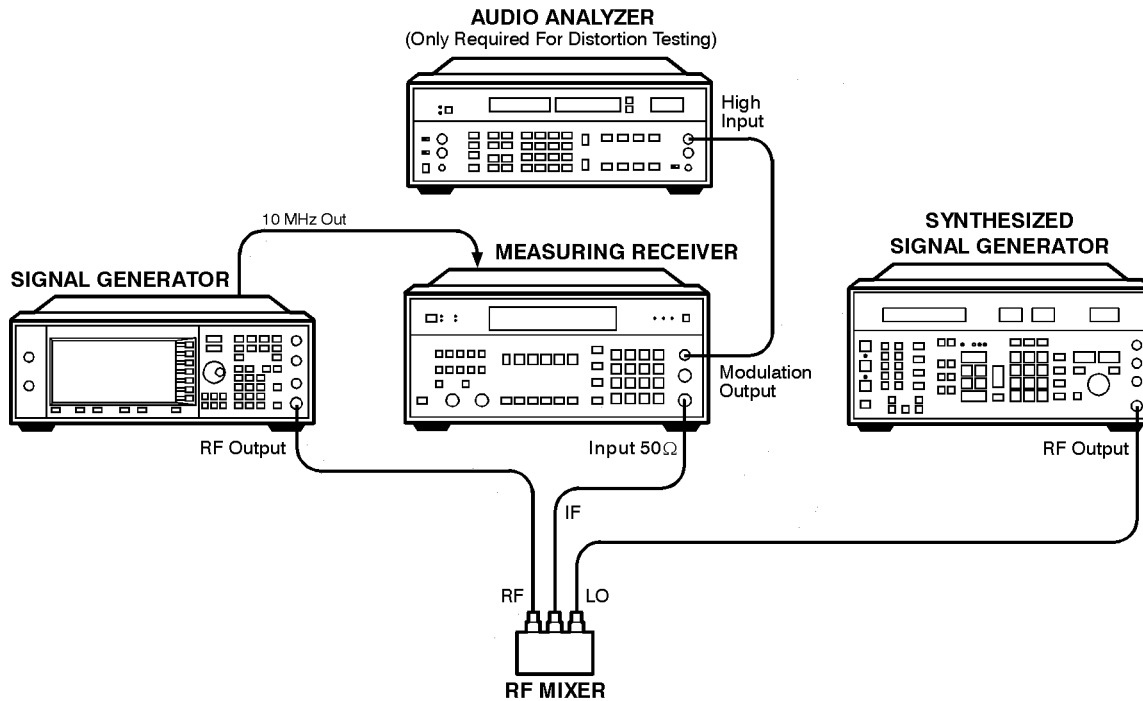
### Recommended Equipment

- HP/Agilent 8902A Measuring Receiver Option 010
- HP/Agilent 8903B Audio Analyzer
- HP/Agilent 8663A Signal Generator
- MD/MDC-174 Mixer (1 to 2800 MHz)
- MD/MDC-164 Mixer (0.5 to 9 GHz)

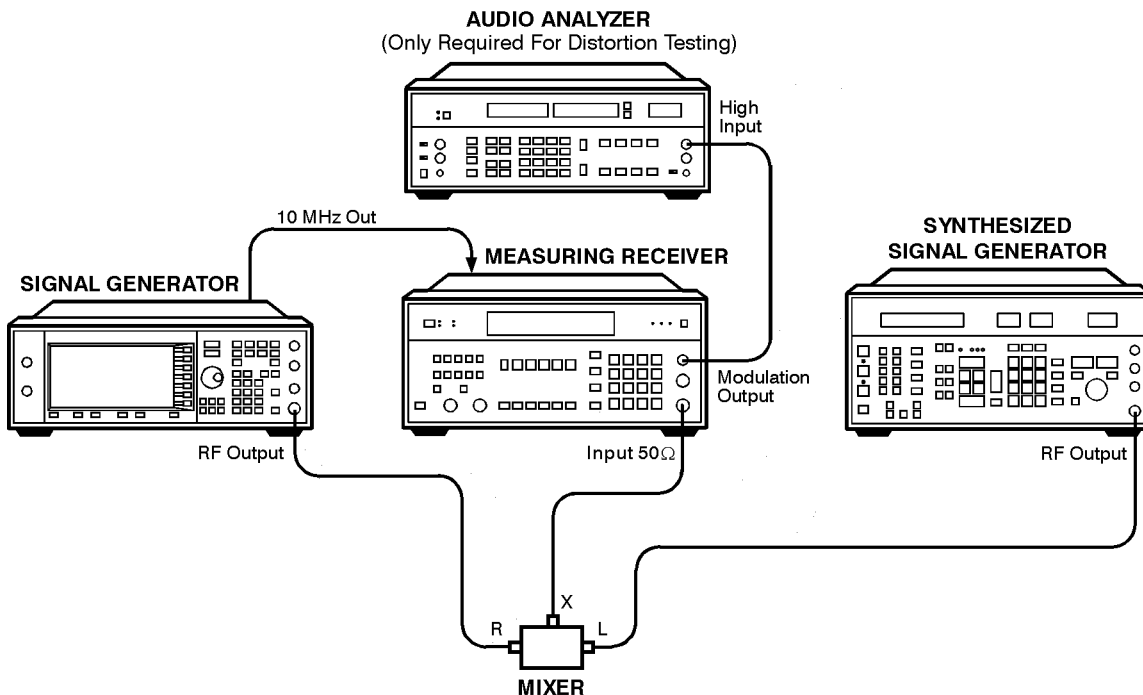
### Equipment Setups

**Figure 4-7 Accuracy and Distortion for AM  $\leq 1300$  MHz Test Setup**



**Figure 4-8 Accuracy and Distortion for AM > 1300 MHz and  $\leq 2500$  MHz Test Setup**

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**Figure 4-9 Accuracy and Distortion for AM > 2500 MHz Test Setup**

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### 3. Phase Modulation Accuracy and Distortion

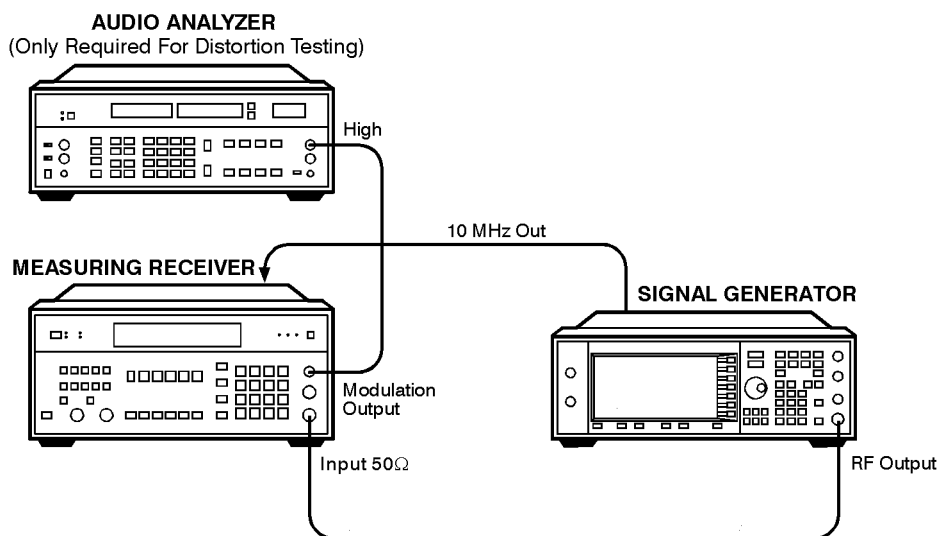
These automated tests verify the phase modulation accuracy and distortion specifications. Accuracy is verified directly with a measuring receiver, and distortion is verified by measuring the demodulated output from the measuring receiver, using the audio analyzer. The audio analyzer provides a more accurate verification with better resolution than using the measuring receiver alone.

#### Recommended Equipment

- HP/Agilent 8902A Measuring Receiver Option 010
- HP/Agilent 8903B Audio Analyzer

#### Equipment Setup

**Figure 4-10 Accuracy & Distortion for Phase Modulation Tests Setup**



wk7110a

## 4. FM Frequency Response

This automated test verifies the FM frequency response specifications. The equipment measures the variations in frequency deviations due to changes in the applied FM rate; dc to 100 kHz. The variations are expressed relative to a reference signal; 1 kHz rate set at 100 kHz deviation, in dB. Each frequency is tested with this sequence:

1. A reference signal is measured.
2. The set deviation is measured for each applied rate change.
3. Each deviation measurement is compared to the reference signal deviation.

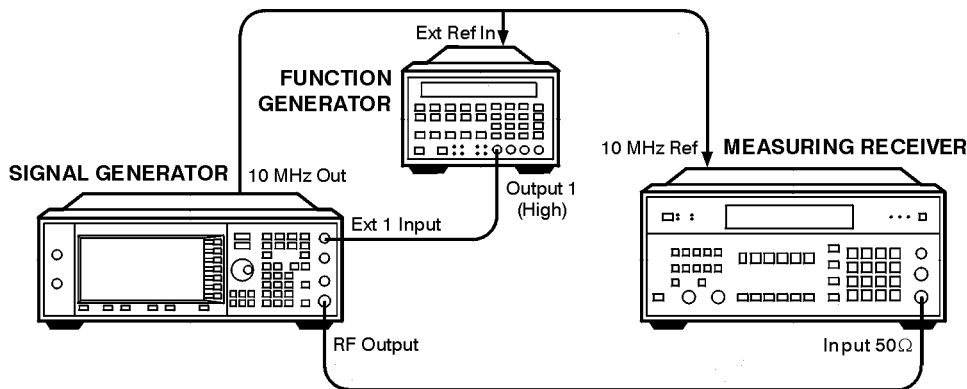
The comparison is a calculation of the difference in the deviations relative to the reference rate. The relative value is the FM frequency response.

### Recommended Equipment

- HP/Agilent 8902A Measuring Receiver Option 010
- HP/Agilent 8904A Function Generator

### Equipment Setup

Figure 4-11 FM Frequency Response Tests Setup



wk7113a

## 5. AM Frequency Response

This automated test verifies the AM frequency response specifications. The equipment measures the variations in modulation depth due to changes in the applied AM rate; dc to 10 kHz. The response is relative to a 1 kHz rate set at the test depth, and expressed in dB. Each frequency is tested with the following sequence:

1. A reference signal is measured.
2. The set depth is measured for each applied rate change.
3. Each depth measurement is compared to the reference signal depth.

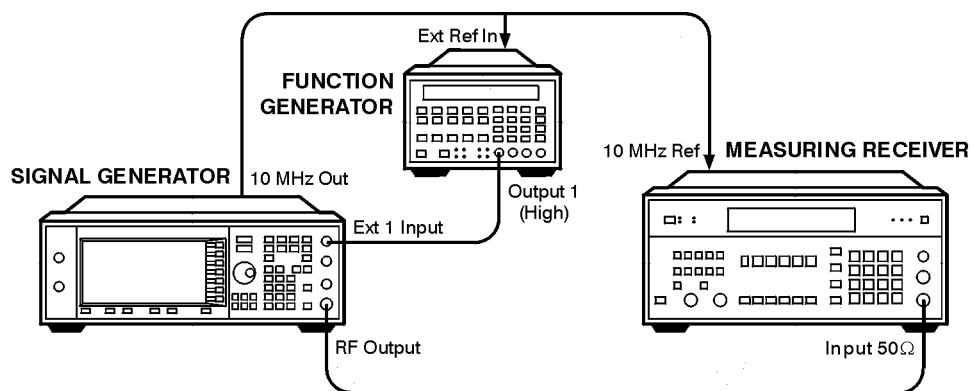
The comparison is a calculation of the difference in the depths relative to the reference rate. The relative value is the AM Frequency Response.

### Recommended Equipment

- HP/Agilent 8902A Measuring Receiver Option 010
- HP/Agilent 8904A Function Generator
- HP/Agilent 8663A Signal Generator
- MD/MDC-164 Mixer (0.5 to 9 GHz)

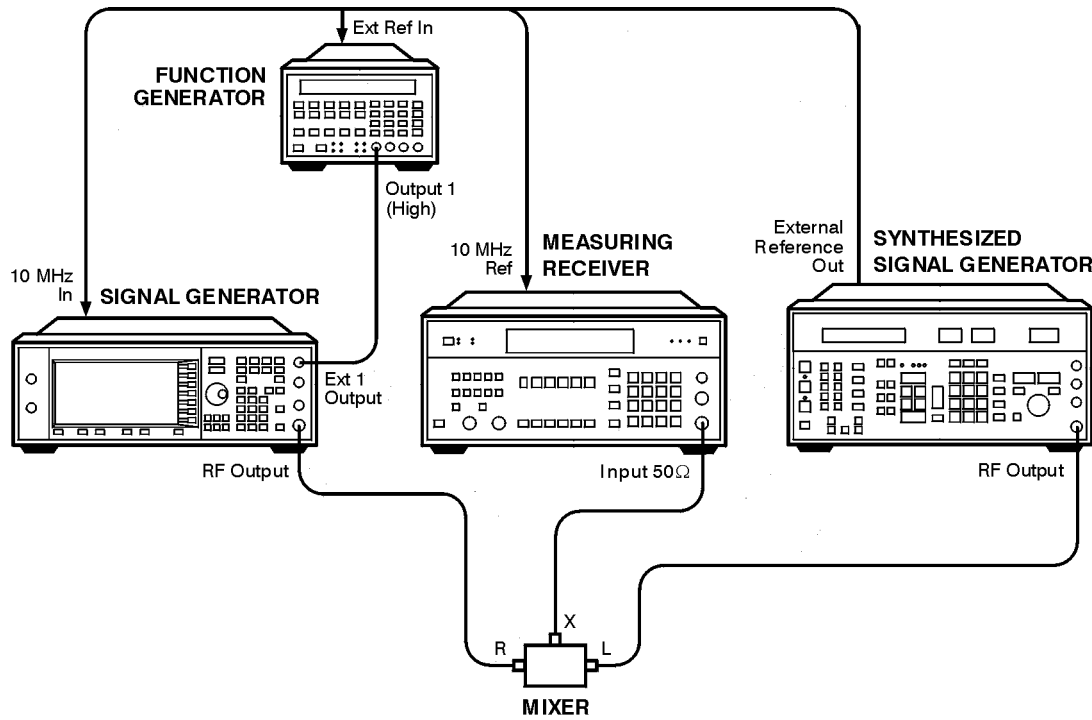
### Equipment Setups

**Figure 4-12 Frequency Response for AM  $\leq 1300$  MHz Test Setup**



wk7113a



**Figure 4-13 Frequency Response for AM > 1300 MHz Test Setup**

wk7114a

## 6. Phase Modulation Frequency Response

### 6. Phase Modulation Frequency Response

This automated test verifies the phase modulation frequency response specifications. The equipment measures the variations in phase deviations due to changes in the applied  $\Phi$ M rate; dc to 100 kHz. The response is relative to a 1 kHz reference at the same phase deviation, and expressed in dB. Each frequency is tested with the following sequence:

1. A reference signal is measured.
2. The set deviation is measured for each applied rate change.
3. Each deviation measurement is compared to the reference signal deviation.

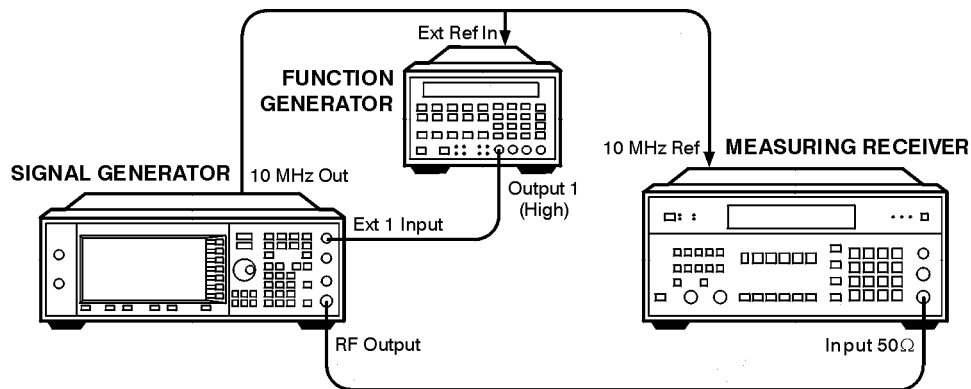
The comparison is a calculation of the difference in the deviations relative to the reference rate. The relative value is the  $\Phi$ M frequency response.

### Recommended Equipment

- HP/Agilent 8902A Measuring Receiver Option 010
- HP/Agilent 8904A Function Generator

### Equipment Setup

**Figure 4-14 Phase Modulation Frequency Response Test Setup**



wk7113a

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## 7. DCFM Frequency Offset Relative to CW

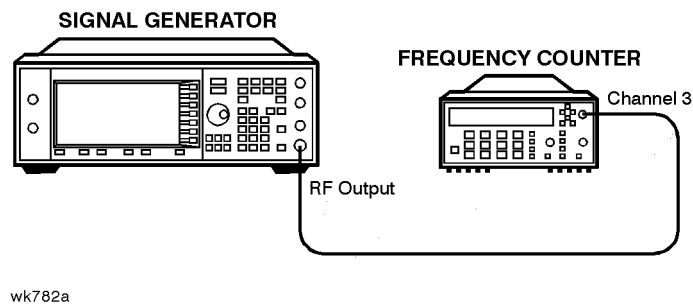
This automated test verifies the carrier frequency offset, relative to CW. The equipment measures the RF output frequency. For each test point, a comparison is made between a CW reference frequency without DCFM selected, and then with the DCFM selected; the difference is the carrier frequency offset.

### Recommended Equipment

- HP/Agilent 53132A Frequency Counter Option 050

### Equipment Setup

**Figure 4-15 DCFM Frequency Offset Test Setup**



## 8. Residual FM (ESG-A and ESG-D only)

## 8. Residual FM (ESG-A and ESG-D only)

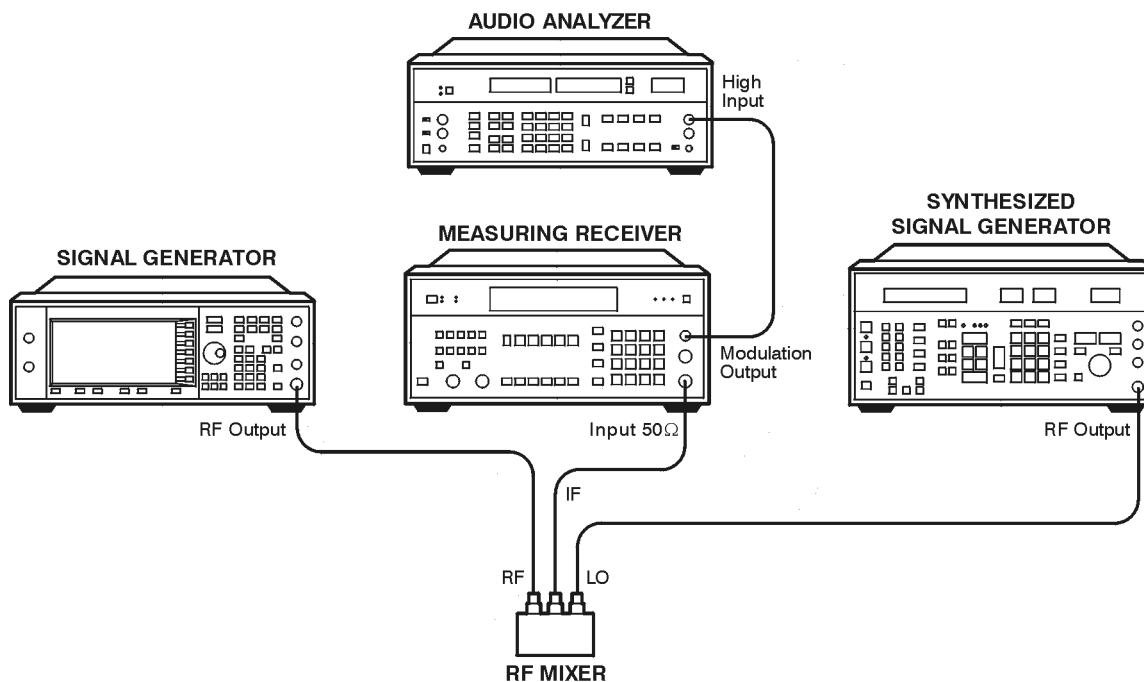
This automated test verifies the residual frequency modulation (FM) specification. The signal generator's RF output signal is mixed with a signal from a low noise external LO. The resultant IF signal is demodulated as it passes through the measuring receiver, bypassing the measuring receiver's internal mixer which is inherently more noisy. Then the audio analyzer measures the demodulated audio signal for an RMS voltage. The measurement is scaled and displayed as RMS mV, but read as residual FM in Hz.

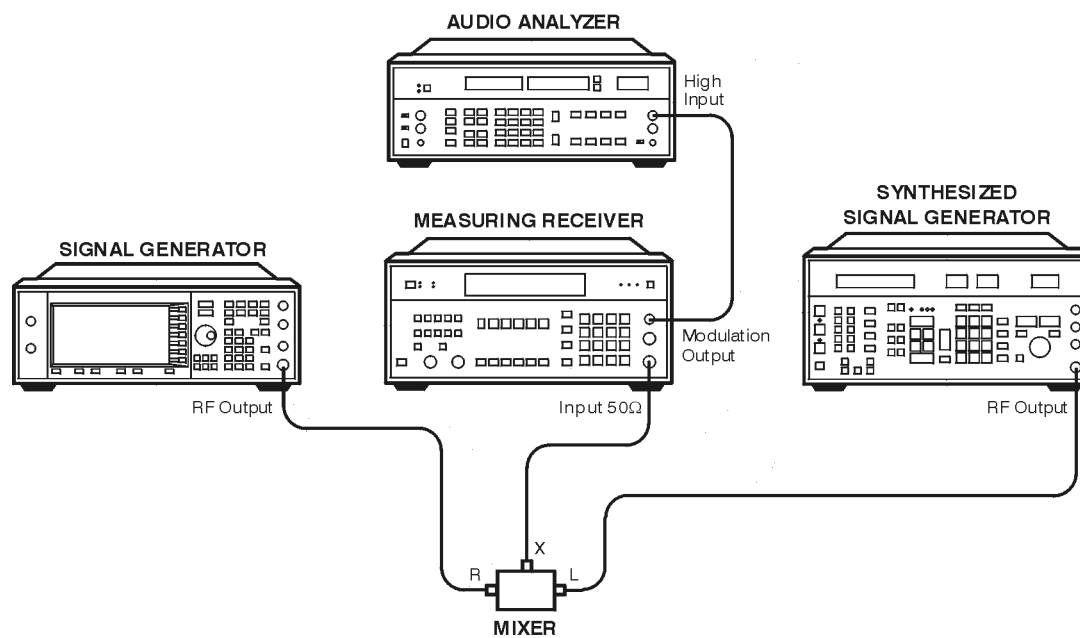
### Recommended Equipment

- HP/Agilent 8902A Measuring Receiver Option 010
- HP/Agilent 8903B Audio Analyzer Options 051, 010
- HP/Agilent 8663A Signal Generator
- MD/MDC-174 Mixer (1 to 2800 MHz)
- MD/MDC-164 Mixer (0.5 to 9 GHz)

### Equipment Setups

**Figure 4-16 Residual FM  $\leq 2500$  MHz Test Setup**



**Figure 4-17 Residual FM > 2500 MHz Test Setup**

wk7117a

## 9. Harmonic, Subharmonic, and Nonharmonic Spurious Signals

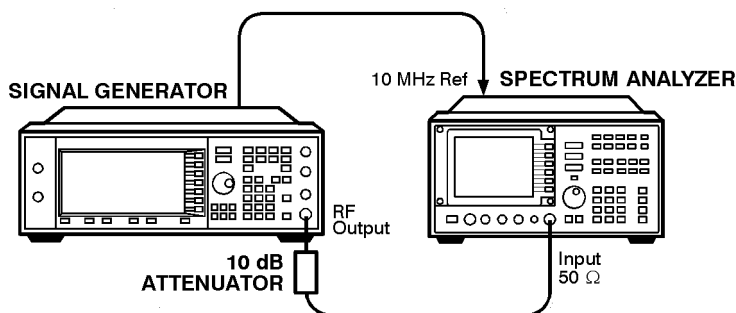
These automated tests verify that the harmonic, subharmonic, and nonharmonic spurious signals are within specifications. The signal generator's output signal is set to values where harmonic and spurious signal performance problems are most likely to occur. Then the spectrum analyzer checks the level of the various harmonic and spurious signals and compares each measurement to a signal of known frequency and amplitude.

### Recommended Equipment

- HP/Agilent 8563E Spectrum Analyzer
- HP/Agilent 8491A/B Attenuator (10 dB) Option 010

### Equipment Setup

**Figure 4-18** Harmonic, Subharmonic, and Nonharmonic Spurious Signals Tests Setup



wk7118a

---

## 10. Power Level Accuracy

A power meter is used to verify performance over the +13 to –15 dBm range. The absolute power level measured at –10 dBm is used as a reference for all lower level measurements.

For power levels below –15 dBm, a vector signal analyzer is used to make relative power measurements. A low noise amplifier (LNA) and step attenuator are connected in series to control the absolute power level input to the signal analyzer. For power level settings  $\geq -60$  dBm, the step attenuator is set to approximately cancel the gain of the LNA. Below –60 dBm, the step attenuator is set to 0 dB, which keeps the signal level well above the signal analyzer's noise floor.

Relative measurements are accomplished by setting the DUT amplitude. For example:

Set the DUT to a specific frequency, and an amplitude of –10 dBm. For the purpose of this example, assume the power meter measures –10.1 dBm at these settings. The signal analyzer does a peak search, sets the reference level, and sets the marker to delta mode (0 dB). The DUT amplitude then changes to –20 dBm, and the signal analyzer makes a relative power measurement (assume it to be –10.15 dB). The absolute power measured is  $-10.1 \text{ dBm} + (-10.15 \text{ dB})$ , or –20.25 dBm.

To determine power level accuracy below –60 dBm, the signal analyzer makes the 0 dB marker delta measurement with the amplitude set to –60 dBm, and all lower level measurements are made relative to this reference. The previously measured error for the –60 dBm setting is then accounted for in the measurement.

For frequencies above 2 GHz, an HP/Agilent 8563E signal analyzer is used to downconvert the frequency to 321.4 MHz.

### Recommended Equipment

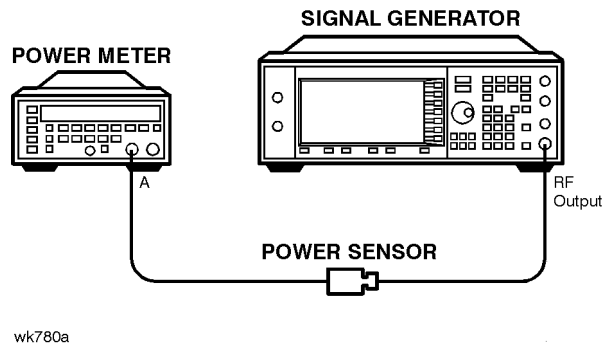
- HP/Agilent 438A Power Meter
- HP/Agilent 8482A Power Sensor
- HP/Agilent 89441A Vector Signal Analyzer
- HP/Agilent 8563E Option 001 Signal Analyzer
- HP/Agilent 8491A/B Option 006 Attenuator (6 dB)
- HP/Agilent 8495G Programmable Step Attenuator (0 to 70 dB)
- HP/Agilent 11713A Step Attenuator Driver

See [page 1-4](#) for Details on the following:

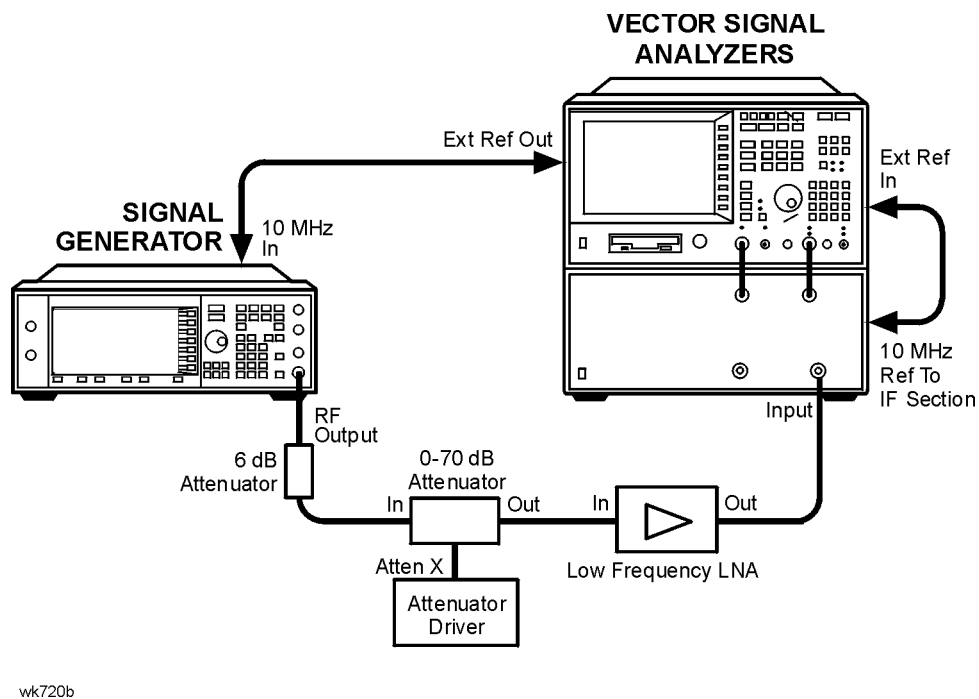
- Low Frequency Noise Amplifier (LNA)
- High Frequency Low Noise Amplifier (LNA)

## Equipment Setups

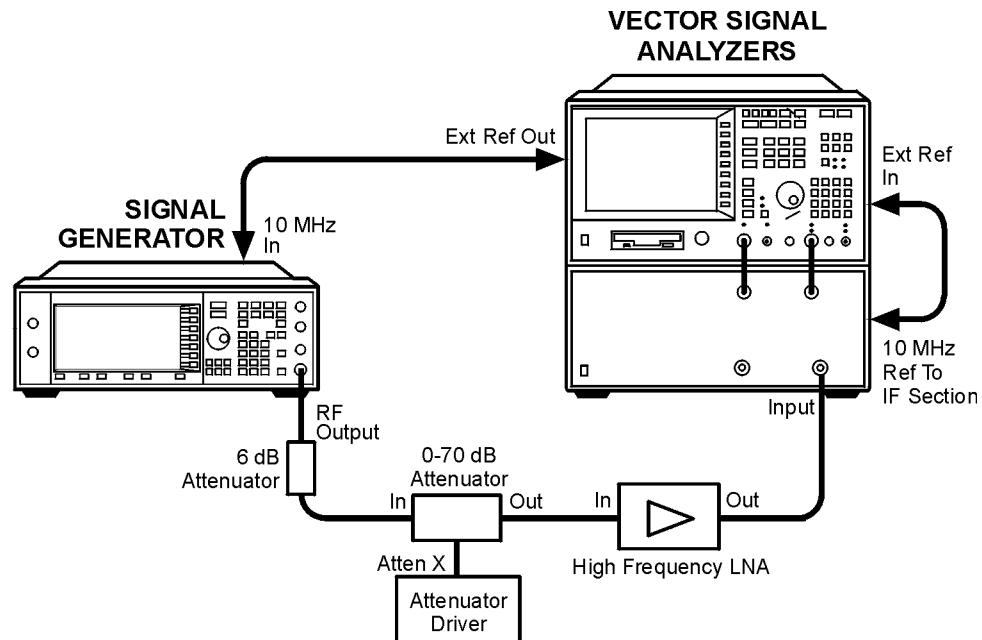
**Figure 4-19 High-Power, Power Level Accuracy Setup**



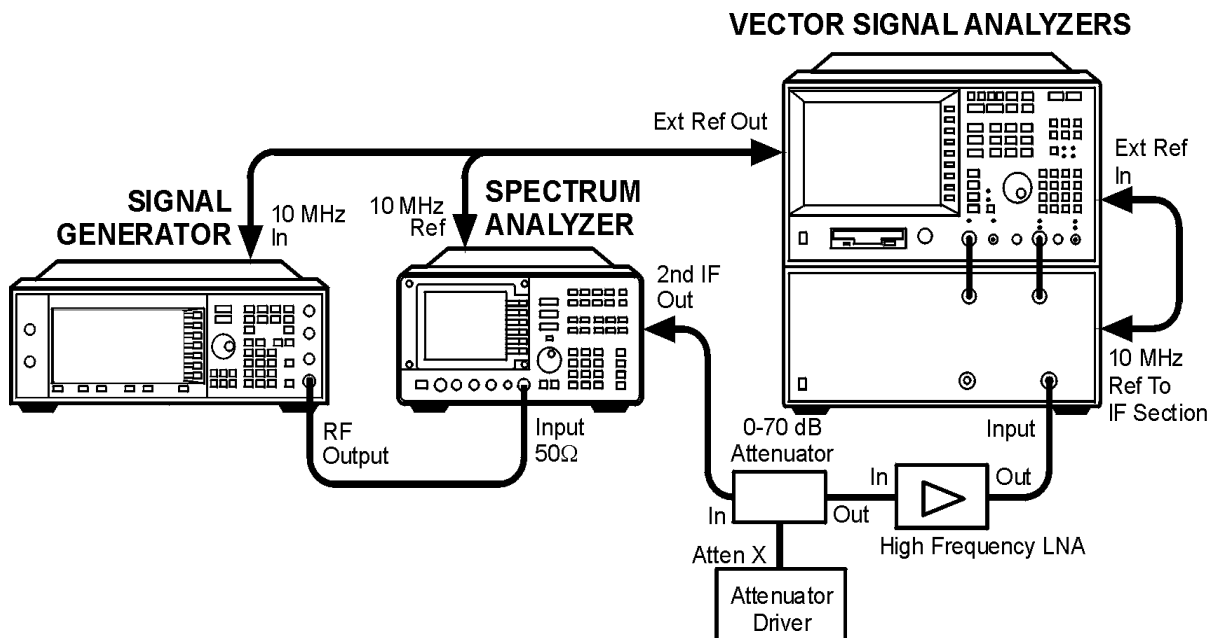
**Figure 4-20 Low-Power, Power Level Accuracy (< 10 MHz) Setup**





**Figure 4-21 Low-Power, Power Level Accuracy ( $\geq 10$  MHz and  $\leq 2$  GHz) Setup**

wk713b

**Figure 4-22 Low-Power, Power Level Accuracy ( $> 2$  GHz) Setup**

wk715b

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## 11. Timebase Aging Rate (ESG-AP, ESG-DP or Option 1E5 only)

This manual test verifies the accuracy of the signal generator's internal timebase. The time required for a 360° phase change is measured both before and after a specified waiting period. The aging rate is inversely proportional to the absolute value of the difference in the measured times. The results of this test can be recorded on the test record provided on [page 4-48](#).

The overall accuracy of the internal timebase is a function of:

TBC  $\pm$ AR  $\pm$ TE  $\pm$ LE where:

TBC = timebase calibration

AR = aging rate

TE = temperature effects

LE = line effects

After the timebase is adjusted, the timebase frequency should stay within the aging rate for the following situations:

- The timebase oven does not cool down.
- The instrument keeps the same orientation, with respect to the earth's magnetic field.
- The instrument stays at the same altitude.
- The instrument does not receive any mechanical shock.

If the timebase oven cools (the instrument power switch is set to off), you may have to readjust the timebase frequency after a new warm-up cycle. Typically, however, the timebase frequency returns to within  $\pm 1$  Hz of the original frequency.

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NOTE	The internal timebase can be tested after the AC power is reconnected for 10 minutes. For best accuracy, retest after the instrument has been on for 24 hours.
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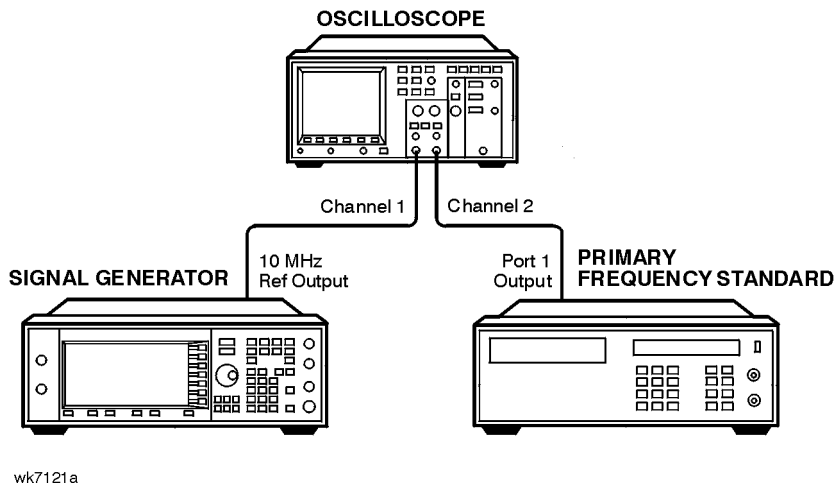
Frequency changes due to either a change in orientation, with respect to the earth's magnetic field, or to a change in altitude usually go away when the instrument is returned to its original position. A frequency change due to mechanical shock usually appears as a fixed frequency error.

### Recommended Equipment

- HP/Agilent 54610B Digital Oscilloscope
- HP/Agilent 5071A Primary Frequency Standard

## Equipment Setup

**Figure 4-23 Timebase Aging Rate Test Setup**



## Procedure

1. Preset all instruments and let them warm up for at least one hour.
2. If the oscilloscope does not have a 50 $\Omega$  input impedance, connect channel 1 through a 50 $\Omega$  feedthrough.
3. On the oscilloscope, adjust the external triggering for a display of the 10 MHz REF OUTPUT signal from the synthesizer.
  - a. On Channel 1 of the oscilloscope, set the following:
    - Display: On
    - Volts/Division: 500 mV
    - Input Coupling: dc
    - Input Impedance: 50 ohms (or use a 50 ohm feedthrough)
  - b. On Channel 2 of the oscilloscope, set the following:
    - Display: Off
    - Input Coupling: dc
    - Input Impedance: 50 ohms (or use a 50 ohm feedthrough)
  - c. On the Timebase of the oscilloscope, set the following:
    - Time/Division: 5 ns
  - d. On the Trigger of the oscilloscope, set the following:
    - Trigger Source: CH 2
    - Trigger Mode: Normal
    - Trigger Level: 0 V

## 11. Timebase Aging Rate (ESG-AP, ESG-DP or Option 1E5 only)

4. If the signal drifts a full cycle (360°) in less than 2 minutes, refer to [Chapter 5, “Adjustments,”](#) and perform the “Internal Reference Oscillator Adjustment.” After the adjustment, restart this performance test.
5. Watch the oscilloscope display and monitor the time. Notice the time required for a 360° phase change and record this time as T1.
6. Wait 3 to 24 hours. Record the time that you waited as T2.
7. Repeat steps 1 through 6. Notice the time required for a 360° phase change and record this time as T3.

8. Calculate the aging rate as follows:

$$\text{Aging Rate} = (1 \text{ cycle}/10 \text{ MHz}) (1/T1 - 1/T3) (24 \text{ hours}/T2)$$

Example:

$$T1 = 351 \text{ seconds}$$

$$T2 = 3 \text{ hours}$$

$$T3 = 349 \text{ seconds}$$

$$= (1 \text{ cycle}/10 \text{ MHz}) (1/351\text{s} - 1/349\text{s}) (24\text{h}/3\text{h})(1.306 \times 10^{-11} \text{ per day})$$

9. Write the test results on the performance test record located at the end of this chapter. Compare the results to the limits in the test record.

---

<b>NOTE</b>	If the absolute frequency of the standard and the timebase oscillator are extremely close, you can reduce the measurement time (T1 and T3) by measuring the time required for a phase change of less than 360°. In step 4, change 1 cycle to 0.5 cycle for 180°, or 0.25 cycle for 90°.
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## 12. Digital Modulation Level Accuracy

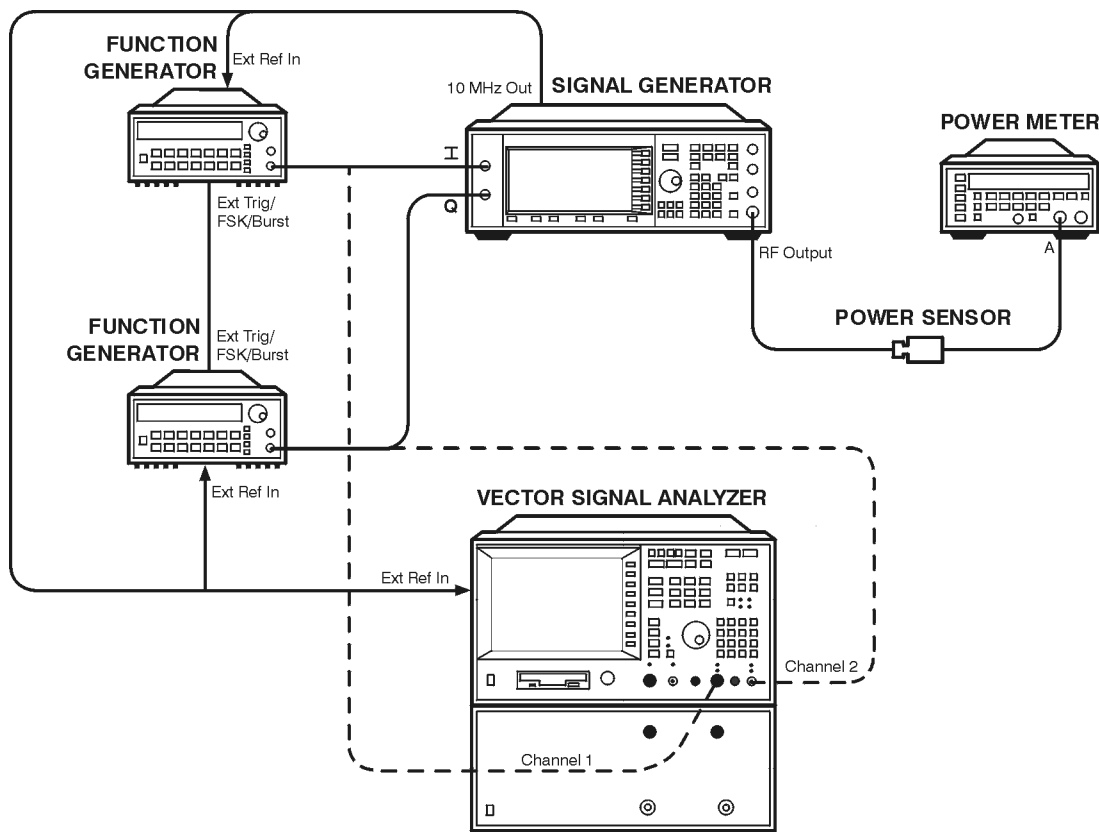
This automated test verifies the level accuracy of the signal generator's I and Q modulation inputs. Two arbitrary waveform generators provide the I and Q modulation inputs to the signal generator. A power meter measures the RF output power with and without QPSK modulation applied to the signal generator. The difference in power measurements is the level accuracy. The QPSK modulation is loaded into the two arbitrary waveform generators from a data file in the performance tests software. The vector signal analyzer verifies the arbitrary waveform generator's outputs are properly scaled and synchronized before the relative power level accuracy is measured.

### Recommended Equipment

- HP/Agilent 438A Power Meter
- HP/Agilent 8482A Power Sensor
- HP/Agilent 33120A Option 001 Arbitrary Waveform Generator (2)
- HP/Agilent 89441A Options AY7, AY9, AYA, UFG or UTH Vector Signal Analyzer

### Equipment Setup

**Figure 4-24 Digital Modulation Level Accuracy Test Setup**



## 13. Internal Digital Modulation Quality

**NOTE** This test is only required for instruments with UN3, UN4, or UN8.

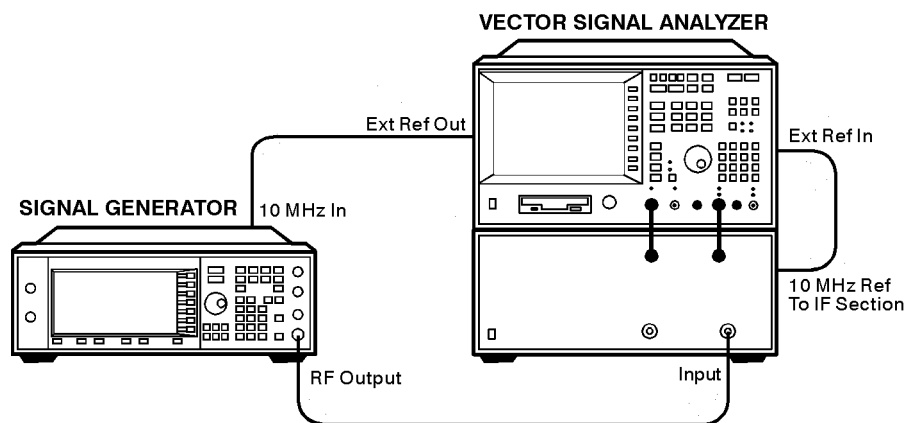
This automated test verifies the RF modulation quality of the signal generator's internal I/Q modulation. A vector signal analyzer is connected to the signal generator's RF output. The internal baseband generator modulates the RF carrier in each of the available digital modulation formats. The vector signal analyzer measures the appropriate error parameter for the modulation generated (EVM for PHS, PDC and NADC formats; global phase error for GSM format).

### Recommended Equipment

- HP/Agilent 89441A Options AYA, AY9, UFG or UTH Vector Signal Analyzer

### Equipment Setup

**Figure 4-25 Internal Digital Modulation Quality Test Setup**



wk7122a

## 14. Custom I/Q RF Modulation Quality (Option UN8 only)

This automated test verifies the RF modulation quality of the Option UN8 signal generator's internal real time I/Q baseband modulation. A vector signal analyzer is connected to the signal generator's RF output. The Option UN8 internal baseband generator modulates the RF carrier in each of the TDMA digital modulation formats. The parameters of the individual TDMA formats common to Options UN3, UN4 and UN8 are tested elsewhere. The vector signal analyzer measures the appropriate error parameter for the modulation generated:

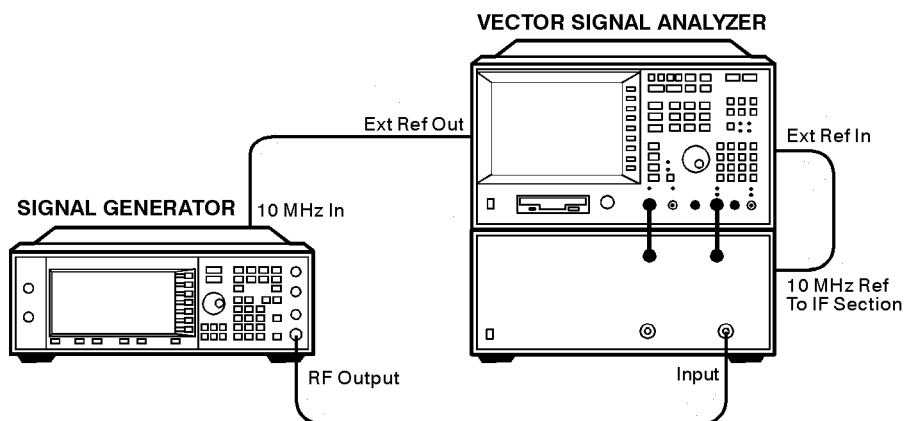
- EVM for QPSK,  $\pi/4$ DQPSK, and QAM16
- Phase error for MSK
- Frequency Shift Error (%) for FSK2

### Recommended Equipment

- MD/MDC-174 Mixer (0.001 to 2.8 GHz)
- HP/Agilent 8663A Signal Generator
- HP/Agilent 89441A Options AY9, AYA, AYH, UFG or UTH Vector Signal Analyzer

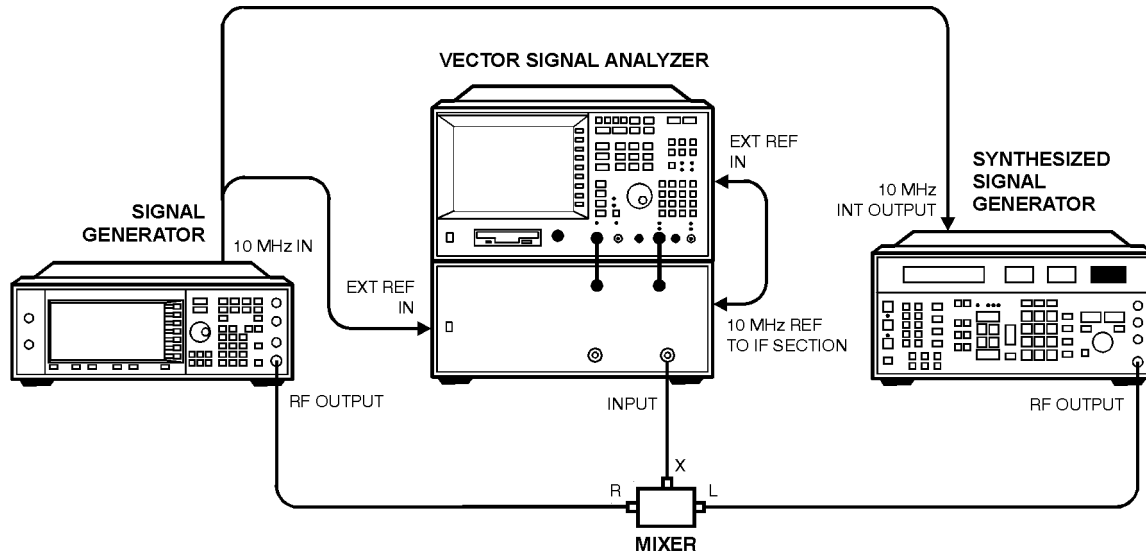
### Equipment Setups

**Figure 4-26 Custom I/Q RF Modulation Quality  $\leq 2000$  MHz Test Setup**



wk7122a

## 14. Custom I/Q RF Modulation Quality (Option UN8 only)

**Figure 4-27 Custom I/Q RF Modulation Quality > 2000 MHz Test Setup**

wk77b

**Procedure**

1. Connect the equipment as shown in [Figure 4-26](#) on page 4-29.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.



## 15. I/Q Modulation Quality (Options UN3, UN4 & UN8)

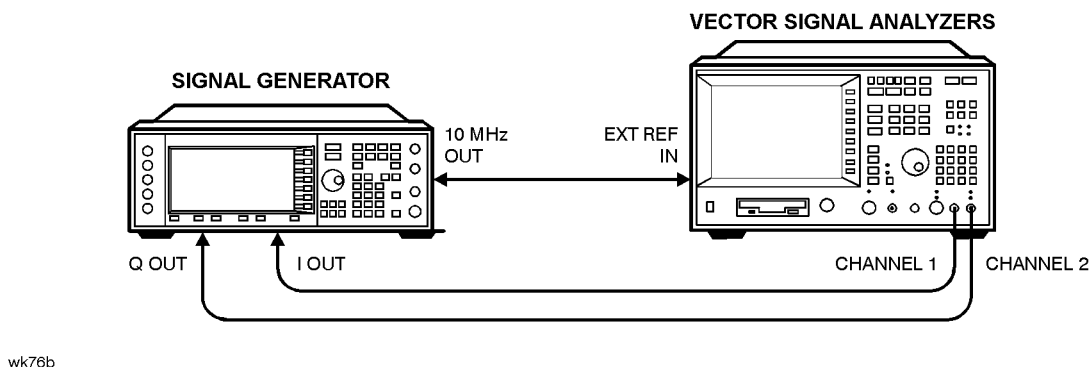
This test measures the accuracy of the rear-panel I and Q output signals created by the internal baseband generator in Option UN3, UN4, or UN8 signal generators. The vector signal analyzer is configured to measure the I and Q baseband signals and demodulate each modulation type separately.

### Recommended Equipment

- HP/Agilent 89441A Vector Signal Analyzer

### Equipment Setup

Figure 4-28 I/Q Modulation Quality Test Setup (Options UN3, UN4, & UN8)



### Procedure

1. Connect the equipment as shown in [Figure 4-28](#).
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

## 16. Pulse Modulation On/Off Ratio

This automated test verifies the pulse modulation on/off ratio. The signal generator is configured for an external pulse input. The spectrum analyzer measures the RF output power with and without the external pulse applied. The power difference is the on/off ratio.

---

**NOTE** This test does *not* test the high performance pulse circuitry used in Option 1E6 instruments. See “20. Pulse Rise/Fall Time (Option 1E6 only)” on page 4-36.

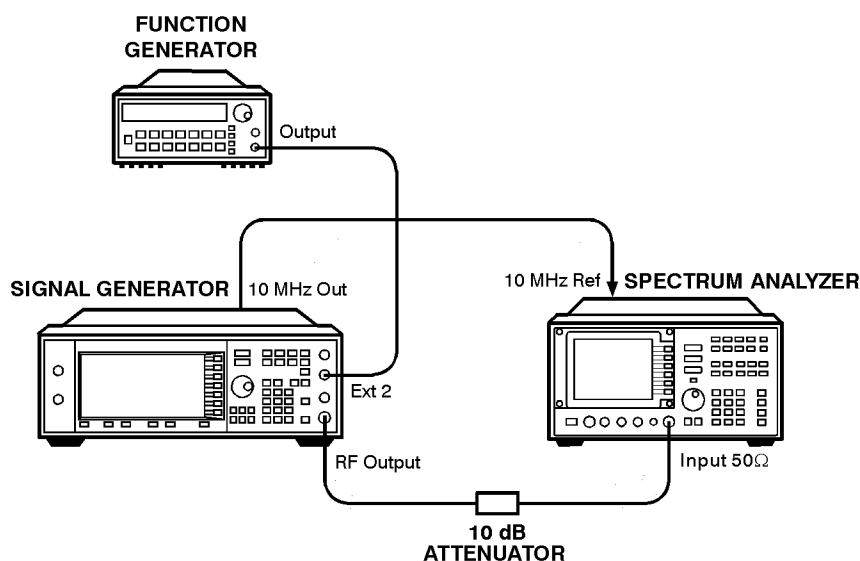
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### Recommended Equipment

- HP/Agilent 8563E Spectrum Analyzer
- HP/Agilent 8491A/B Option 010 Attenuator (10 dB)
- HP/Agilent 33120A Arbitrary Waveform Generator

### Equipment Setup

**Figure 4-29 Pulse Modulation On/Off Ratio Test Setup**



wk7123a

## 17. Burst Modulation On/Off Ratio (ESG-D only)

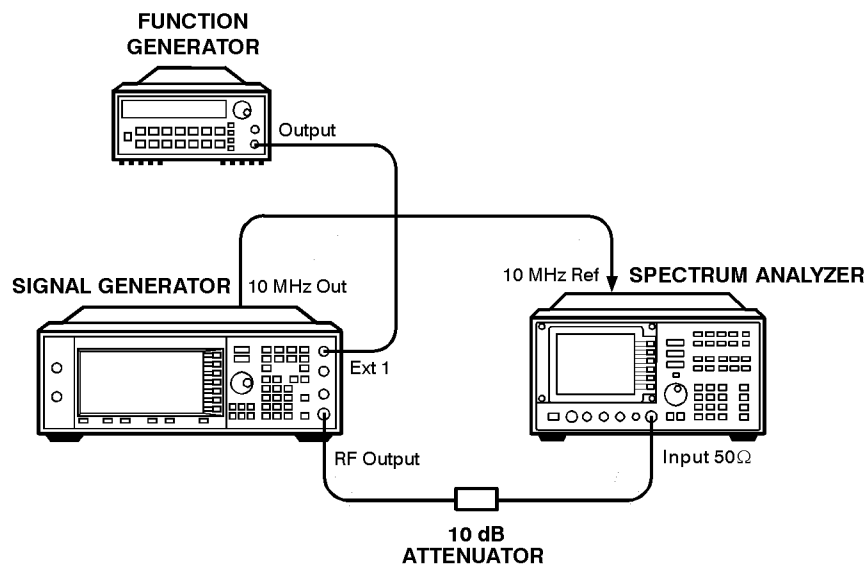
This automated test verifies the burst modulation on/off ratio. The signal generator is configured for an external burst input. The spectrum analyzer measures the RF output power with and without the external burst applied. The power difference is the on/off ratio.

### Recommended Equipment

- HP/Agilent 8563E Spectrum Analyzer
- HP/Agilent 8491A/B Option 010 Attenuator (10 dB)
- HP/Agilent 33120A Arbitrary Waveform Generator

### Equipment Setup

Figure 4-30 Burst Modulation On/Off Ratio Test Setup



wk7124a

**18. CDMA Adjacent Channel Power (Option UN5 only)**

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## 18. CDMA Adjacent Channel Power (Option UN5 only)

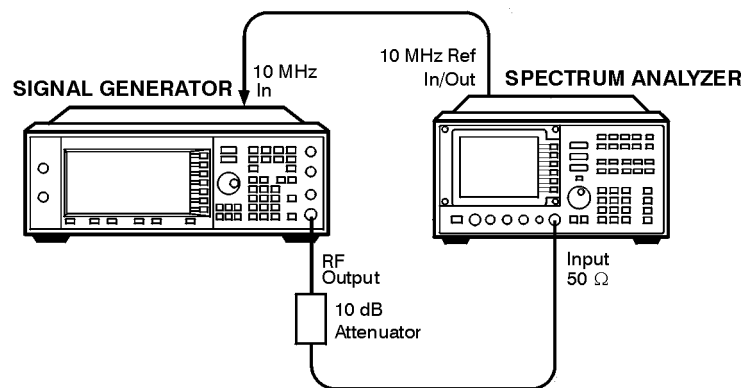
This automated test verifies the energy at an offset to the main channel relative to the total energy in the main channel. Post-processing averaging techniques are used to improve repeatability.

### Recommended Equipment

- HP/Agilent 8563E Spectrum Analyzer
- HP/Agilent 8491A/B Option 010 Attenuator (10 dB)

### Equipment Setup

**Figure 4-31 Adjacent Channel Power Test Setup (Option UN5)**



hk73b

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## 19. Alternate Timeslot Power Settling Time (Option UNA only)

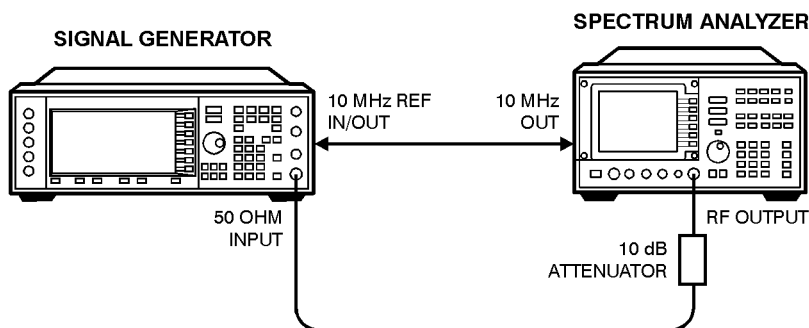
This test measures the time required for a waveform envelope to settle within the tolerance of its final amplitude after a sharp amplitude transition provided by the Alternate Timeslot Power feature (Option UNA). Settling time is the result of heating and cooling effects in the step attenuator and ALC loop. The rise and fall response times of the ALC loop and each attenuator segment is characterized and combined to construct the settling curve for any arbitrary transition.

### Recommended Equipment

- HP/Agilent 8563E Option 007 Spectrum Analyzer
- HP/Agilent 8491A/B Option 010 Attenuator (10 dB)

### Equipment Setup

**Figure 4-32** Alternate Timeslot Power Settling Time Test Setup (Option UNA)



wk73b

### Procedure

1. Connect the equipment as shown in [Figure 4-32](#).
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

**20. Pulse Rise/Fall Time (Option 1E6 only)**

---

## 20. Pulse Rise/Fall Time (Option 1E6 only)

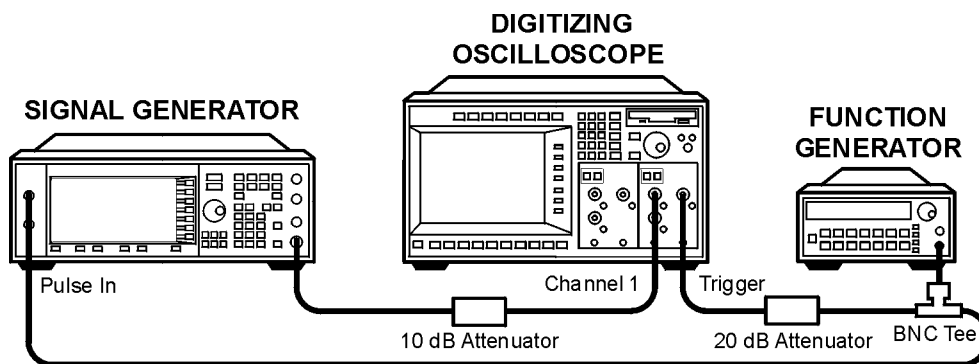
This test checks the rise/fall time performance of the RF carrier when pulse modulated by way of the PULSE IN path. The oscilloscope captures the rising or falling edge of the RF pulse envelope, and calculations are made from the digitized data. Transition time calculated is for the 10% to 90% portion of the envelope.

### Recommended Equipment

- HP/Agilent 54750A Digitizing Oscilloscope
- HP/Agilent 54751A or 54752A Plug-in
- HP/Agilent 33120A Function Generator
- HP/Agilent 8491A/B Opt 010 Attenuator (10 dB)
- HP/Agilent 8491A/B Opt 020 Attenuator (20 dB)

### Equipment Setup

**Figure 4-33 Pulse Rise/Fall Time Setup (Option 1E6)**



wk717b

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## 21. Measuring Phase Noise and Residual FM (ESG-AP and ESG-DP Series Signal Generators)

The signal generator's automated performance tests do not include a test for either phase noise or residual FM. These tests must be done separately and the results attached to the test results obtained with the performance test software. Either output a plot for each measured frequency, or copy the data onto the test record provided on [page 4-48](#).

Measure phase noise and residual FM on an HP/Agilent E5500 system or its equivalent, at 0.5, 1, 2, 3, and 4 GHz as applicable to the model under test.

### Measuring Phase Noise

Because of the excellent phase noise performance of ESG-P series signal generators, a special procedure and extensive equipment is required. The recommended method is to use an HP/Agilent E5500 series phase noise measurement system. This system is recommended over the older HP/Agilent 3048 system due to speed issues and the fact that the older system can not directly measure residual FM. Most of the rest of this discussion refers to the E5500 system, although the principles apply to both.

The limitation of any measurement of phase noise is that the resulting measurement can never be better than the phase noise of the source used to down-convert the signal. In an E5500 system this source is typically either an HP/Agilent 8644B or an HP/Agilent 8662A/63A. Both have advantages and disadvantages. The 8644B has better phase noise above 10 kHz from the carrier, while the 8662/3 has better close-in phase noise, but is worse above 10 kHz. Other sources may have different characteristics. To fully characterize a signal generator to a high degree of accuracy, both sources may be needed.

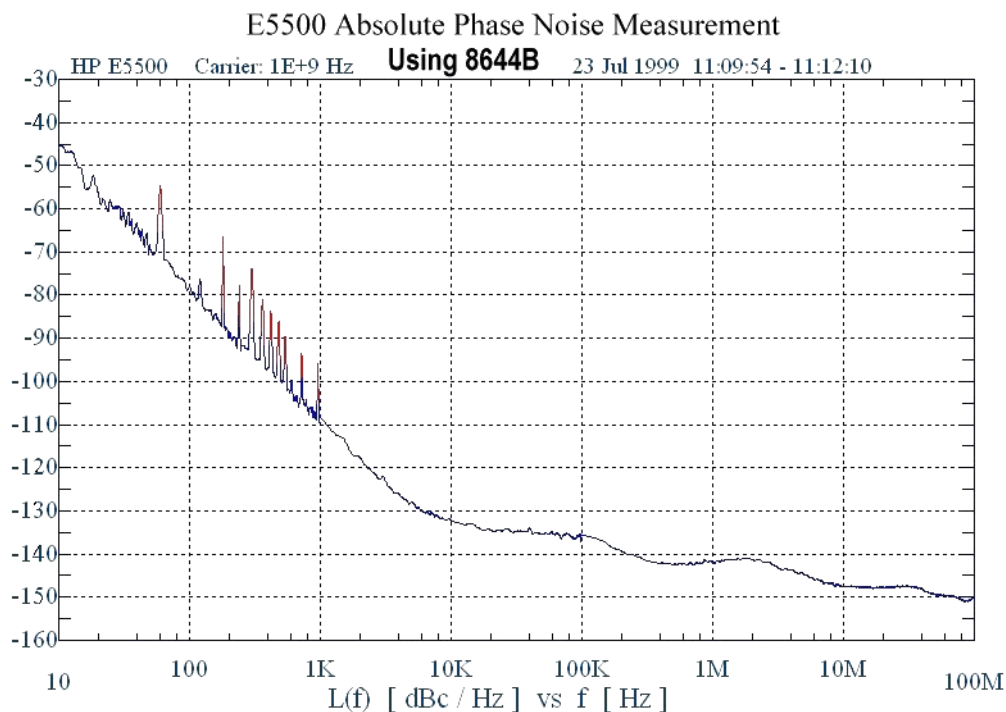
The following sections illustrate three different measurements of the same device under test (DUT):

- [“Using an HP/Agilent 8644B”](#) on page 4-38
- [“Using an HP/Agilent 8663A Synthesizer”](#) on page 4-39
- [“Using Electronic Frequency Locking \(EFC\)”](#) on page 4-40

## 21. Measuring Phase Noise and Residual FM (ESG-AP and ESG-DP Series Signal Generators)

**Using an HP/Agilent 8644B**

Figure 4-34 shows the phase noise results of the DUT using the 8644B as the down-converting source. Note that while it has excellent phase noise above 10 kHz, the results below 10 kHz rapidly degrade. The 60 Hz related noise spikes are typically due to the DCFM method of phase locking the DUT to the E5500.

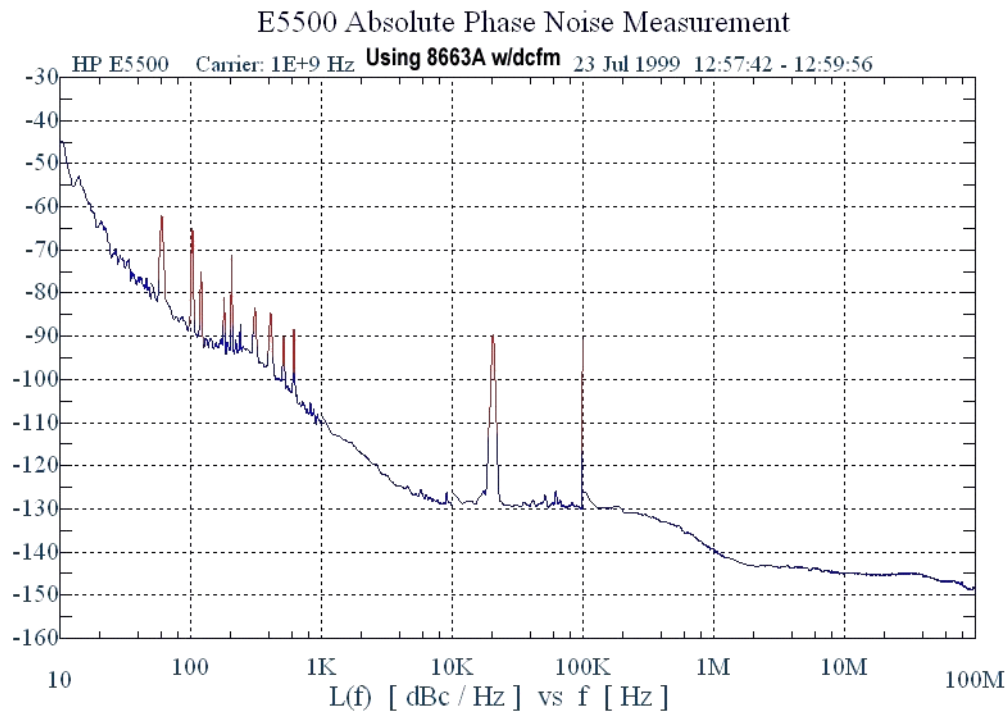
**Figure 4-34**



## Using an HP/Agilent 8663A Synthesizer

Figure 4-35 shows the results of the same DUT measured with a 8663A Synthesizer. In this measurement, the DCFM method was also used to phase lock the DUT to the E5500 system. Again, this produces 60 Hz-related spikes as well as other spurs at 20 and 100 kHz. Notice that the phase noise above 10 kHz is also worse than with the HP/Agilent 8644B. The DCFM method of testing phase noise with an HP/Agilent 8662/3 should *not* be used.

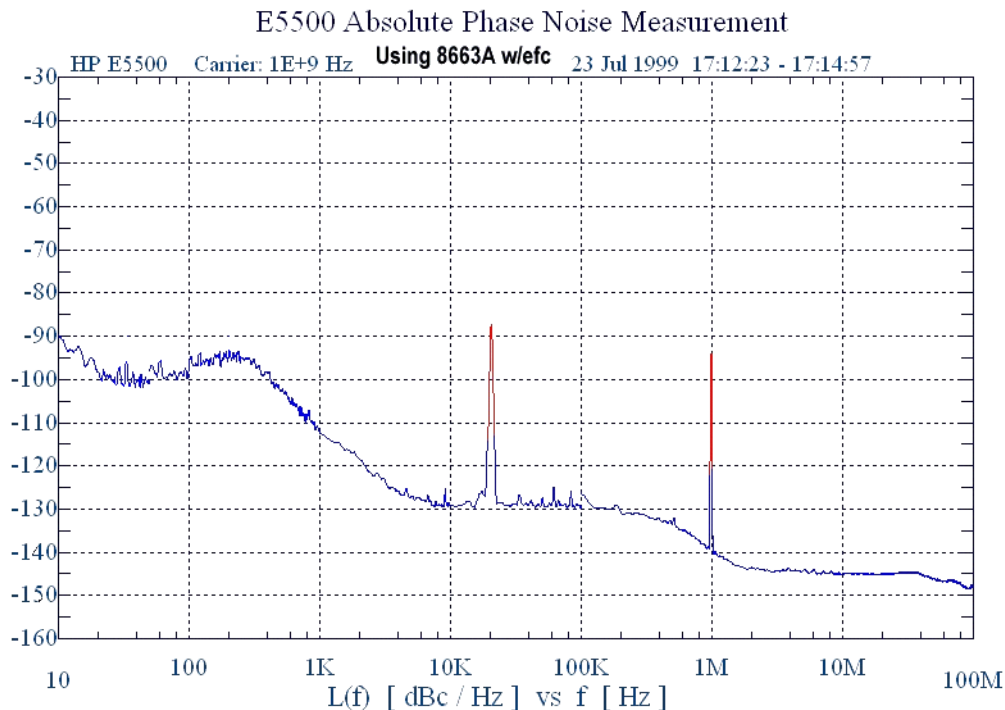
**Figure 4-35**



## Using Electronic Frequency Locking (EFC)

Figure 4-36 shows the result of using the electronic frequency control (EFC) method of phase-locking the DUT to the E5500 system (see the E5500 manual for set up). This method produces the best result, but is not available on all sources (such as the HP/Agilent 8644B). Note that the close-in phase noise is now much improved and the 60 Hz related spikes are eliminated. Although the two large spikes still exist, they are the result of the HP/Agilent 8662/3 and are not characteristics of the DUT.

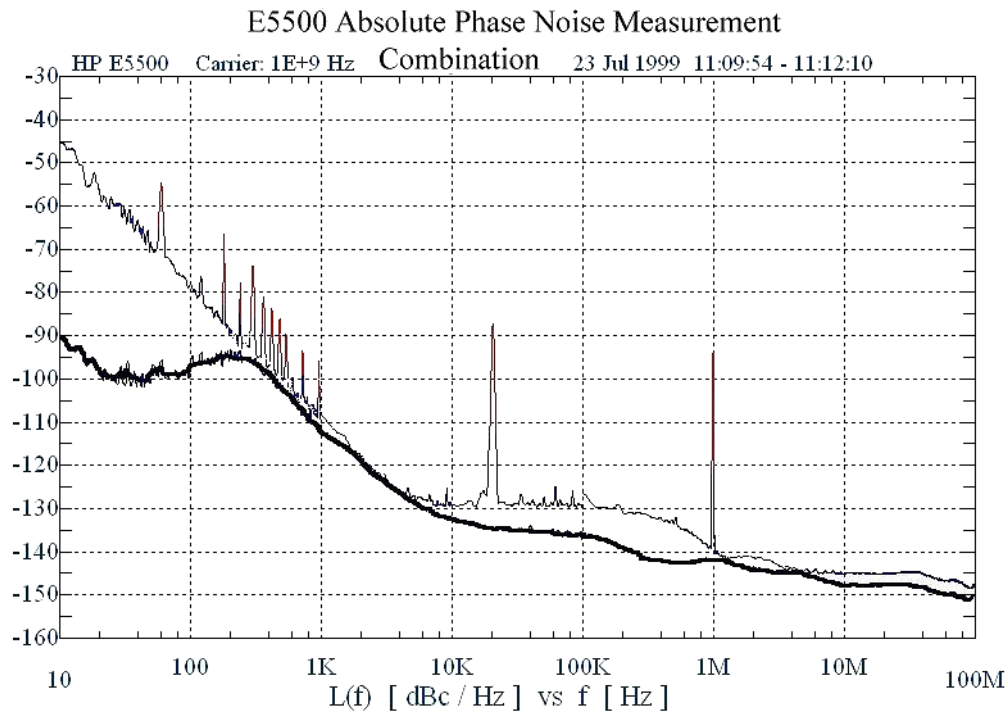
**Figure 4-36**



To get an accurate idea of the actual phase noise of the DUT, it may be necessary to combine the two plots, always using the lowest result of both (see Figure 4-37). Keep in mind that the actual phase noise results are probably better than what is displayed.

The results shown on the E5500 system may be worse than the actual DUT. If a tested device has the same phase noise characteristics as the system's down-converting source, the displayed result will be 3 dB worse than either device. To eliminate this error, measure three different sources. This results in three equations and three unknowns, and the software can then sort out the actual results for each device. This 3-source substitution method generates a correction table that can be used for future measurements, effectively eliminating the combined error (of up to 3 dB) for subsequent measurements. For best results, use this method. Refer to the E5500 documentation for instructions on how to implement a 3-source substitution. When the plots in this section were taken, this method was *not* used. If it had been used, portions of the plots could have been up to 3 dB better.

Another way of stating the above: for any phase noise measurement where a 3-source substitution is *not* performed, the actual phase noise of *one* of the two sources involved (DUT or down-converting source) is at least 3 dB better than shown.

**Figure 4-37**

## Measuring Residual FM

Residual FM is closely related to phase noise. Good phase noise typically implies good residual FM. Directly measuring residual FM at very low levels is difficult, but the HP/Agilent E5500 system can integrate the phase noise results to determine an accurate value. This is done under the E5500 software Trace Integration menu by selecting a data type of  $S_{nu}(f)$  or Spectral density of frequency fluctuations.

In the ESG-P series, residual FM is defined only within a 300-3000 Hz bandwidth and with a specified frequency response within this band. That frequency response is specified by a CCITT filter characteristic. In the E5500 system, software revision 5.0 or higher, use of this filter response can be achieved by simply checking the CCITT weighting box under the Trace Integration menu.

If you use the older HP/Agilent 3048 phase noise system, there is no direct way to measure residual FM, but because residual FM and phase noise are so closely related and interdependent, it is safe to assume that if the DUT's phase noise meets specification, looks typical (between 300 and 3000 Hz), and shows no unexpected large spikes in the response, then it will most likely also meet the residual FM specification.

---

## 22. Dual Arbitrary Waveform Generator Check (Option UND only)

This check verifies the functionality of the dual arbitrary waveform generator. A triangular waveform is downloaded into the signal generator and then output to the rear-panel I and Q outputs. An oscilloscope is used to monitor the rear-panel I and Q outputs.

---

NOTE	This is <i>not</i> a performance test. This check is only provided to ensure that the dual arbitrary waveform generator is operational. The results are verified visually on the oscilloscope, and there is no data that is automatically logged or that can be printed out.
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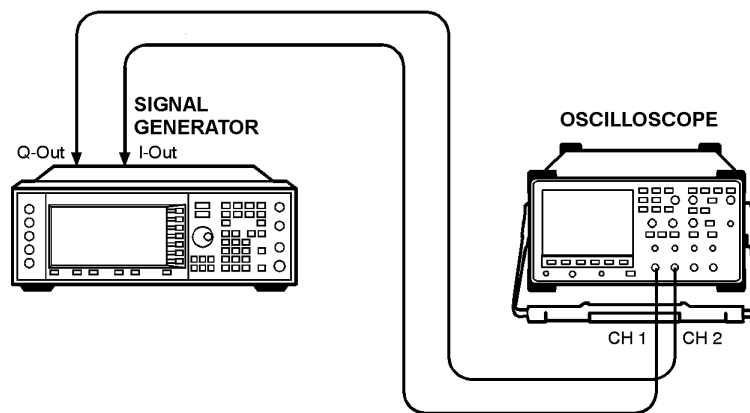
---

### Recommended Equipment

- An oscilloscope with 2 input channels

### Equipment Setup

**Figure 4-38 Dual Arbitrary Waveform Generator Setup (Option UND)**



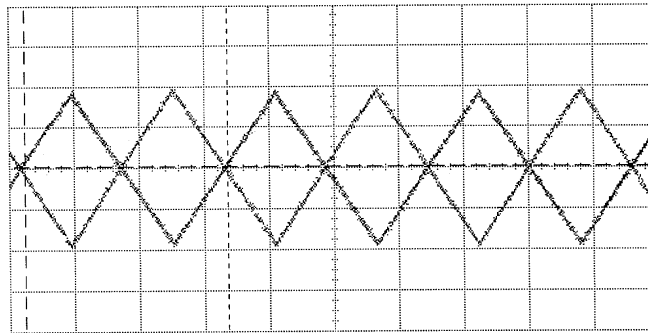
wk71b

### Procedure

1. Connect the test equipment as shown. The oscilloscope is not connected to GPIB; this allows for the use of most general 2-channel oscilloscopes.
2. Set the oscilloscope to display both Channel 1 and Channel 2. Set the oscilloscope to trigger on Channel 1. The recommended settings are:
  - Vertical Scale: 500 mV/div
  - Timebase: 5 microseconds/div

## 22. Dual Arbitrary Waveform Generator Check (Option UND only)

3. Verify that Channel 1 and Channel 2 are both displaying triangular waveforms approximately 180 degrees out of phase and that they do not have any discontinuities. Refer to the illustration below.



- Frequency is approximately 64 kHz.
- Amplitude is approximately 1.9 V<sub>p-p</sub>.
- Both waveforms are symmetrical around 0 volts (the average voltage is approximately 0V).

**23. GSM Loopback BER Check (Option 300 only)**

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## 23. GSM Loopback BER Check (Option 300 only)

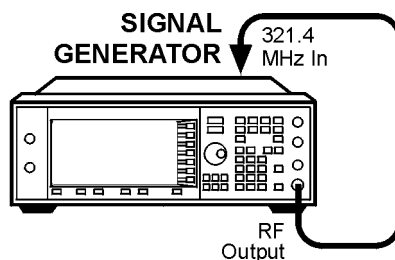
This test is a functionality check of the Option 300 GSM BER hardware, and does *not* test any specifications. The instrument's RF output is connected to the rear panel 321.4 MHz IF input. The test is made with the RF signal set to 321.4 MHz at 0 dBm. The instrument is specially configured to emulate a GSM base station (transmitting BCH then TCH signals for synchronization). A BER measurement is made with an expected result of 0% error. A second BER measurement is made where known errors are added to the bitstream.

### Recommended Equipment

No equipment is required.

### Equipment Setup

**Figure 4-39 GSM Loopback BER Check Setup (Option 300)**



wk714b

---

## 24. Frac-N Check (ESG-AP, ESG-DP only)

This test uses the internal analog bus (ABUS) to verify proper operation of the Fractional-N assembly. It also checks for unlocked conditions at frequencies across the tune range. Use this test as a diagnostic tool; it does *not* verify actual instrument performance.

### Recommended Equipment

No equipment is required.

---

## 25. Sampler/YO Driver Check (ESG-AP, ESG-DP only)

This test uses the internal analog bus (ABUS) to verify proper operation of the Sampler and YO Driver assemblies. It also checks for unlocked conditions at frequencies across the tune range. Use this test as a diagnostic tool; it does *not* verify actual instrument performance.

### Recommended Equipment

No equipment is required.

---

## Performance Test Records

The test records at the end of this chapter are provided as masters for you to photocopy.

[Table 4-1](#) on page 4-47 provides a place to record the equipment used for the tests in this chapter.

[Table 4-2](#) and [Table 4-3](#) on page 4-48 are provided for recording the results of manual tests:

- Timebase aging rate ([page 4-24](#))
- Phase noise and Residual FM ([page 4-37](#))

Where applicable, use the ESG Family Support Software to print out a test record of the results obtained from the automated performance tests.



**Table 4-1 ESG Family Signal Generators Performance Test Record**

Test Equipment Used	Model Number	Trace Number	Cal Due Date
Model _____	Report Number _____		Date _____
Arbitrary Waveform Generator	_____	_____	_____
Attenuator (6 dB)	_____	_____	_____
Attenuator (10 dB)	_____	_____	_____
Audio Analyzer	_____	_____	_____
Frequency Counter	_____	_____	_____
Function Generator	_____	_____	_____
Low Noise Amp (0.1–10 MHz)	_____	_____	_____
Low Noise Amp (0.03–2 GHz)	_____	_____	_____
Measuring Receiver	_____	_____	_____
Mixer (0.5–9 GHz)	_____	_____	_____
Mixer (0.001–2.8 GHz)	_____	_____	_____
Oscilloscope, Digital	_____	_____	_____
Oscilloscope, Digitizing	_____	_____	_____
Oscilloscope Plug-in	_____	_____	_____
Power Meter	_____	_____	_____
Power Sensor	_____	_____	_____
Power Splitter	_____	_____	_____
Primary Frequency Standard	_____	_____	_____
Signal Generator	_____	_____	_____
Spectrum Analyzer	_____	_____	_____
Vector Signal Analyzer	_____	_____	_____
W-CDMA Spectrum Analyzer	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

**Table 4-2 ESG Family Signal Generators Timebase Aging Rate Performance Test Record**

Model _____	Report Number _____		Date _____
Test Description	Results	Specification	Measurement Uncertainty
<b>Timebase Aging Rate</b> ESG-AP, ESG-DP, or Option 1E5 only	_____	< ±0.0005 ppm/day	$5.6 \times 10^{-11}$ per day

**Table 4-3 ESG-AP and ESG-DP Series Signal Generators Phase Noise and Residual FM Performance Test Record**

Model _____	Serial No. _____	Date _____	Tester _____
<b>Phase Noise (20kHz Offset)</b>			
Frequency (GHz)	Specification (dBc/Hz)	Measurement	Pass/Fail?
0.5	< -134		
1.0	< -130		
2.0	< -123		
3.0	< -120		
4.0	< -118		
<b>Residual FM (CCITT Weighting)</b>			
Frequency (GHz)	Specification (Hz)	Measurement	Pass/Fail?
0.5	< 0.5		
1.0	< 1		
2.0	< 2		
3.0	< 3		
4.0	< 4		

# 5 Adjustments

This chapter contains the adjustment procedures that may be required for the signal generator.

---

## Adjustment Relationships

Anytime an adjustment is made to the signal generator other related adjustments may be affected. For optimal performance, whenever an adjustment is performed, the related adjustments should also be performed.

### Analog Bus Related Adjustments

The following adjustments are optimized if the Analog Bus ADC Calibration has been run:

- VCO Bias Potentiometer Adjustment
- FM Inverting Amplifier Offset Calibration
- ALC Modulation Drive Bias Calibration
- VBLO Mixer Bias Calibration
- Level Meter Calibration
- I/Q Gain/Offset/Quadrature Calibration (*ESG-D only*)
- I/Q Impairment Adjustment (*ESG-D only*)

### Synthesizer Potentiometer Related Adjustments

The Lock Angle potentiometer is preset fully counter-clockwise in the VCO Bias Adjustment. Both adjustments should always be performed together.

- VCO Bias Potentiometer Adjustment
- Lock Angle Adjustment

### AM Accuracy Related Adjustments

- AM Audio Path Offset Calibration
- AM Gain Calibration

### I/Q Modulation Accuracy Related Adjustments

- VBLO Mixer Bias Calibration
- I/Q Gain/Offset/Quadrature Calibration (*ESG-D only*)
- I/Q Impairment Adjustment (*ESG-D only*)
- Baseband Generator I/Q Gain and Offset Adjustment (Options UN3 or UN4 *only*)

### Burst Modulation Accuracy Related Adjustments

- Burst Modulator Calibration (*ESG-D only*)
- Burst Audio Path Gain Calibration (*ESG-D only*)

## FM Accuracy Related Adjustments

- KV versus Frequency Calibration
- FM Scale DAC Offset Adjustment
- FM Path Offset Adjustment
- FM In-Band DAC Offset Adjustment
- FM Inverting Amplifier Offset Calibration
- FM 1/2 Path Ratio Adjustment
- Modulation Source Relative Gain Calibration
- FM Out-of-Band Calibration
- FM Delay Potentiometer Adjustment
- FM/PM YO Frequency Compensation Calibration (*ESG-AP and ESG-DP only*)
- FM/PM OB Cal (*ESG-AP and ESG-DP only*)
- DCFM Calibration

## Power Level Range and Accuracy Related Adjustments

- Prelevel Calibration
- Gain Adjustment
- Low Noise Floor Gain Adjustment (*ESG-AP and ESG-DP only*)
- ALC Modulation Driver Bias Calibration
- VBLO Mixer Bias Calibration
- Power Level Accuracy
- Level Meter Calibration
- ALC Modulation Flatness Calibration

## Internal Reference Oscillator Adjustment

Use this procedure to adjust the internal reference DACs (Digital-to-Analog Convertors). The internal reference oscillator is adjusted with two DACs, one for coarse tuning and one for fine tuning. Using the two DACs, the internal reference oscillator can be adjusted to the resolution of the frequency counter used.

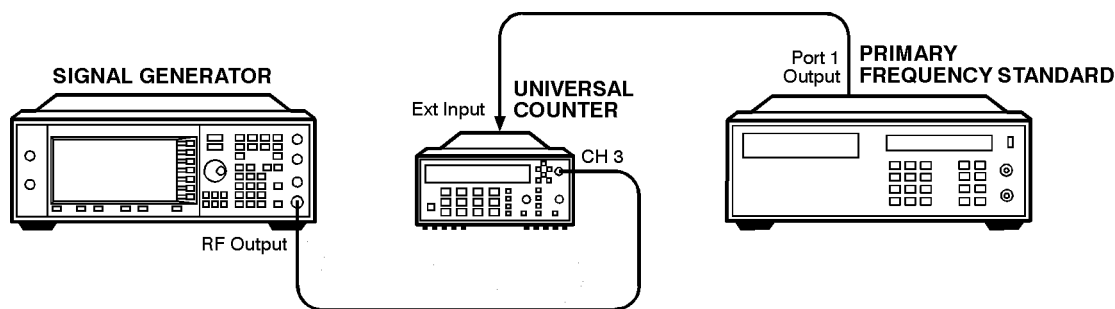
This is a manual adjustment. An automated version of this adjustment is also provided.

### Required Test Equipment

- HP/Agilent 53132A Option 050 Universal Counter
- HP/Agilent 5071A Primary Frequency Standard

### Procedure

**Figure 5-1 Internal Reference Oscillator Adjustment Setup**



wk7101a

1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Set the universal counter input to 50Ω.
4. On the signal generator press, **Preset > Amplitude > 0 > dBm > RF ON/OFF > Utility > Instrument Adjustments > Reference Oscillator Adjustment > Ref Osc Fine**.
5. Center the fine tuning DAC setting for a value of 128.
6. Press **Ref Osc Coarse** on the signal generator.
7. Adjust the coarse tuning DAC setting for a universal counter reading of 100 MHz.
8. Press **Ref Osc Fine** and adjust the fine tuning DAC setting for a frequency counter reading of 100 MHz, within 0.1 Hz resolution.
9. After adjusting both of the DAC settings, press **Store Ref Osc Setting > Confirm Store**.

---

## Analog Bus ADC Calibration

### Description

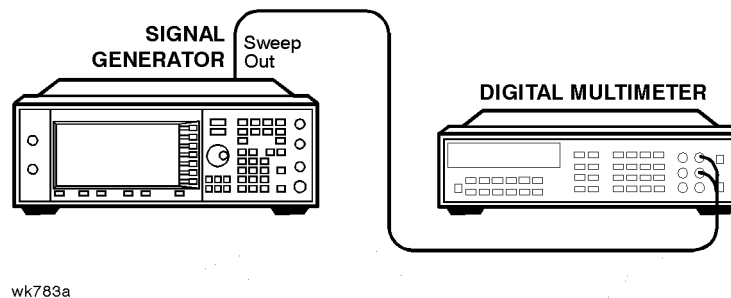
This test is used to calibrate the gain of the ABUS. The ABUS is connected to the ground node (ACOM) and the ADC is zeroed. The ABUS is then connected to the 10 V reference and measured. The result of the measured value divided by the ideal value is the ABUS gain calibration constant. This value is then saved in the signal generator's firmware.

### Required Test Equipment

- HP/Agilent 3458A Digital Multimeter

### Procedure

**Figure 5-2 Analog Bus ADC Calibration Setup**



1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

---

## Pretune Calibration (ESG-AP and ESG-DP only)

### Description

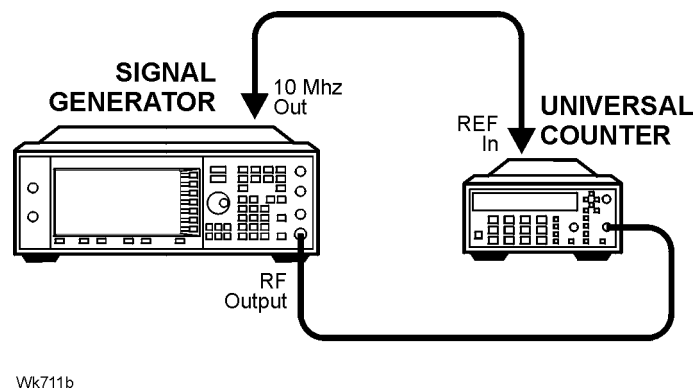
This adjustment determines the YO offset and gain calibration constants that minimize the YO phase lock error voltage. The phase lock error voltage is measured with the internal analog bus and is minimized at both low and high YO frequencies by controlling the YO pretune DAC. The YO pretune DAC settings are used to calculate the YO offset and gain calibration constants.

### Required Test Equipment

- HP/Agilent 53132A Option 050 Universal Counter

### Procedure

**Figure 5-3** Pretune Calibration Setup



1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.



---

## Internal Source Calibration

### Description

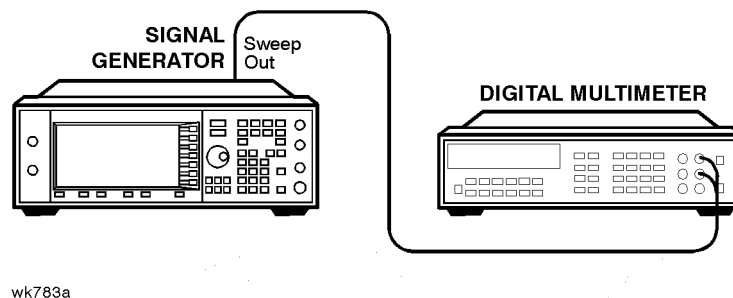
This test is used to calibrate the internal source amplitude versus frequency. The values for offset and gain are set to their default values in the internal source calibration arrays. Next, the offset calibration factor is determined by connecting the DVM to the ABUS and measuring the dc offset of the motherboard common ground ABUS node and the offset of the DSP ABUS node with the DSP set to 0 Vdc. The calibration factor is the difference between these two measurements. The scaling factors are determined by setting the DSP to output a full-scale sinewave with the DVM connected to the front panel LF OUTPUT port. Measurements are then made in 1 kHz steps and the calibration factors are calculated to achieve  $2 V_{\text{peak}}$  on the motherboard by accounting for the nominal gain presented by the reference board. Upon completion, the calibration factors are stored in the signal generator's firmware.

### Required Test Equipment

- HP/Agilent 3458A Digital Multimeter

### Procedure

**Figure 5-4 Internal Source Calibration Setup**



1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

## VCO Bias Potentiometer Adjustment

### Description

This test sets the VCO bias potentiometer at a level that will keep the VCO in a stable operating region over the entire frequency and temperature range. First, the F/2 and the lock angle potentiometers are set fully CW (clock-wise). The signal generator is set to 750 MHz and the potentiometer is adjusted until the F/2 oscillations disappear. The voltage at the SYNTH\_F2 ABUS node is measured and then the potentiometer is adjusted for a 0.77 V to 0.80 V drop.

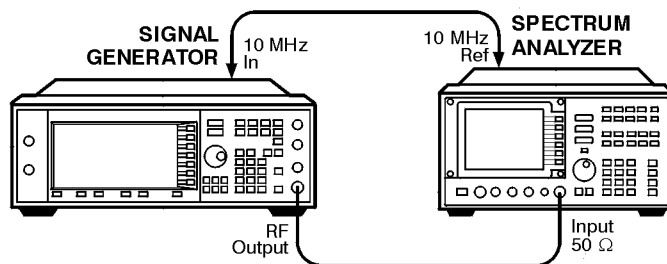
After you have performed this adjustment, you must perform the Lock Angle Potentiometer Adjustment on the following page.

### Required Test Equipment

- HP/Agilent 8563E Spectrum Analyzer

### Procedure

**Figure 5-5 VCO Bias Potentiometer Adjustment Setup**



wk719b

1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

---

## Lock Angle Potentiometer Adjustment

### Description

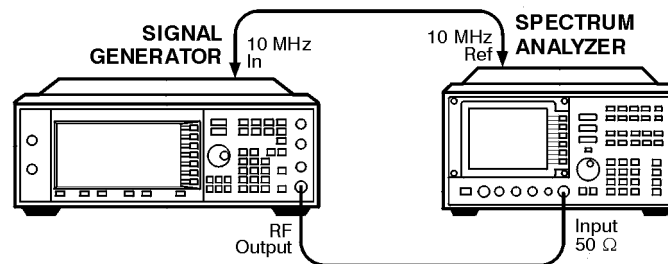
This test is used to optimize the phase detector sampling of the synthesizer phase-locked loop reference frequencies. The lock angle adjustment sets the time during the reference cycle when the ultra-quiet time phase detector measurement occurs. The phase detector needs to make its measurement at the quietest point in the reference cycle. By adjusting this potentiometer to minimize the level of the fractional-N spur, the time of the phase detector sample can be optimized.

### Required Test Equipment

- HP/Agilent 8563E Spectrum Analyzer

### Procedure

**Figure 5-6 Lock Angle Potentiometer Adjustment Setup**



wk719b

1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

---

## KV versus Frequency Calibration

### Description

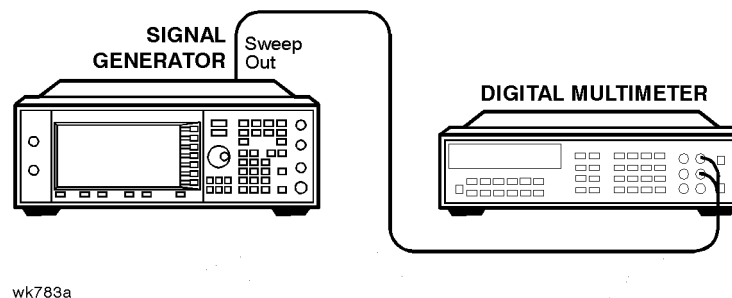
This test determines the tuning sensitivity of the synthesizer loop. To measure the sensitivity, the tuning voltage is measured as the frequency is stepped from 500 to 1000 MHz in 10 MHz steps. At each incremental frequency the tuning voltage is measured (Vtune1) and again at the incremental frequency +300 kHz (Vtune2). The sensitivity is then calculated in units of MHz/V and stored in the signal generator's firmware.

### Required Test Equipment

- HP/Agilent 3458A Digital Multimeter

### Procedure

**Figure 5-7 KV versus Frequency Calibration Setup**



1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

---

## AM Audio Path Offset Calibration

### Description

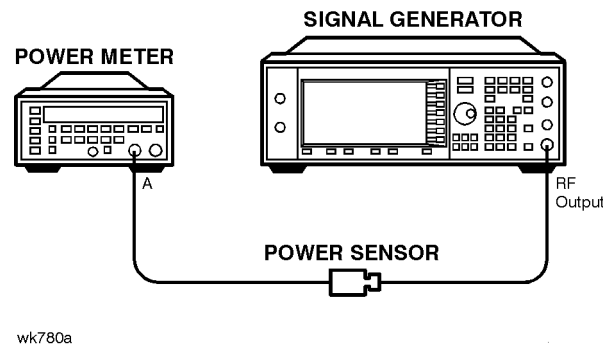
This test calibrates the AM path to remove any offset generated when LIN AM, LIN BURST, or LOG BURST are enabled. This test determines the ALC\_REF\_DAC delta value which is used to correct the offset when the modulation is enabled. This value is then stored in the appropriate calibration constant.

### Required Test Equipment

- HP/Agilent 438A Power Meter
- HP/Agilent 8482A Power Sensor

### Procedure

**Figure 5-8 AM Audio Path Offset Calibration Setup**



1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

---

## Timebase DAC Calibration

### Description

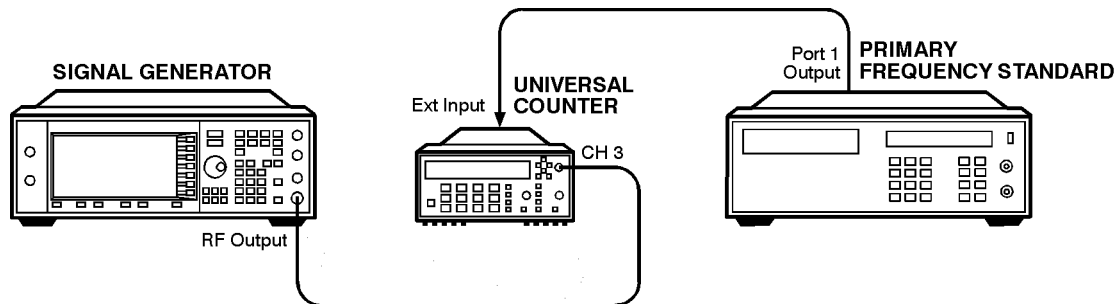
This test ensures that the signal generator has warmed-up sufficiently and then adjusts the coarse and fine reference timebase DACs for minimum internal reference frequency error. The coarse and fine DAC calibration factors are then stored in the signal generator's firmware.

### Required Test Equipment

- HP/Agilent 53132A Option 050 Universal Counter
- HP/Agilent 5071A Primary Frequency Standard

### Procedure

**Figure 5-9 Timebase DAC Calibration Setup**



wk7101a

1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

---

## FM Scale DAC Offset Calibration

### Description

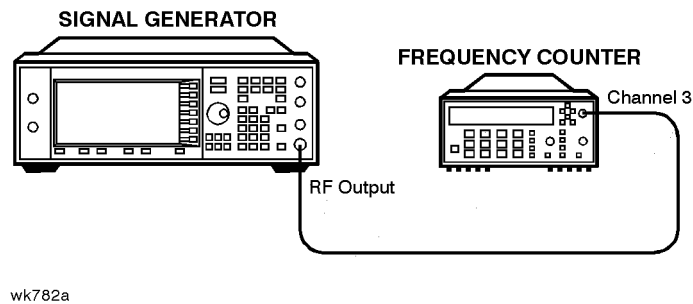
This test is used to remove the offset associated with the FM SCALE DAC operational amplifier located on the reference board. This calibration results in a DAC value for FM OFFSET DAC 2. After this DAC value has been properly adjusted, the effects of the FM SCALE DAC value on the offset will be minimized.

### Required Test Equipment

- HP/Agilent 53132A Option 050 Universal Counter

### Procedure

**Figure 5-10 FM Scale DAC Offset Calibration Setup**



1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

---

## FM Path Offset Calibration

### Description

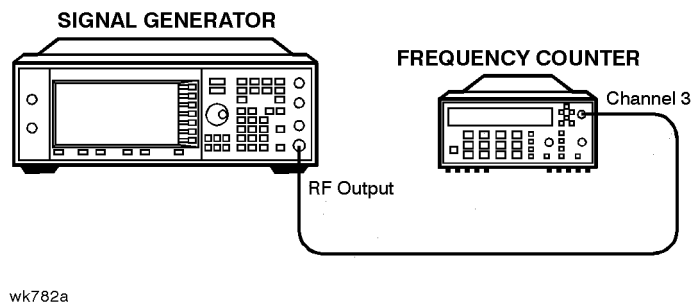
This test is used to remove the offsets associated with the various FM1 and FM2 audio paths on the reference board. When FM is enabled, voltage offsets on the reference and synthesizer boards appear as frequency shifts on the synthesizer VCO. By using a frequency counter to measure the frequency of the VCO, the voltage offsets can be quantified. The voltage offsets are adjusted and stored in the signal generator's firmware.

### Required Test Equipment

- HP/Agilent 53132A Option 050 Universal Counter

### Procedure

**Figure 5-11** FM Path Offset Calibration Setup



1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.



---

## FM In-Band DAC Offset Calibration

### Description

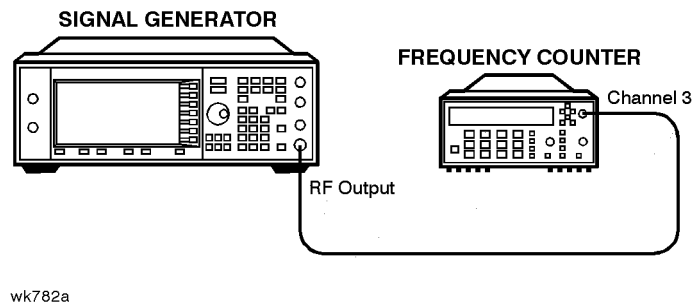
This test is used to remove the offset associated with the FM IN-BAND DAC located on the synthesizer board. The calibration determines the DAC value for the FM IN-BAND OFFSET DAC on the synthesizer board which will remove the offset.

### Required Test Equipment

- HP/Agilent 53132A Option 050 Universal Counter

### Procedure

**Figure 5-12** FM In-Band DAC Offset Calibration



1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

---

## FM Inverting Amplifier Offset Calibration

### Description

This test is used to remove the offset associated with the differential inverting amplifier on the FM input of the synthesizer board. The calibration determines the DAC value for the FM OFFSET DAC 1 on the reference board which will remove the offset associated with the amplifier.

### Required Test Equipment

- None

### Procedure

1. Preset the signal generator.
2. Follow the instructions as they appear on the controller's display.

---

## FM 1/2 Path Ratio Gain Calibration

### Description

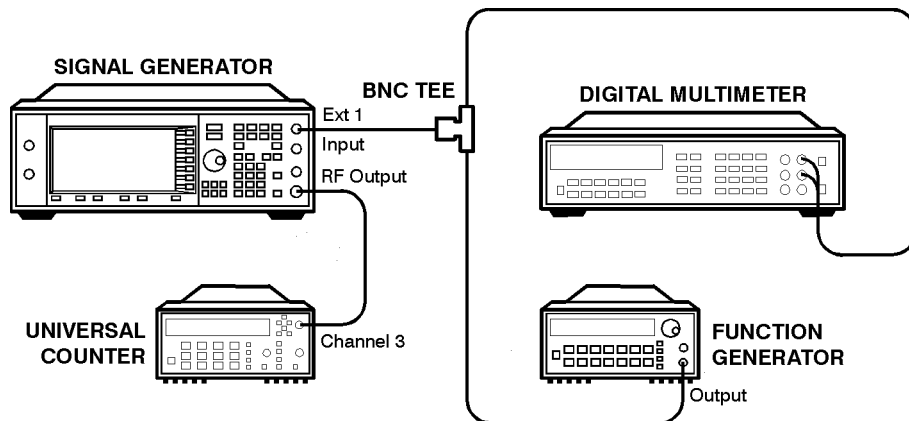
This test equalizes the gain between the FM1 and FM2 paths. The gain of the FM2 path is adjusted using the FM SCALE DAC and the resulting DAC value is stored in the signal generator's firmware. This calibration only affects source-independent gains. When uncalibrated sources feed into the paths, the gains are adjusted using the Modulation Source Relative Gain Calibration.

### Required Test Equipment

- HP/Agilent 3458A Digital Multimeter
- HP/Agilent 53132A Option 050 Universal Counter
- HP/Agilent 33120A 15 MHz Function/Arbitrary Waveform Generator

### Procedure

**Figure 5-13** FM 1/2 Path Ratio Gain Calibration Setup



wk785a

1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

## Modulation Source Relative Gain Compression Calibration

### Description

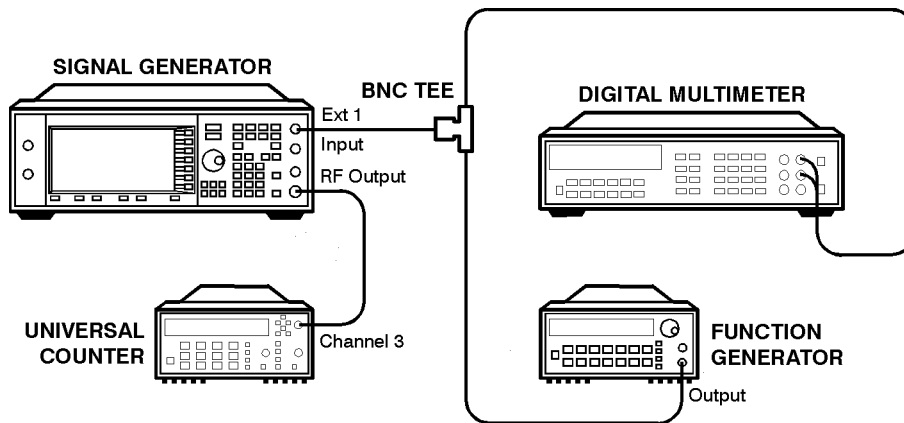
This test provides a scaling factor for all of the multiplexed FM modulation inputs. The scaling factor is used by the signal generator's firmware to scale the actual requested FM deviation from the synthesizer board when the corresponding input is selected. Three scaling factors (EXT1, EXT2, and INT1) are generated during this calibration. The resulting values are used to calculate the calibration values that are then stored in the signal generator's firmware.

### Required Test Equipment

- HP/Agilent 3458A Digital Multimeter
- HP/Agilent 53132A Option 050 Universal Counter
- HP/Agilent 33120A 15 MHz Function/Arbitrary Waveform Generator

### Procedure

**Figure 5-14 Modulation Source Relative Gain Compression Calibration Setup**



wk785a

1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

---

## FM Out-of-Band Calibration (ESG-A and ESG-D only)

### Description

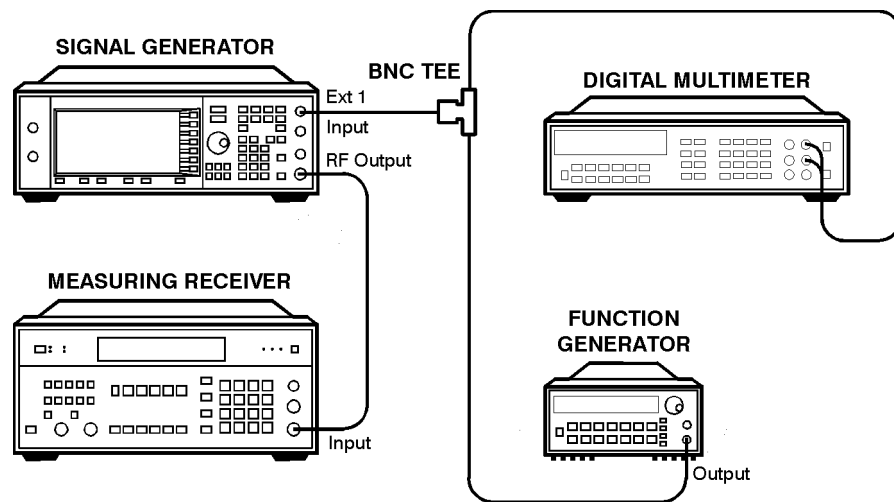
This test adjusts the FM out-of-band deviation to match the in-band FM deviation. It also determines the attenuation values of the out-of-band attenuators and sets the values of some other FM constants. The loop bandwidth of the synthesizer phase-locked loop is approximately 5 kHz. This calibration is used to set the FM deviation at rates above the loop bandwidth (out-of-band) so they will equal the deviation rates within the loop bandwidths (in-band).

### Required Test Equipment

- HP/Agilent 3458A Digital Multimeter
- HP/Agilent 8902A Option 010 Measuring Receiver
- HP/Agilent 33120A 15 MHz Function/Arbitrary Waveform Generator

### Procedure

**Figure 5-15 FM Out-of-Band Calibration Setup**



wk786a

1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

## FM Delay Potentiometer Adjustment (ESG-A and ESG-D only)

### Description

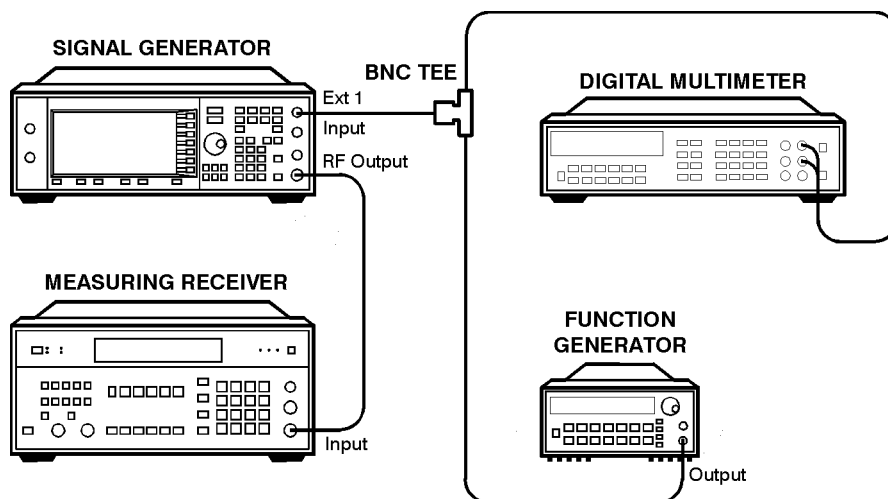
This test adjusts the match between the delay of the signal passing through the FM in-band path to the delay of the signal passing through the FM out-of-band path. This calibration is the final adjustment required to achieve good FM performance over a wide range of different rates. The FM delay potentiometer forms part of an RC network on the input of the FM out-of-band circuit. The adjustment is used to flatten the delay of the FM response from low rates to high rates. The delay affects the deviation accuracy. By monitoring the deviation, the delay can be adjusted.

### Required Test Equipment

- HP/Agilent 3458A Digital Multimeter
- HP/Agilent 8902A Option 010 Measuring Receiver
- HP/Agilent 33120A 15 MHz Function/Arbitrary Waveform Generator

### Procedure

**Figure 5-16 FM Delay Potentiometer Adjustment Setup**



wk786a

1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

---

## Wide Bandwidth Phase Modulation Calibration (ESG-A and ESG-D only)

### Description

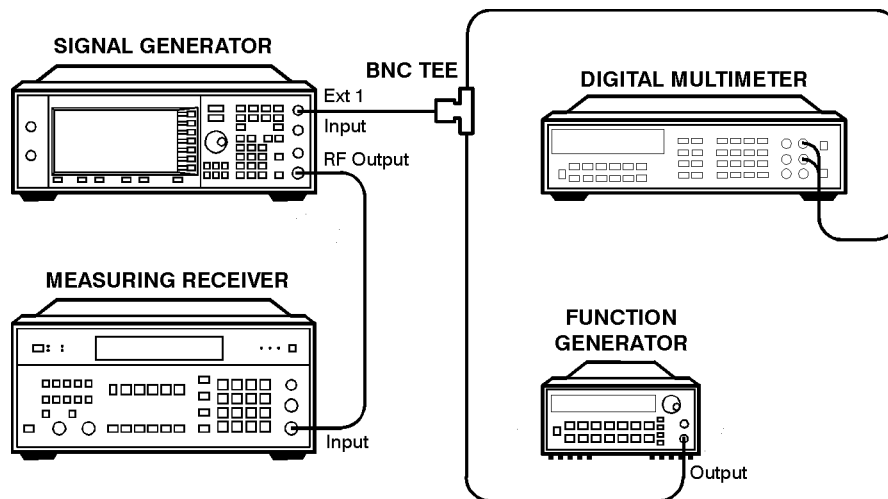
This test is used to calibrate the phase modulation circuitry on the synthesizer board. The phase modulation has two operational modes: normal and wide bandwidth. This calibration determines the attenuation correction factors for maximum deviation for each of the phase modulation out-of-band ranges for normal and wide bandwidth modes and in-band and out-of-band operation. This calibration **MUST** be performed at the same frequency as the FM out-of-band calibration (1 GHz). The resulting correction factors are then stored in the signal generator's firmware.

### Required Test Equipment

- HP/Agilent 3458A Digital Multimeter
- HP/Agilent 8902A Option 010 Measuring Receiver
- HP/Agilent 33120A 15 MHz Function/Arbitrary Waveform Generator

### Procedure

**Figure 5-17 Wide Bandwidth Phase Modulation Calibration Setup**



wk786a

1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

---

## FM/PM Out-of-Band Calibration (ESG-AP and ESG-DP only)

### Description

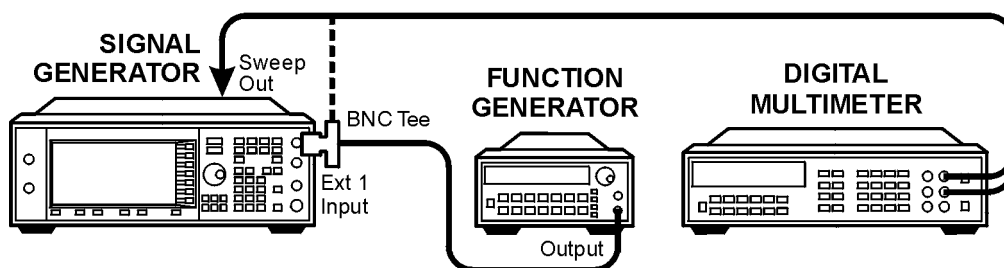
This adjustment calibrates the FM/PM out-of-band paths on the Fractional-N and YO driver modules. The internal ABUS is connected to the phase lock loop integrator node on each board, and the attenuators and DAC are adjusted to minimize the voltage. This ensures that the in-band and out-of-band paths are matched. The [“FM In-Band DAC Offset Calibration”](#) on page 5-15 *must* be performed prior to this adjustment.

### Required Test Equipment

- HP/Agilent 3458A Digital Multimeter
- HP/Agilent 33120A 15 MHz Function/Arbitrary Waveform Generator

### Procedure

**Figure 5-18 FM/PM Out-of-Band Calibration Setup**



wk710b

1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.



---

## FM/PM YO Frequency Compensation Calibration (ESG-AP and ESG-DP only)

### Description

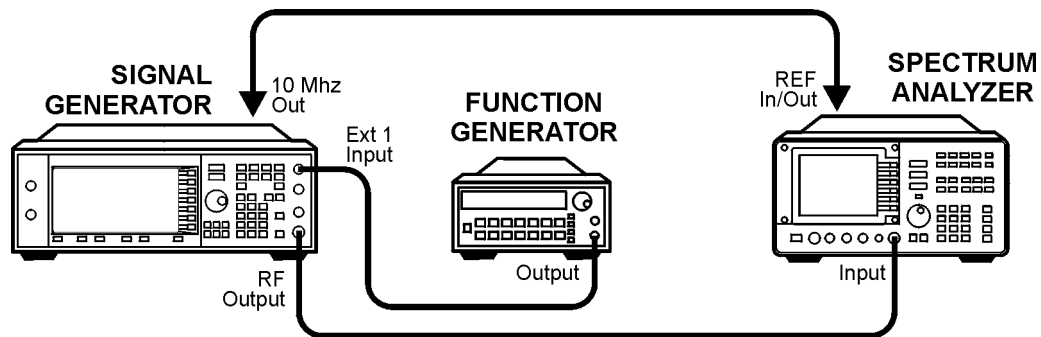
This adjustment calibrates the FM/PM YIG oscillator frequency compensation latches on the YO driver assembly. These latches adjust the flatness of the YO FM/PM paths for rates greater than 100 kHz. The [“FM In-Band DAC Offset Calibration”](#) on page 5-15 and the [“FM/PM Out-of-Band Calibration \(ESG-AP and ESG-DP only\)”](#) on page 5-22 *must* be performed prior to this adjustment.

### Required Test Equipment

- HP/Agilent 8563E Spectrum Analyzer
- HP/Agilent 33120A 15 MHz Function/Arbitrary Waveform Generator

### Procedure

**Figure 5-19 FM/PM YO Freq. Compensation Setup**



wk79b

1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

---

## DCFM Calibration

### Description

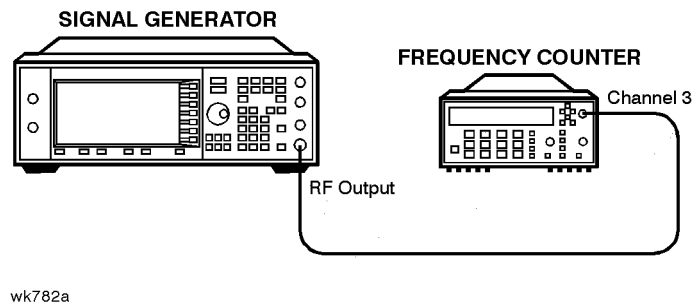
This test removes all of the dc offsets associated with the FM path while in DCFM mode. This test uses only the FM1 path to verify the functionality of the circuitry. The resulting values are stored in the signal generator's firmware.

### Required Test Equipment

- HP/Agilent 53132A Option 050 Universal Counter

### Procedure

**Figure 5-20 DCFM Calibration Setup**



1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

---

## Low Frequency (LF) Output Calibration

### Description

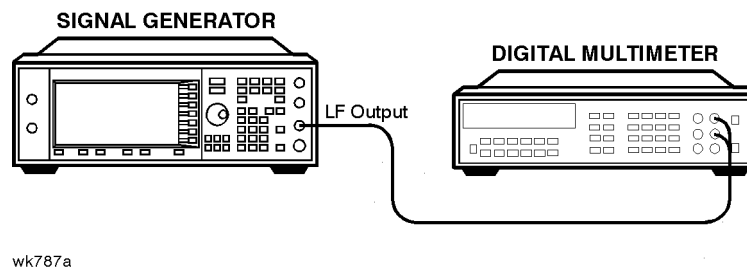
The LF output provides a calibrated audio frequency signal. This test is used to set the full-scale amplitude of the LF-OUT DAC on the reference board. When the calibration is complete, the voltage on the LF output should be equal to the input voltage, plus or minus 1 mV. The resulting DAC values are then stored in the signal generators firmware.

### Required Test Equipment

- HP/Agilent 3458A Digital Multimeter

### Procedure

**Figure 5-21 Low Frequency (LF) Output Calibration Setup**



1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

## External Input Peak Detector Calibration

### Description

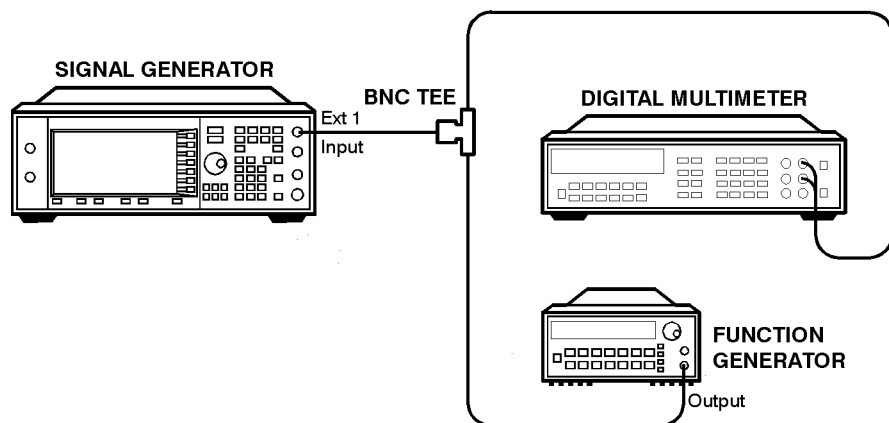
This test is used to calibrate the positive trip level of the EXT1 and EXT2 peak detectors located on the reference board. The calibration generates DAC values for the modulation comparator DACs which provide a voltage to the window comparator operational amplifiers. When the peak detector level DACs are set correctly, the overmodulation indicator will trigger whenever the voltage to the EXT1/EXT2 input is greater than 1.03V. The resulting DAC values are saved as a calibration constant in the signal generator's firmware.

### Required Test Equipment

- HP/Agilent 3458A Digital Multimeter
- HP/Agilent 33120A 15 MHz Function/Arbitrary Waveform Generator

### Procedure

**Figure 5-22 External Input Peak Detector Calibration Setup**



wk788a

1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

---

## Burst Modulator Calibration (ESG-D only)

### Description

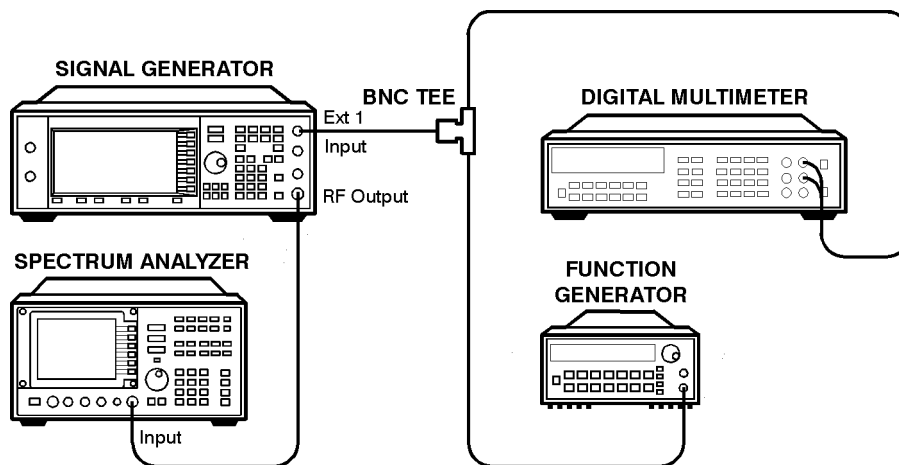
This test is used to adjust the bias modulator circuitry to provide an accurate logarithmic drop in power level for a linear input voltage. When properly adjusted, a one-volt signal on the input will result in a 10 dB drop in power level. The adjustment involves the adjustment of three DACs (BURST BIAS, BURST GAIN, and BURST OFFSET) at several different frequencies. The BURST OFFSET DAC sets the initial current level through the burst modulator diode. The BURST GAIN DAC is used to calibrate the input voltage level to the burst driver circuit. The BURST BIAS DAC sets the breakpoint at which the modulator switches from a logarithmic to a linear transfer function. The results are stored in the calibration arrays associated with each DAC.

### Required Test Equipment

- HP/Agilent 8904A Function Generator (used as audio source)
- HP/Agilent 8563E Spectrum Analyzer
- HP/Agilent E4400-60073 Digital Test Card
- HP/Agilent 3458A Digital Multimeter

### Procedure

**Figure 5-23 Burst Modulator Calibration Setup**



wk789a

1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

## Burst Audio Path Gain Calibration

### Description

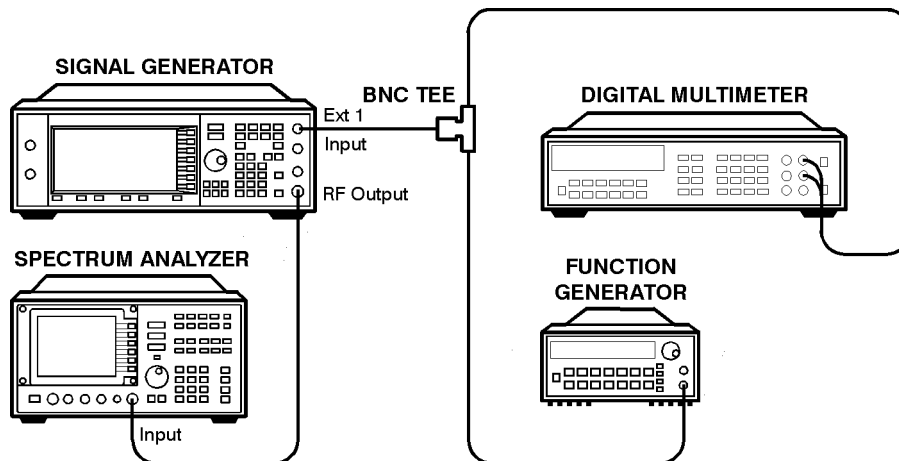
This test adjusts the scaling of the linear burst audio path until a -0.99 Vdc input to the EXT1 connector results in a 40 dB drop in power relative to 0.00 Vdc input when linear burst is activated. The AM 1 DAC value is changed until this result is achieved and its value is stored as a calibration array.

### Required Test Equipment

- HP/Agilent 3458A Digital Multimeter
- HP/Agilent 33120A 15 MHz Function/Arbitrary Waveform Generator
- HP/Agilent 8563E Spectrum Analyzer

### Procedure

**Figure 5-24 Burst Audio Path Gain Calibration Setup**



wk789a

1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

---

## Prelevel Calibration, Digital

### Description

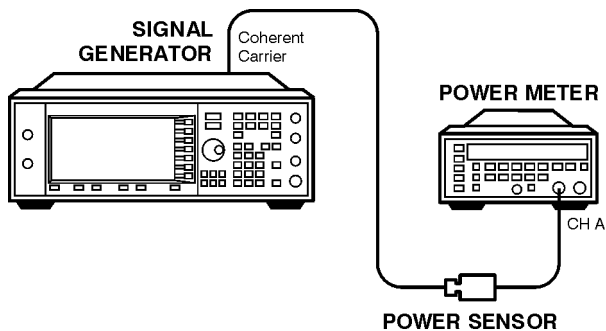
This test calibrates the PRE LEVEL REF DAC on the output board. This DAC is used to control the RF power level that is incident upon the marble I/Q modulator by setting the control point for the prelevel loop. The prelevel loop detector is on the output of the marble I/Q modulator, its drive circuitry on the output board, and its RF modulator on the synthesizer board. This calibration ensures that there will be sufficient power available at the marble I/Q modulator to perform the desired modulation while minimizing intermodulation distortion when the digital modulation is activated. The signal generator is set to a frequency and the auxiliary output amplitude level is adjusted using the PRE LEVEL DAC to within the specified tolerance of the desired value. This process is repeated for all the frequencies in the marble I/Q modulator index array. The results are then stored in the signal generator's firmware.

### Required Test Equipment

- HP/Agilent 438A Power Meter
- HP/Agilent 8482A Power Sensor

### Procedure

**Figure 5-25 Prelevel Calibration Setup**



wk7100a

1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

---

## Prelevel Calibration, Analog (ESG-A only)

### Description

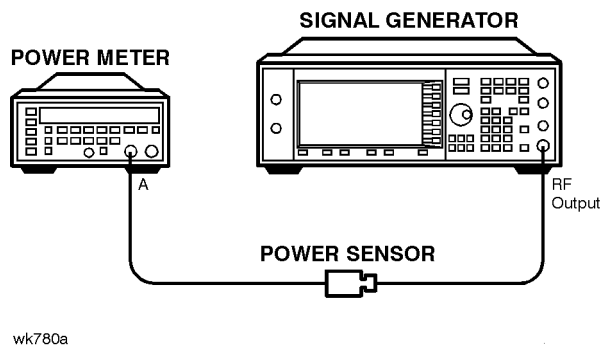
This adjustment determines and stores calibration data for the prelevel reference DAC on the output module. This DAC maintains a consistent RF power level over the full frequency range between the synthesizer module and the output module. Measurements are performed at the RF OUTPUT connector. DAC calibration is determined by making measurements at a high power level, reducing power level 10 dB with the ALC DAC, then setting the prelevel reference DAC to set the RF output to +10 dBm.

### Required Test Equipment

- HP/Agilent 438A Power Meter
- HP/Agilent 8482A Power Sensor

### Procedure

**Figure 5-26 Prelevel Calibration Setup**



1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.



---

## Gain Adjust Calibration

### Description

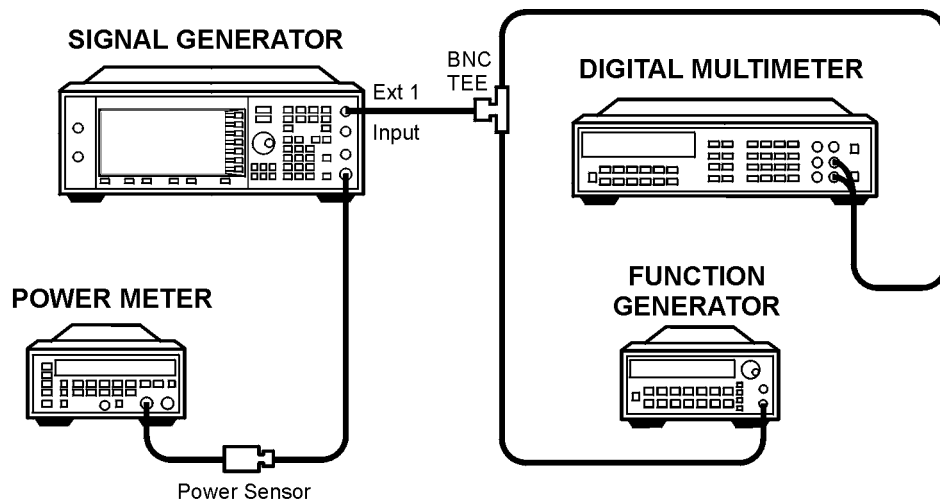
This test calibrates the GAIN ADJUST DAC on the output board. This DAC is used to control the RF power level that is incident upon the switched filters and subsequent RF amplifiers by setting the control point for the gain adjust modulator. This calibration ensures that there will be sufficient power available at the RF amplifiers to perform the desired modulation while minimizing intermodulation distortion when the digital modulation is activated. After adjustment, the results are stored in the signal generator's firmware.

### Required Test Equipment

- HP/Agilent 438A Power Meter
- HP/Agilent 8482A Power Sensor
- HP/Agilent 3458A Digital Multimeter
- HP/Agilent 33120A 15 MHz Function/Arbitrary Waveform Generator

### Procedure

**Figure 5-27 Gain Adjust Calibration Setup**



wk718b

1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

---

## Low Noise Floor Gain Adjust (ESG-AP and ESG-DP only)

### Description

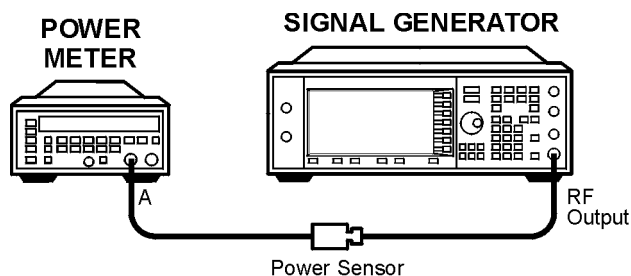
This adjustment calibrates the gain adjust DAC on the output module for low noise floor (LNF) mode. The instrument is set up with attenuation applied by way of the burst modulator. This ensures that the RF chain is not in compression. The gain adjust DAC is then set for a specific RF output power, as measured with a power meter.

### Required Test Equipment

- HP/Agilent 438A Power Meter
- HP/Agilent 8482A Power Sensor

### Procedure

**Figure 5-28** LNF Gain Adjust Setup



wk716b

1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

---

## ALC Modulation Driver Bias Calibration

### Description

This test adjusts the ALC MOD DRV BIAS DAC on the output board. This DAC is used to control the bias current to the ALC modulator driver. It is primarily used to accommodate unmatched  $V_{BE}$  values in the drives, but has a strong influence on modulator gain. This test adjusts the DAC until the ALC modulator gain is balanced around its nominal design center. The results are stored as a calibration array in the signal generator's firmware.

### Required Test Equipment

- None

### Procedure

1. Preset the signal generator.
2. Follow the instructions as they appear on the controller's display.

---

## VBLO Mixer Bias Calibration

### Description

This test calibrates the VBLO MIXER BIAS DAC on the output board. This DAC is used to control the bias voltage to the internal marble mixers. This DAC is primarily used to adjust the mixer bias for optimum I/Q modulation linearity, but it has a secondary influence on mixer gain. This calibration ensures that there will be sufficient power available through the marble mixers to perform the desired modulation while minimizing intermodulation distortion when the digital modulation is activated. After adjustment, the results are stored in the signal generator's firmware.

### Required Test Equipment

- None

### Procedure

1. Preset the signal generator.
2. Follow the instructions as they appear on the controller's display.

---

## Power Level Accuracy

### Description

This test adjusts both power flatness and power level accuracy. First the power flatness and accuracy calibration constants are initialized to zero. Then power flatness is measured with a power meter, and corrected, with the internal attenuator set to 0 dB. The power meter then measures the RF output over the +13 to -15 dBm dynamic range, and calibration constants are set to optimize power level accuracy over this range.

For power levels below -15 dBm, a vector signal analyzer is used to make relative power measurements. A low noise amplifier (LNA) and step attenuator are connected in series to control the absolute power level input to the signal analyzer. For power level settings  $\geq -60$  dBm, the step attenuator is set to approximately cancel the gain of the LNA. Below -60 dBm, the step attenuator is set to 0 dB, which keeps the signal level well above the signal analyzer's noise floor.

Relative measurements are accomplished by setting the DUT amplitude. For example:

The DUT is set to a frequency and the internal step attenuator is set to 0 dB. The signal analyzer does a peak search, sets the reference level, and sets the marker to delta mode (0 dB). The DUT internal attenuator is set to 20 dB, and the signal analyzer makes another measurement. The signal analyzer relative measurement should be -20 dB. Any variation from this value is used to set a calibration constant for the 20 dB attenuator setting at that frequency.

To determine calibration values for internal step attenuator settings below 60 dB, the signal analyzer makes the 0 dB marker delta measurement with the internal step attenuator set to 60 dB, and all lower level measurements are made relative to this reference. The previously measured error for the 60 dB setting is then accounted for in the measurement.

For frequencies above 2 GHz, an HP/Agilent 8563E signal analyzer is used to downconvert the frequency to 321.4 MHz.

### Required Test Equipment

- HP/Agilent 438A Power Meter
- HP/Agilent 8482A Power Sensor
- HP/Agilent 89441A Vector Signal Analyzer
- HP/Agilent 8563E Option 001 Signal Analyzer
- HP/Agilent 8491A/B Option 006 (6dB) Attenuator
- HP/Agilent 8495G Programmable Step Attenuator (0 to 70 dB)
- HP/Agilent 11713A Step Attenuator Driver

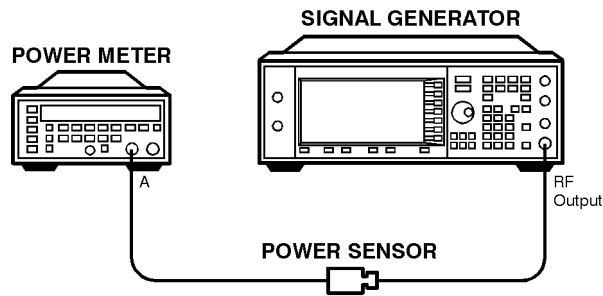
See [page 1-4](#) for Details on the following:

- Low Frequency Noise Amplifier (LNA)
- High Frequency Low Noise Amplifier (LNA)

## Procedure

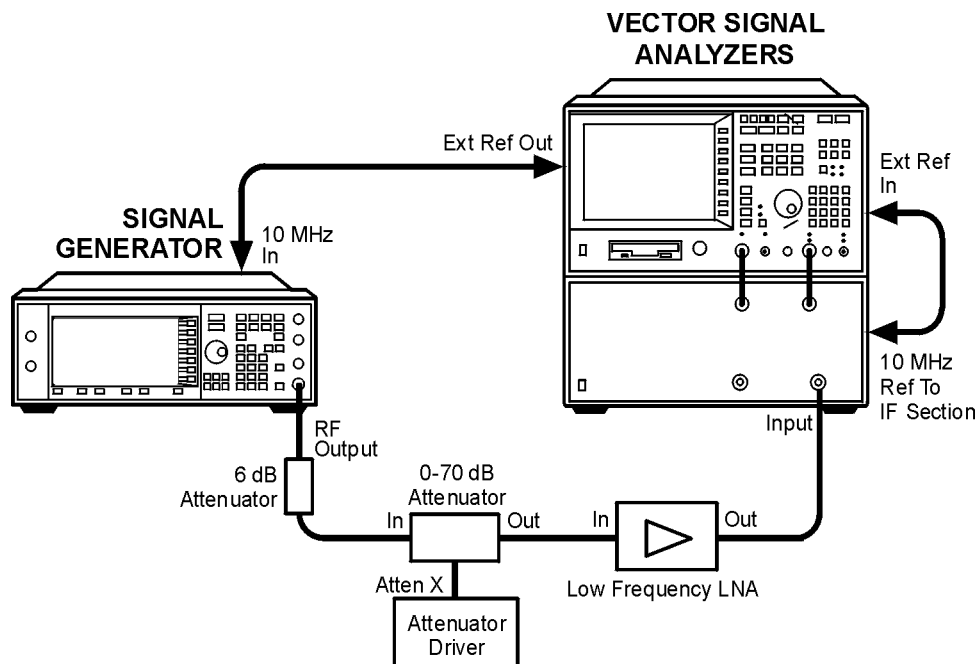
1. Connect the equipment as shown below.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

**Figure 5-29 High-Power, Power Level Accuracy Setup**

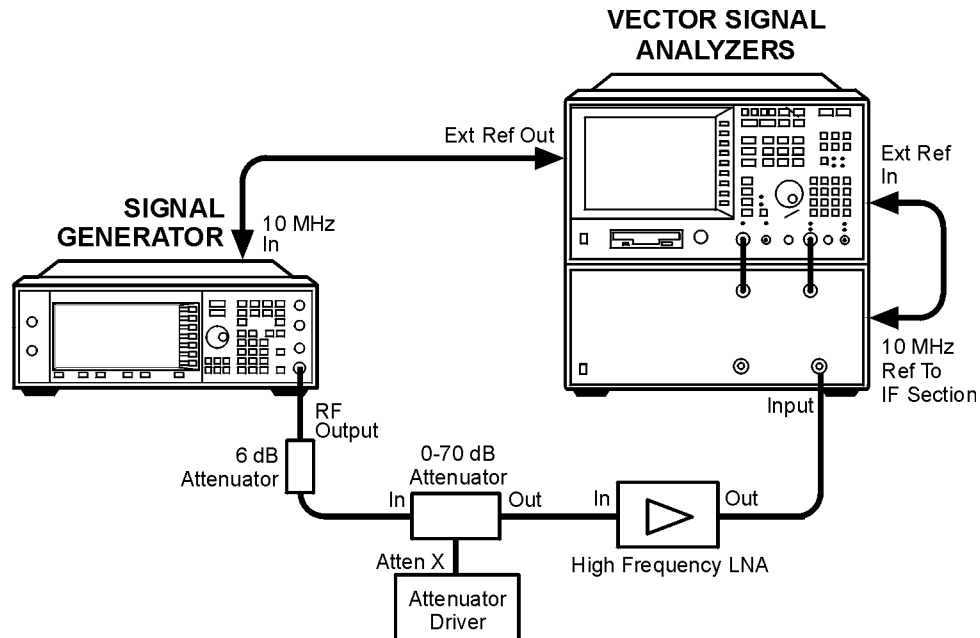


wk780a

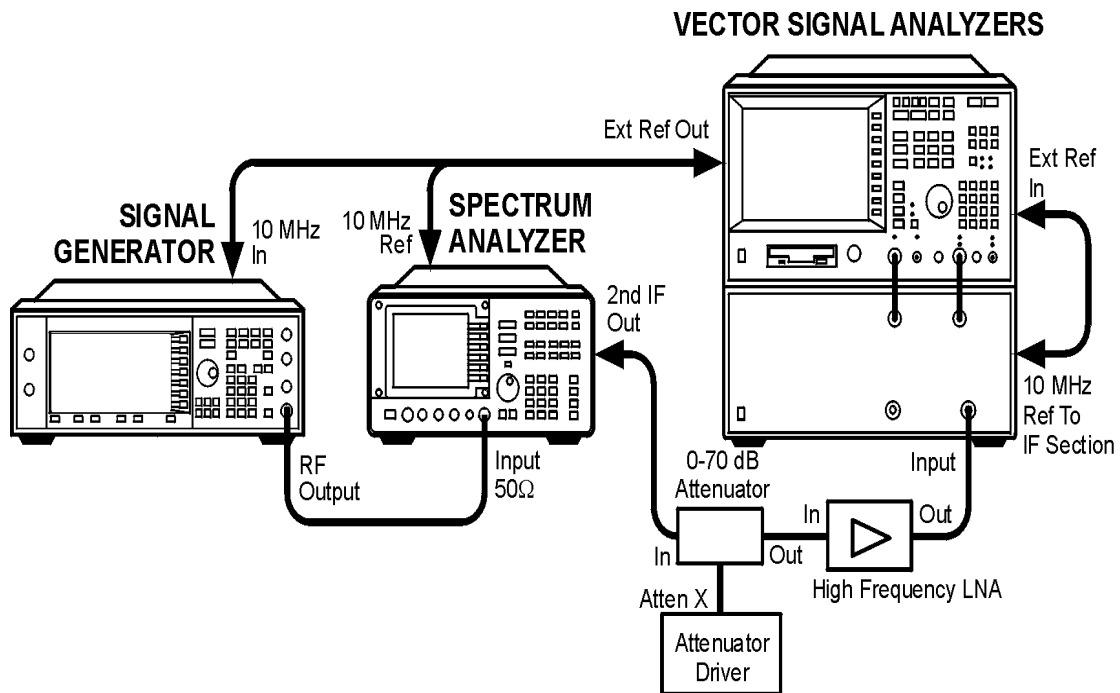
**Figure 5-30 Low-Power, Power Level Accuracy (< 10 MHz) Setup**



wk720b

**Figure 5-31 Low-Power, Power Level Accuracy ( $\geq 10$  MHz and  $\leq 2$  GHz) Setup**

wk713b

**Figure 5-32 Low-Power, Power Level Accuracy ( $> 2$  GHz) Setup**

wk715b

---

## Level Meter Calibration

### Description

This test determines the level meter gain and offset calibration constants on the output board. The level meter function is used when the ALC loop is open. It allows the output power of the signal generator to be monitored and controlled without using the ALC loop. After the level meter gain and offsets are measured, a calibration constant is calculated and stored in the appropriate calibration array.

### Required Test Equipment

- None

### Procedure

1. Preset the signal generator.
2. Follow the instructions as they appear on the controller's display.



---

## ALC Modulation Flatness Calibration

### Description

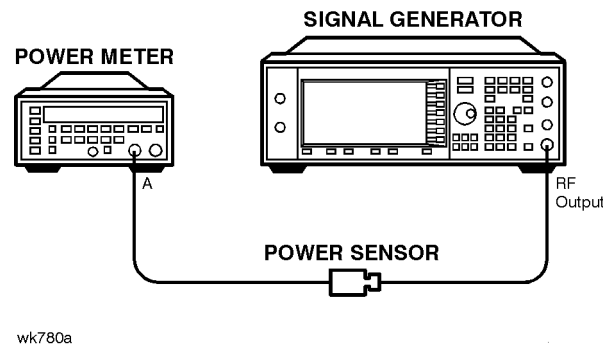
This test calibrates the ALC REF DAC corrections necessary to maintain power flatness in the ALC open-loop mode of operation. The nominal ALC REF DAC settings are adjusted to re-align the ALC open-loop power with the desired level. The resulting values are stored as calibration arrays in the signal generator's firmware.

### Required Test Equipment

- HP/Agilent 438A Power Meter
- HP/Agilent 8482A Power Sensor

### Procedure

**Figure 5-33 ALC Modulation Flatness Calibration Setup**



1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

## AM Gain Calibration

### Description

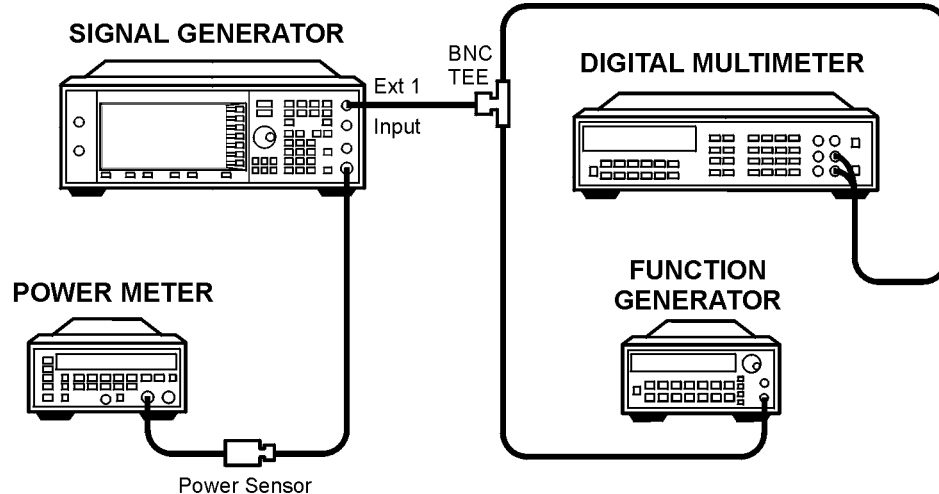
This test adjusts the gain of the AM circuitry to provide a 10 dB drop for a 1 V input signal. First a power level is set and a one-volt signal is connected to the input. AM is enabled and the AM DACs are adjusted for an exact 10 dB drop. The resulting DAC value is stored as a calibration array.

### Required Test Equipment

- HP/Agilent 438A Power Meter
- HP/Agilent 8482A Power Sensor
- HP/Agilent 33120A 15 MHz Function/Arbitrary Waveform Generator
- HP/Agilent 3458A Digital Multimeter

### Procedure

**Figure 5-34** AM Gain Calibration Setup



wk718b

1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display.

---

## I/Q Gain/Offset/Quadrature Calibration (ESG-D only)

### Description

This test determines the required I/Q gain, offset, and quadrature calibration constants/arrays that will minimize the I/Q modulation imperfections on the output board. Several calibration constants are determined and then the I/Q gain, offset, and quadrature DACs are adjusted over frequency to minimize the static vector modulation errors. The results are stored in the signal generator as calibration arrays.

### Required Test Equipment

- None

### Procedure

1. Preset the signal generator.
2. Follow the instructions as they appear on the controller's display.

---

## I/Q Impairment Adjustment (ESG-D only)

### Description

This adjustment sets internal calibration array values to minimize errors in the I/Q adjustments (I/Q gain, I offset, Q offset, and quadrature skew) in the I/Q menu.

---

NOTE	This adjustment assumes the I/Q Gain/Offset/Quadrature calibration has already been performed.
------	--

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### Required Test Equipment

- None

### Procedure

1. Preset the signal generator.
2. Follow the instructions as they appear on the controller's display.

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## Baseband Generator I/Q Gain and Offset Adjustment (ESG-A and ESG-D Options UN3 and UN4 only)

### Description

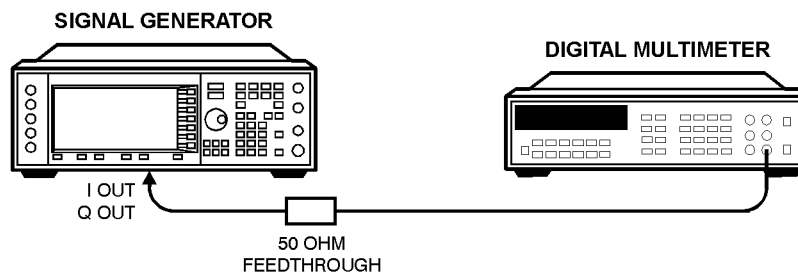
This adjustment uses a DVM to set the baseband generator's four potentiometers (I Gain, I Offset, Q Gain, and Q Offset) to minimize the dc offset and set the AC voltage level to  $0.5 V_{pk}$  (into 50 ohms) at the rear-panel I and Q output connectors.

### Required Test Equipment

- HP/Agilent 3458A Digital Multimeter
- HP/Agilent 10100C 50Ω Feed Through

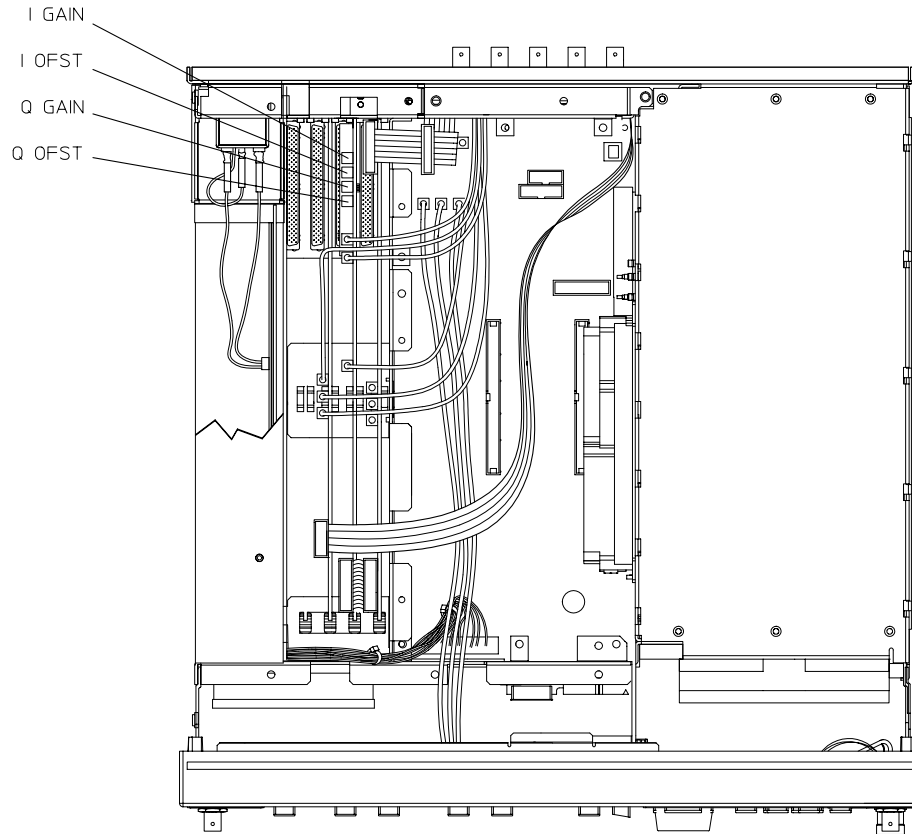
### Procedure

**Figure 5-35 Baseband Generator I/Q Gain and Offset Adjustment Setup**



wk74b

1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Follow the instructions as they appear on the controller's display. See [Figure 5-36](#) on page 5-44 for the location of the adjustments.

**Figure 5-36 Baseband Generator I/Q Gain and Offset Adjustment Location**

wk75b

## **6 Maintenance and Service**

This chapter contains preventive maintenance procedures, and it explains how to return a signal generator to Agilent Technologies for service.

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## Preventive Maintenance Procedures

The ESG Family Signal Generators require no regular maintenance. This section contains cleaning procedures for the signal generator.

### Cleaning the Cabinet

Use a damp cloth to clean the exterior of the instrument. Do not use any cleaning products.

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<b>WARNING</b>	<b>To prevent electrical shock, disconnect the signal generator from mains before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.</b>
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### Cleaning the Display

Use a soft cloth to clean the window in front of the display assembly. Isopropyl alcohol can also be used on the window for dirt that is difficult to remove. Do not use these products on the display assembly. Refer to the service guide, if the display assembly requires cleaning.

---

## Returning a Signal Generator for Service

If you are returning your signal generator to Agilent Technologies for servicing, fill out and attach a blue repair tag to the instrument. Repair tags are located at the end of this chapter.

Include as much information as possible about the problem: record any error messages that appeared on the display, and include performance test results or any other specific data on the performance of the signal generator.

Ship the instrument in the original factory packaging materials, if they are available. If not, use similar packaging to properly protect the instrument.

Return the instrument to the nearest Agilent Technologies sales and service office. A list of sales and service offices follows on the next page.



## Sales and Service Offices

**Table 6-1 Sales and Service Offices**

<b>UNITED STATES</b>		
<b>Instrument Support Center</b> Agilent Technologies (800) 403-0801		
<b>EUROPEAN FIELD OPERATIONS</b>		
<b>Headquarters</b> Agilent Technologies S.A. 150, Route du Nant-d'Avril 1217 Meyrin 2/ Geneva Switzerland (41 22) 780.8111	<b>France</b> Agilent Technologies France 1 Avenue Du Canada Zone D'Activite De Courtaboeuf F-91947 Les Ulis Cedex France (33 1) 69 82 60 60	<b>Germany</b> Agilent Technologies GmbH Agilent Technologies Strasse 61352 Bad Homburg v.d.H Germany (49 6172) 16-0
<b>Great Britain</b> Agilent Technologies Eskdale Road, Winnersh Triangle Wokingham, Berkshire RG41 5DZ England (44 118) 9696622		
<b>INTERCON FIELD OPERATIONS</b>		
<b>Headquarters</b> Agilent Technologies 3495 Deer Creek Rd. Palo Alto, CA 94304-1316 USA (650) 857-5027	<b>Australia</b> Agilent Technologies Australia 31-41 Joseph Street Blackburn, Victoria 3130 (61 3) 895-2895	<b>Canada</b> Agilent Technologies Canada 17500 South Service Road Trans-Canada Highway Kirkland, Quebec H9J 2X8 Canada (514) 697-4232
<b>Japan</b> Agilent Technologies Japan Measurement Assistance Center 9-1 Takakura-Cho, Hachioji Tokyo 192, Japan TEL (81) -426-56-7832 FAX (81) -426-56-7840	<b>Singapore</b> Agilent Technologies Singapore (Pte.) 150 Beach Road #29-00 Gateway West Singapore 0718 (65) 291-9088	<b>Taiwan</b> Agilent Technologies Taiwan 8th Floor, H-P Building 337 Fu Hsing North Road Taipei, Taiwan (886 2) 712-0404
<b>China</b> China Agilent Technologies 38 Bei San Huan X1 Road Shuang Yu Shu Hai Dian District Beijing, China (86 1) 256-6888		



## **7 Safety and Regulatory**

This chapter provides product warranty information, regulatory declarations, information about ESD and restricted materials, and explanations of caution and warning statements marked on the instrument.

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## Safety Notes

The following safety notes are used throughout this manual. Familiarize yourself with each of the notes and its meaning before operating this instrument.

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CAUTION	Caution denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, would result in damage to or destruction of the product. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.
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WARNING	<b>Warning denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.</b>
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# Instrument Markings

The following markings and caution and warning labels are used on the instrument. Be sure to observe all cautions and warnings.

**WARNING**      **No user serviceable parts inside. Refer servicing to qualified personnel.**



The instruction manual symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the manual.



The CE mark is a registered trademark of the European Community (if accompanied by a year, it is the year when the design was proven).



The CSA mark is the Canadian Standards Association safety mark.



The C-Tick Mark is a trademark registered to the Australian Communications Authority and indicates compliance with the standard which limits electromagnetic radiation from computing hardware.



This symbol is used to mark the on position of the power line switch.



This symbol is used to mark the standby position of the power line switch.



This symbol indicates that the input power required is AC.

ISM 1-A

This is a symbol of an Industrial Scientific and Medical Group 1 Class A product. (CISPER 11, Clause 4)

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## General Safety Considerations

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<b>WARNING</b>	<b>No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.</b>
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<b>WARNING</b>	<b>This is a Safety Class 1 Product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.</b>
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## Statement of Compliance

This product has been designed and tested in accordance with IEC Publication 1010, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

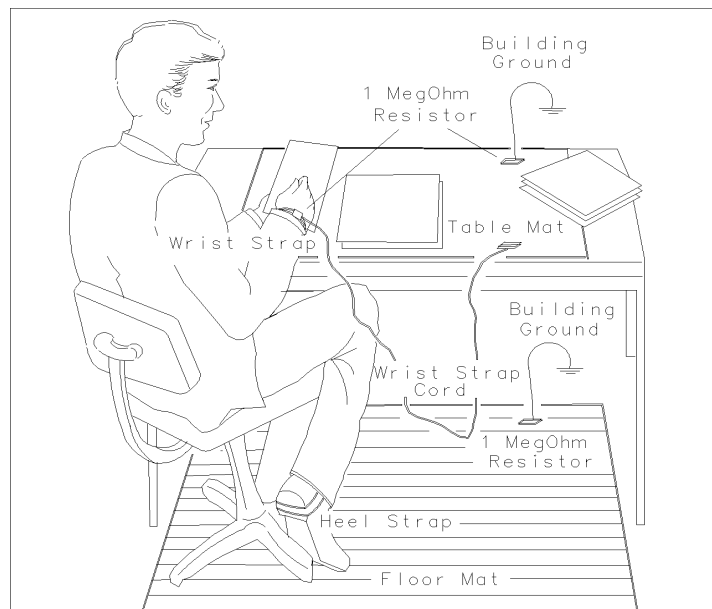
## Electrostatic Discharge

Electrostatic discharge (ESD) can damage or destroy electronic components. Therefore, all work performed on assemblies consisting of electronic components should be done at a static-free work station. [Figure 7-1](#) shows an example of a static-safe work station using two kinds of ESD protection:

- conductive table mat and wrist-strap combination
- conductive floor mat and heel-strap combination

These methods may be used together or separately.

**Figure 7-1 Static-Safe Work Station**



FORMAT46

## Reducing Potential for ESD Damage

The following suggestions may help reduce ESD damage that occurs during instrument testing and servicing:

- Before connecting any coaxial cable to a connector for the first time each day, momentarily ground the center and outer connectors of the cable.
- Ground personnel with a resistor-isolated wrist strap before touching any connector and before removing any assembly from the instrument.
- All instruments should be earth-grounded to prevent build-up of static discharge.



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## Warranty

This Agilent Technologies instrument product is warranted against defects in material and workmanship for a period of three years from date of shipment. During the warranty period, Agilent Technologies will, at its option, either repair or replace products which prove to be defective.

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

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

### LIMITATION OF WARRANTY

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

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

### EXCLUSIVE REMEDIES

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

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## Assistance

Product maintenance agreements and other customer assistance agreements are available for Agilent Technologies products. For any assistance, contact your nearest Agilent Technologies sales and service office. (See [“Sales and Service Offices”](#) on page 6-3.)

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## Certification

Agilent Technologies certifies that this product met its published specifications at the time of shipment from the factory. Agilent Technologies further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology, to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.



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## A

AC symbol, [7-3](#)  
add/remove programs, [3-5](#)  
adding datapacks, [3-17](#)  
adjustments, [5-1](#)  
    ALC modulation driver bias, [5-33](#)  
    ALC modulation flatness, [5-39](#)  
    AM audio path offset, [5-11](#)  
    AM gain, [5-40](#)  
    analog bus ADC, [5-5](#)  
    baseband generator I/Q gain and offset, [5-43](#)  
    burst audio path gain, [5-28](#)  
    burst modulator, [5-27](#)  
    DCFM, [5-24](#)  
    external input peak detector, [5-26](#)  
    FM 1/2 path ratio gain, [5-17](#)  
    FM delay potentiometer, [5-20](#)  
    FM in-band DAC offset, [5-15](#)  
    FM inverting amplifier offset, [5-16](#)  
    FM out-of-band, [5-19](#)  
    FM path offset, [5-14](#)  
    FM scale DAC offset, [5-13](#)  
    FM/PM OB cal and delay potentiometer, [5-22](#)  
    FM/PM YO frequency compensation calibration, [5-23](#)  
    gain adjust, [5-31](#)  
    I/Q gain/offset/quadrature, [5-41](#)  
    I/Q impairment, [5-42](#)  
    internal reference oscillator, [5-4](#)  
    internal source, [5-7](#)  
    KV versus frequency, [5-10](#)  
    level meter, [5-38](#)  
    LNF gain adjust, [5-32](#)  
    lock angle potentiometer, [5-9](#)  
    low frequency output, [5-25](#)  
    modulation source relative gain compression, [5-18](#)  
    power level accuracy, [5-35](#)  
    prelevel, [5-29](#), [5-30](#)  
    pretune calibration, [5-6](#)  
    relationships between adjustments, [5-2](#)  
    timebase DAC, [5-12](#)  
    VBLO mixer bias, [5-34](#)  
    VCO bias potentiometer, [5-8](#)  
    wide bandwidth phase modulation, [5-21](#)  
administration configuration  
    service software, [3-7](#)  
administration of service software, [3-6](#)  
ALC  
    calibrations  
        modulation driver bias, [5-33](#)  
        modulation flatness, [5-39](#)  
        power level accuracy (4-point fit), [5-35](#)  
alternate timeslot power settling time performance test, [4-35](#)

## AM

    accuracy, [4-10](#)  
AM accuracy check, [2-8](#)  
AM audio path offset calibration, [5-11](#)  
AM frequency response performance test, [4-14](#)  
AM gain calibration, [5-40](#)  
analog bus ADC calibration, [5-5](#)  
analyzer  
    audio, [1-2](#)  
    spectrum, [1-2](#)  
    vector signal, [1-2](#)  
arbitrary waveform generator, [1-3](#)  
assistance, [7-8](#)  
attenuator, [1-3](#)  
audio analyzer, [1-2](#)  
automatic leveling control calibration, [5-35](#)

## B

baseband generator I/Q gain and offset adjustment, [5-43](#)  
burst audio path gain calibration, [5-28](#)  
burst modulation on/off ratio performance test, [4-33](#)  
burst modulator calibration, [5-27](#)

## C

calibration cycle, [4-2](#)  
calibration due date, [3-9](#)  
calibration tracking number, [3-9](#)  
calibration type, [3-9](#)  
Canadian Standards Association, [7-3](#)  
carrier frequency offset, [4-17](#)  
caution sign, [7-2](#)  
CDMA adjacent channel power performance test, [4-34](#)  
CE mark, [7-3](#)  
certification, [7-9](#)  
    specifications, [7-9](#)  
choose destination location screen, [3-3](#)  
compliance  
    statement of, [7-5](#)  
configuring the software, [3-6](#)  
counter  
    universal, [1-3](#)  
CSA mark, [7-3](#)  
custom I/Q RF modulation quality performance test, [4-29](#)

## D

datapacks  
    adding, [3-17](#)

---

## *datapacks (Continued)*

- removing, [3-19](#)
- DCFM calibration, [5-24](#)
- DCFM frequency offset relative to CW performance test, [4-17](#)
- destination folder, [3-3](#)
- device drivers
  - adding, [3-12](#)
- device type, [3-8](#)
- digital
  - multimeter, [1-3](#)
  - oscilloscope, [1-2](#)
- digital modulation level accuracy performance test, [4-27](#)
- digitizing oscilloscope, [1-2](#)
- drivers
  - device, [3-12](#)
  - test
    - adding, [3-14](#)
    - removing, [3-17](#)
- dual arbitrary waveform generator check, [4-42](#)
- DUT
  - identifying, [3-7](#), [3-21](#)
- DUT selection window, [4-4](#)

## **E**

- electrostatic discharge, [7-6](#)
  - reducing potential for damage, [7-6](#)
- equipment required
  - adjustments, [1-2](#)
  - performance tests, [1-2](#)
  - service software, [3-2](#)
  - verification procedures, [2-2](#)
- equipment serial number
  - in software, [3-9](#)
- error messages
  - check for, [2-3](#)
- ESD, [7-6](#)
- European Community trademark, [7-3](#)
- exiting service software, [3-27](#)
- exiting support software, [4-8](#)
- external input peak detector calibration, [5-26](#)

## **F**

- FM, [4-9](#)
  - accuracy, [4-9](#)
  - residual performance test, [4-18](#)
- FM 1/2 path ratio gain calibration, [5-17](#)
- FM accuracy check, [2-7](#)

- FM delay potentiometer adjustment, [5-20](#)
- FM frequency response, [4-13](#)
- FM in-band DAC offset calibration, [5-15](#)
- FM inverting amplifier offset calibration, [5-16](#)
- FM out-of-band calibration, [5-19](#)
- FM path offset calibration, [5-14](#)
- FM scale DAC offset calibration, [5-13](#)
- FM/PM OB cal and delay potentiometer, [5-22](#)
- FM/PM YO frequency compensation calibration, [5-23](#)
- Frac-N/Divider assembly check, [4-45](#)
- frequency
  - standard, [1-2](#)
- frequency offset, [4-17](#)
- frequency range and accuracy check, [2-3](#)
- function generator, [1-3](#)

## **G**

- gain adjust calibration, [5-31](#)
- generator
  - arbitrary waveform, [1-3](#)
  - function, [1-3](#)
  - signal, [1-2](#)
- GPIB
  - interface card, [1-3](#)
- GPIB address
  - in software, [3-9](#)

## **H**

- harmonic spurious signals, [4-20](#)
- harmonic, subharmonic, and nonharmonic spurious signals performance test, [4-20](#)

## **I**

- I/Q gain/offset/quadrature calibration, [5-41](#)
- I/Q impairment adjustment, [5-42](#)
- I/Q modulation check, [2-9](#)
- I/Q modulation quality performance test, [4-31](#)
- identifying the DUT, [3-7](#), [3-21](#)
- IEC Publication 1010, [7-5](#)
- important information screen, [3-3](#)
- info file, [3-4](#)
- installation
  - service software, [3-3](#)
- instruction manual symbol, [7-3](#)
- instrument markings, [7-3](#)
- interface card, [1-3](#)
- internal
  - timebase, [4-24](#)

---

internal AM accuracy and distortion test, [4-10](#)  
internal digital modulation quality performance test, [4-28](#)  
internal reference oscillator adjustment, [5-4](#)  
internal source calibration, [5-7](#)  
ISM 1-A symbol, [7-3](#)

## K

KV versus frequency calibration, [5-10](#)

## L

level meter calibration, [5-38](#)  
list, [4-5](#)  
lock angle potentiometer adjustment, [5-9](#)  
low frequency output calibration, [5-25](#)  
low noise floor (LNF) gain adjust, [5-32](#)

## M

main test and results window, [4-7](#)  
maintenance agreements, [7-8](#)  
maintenance and service, [6-1](#)  
maintenance procedures  
    cleaning the cabinet, [6-2](#)  
    cleaning the display, [6-2](#)  
measuring receiver, [1-2](#)  
meter  
    power, [1-3](#)  
mixer, [1-3](#)  
modulation, [4-2](#)  
    burst on/off ratio performance test, [4-33](#)  
    internal digital quality performance test, [4-28](#)  
modulation source relative gain compression  
    calibration, [5-18](#)  
multimeter digital, [1-3](#)

## N

new test equipment window, [3-9](#)  
nonharmonic spurious signals, [4-20](#)

## O

operation verification, [2-1](#)  
option 1E6  
    pulse rise/fall time test, [4-36](#)  
oscilloscope  
    digital, [1-2](#)  
    digitizing, [1-2](#)  
    plug-in, [1-2](#)

output power level check, [2-4](#)

## P

password  
    service software, [3-20](#)  
performance tests  
    alternate timeslot power settling time, [4-35](#)  
    AM frequency response, [4-14](#)  
    burst modulation on/off ratio, [4-33](#)  
    CDMA adjacent channel power, [4-34](#)  
    custom I/Q RF modulation quality, [4-29](#)  
    DCFM frequency offset relative to CW, [4-17](#)  
    digital modulation level accuracy, [4-27](#)  
    dual arbitrary waveform generator check, [4-42](#)  
    FM frequency response, [4-13](#)  
    Frac-N/Divider assembly check, [4-45](#)  
    GSM loopback BER check, [4-44](#)  
    harmonic, subharmonic, and nonharmonic spurious signals, [4-20](#)  
    I/Q modulation quality, [4-31](#)  
    internal AM accuracy and distortion, [4-10](#)  
    internal digital modulation quality, [4-28](#)  
    internal FM accuracy and distortion, [4-9](#)  
    list, [4-5](#)  
    measuring phase noise and residual FM, [4-37](#)  
    modulation source frequency accuracy, [4-2](#)  
    phase modulation accuracy and distortion, [4-12](#)  
    phase modulation frequency response, [4-16](#)  
    power level accuracy, [4-21](#)  
    pulse modulation on/off ratio, [4-32](#)  
    pulse rise/fall time (option 1E6), [4-36](#)  
    records, [4-2](#), [4-46](#), [4-47](#)  
    residual FM, [4-18](#)  
    sampler/YO driver check, [4-45](#)  
    timebase aging rate, [4-2](#), [4-24](#)  
phase modulation accuracy and distortion  
    performance test, [4-12](#)  
phase modulation frequency response performance test, [4-16](#)  
plug-in, oscilloscope, [1-2](#)  
power  
    meter, [1-3](#)  
    sensor, [1-3](#)  
power flatness calibration, [5-35](#)  
power level accuracy performance test, [4-21](#)  
power on symbol, [7-3](#)  
prelevel calibration, [5-29](#), [5-30](#)  
pretune calibration, [5-6](#)  
preventive maintenance procedures, [6-2](#)  
printer, [1-3](#)  
printing test results, [4-8](#)

---

pulse modulation on/off ratio performance test, [4-32](#)  
pulse rise/fall time performance test, [4-36](#)

## Q

QSPK modulation, [4-27](#)

## R

readme file, [3-4](#)  
receiver  
    measuring, [1-2](#)  
recommended test equipment, [4-2](#)  
records, [2-10](#), [4-2](#), [4-46](#), [4-47](#), [4-48](#)  
removing datapacks, [3-19](#)  
removing test drivers, [3-17](#)  
removing test equipment, [3-10](#)  
required test equipment  
    adjustments, [1-2](#)  
    performance tests, [1-2](#)  
    service software, [3-2](#)  
    verification procedures, [2-2](#)  
residual FM performance test, [4-18](#)  
returning your signal generator, [6-2](#)  
running tests and adjustments  
    service software, [3-25](#)  
running the performance tests, [4-3](#)

## S

safety, [7-1](#)  
sales and service offices, [6-3](#)  
sampler/YO driver check performance test, [4-45](#)  
save as window, [4-6](#)  
saving test results, [4-6](#)  
    service software, [3-24](#)  
select test equipment and tests window, [4-5](#)  
sensor, [1-3](#)  
serial number  
    in software, [3-9](#)  
service software, [3-1](#)  
    adding test equipment, [3-8](#)  
    equipment required, [3-2](#)  
    installing, [3-3](#)  
    password, [3-7](#), [3-20](#)  
    running, [3-20](#)  
    starting, [3-20](#)  
    uninstalling, [3-5](#)  
    user name, [3-20](#)  
signal generator, [1-2](#)  
    returning, [6-2](#)

software  
    adding test equipment, [3-8](#)  
    administration, [3-6](#)  
    administration configuration, [3-7](#)  
    configuration, [3-6](#)  
    equipment required, [3-2](#)  
    exiting, [3-27](#)  
    GPIB address, [3-9](#)  
    installing, [3-3](#)  
    password, [3-7](#), [3-20](#)  
    printing test results, [3-27](#)  
    running, [3-20](#)  
    running adjustments, [3-25](#)  
    running tests, [3-25](#)  
    saving test results, [3-24](#)  
    selecting test equipment, [3-22](#)  
    service, [3-1](#)  
    uninstalling, [3-5](#)  
    user configuration, [3-7](#)  
    user name, [3-20](#)  
    viewing test results, [3-26](#)  
software, support, [4-3](#)  
spectrum analyzer, [1-2](#)  
spurious signals, [4-20](#)  
standby symbol, [7-3](#)  
starting the software, [3-20](#)  
statement of compliance, [7-5](#)  
static-safe work station, [7-6](#)  
subharmonic spurious signals, [4-20](#)  
support software, [4-3](#)  
    exiting, [4-8](#)

## T

tables  
    verification procedures, [2-10](#)  
test drivers  
    adding, [3-14](#)  
    removing, [3-17](#)  
    window, [3-14](#)  
test equipment  
    adjustments, [1-2](#)  
    editing, [3-11](#)  
    list, [4-5](#)  
    performance tests, [1-2](#)  
    recommended, [4-2](#)  
    removing, [3-10](#)  
    service software, [3-2](#)  
    verification procedures, [2-2](#)  
test equipment dialog box, [3-8](#), [3-10](#)  
test equipment drivers dialog box, [3-14](#)



---

test equipment selection  
    service software, [3-22](#)  
test records, [4-2](#), [4-46](#), [4-47](#), [4-48](#)  
test results  
    printing, [3-27](#), [4-8](#)  
    saving, [4-6](#)  
    viewing, [3-26](#)  
test tables, [2-10](#)  
timebase aging rate, [4-2](#)  
timebase aging rate performance test, [4-24](#)  
timebase DAC calibration, [5-12](#)  
trace number, [3-9](#)

## U

uninstalling the software, [3-5](#)  
universal counter, [1-3](#)  
user configuration  
    service software, [3-7](#)  
user information window, [4-3](#)  
user name  
    service software, [3-20](#)

## V

VBLO mixer bias calibration, [5-34](#)  
VCO bias potentiometer adjustment, [5-8](#)  
vector signal analyzer, [1-2](#)  
verification procedure tables, [2-10](#)  
verification procedures, [2-2](#)  
    test tables/records, [2-10](#)  
verifying operation, [2-1](#)

## W

warning sign, [7-2](#)  
warranty, [7-7](#)  
waveform generator, [1-3](#)  
welcome screen, [3-3](#)  
wide bandwidth phase modulation calibration, [5-21](#)  
window  
    DUT, [4-4](#)  
    main test and results, [4-7](#)  
    save as, [4-6](#)  
    select test equipment and tests, [4-5](#)  
    user information, [4-3](#)

## Y

YO  
    sampler driver check performance test, [4-45](#)

