

Calibration Guide
HP ESG and HP ESG-D Series Signal Generators



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1 Specifications

This chapter lists the specifications and supplemental characteristics for the analog HP ESG Series and digital HP ESG-D Series Signal Generators for instruments whose serial prefixes are documented by this manual.

Signal Generators Specifications

Specifications describe the instrument's warranted performance and apply after a 45 minute warm-up. All specifications are valid over the signal generator's entire operating and environmental range while in phase noise mode 2, unless otherwise noted.

Supplemental characteristics (shown in italics and denoted typical or nominal) provide additional, non-warranted information useful in applying the signal generator.

Frequency

Range (ESG Series):

| | |
|----------------|------------------|
| E4400B: | 250 kHz to 1 GHz |
| E4420B: | 250 kHz to 2 GHz |
| E4421B: | 250 kHz to 3 GHz |
| E4422B: | 250 kHz to 4 GHz |

Range (ESG-D Series):

| | |
|----------------|------------------|
| E4430B: | 250 kHz to 1 GHz |
| E4431B: | 250 kHz to 2 GHz |
| E4432B: | 250 kHz to 3 GHz |
| E4433B: | 250 kHz to 4 GHz |

Underrange: 100 kHz

Resolution: 0.01 Hz

Accuracy: Same as timebase

Switching Speed¹ (typical):**Modulation On:****Analog:** < 40 ms (45 ms, Option UNB)**Digital:** < 80 ms**Modulation Off:** < 35 ms

1. To within 0.1 ppm of final frequency above 250 MHz or within 100 Hz below 250 MHz.

Phase Offset: Phase is adjustable via HP-IB or from the front panel in nominal 0.1 degree increments.

| Frequency Bands: | | |
|-------------------------|--------------------------|------------|
| Band | Frequency Range | N # |
| 1 | 250 kHz to ≤ 249.999 MHz | 1 |
| 2 | > 249.999 to ≤ 500 MHz | 0.5 |
| 3 | > 500 MHz to ≤ 1 GHz | 1 |
| 4 | > 1 to ≤ 2 GHz | 2 |
| 5 | > 2 to 4 GHz | 4 |

Sweep Modes

Operating Modes: Frequency Step, Amplitude Step, and Arbitrary List

Dwell Time: 1 ms to 60 s

Number of Points: 2 to 401

Internal Reference Oscillator

| Stability: | | |
|------------------------------------|------------------------------------|--|
| | Standard | Option 1E5 |
| Aging Rate | < ±1 ppm/year | < ±0.1 ppm/year or < ±0.0005 ppm/day after 45 days |
| Temperature (0 to 55°C) | < ±1 ppm, typical | < ±0.05 ppm, typical |
| Line Voltage | < ±0.1 ppm, typical (+5%, -10%) | < ±0.002 ppm, typical (+5%, -10%) |

Timebase Reference Output:

| | |
|-------------------|---------------------------------------|
| Frequency: | 10 MHz |
| Amplitude: | > 0.35 V _{rms} into 50Ω load |

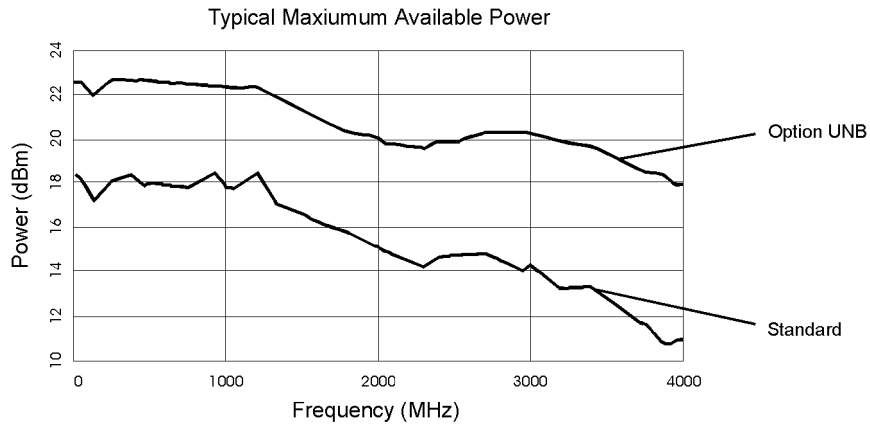
External Reference Input:

| | |
|-------------------------|--|
| Frequency: | 1, 2, 5, 10 MHz ± typically 10 ppm (typically 1 ppm, Opt. 1E5) |
| Amplitude: | > 0.15 V _{rms} |
| Input Impedance: | 50Ω |

Output

Power:

| | Electronic Attenuator (Standard) | Mechanical Attenuator (Option UNB) |
|--------------------------|-------------------------------------|---------------------------------------|
| 250 kHz to 1 GHz: | +13 to -136 dBm | +17 to -136 dBm |
| > 1 to 3 GHz: | +10 to -136 dBm | +16 to -136 dBm |
| > 3 to 4 GHz: | +7 to -136 dBm | +13 to -136 dBm |



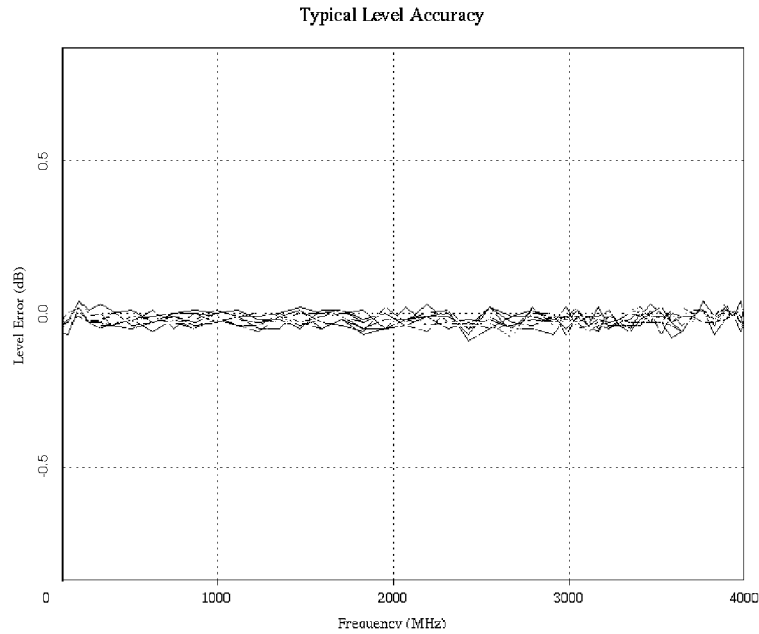
Resolution: 0.02 dB

Attenuator Hold Level Range:

| | Electronic Attenuator (Standard) | Mechanical Attenuator (Option UNB) |
|-------------------|---|---|
| 250 kHz to 1 GHz: | 23 dB | 27 dB |
| > 1 to 3 GHz: | 20 dB | 26 dB |
| > 3 to 4 GHz: | 17 dB | 23 dB |

| Level Accuracy ¹: | | | |
|-------------------------------------|------------------------|-------------------------|----------------------|
| Standard Attenuator | +7 to -127 dBm | | < -127 dBm |
| Option UNB | +10 to -120 dBm | -120 to -127 dBm | < -127 dBm |
| 250 kHz to 2 GHz: | ± 0.5 dB | ± 0.5 dB | ± 1.5 dB |
| > 2 to 3 GHz: | ± 0.9 dB | ± 0.9 dB | ± 2.5 dB |
| > 3 to 4 GHz: | ± 0.9 dB | ± 1.5 dB | ± 2.5 dB |

1. For 23° ±5°C. Accuracy degrades by 0.02 dB per degree C over the full temperature range and by 0.3 dB above +7 dBm (+10 dBm for Option UNB). Level accuracy specification maintained only with return to HP calibration.



Amplitude Switching Speed: *< 25 ms (< 30 ms, Option UNB), typical*
When Using Power Search: *< 235 ms (< 245 ms, Option UNB), typical*

Reverse Power Protection¹:

250 kHz to 2 GHz: 50 watts
> 2 to 4 GHz: 25 watts
Maximum DC Voltage: 50 V

1. The reverse power protection circuitry triggers at nominally 1 watt.

SWR (typical):

| | Electronic Attenuator (Standard) | Mechanical Attenuator (Option UNB) |
|--------------------------|---|---|
| 250 kHz to 2 GHz: | <i>< 1.4:1</i> | <i>< 1.25:1</i> |
| > 2 to 4 GHz: | <i>< 1.9:1</i> | <i>< 1.35:1</i> |

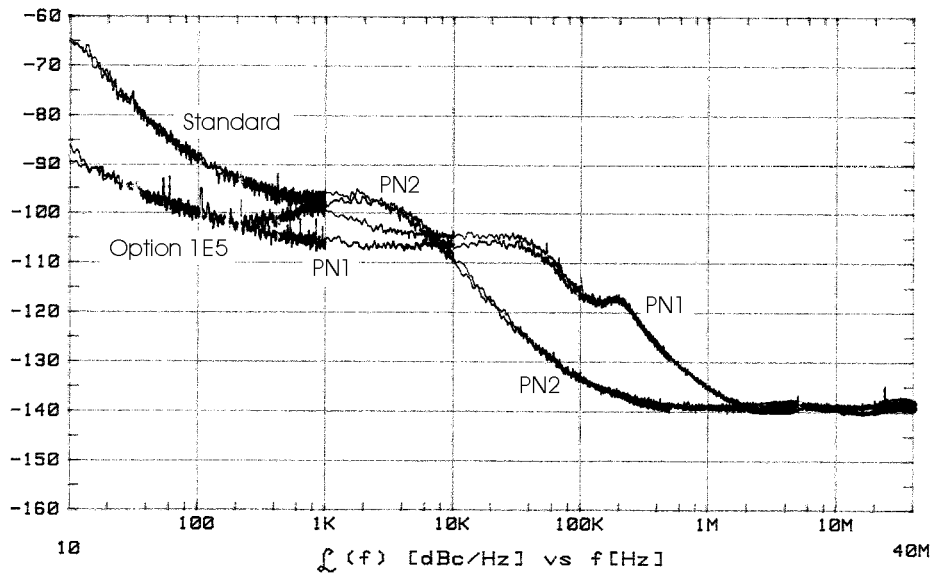
Output Impedance: 50Ω

Spectral Purity

SSB Phase Noise (typical, at 20 kHz offset):

- at 500 MHz:** < -120 dBc/Hz
- at 1 GHz:** < -116 dBc/Hz
- at 2 GHz:** < -110 dBc/Hz
- at 3 GHz:** < -104 dBc/Hz
- at 4 GHz:** < -104 dBc/Hz

Typical Single Sideband Phase Noise at 1 GHz (phase noise modes 1 and 2)



Residual FM¹ (CW mode, 0.3 to 3 kHz BW, CCITT, rms):

- Phase Noise Mode 1: < N x 2 Hz
- Phase Noise Mode 2: < N x 4 Hz

1. Refer to "Frequency Bands" on [page 1-3](#) to compute specifications.

Harmonics [$\leq +4$ dBm ($\leq +7.5$ dBm, Option UNB) output level]: < -30 dBc

| Nonharmonics [$< +7$ dBm ($< +10$ dBm, Option UNB) output level] ¹ : | | |
|--|--------------------------|--|
| | > 3 kHz Offset | > 10 kHz Offset (<i>typical</i>) |
| 250 kHz to 1 GHz: | < -65 dBc | < -75 dBc |
| > 1 to 2 GHz: | < -59 dBc | < -69 dBc |
| > 2 GHz: | < -53 dBc | < -63 dBc |

1. Performance is typical for spurs at frequencies above the maximum operating frequency of the instrument and with digital modulation on. Performance typically is -60 dBc between 225 and 249.999 MHz. Specifications apply for FM deviations < 100 kHz and are not valid for Φ M. For non-constant amplitude digital formats, unspecified spur levels occur up to the second harmonic of the baseband rates.

Subharmonics:

- ≤ 1 GHz: None
- > 1 GHz: < -40 dBc

Frequency Modulation

Maximum Deviation¹: $N \times 10$ MHz

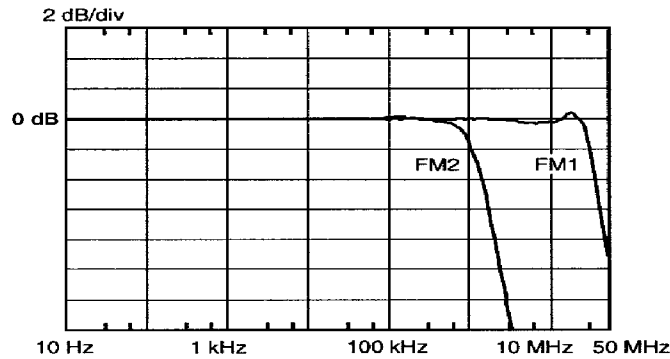
1. Refer to “Frequency Bands” on [page 1-3](#) to compute specifications.

Resolution: 0.1% of deviation or 1 Hz, whichever is greater

| Modulation Frequency Response ¹ (deviation = 100 kHz): | | |
|--|-----------------------|--|
| | Rates | |
| | 1 dB Bandwidth | 3 dB Bandwidth (<i>typical</i>) |
| FM 1: | dc/20 Hz to 100 kHz | dc/5 Hz to 10 MHz |
| FM 2: | dc/20 Hz to 100 kHz | dc/5 Hz to 1 MHz |

1. Since the internal modulation source operates over 0.1 Hz to 50 kHz, FM rates above 50 kHz must be supplied externally.

Typical FM 1 and FM 2 Frequency Response



Deviation Accuracy¹

(1 kHz rate, deviation < N x 100 kHz): $\pm(3.5\% \text{ of FM deviation setting} + 20 \text{ Hz})$

1. Refer to "Frequency Bands" on [page 1-3](#) to compute specifications.

Carrier Frequency Accuracy

Relative to CW in DCFM^{1,2}: $\pm 0.1\% \text{ of set deviation} + (N \times 1 \text{ Hz})$

1. Refer to the "Frequency Bands" on [page 1-3](#) to compute specifications.
2. At the calibrated deviation and carrier frequency, within 5 °C of ambient temperature at time of calibration.

Distortion¹ (1 kHz rate, THD, Deviations = N x 100 kHz): <math>< 1\%</math>

1. Refer to "Frequency Bands" on [page 1-3](#) to compute specifications.

External Inputs: Ext 1 or Ext 2

Sensitivity: 1 V_{peak} for indicated deviation

Input Impedance: 50Ω, nominal

Paths: FM 1 and FM 2 are summed internally for composite modulation. Either path may be switched to any one of the modulation sources: Int, Ext 1, Ext 2. The FM 2 path is limited to a maximum rate of 1 MHz. The FM 2 path must be set to a deviation less than FM 1.

Phase Modulation

Maximum Deviation:¹ $N \times 90$ radians

1. Refer to "Frequency Bands" on [page 1-3](#) to compute specifications.

Resolution: 0.1% of set deviation

| Modulation Frequency Response ¹ : | | | |
|---|--------------------------|------------------------------|------------------------------|
| Phase Modulation Mode | Maximum Deviation | Rates (3 dB BW) | |
| | | $\Phi M1$ | $\Phi M2$ |
| Normal | $N \times 90$ radians | dc - 100 kHz | dc - 100 kHz |
| High Bandwidth | $N \times 2\pi$ radians | <i>dc - 1.5 MHz, typical</i> | <i>dc - 0.9 MHz, typical</i> |
| | $N \times \pi/2$ radians | <i>dc - 4 MHz, typical</i> | <i>dc - 1 MHz, typical</i> |

1. Refer to "Frequency Bands" on [page 1-3](#) to compute specifications.

Deviation Accuracy (1 kHz rate): $< \pm(5\% \text{ of deviation} + 0.01 \text{ radians})$

Distortion¹ (1 kHz rate, THD, Deviations $< N \times 90$ radians): $< 1\%$

1. Refer to "Frequency Bands" on [page 1-3](#) to compute specifications.

External Inputs: Ext 1 or Ext 2

Sensitivity: $1 V_{\text{peak}}$ for indicated deviation

Input Impedance: 50Ω , nominal

Paths: $\Phi M 1$ and $\Phi M 2$ are summed internally for composite modulation. Either path may be switched to any one of the modulation sources: Int, Ext 1, Ext 2. The $\Phi M 2$ path is limited to a maximum rate of 1 MHz. The $\Phi M 2$ path must be set to a deviation less than $\Phi M 1$.

Amplitude Modulation at $F_c > 500$ kHz

AM is typical above 3 GHz or if wideband AM or I/Q modulation is simultaneously enabled.

Range (envelope peak \leq maximum specified power): 0 to 100%

Resolution: 0.1%

Rates (3 dB bandwidth): dc/10 Hz to 10 kHz

Accuracy (1 kHz rate): $< \pm(6\% \text{ of setting} + 1\%)$

Distortion (1 kHz rate, THD):

30% AM: $< 1.5\%$

90% AM: $< 4\%$, *typical*

External Inputs: Ext 1 or Ext 2

Sensitivity: 1 V_{peak} for indicated depth

Input Impedance: 50Ω , *nominal*

Paths: AM 1 and AM 2 are summed internally for composite modulation. Either path may be switched to any one of the modulation sources: Int, Ext 1, Ext 2.

Wideband AM (HP ESG-D Series Only)

Rate (1 dB bandwidth, *typical*):

ALC On: 400 Hz to 10 MHz

ALC Off: dc to 10 MHz

External Input: I input

Sensitivity: 0.5 V = 100%

Input Impedance: 50 Ω , *nominal*

Pulse Modulation

On/Off Ratio:

≤ 3 GHz: > 80 dB

> 3 GHz: > 60 dB

Rise/Fall Times: 150 ns, *typical*

Minimum Width:

ALC On: 2 μ s, *typical*

ALC Off: 0.4 μ s, *typical*

Pulse Repetition Frequency:

ALC On: 10 Hz to 250 kHz, *typical*

ALC Off: dc to 1.0 MHz, *typical*

Level Accuracy (relative to CW) ¹: ± 0.5 dB, typical

1. With ALC off, specifications apply after the execution of power search.
With ALC on, specifications apply for pulse repetition rates ≤ 10 kHz and pulse widths ≥ 5 μ s.

External Input: Ext 2

Input Voltage:

RF On: $> +0.5$ V, nominal

RF Off: $< +0.5$ V, nominal

Input Impedance: 50Ω , nominal

Internal Pulse Generator:

Squarewave Rate: 0.1 Hz to 50 kHz

Pulse:

Period: 16 μ s to 30 s

Width: 8 μ s to 30 s

Resolution: 4 μ s

Internal Modulation Source

Provides FM, Φ M, and AM modulation signals and LF Out.

Waveforms: Sine, Square, Ramp, Triangle, Pulse, and Noise

Rate Range:

Sine: 0.1 Hz to 50 kHz

Square, Ramp, Triangle: 0.1 Hz to 10 kHz

Resolution: 0.1 Hz

Pulse Only: 4 μ s

Frequency Accuracy: *0.005%, typical*

Swept Sine Mode (frequency, phase continuous):

Operating Modes: Triggered or continuous sweeps

Frequency Range: 0.1 Hz to 50 kHz

Sweep Time: 1 ms to 65 s

Resolution: 1 ms

Dual Sinewave Mode:

Frequency Range: 0.1 Hz to 50 kHz

Amplitude Ratio: 0 to 100%

Amplitude Ratio Resolution: 0.1%

LF Out (Internal Modulation Source)

Amplitude: 0 to 3 V_{peak} into 50Ω

Output Impedance: < 1Ω

External Modulation Inputs

Modulation Types:

Ext 1: FM, ΦM, AM, and Burst Envelope

Ext 2: FM, ΦM, AM, and Pulse

High/Low Indicator: *Indicator is activated when input level error exceeds 3% (nominal)*
(100 Hz to 10 MHz BW, AC-coupled inputs only)

Simultaneous Modulation

All modulation types may be simultaneously enabled, except: FM with Φ M, AM with burst envelope, and wideband AM with I/Q. AM, FM and Φ M can sum simultaneous inputs from any two sources (Int, EXT 1, and EXT 2.) Any given source (Int, EXT 1, or EXT 2) may only be routed to one activated modulation type.

Level Accuracy with Digital Modulation (HP ESG-D Series Only)

(With ALC On; relative to CW; with PRBS modulated data; if using I/Q inputs,

$$\sqrt{I^2 + Q^2} = 0.5 V_{\text{rms nominal}})^1$$

1. The optimum I/Q input level is $\sqrt{I^2 + Q^2} = 0.5 V_{\text{rms}}$. I/Q drive affects EVM, origin offset, spectral regrowth, and noise floor. Typically, level accuracy with ALC on will be maintained with drive levels between 0.25 and 1.0 V_{rms} .

$\pi/4$ DQPSK or QPSK Formats¹: ± 0.15 dB

1. Relative to CW; with raised cosine or root-raised cosine filter and $\alpha \geq 0.35$; with 10 kHz \leq symbol rate \leq 1 MHz; at RF frequency \geq 25 MHz; power \leq maximum specified -3 dB (-6 dB, Option UNB).

Constant Amplitude Formats (FSK, GMSK, etc): No degradation in power level accuracy

Level Accuracy with ALC Off¹: ± 0.3 dB, typical

(After power search is executed; relative to CW level with ALC on; with burst off; if external I/Q is

enabled: $\sqrt{I^2 + Q^2} = 0.5 V_{\text{rms}}$)

1. When applying external I/Q signals with ALC off, output level will vary directly with I/Q input level. Power search is an internal calibration routine used to set output power when ALC is off. The routine disables all modulation inputs, adjusts output power while applying 0.5 V_{rms} to the I/Q modulator, then enables modulation.

I/Q Modulation (HP ESG-D Series Only)

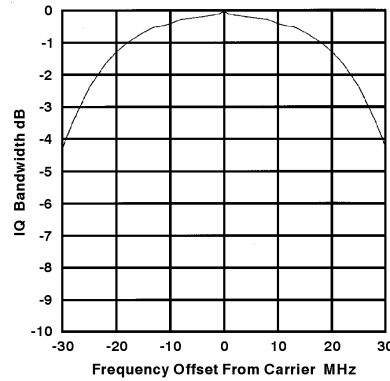
I/Q Inputs:

Input Impedance: 50 Ω

Full Scale Input: ¹ $\sqrt{I^2 + Q^2} = 0.5 V_{\text{rms}}$

1. The optimum I/Q input level is $\sqrt{I^2 + Q^2} = 0.5 V_{\text{rms}}$. I/Q drive affects EVM, origin offset, spectral regrowth, and noise floor. Typically, level accuracy with ALC on will be maintained with drive levels between 0.25 and 1.0 V_{rms} .

Typical I/Q Frequency Response



Adjustments/Impairments (nominal):

DC Offset (I and Q independently adjustable): $\pm 100\%$

I/Q Gain Ratio: ± 4 dB

I/Q Quadrature: $\pm 10^\circ$ (for $f_c \leq 3.3$ GHz)

| DC Vector Accuracy¹: [relative to full scale, power $\leq +7$ dBm ($\leq +10$ dBm, Option UNB)] | | | | |
|--|-----------------|-----------------|-----------------|----------------------------|
| Frequency (GHz): | < 0.6 | 0.6 to 2 | 2 to 3.7 | ≤ 4 |
| Static EVM (²rms): | < 0.75% | < 0.5% | < 0.75% | < 1% |
| Magnitude Error ²(rms): | < 0.5% | < 0.35% | < 0.5% | < 0.75% |
| Phase Error² (rms): | < 0.35° | < 0.25° | < 0.35° | < 0.5° |
| Origin Offset (dBc): | < -46 | < -46 | < -40 | < -40 |

1. Valid for 10 days after executing internal calibration routine, provided temperature is maintained within ± 5 °C of calibration temperature.

2. Measured at full scale with origin offset removed.

External Burst Envelope (HP ESG-D Series Only)

Input Voltage:

RF On: 0 V

RF Off: -1 V

Linear Control Range: 0 to -1 V

On/Off Ratio:

| | |
|------------------------|-----------|
| ≤ 3 GHz: | > 75 dB |
| > 3 GHz: | > 60 dB |
| V_{In}: | ≤ -1.05 V |

Rise/Fall Time: < 2 μs with rectangular input, typical

Minimum Burst Repetition Frequency:

| | |
|-----------------|----------------|
| ALC On: | 10 Hz, typical |
| ALC Off: | dc |

External Input: Ext 1

Input Impedance: 50Ω, nominal

Coherent Carrier Out (HP ESG-D Series Only)

Coherent Carrier is modulated by FM or ΦM when enabled.

Range: 250 MHz to maximum carrier frequency

Level: 0 dBm ±5 dB, typical

Impedance: 50Ω

I/Q Baseband Generator (Option UN8 Only)

Modulation:

- PSK:** BPSK, QPSK, OQPSK, $\pi/4$ DQPSK, 8PSK, 16PSK, D8PSK
MSK: User-defined phase offset from 0 to 100°
QAM: 4, 16, 32, 64, 256
FSK: Selectable: 2, 4, 8, 16 level symmetric
 Custom: Custom map of up to 16 deviation levels
 Deviation: Modulation index ≤ 1 , ≤ 1.5 Msymbols/second
 Modulation index ≤ 0.5 , ≤ 2.0 Msymbols/second
 Resolution: 0.1 Hz
I/Q: Custom map of 16 unique values for I and Q

Filter:

- Selectable:** Nyquist, Root Nyquist, Gaussian, Rectangular
 α : 0 to 1, B_bT : 0.1 to 1
Custom FIR: 256 coefficients, 16 bit resolution, 16 symbols long, automatically scaled

Symbol Rate: For external data or internal PN sequences in pattern mode, symbol rate is adjustable from 200 symbols/second to the maximum listed in the following table. For all other data types and data structures, the maximum bit rate is 5 Mbits/second.

| Bits/Symbol | Maximum Symbol Rate (Msymbols/second) | Maximum Data Rate (Mbits/second) |
|-------------|---------------------------------------|----------------------------------|
| 1 | 12.5 | 12.5 |
| 2 | 12.5 | 25 |
| 3 | 8.33 | 25 |
| 4 | 12.5 | 50 |
| 5 | 10 | 50 |
| 6 | 8.33 | 50 |
| 7 | 7.14 | 50 |
| 8 | 6.25 | 50 |

TDMA Data Structure:

Frames and timeslots may be configured as different types of traffic or control channels. The data field of a timeslot can accept a user file, PRBS (PN9 or PN15), or external data. The maximum bit rate is 5 Mbits/second.

Data Types:**Internally Generated Data:**

Pseudorandom Patterns
(meets ITU-T standard): Continuous PN9 (PRBS $2^9 - 1$), PN11 (PRBS $2^{11} - 1$), PN15¹ (PRBS $2^{15} - 1$), PN20 (PRBS $2^{20} - 1$), PN23 (PRBS $2^{23} - 1$)

Repeating Sequence: Any 4-bit sequence

Downloadable Data:

Maximum Bit Rate: 5 Mbits/second

Direct-pattern RAM (PRAM):

Maximum Size: 1 Mbits (Standard), 8 Mbits (Option UN9)

Use: Nonstandard framing

User File:

Maximum Size: 128 kbytes

Use: Continuous modulation or internally generated TDMA standard

Externally Generated Data:

Type: Serial data

Use: Real-time data

Inputs: Data, bit/symbol clocks
Accepts data rates $\pm 5\%$ of specified data rate

1. PN15 is not continuous in burst mode when TETRA is operated in a downlink mode.

Reference Frequency: Internal or external 1, 2, 5, 10 MHz reference
Data clock can be locked to an external 13 MHz (GSM) reference

Frame Trigger Delay Control:

Range: 0 to 65,535 bits

Resolution: 1 bit

Internal burst Shape Control:

(Varies with standards and bit rates)

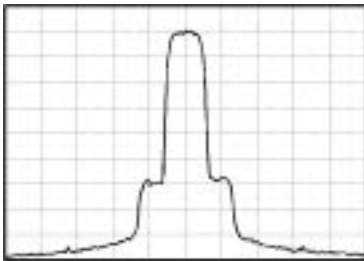
Rise/Fall Time Range: Up to 30 bits

Rise/Fall Delay Range: 0 to 63.5 bits (varies with standard)

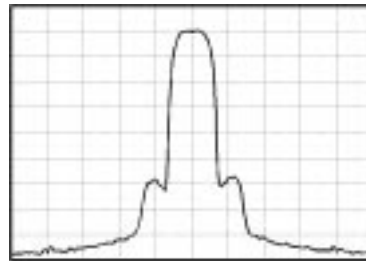
Digital Communications Standards

| | NADC | | PDC | | PHS | | TETRA | | DECT | GSM (DCS, PCS) | |
|--|------------------------|-------|-----------------------------------|-------|-------------------------|-------|---|--------------------|---|---|-------|
| Error Vector Magnitude¹ (% rms) | Cont. | Burst | Cont. | Burst | Cont. | Burst | Cont. | Burst | N/A | N/A | |
| Low EVM Mode | 0.7 | 1.4 | 0.9 | 1.3 | 0.9 | 0.9 | 0.8 | 1.7 | | | |
| Low EVM Mode (typical) | 0.4 | 1.1 | 0.6 | 0.9 | 0.6 | 0.7 | 0.5 | 1.3 | | | |
| Low ACP Mode (typical) | 1.0 | 1.4 | 0.8 | 1.0 | 0.9 | 0.9 | 0.9 | 1.5 | | | |
| Global Phase Error¹ (rms/pk) | N/A | | N/A | | N/A | | N/A | | N/A | 0.6°/2.2° 0.3°/1.3°, typ | |
| Deviation Accuracy¹ (kHz) | N/A | | N/A | | N/A | | N/A | | 3 (2, typ) | N/A | |
| Channel Spacing (kHz) | 30 | | 25 | | 300 | | 25 | | 1728 | 200 | |
| Adj. Channel Power¹(ACP) (Low ACP Mode, dBc, typical) | Cont. | Burst | Cont. | Burst | Cont. | Burst | Cont. | Burst ² | N/A | Cont. | Burst |
| at Adjacent Channel³ | -35 | -34 | -- | -- | -- | -- | -69 | -64 | | -37 | -37 |
| at 1st Alternate Channel³ | -80 | -78 | -74 | -72 | -80 | -78 | -80 | -78 | | -72 | -71 |
| at 2nd Alternate Channel³ | -82 | -81 | -- | -- | -80 | -79 | -81 | -80 | | -82 | -80 |
| at 3rd Alternate Channel³ | -84 | -83 | -81 | -79 | -- | -- | -81 | -80 | | -82 | -81 |
| Supported Burst Types | Custom, Up/Down TCH | | Custom, Up/Down TCH, Up Vox | | Custom, TCH, Sync | | Custom, Up Control 1&2, Up Normal, Down Normal, Down Sync | | Custom, Dummy B 1&2, Traffic B, Low Capacity | Custom, Normal, FCorr, Sync, Dummy, Access | |
| Scramble Capabilities | | | | | Yes | | Yes | | | | |

1. Specifications apply for the frequency range, symbol rates, root-raised cosine filter, filter factors (α or B_bT), and default scaling factor specified for each standard and at power levels $\leq +7$ dBm ($\leq +10$ dBm, Option UNB); for TETRA.
2. ACP for TETRA is measured over a 25 kHz bandwidth, with an 18 kHz root-raised cosine filter applied at power levels $\leq +4$ dBm ($\leq +8$ dBm, Option UNB).
3. The "channel spacing" determines the offset size of the adjacent and alternate channels: Adjacent channel offset = 1x channel spacing, 1st alternate channel = 2 x channel spacing, 2nd alternate channel = 3 x channel spacing, etc.



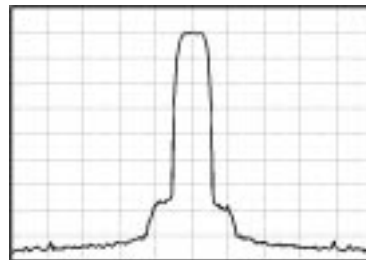
NADC Spectrum
 $F_c = 849 \text{ MHz}$
 Span = 0.3 MHz
 Scale = 10 dB/div
 Level = +4 dBm



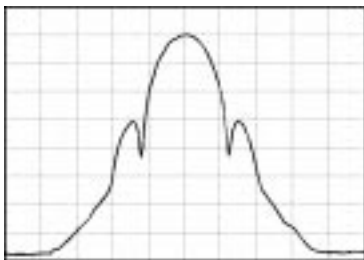
PDC Spectrum
 $F_c = 810 \text{ MHz}$
 Span = 0.25 MHz
 Scale = 10 dB/div
 Level = +4 dBm



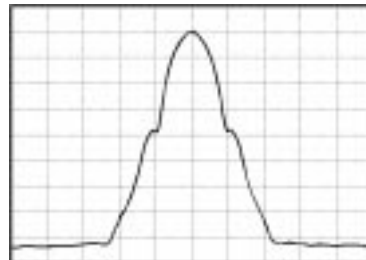
PHS Spectrum
 $F_c = 1907 \text{ MHz}$
 Span = 2 MHz
 Scale = 10 dB/div
 Level = +4 dBm



TETRA Spectrum
 $F_c = 400 \text{ MHz}$
 Span = 0.25 MHz
 Scale = 10 dB/div
 Level = +4 dBm



DECT Spectrum
 $F_c = 1800 \text{ MHz}$
 Span = 7 MHz
 Scale = 10 dB/div
 Level = +4 dBm



GSM Spectrum
 $F_c = 920 \text{ MHz}$
 Span = 2 MHz
 Scale = 10 dB/div
 Level = +4 dBm

I/Q Outputs

Baseband I/Q outputs can be scaled from 0 to 1 V_{p-p} into 50Ω¹.

1. Baseband I/Q outputs cannot be scaled for GSM and DECT.

| Standard | Default Scaling | Maximum V (rms) |
|----------------|-----------------|-----------------|
| NADC, PHS, PDC | 100 | 0.25 |
| TETRA | 65 | 0.25 |
| GSM, DECT | NA | 0.35 |

EVM (NADC, PDC, PHS, TETRA)¹: 1%

Global Phase Error (GSM)¹: 0.75° rms

Deviation Accuracy (DECT)¹: 1 kHz

1. Specifications apply for the frequency range, symbol rates, root Nyquist filter, filter factors, and the default scaling factor specified for each standard.

Custom Digitally Modulated Signals

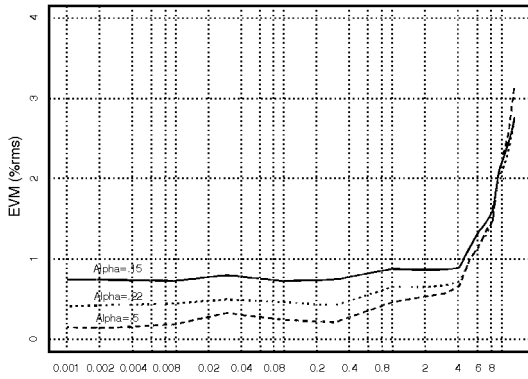
| Modulation: | QPSK | π/4DQPSK | 16QAM | 2FSK | GMSK |
|--|--|----------|-------|---|--|
| Filter: | Root Nyquist | | | Gaussian | |
| Filter Factor (α or B _b T): | 0.25 | 0.25 | 0.25 | 0.5 | 0.5 |
| Modulation Index: | N/A | N/A | N/A | 0.5 | N/A |
| Symbol Rate (Msymbols/second): | 4 | 4 | 4 | 1 | 1 |
| | Error Vector Magnitude¹ (% rms) | | | Shift Error¹ (% rms) | Global Phase Error¹ (degrees rms) |
| f_c=1 GHz: | 1.2 | 1.2 | 1.0 | 0.8 | 0.4 |
| f_c=2 GHz: | 1.3 | 1.3 | 1.2 | 0.9 | 0.4 |
| f_c=3 GHz: | 1.8 | 1.9 | 1.7 | 1.0 | 0.6 |
| f_c=4 GHz: | 3.7 | 3.6 | 4.0 | 1.3 | 1.0 |

1. Specifications apply at power levels ≤ +4 dBm (≤ +8 dBm, Option UNB) with default scale factor of I/Q outputs.

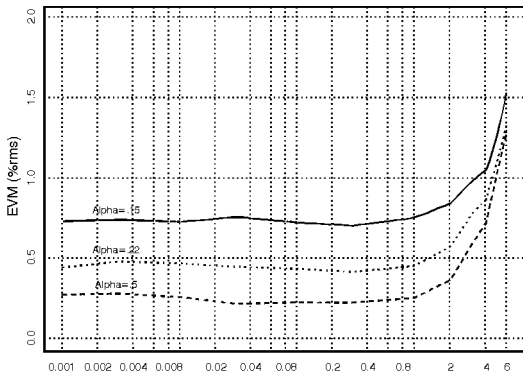
Typical Performance

Power levels $\leq +4$ dBm ($\leq +8$ dBm, Option UNB).

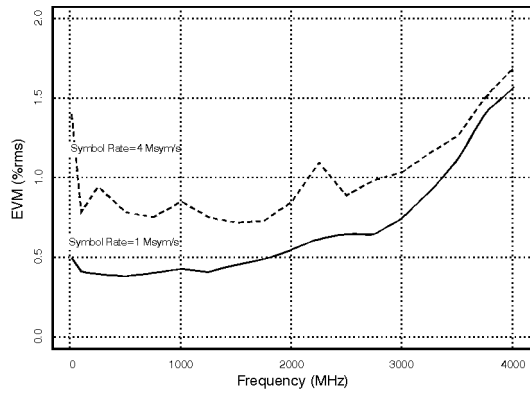
QPSK Formats.



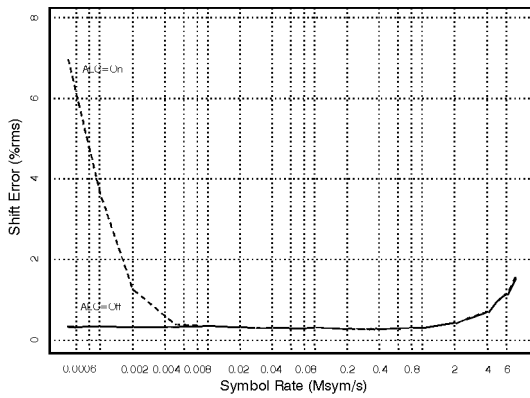
Baseband EVM performance versus symbol rate
(root Nyquist filter, modulation = QPSK)



RF EVM performance versus symbol rate
($f_c = 1$ GHz, root Nyquist filter, ALC = off, modulation = QPSK)

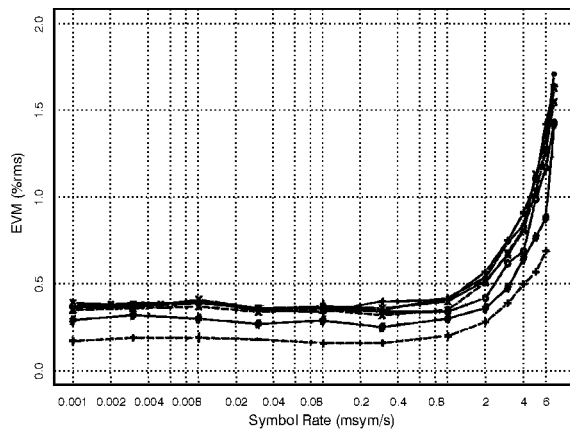


RF EVM performance versus frequency
(root Nyquist filter, $\alpha = 0.25$, ALC = off,
modulation = $\pi/4$ DQPSK)



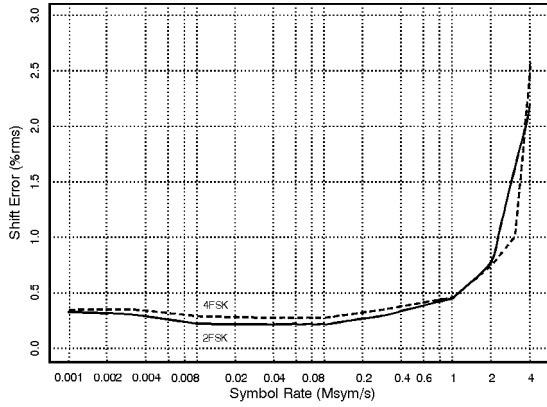
Effects of automatic level control (ALC) on EVM performance
($f_c = 1$ GHz, root Nyquist filter, $\alpha = 0.25$, modulation = QPSK)

Non-constant Amplitude Formats.

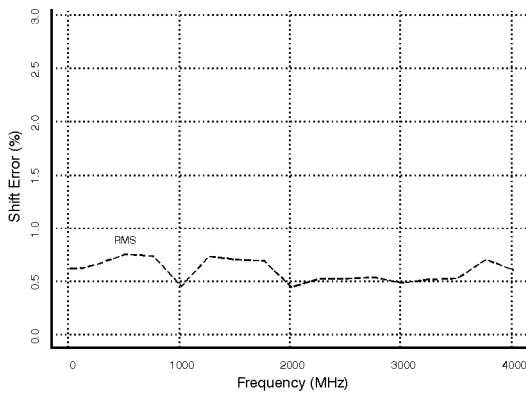


RF EVM performance versus symbol rate
($f_c = 1$ GHz, root Nyquist filter, $\alpha = 0.25$)

FSK Formats.

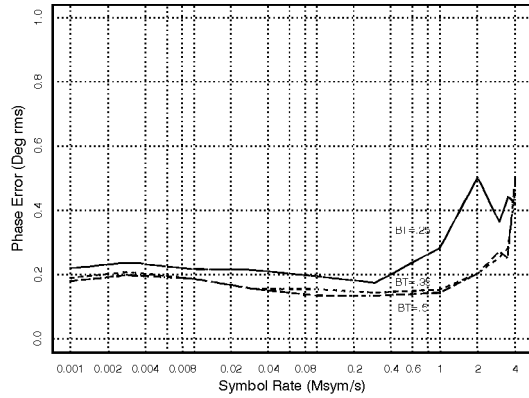


Shift error versus symbol rate
($f_c = 1$ GHz, Gaussian filter, $B_bT = 0.5$, modulation index = 0.5)

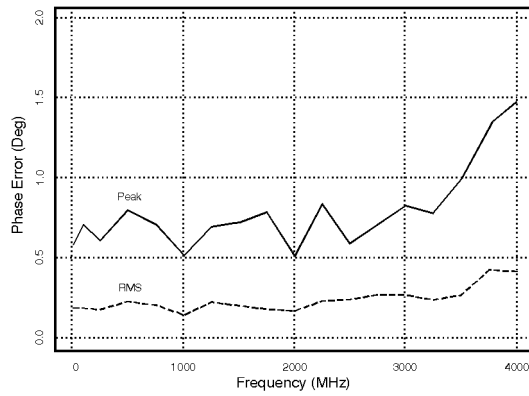


Shift error versus frequency
(Gaussian filter, $B_bT = 0.5$, modulation index = 0.5, symbol rate = 1 Msymbol/second)

MSK Formats.



Phase error versus symbol rate
($f_c = 1$ GHz, Gaussian filter)



Phase error versus frequency
(Gaussian filter, $B_b T = 0.5$, symbol rate = 1 Msymbol/second)

I/Q Outputs

Baseband I/Q outputs can be scaled from 0 to 1 V_{p-p} into 50Ω ¹.

1. Baseband I/Q outputs cannot be scaled for FSK and MSK.

| Custom Format ¹ | Default Scaling | Maximum V (rms) |
|----------------------------|-----------------|-----------------|
| FSK, MSK | NA | 0.35 |
| QPSK, BPSK | 70 | 0.32 |
| 8PSK, 16PSK, D8PSK | 70 | 0.20 |
| $\pi/4$ DQPSK | 70 | 0.25 |
| QAM | 70 | > 0.10 |

1. Filter factor (α or $B_b T$) is set to 0.5.

Alternate Timeslot Power Level Control (Option UNA Only)

Amplitude is settled within 0.5 dB in 20 μ s, from +4 to -136 dBm at 23° C \pm 5° C.

Dual Arbitrary Waveform Generator (Option UND Only)

Number of Channels: 2

Resolution: 14 bits (1/16384)

Waveform Memory:

Length (playback): 1 Megasample/channel

Length (storage): 1 Megasample/channel in non-volatile RAM

Waveform Segments:

Segment Length: 16 samples to 1 Megasample

Number of Segments: 1 to 128 (even number of samples)

Waveform Sequences:

Sequencing: Continuously repeating

Number of Sequences: 1 to 128

Segments/Sequence: 1 to 65,535

Segment Repetitions: 1 to 4,095

Clock:

Sample Rate: 1 Hz to 40 MHz

Resolution: 1 Hz

Accuracy: Same as timebase

Output Reconstruction Filters:

Type: Elliptic
FCutoff (nominal, 3 dB): *250 kHz, 2.5 MHz, 8 MHz, and through (user-supplied external filter)*

Baseband Spectral Purity (typical, full scale sinewave, > 20x oversampling):

Harmonic Distortion:

≤ 100 kHz: < -80 dBc
100 kHz to 2 MHz: < -65 dBc

Non-Harmonic Spurious: < -80 dBc
(spur frequencies ≤ 10 MHz)

Phase Noise (baseband output of 1 MHz sinewave at 20 kHz offset): < -120 dBc/Hz

IM Performance (two sinewaves at 950 kHz and 1050 kHz at baseband, full scale): < -69 dB

Triggers:

Types: Continuous, Single, Gated, Segment Advance
Source: Trigger Key, Bus, External
External Polarity: Negative, Positive
External Delay Time: 2 μs to 3.6 ks

Markers:

(Markers are defined in a segment during the waveform generation process, or from the HP ESG-D front panel. A marker can also be tied to the RF blanking feature of the HP ESG-D.)

Marker Polarity: Negative, Positive

Multitone:

Number of Tones: 2 to 64 (with selectable on/off state per tone)
Frequency Spacing: 100 Hz to 5 MHz
Bandwidth: *Up to 16 MHz, typical*
Phase (per tone): 0 to 360 Degrees

Additive White Gaussian Noise:

| | |
|--------------------------|--|
| Bandwidth: | 50 kHz to 15 MHz |
| Waveform Lengths: | 16, 32, 64, 128, 256, 512, 1024 ksamples |
| Noise Seeds: | Fixed, Random |

Multi-channel CDMA Personality (Option UN5 Only)

Frequency Range: 250 kHz to maximum instrument frequency

Chip (Symbol) Rate: 1.2288 MHz (default)
Adjustable from 1 Hz to 10 MHz with 4x oversampling

Modulation:

| | |
|-------------------------------|--|
| QPSK (forward): | with Walsh and Short Code spreading |
| Offset QPSK (reverse): | with Short Code spreading of random data |

Pre-defined Channel Configurations (power levels per IS-97-A):

| | |
|-------------------------|--|
| Pilot Channel: | Includes IS-95 modified filter, with equalizer |
| 9 Channel: | Includes pilot, paging, Sync, 6 traffic and IS-95 modified filter, with equalizer |
| 32 Channel: | Includes pilot, paging, Sync, 29 traffic and IS-95 modified filter, with equalizer |
| 64 Channel: | Includes pilot, 7 paging, Sync, 55 traffic and IS-95 modified filter, with equalizer |
| Reverse Channel: | Includes IS-95 filter |

Rho (≤ 4 dBm, IS-95 filter, ≤ 2 GHz, *typical*): *0.9996*

Pilot Time Offset: ≤ 2 μ s, *typical*

User-defined CDMA

Channel Table Editor:

| | |
|----------------------------|-----------------------|
| Number of Channels: | 1 to 256 |
| Walsh Codes: | 0 to 63 |
| Channel Power: | 0 to -40 dB |
| PN Offset: | 0 to 511 |
| Data: | 00–FF (HEX) or random |

| | |
|------------------------------------|--|
| Walsh Code Power Selection: | IS-97 compliant Equal channel power Scaled to 0 dB User-defined |
|------------------------------------|--|

| | |
|--------------------------------|--|
| IS-95 Filter Selection: | IS-95 IS-95 with equalizer IS-95 modified IS-95 modified with equalizer |
|--------------------------------|--|

All are IS-95 compliant. “Modified” filters reduce spurious emissions for adjacent channel power measurements.

Other FIR Filters:

| | |
|-------------------------------|---|
| Nyquist, Root Nyquist: | $\alpha = 0$ to 1 |
| Gaussian: | BT = 0.1 to 1 |
| Custom FIR: | Up to 256 coefficients 16-bit resolution Automatically scaled |

Oversample Ratio:

| | |
|--------------------|--------|
| Range: | 2 to 8 |
| Resolution: | 1 |

| Multi-channel CDMA Spurious Emissions¹ (dBc, with high crest factor on): | | | | | | |
|--|--------------------------|-----------------|-------------------------|-----------------|----------------------------------|-----------------|
| Channels/Offsets: | 0.885 to 1.25 MHz | | 1.25 to 1.98 MHz | | 1.98 to 5 MHz² | |
| | Std. | Opt. UNB | Std. | Opt. UNB | Std. | Opt. UNB |
| Reverse (at ≤ 0 dBm) | | | | | | |
| 30 - 200 MHz: | -66 (-72) | -70 (-75) | (-76) | (-78) | (-79) | (-79) |
| 700 - 1000 MHz: | -68 (-73) | -72 (-76) | (-76) | (-79) | (-79) | (-79) |
| 1000 - 2000 MHz: | -63 (-66) | -70 (-74) | (-70) | (-78) | (-79) | (-79) |
| 9/64 Channels (at ≤ -2 dBm) | | | | | | |
| 30 - 200 MHz: | -65 (-68) | -68 (-71) | (-73) | (-76) | (-78) | (-78) |
| 700 - 1000 MHz: | -64 (-70) | -69 (-73) | (-75) | (-77) | (-79) | (-79) |
| 1000 - 2000 MHz: | -60 (-63) | -67 (-71) | (-68) | (-75) | (-78) | (-78) |

- 1. Parenthesis denote typical performance.
- 2. Specifications apply with high crest factor off.

Multicarrier:

- Number of Carriers:** Predefined 3 or 4, user-defined up to 12
- Carrier Channels:** Pilot, 9 Channel, 32 Channel, 64 Channel, Reverse, Custom
- Frequency Offset (per carrier):** ± 7.5 MHz
- Offset Resolution:** < 100 Hz
- Carrier Power (per carrier):** 0 dB to -40 dB

Bit Error Rate Test (Option UN7 Only)

| | |
|--|---|
| Clock Rate: | 100 Hz to 10 MHz |
| Supported Data Patterns: | PN9 and PN15 |
| Resolution: | 10 digits [6 digits for BER (exponential display mode)] |
| Minimum Synchronization Length: | |
| 2 Mbps Mode: | 9 bits (PN9), 15 bits (PN15) |
| 10 Mbps Mode: | 43 bits (PN9), 48 bits (PN15) |
| Bit Sequence Length: | 100 bits to 4.294 Gbits, after synchronization |

| Features: | | |
|--|-------------|--------------|
| | 2 Mbps Mode | 10 Mbps Mode |
| Real-time Display | | |
| Bit Count: | X | X |
| Error Bit Count: | X | |
| Bit Error Rate: | X | |
| Pass/Fail Indication: | X | X |
| Valid Data and Clock Detection: | X | X |
| Automatic Re-synchronization: | X | |
| Special Pattern Ignore: | X | |

Inputs:

Data, Clock, and Clock Gate:

| | |
|----------------------------|--|
| Clock Duty Cycles: | 30% to 70% |
| Input Level: | TTL or 75Ω |
| 75Ω Voltage Levels: | 1.4 V for low to high 1.2 V for high to low |
| Polarity: | Selectable |
| Connectors: | Rear-panel BNC (SMB with Option 1EM) |
| Damage Levels: | < -4 V, > 8 V |

Outputs:

| | |
|--|---|
| Connectors: | Rear-panel SMB |
| Damage Levels: | <-4 V, > 8 V |
| Sync Loss Output: | Outputs a TTL signal that is low when sync is lost. Valid only when "Measure End" is high. |
| No Data Detection Output: | Outputs a TTL signal that is low when no data is detected. Valid only when "Measure End" is high. |
| Error Bit Output (Not Supported at 10 Mbps Rate): | Outputs 80 ns (typical) pulse when error bit is detected. |
| Test Result Output: | Outputs a TTL signal that is high for fail and low for pass. Valid only on "Measure End" falling edge. |
| Measure End Output: | Outputs a TTL signal that is high during measurement. Trigger events are ignored while high. |

Remote Programming

| | |
|--|--|
| Interface: | HP-IB (IEEE-488.2-1987) with Listen and Talk. RS-232. |
| Control Languages: | SCPI version 1992.0, also compatible with HP 8656B and 8657A/B/C/D/J ¹ mnemonics. |
| 1. HP ESG Series and HP ESG-D Series do not implement HP 8657A/B 'Standby' or 'On' (R0 or R1, respectively) mnemonics. | |
| Functions Controlled: | All front panel functions except power switch and knob. |
| IEEE-488 Functions: | SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT0, C0, E2 |

ISO Compliant

The HP ESG Series and ESG-D Series Signal Generators are manufactured in an ISO 9001 registered facility in concurrence with Hewlett-Packard's commitment to quality.

General

Power Requirements: 90 to 254 V; 50, 60, or 400 Hz; 200 W maximum

Operating Temperature Range: 0 to 55 °C

Storage Temperature Range: -40 to +71 °C

Shock and Vibration: Meets MIL STD 28800E Type III, Class 3

Leakage: Conducted and radiated interference meets MIL STD 461C CE02 Part 2 and CISPR 11. Leakage is typically < 1 μ V (nominally 0.1 μ V with a 2-turn loop) at \leq 1000 MHz, measured with a resonant dipole antenna one inch from any surface with output level < 0 dBm (all inputs/outputs properly terminated).

Storage Registers: Memory is shared by instrument states, user data files, sweep list files, and waveform sequences. Depending on the number and size of these files, up to 800 storage registers and 10 register sequences are available.

Weight: < 12.7 kg (28 lb.) net, < 21 kg (46 lb.) shipping

Dimensions: 133 mm H x 426 mm W x 432 mm D
(5.25 in. H x 16.8 in. W x 17 in. D)

Accessories

Transit Case, HP Part Number 9211-1296

HP 83300A Remote Interface

Options

| | |
|-----|---|
| 0B0 | Deletes Standard Manual Set |
| 0B1 | Adds Extra Manual Set |
| 0BV | Adds Component Level Information Package |
| 0BW | Adds Service Documentation (Assembly Level Repair) |
| 0BX | Adds Service Documentation and Component Level Information Package |
| 1CM | Adds Rack Mount Kit |
| 1CN | Adds Front Handles |
| 1CP | Adds Rack Mount Kit with Handles |
| 1E5 | Adds High Stability timebase |
| 1EM | Moves All Front Panel Connectors to Rear Panel |
| AB0 | User's Information, Chinese for Taiwan Translation |
| AB1 | User's Information, Korean Translation |
| AB2 | User's Information, Chinese Translation |
| ABD | User's Information, German Translation |
| ABE | User's Information, Spanish Translation |
| ABF | User's Information, French Translation |
| UN5 | Adds Multi-channel CDMA Personality |
| UN7 | Adds Bit Error Rate Test |
| UN8 | Adds Real-Time I/Q Baseband Generator with TDMA Standards and 1 Mbit of RAM |
| UN9 | Adds 7 Mbits RAM to Option UN8 |
| UNA | Adds Alternate Timeslot Power Level Control |
| UNB | Adds Higher Power with Mechanical Attenuator |
| UND | Adds Internal Dual Arbitrary Waveform Generator |
| W50 | Adds Additional Warranty for a Total of Five Years |

2 Equipment Required

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

Required Equipment

- HP 8902A Measuring Receiver¹
 - FM accuracy: $\pm 2\%$ of reading ± 1 digit
 - AM accuracy: $\pm 2\%$ of reading ± 1 digit
 - Range: 250 kHz to 1300 MHz
 - Filters: 300 Hz high pass and 15 kHz and 3 kHz low pass
 - Detectors: Peak+
- HP 54610B Digital Oscilloscope¹
 - Bandwidth: 500 MHz
- HP 5071A Primary Frequency Standard
 - Frequency: 10 MHz
 - Stability: $> 1 \times 10^{-10}$ /year
- HP 8903B Option 051 Audio Analyzer¹
 - Distortion accuracy: ± 1 dB
 - Residual distortion: -80 dB at 80 kHz BW
 - 30 kHz low pass filter
 - AC level accuracy: $\pm 4\%$
- HP 8563E Option 007 Spectrum Analyzer¹
 - Frequency range: 100 kHz to 4000 MHz
 - Relative level accuracy (harmonic and spurious measurements) ± 2 dB
 - Displayed average noise level (1 Hz BW) -110 dBm at 100 kHz, -130 dBm at 1 MHz 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
- HP 89441A Options AY7, AYA, AY9, AYB, UFG, UG7, and AYH Vector Signal Analyzer^{1,2}
 - No Substitution

1. Equipped with HP-IB computer interface.
2. Used only with ESG-D models.

- HP 8663A Signal Generator¹
 - Frequency Range: 11.5 MHz to 2500 MHz
 - Output level: +16 dBm
 - Meets HP 8663A single-sideband phase noise specifications
- HP 8904A Function Generator¹
 - Frequency range (sinewave): 0 Hz to 600 kHz
 - AC Amplitude (sinewave only):
 - Range: 0 to 10Vp-p into a 50Ω load
 - Flatness (>630 mVp-p into 50Ω): ±0.1% (±0.009 dB), 0.1 Hz to 100 kHz
- HP 53132A Option 050 Universal Counter¹
 - Frequency range: 4 GHz
 - Resolution: 0.1 Hz
 - External timebase input
- HP 33120A Option 001 Arbitrary Waveform Generator¹ (2)
 - No Substitution
- HP 438A Power Meter¹
 - Instrumentation accuracy: ±0.5%
 - Power reference accuracy: 0.9%

1. Equipped with HP-IB computer interface.

- HP 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): $\leq 1.6\%$
- HP 8447D Preamplifier-Amplifier
Frequency range: 100 kHz to 1.3 GHz
Gain (mean, per channel): 22 dB ± 1.5 dB (20 ° to 30 °C)
- HP 8449B Preamplifier
Frequency range: 1.0 to 26.5 GHz
Gain (mean, per channel): ≤ 26 dB (20 ° to 30 °C)
Noise figure: 1.0 to 26.5 GHz (≤ 8.5 dB typical) 7 dB
- MD/MDC-174 Mixer
Frequency range: 0.001 to 2.8 GHz
- MD/MDC-164 Mixer
Frequency range: 0.5 to 9 GHz
- HP 8491A/B Option 006 Attenuator
Attenuation: 6 dB
- HP 3458A Digital Multimeter¹
DC Volts: 0.1 V to 100 V
Input resistance: 10 Ω to 1 K Ω

1. Equipped with HP-IB computer interface.

- HP 8491A/B Option 010 Attenuator
Attenuation: 10 dB
- HP Vectra Personal Computer
CPU: 386 (or better)
Clock: 33 MHz (or faster)
RAM: 8Mb (or more)
3.5-inch disk drive
350 Mb (or more) hard drive
16-color VGA monitor
MS Windows® 3.X or MS Windows 95 (Microsoft Windows is a registered trademark of Microsoft Corp.)
- HP LaserJet 5L Printer
MS Windows supported
- HP 82341C HP-IB Interface Card with SICL HP I/O Library installed
No Substitution

3 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 to specifications 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.

Verification Procedures

Perform the following procedures in the order they are presented.

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

Equipment Required

- HP 5350A Frequency Counter
- HP 438A Power Meter
- HP 8482A Power Sensor
- HP 8563E Spectrum Analyzer
- HP 8491A/B Option 006 Attenuator (6 dB)
- HP 8491A/B Option 010 Attenuator (10 dB)
- HP 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.
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 service 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. Then restart this procedure at Step 2, "Check for Error Messages."

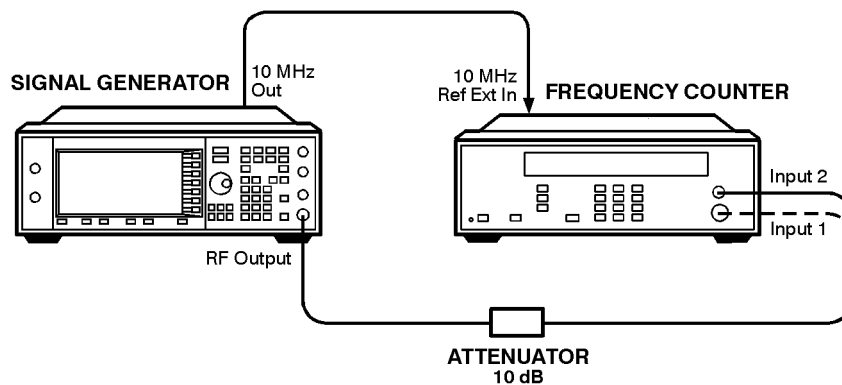
NOTE For signal generators with Option 1E5, ERROR 514, Reference Oven Cold will occur whenever the signal generator is first connected to AC line power. The **OVEN COLD** annunciator and the **ERR** annunciator will both turn on. The **OVEN COLD** annunciator will automatically clear after approximately 5 minutes. The error queue *cannot* be cleared, however, until the **OVEN COLD** annunciator has turned off.

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 3-1 Frequency Range and Accuracy Equipment Setup



wk7106a

Configure the Signal Generator

1. Preset the signal generator to normal (factory-defined) preset conditions.
2. For frequencies < 10 MHz:
 - a. Set the amplitude to 10 dBm. Press **Amplitude**. Enter 10 dBm using the numeric keypad and pressing the **dBm** terminator softkey.
 - b. Turn the RF output on. Press **RF On/Off**. The **RF ON** annunciator should be turned on.

3. For frequencies > 10 MHz:
 - a. Set the amplitude to 0 dBm. Press **Amplitude**. Enter 0 dBm using the numeric keypad and pressing the **dBm** terminator softkey.
 - b. Turn the RF output on. Press **RF On/Off**. The **RF ON** annunciator should be turned on.

Configure the Frequency Counter

1. For frequencies < 10 MHz use Input 2. Press **1 MΩ**.
2. For frequencies > 10 MHz and ≤ 500 MHz use Input 2. Press **50 Ω**.
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.

Measure the Frequency Accuracy

1. Set the frequencies shown in Table 3-1 (to the maximum frequency of your signal generator).
2. For each measurement point, measure the carrier frequency with modulation turned off. Press **Mod On/Off**. The **MOD OFF** annunciator should be turned on.
3. Record the measured frequency in Table 3-1.
4. Compute the error (difference) and compare it to the corresponding limits.

Table 3-1 Frequency Accuracy Measurement Points

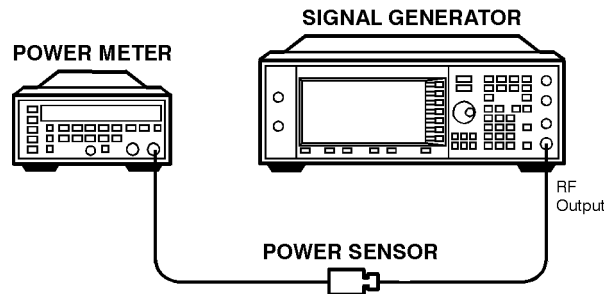
| Frequency (MHz) | Limits | | |
|-----------------|----------------|---------------|----------------|
| | Lower (Hz) | Measured (Hz) | Upper (Hz) |
| 0.25 | 99 999. | | 100 001. |
| 0.5 | 499 999. | | 500 001. |
| 1 | 999 999. | | 1 000 001. |
| 10 | 9 999 999. | | 10 000 001. |
| 50 | 49 999 999. | | 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. |

4. Power Level Accuracy Check

Performing this check will provide a high level of confidence and a verification that the signal generator's power level circuitry is functioning correctly. The 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. Contact your nearest HP service center for information concerning calibration.

Connect the Test Equipment for Setup 1

Figure 3-2 Power Level Accuracy Equipment Setup 1



wk7107a

Configure the Signal Generator

1. Preset the signal generator to normal (factory-defined) preset conditions.
2. Set the frequency to 277 kHz. Press **Frequency**. Enter 277 kHz using the numeric keypad and pressing the **kHz** terminator softkey.
3. Set the amplitude to 13 dBm. Press **Amplitude**. Enter 13 dBm using the numeric keypad and pressing the **dBm** terminator softkey.
4. Turn modulation off. Press **Mod On/Off**. The **MOD OFF** annunciator should be turned on.
5. Turn the RF output on. Press **RF On/Off**. The **RF ON** annunciator should be turned on.

Configure the Power Meter

1. Zero and calibrate the power meter.
2. Set the power meter to measure absolute log power (dBm). Make sure to set the power meter cal factor as necessary for each frequency.

Measure the Power Level Accuracy

1. Set the power levels and the frequencies shown in the following table (to the maximum frequency of your signal generator).
2. Record the measured power level in the following table and compare it to the corresponding limits.

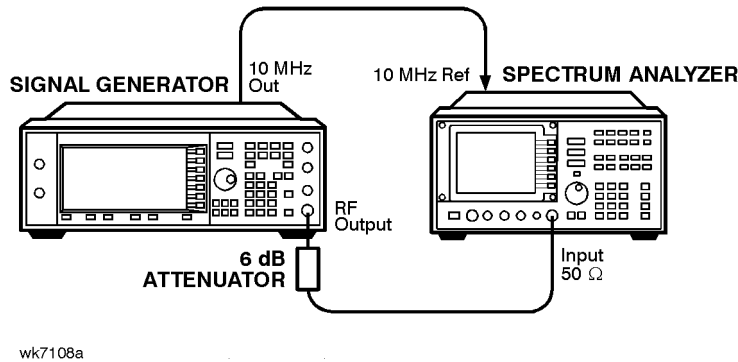
Table 3-2 Power Level Accuracy Measurement Points for Setup 1

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

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

Connect the Test Equipment for Setup 2

Figure 3-3 Power Level Accuracy Equipment Setup 2



Configure the Signal Generator

1. Set the frequency to 277 kHz. Press **Frequency**. Enter 277 kHz using the numeric keypad and pressing the **kHz** terminator softkey.
2. Set the amplitude to -15 dBm. Press **Amplitude**. Enter -15 dBm using the numeric keypad and pressing 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 3-2 to the Power Meter Reading for -15 dBm column in Table 3-3.
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 reads other than 0 dB, select **Marker Normal**, **Peak Search**, and **Marker Delta** until the marker reads 0 dB.
6. Decrease the signal generator amplitude in 10 dB steps to -85 dBm. At each 10 dB step, select **Peak Search** to ensure that the marker is at the signal peak.
7. Measure for each of the frequencies listed and record the results in the Spectrum Analyzer Marker column of Table 3-3 (to the maximum frequency of your signal generator).
8. Return the spectrum analyzer reference level back to -15 dBm 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 3-3 and repeat the process from Step 3 until all of the frequencies have been measured and recorded.

Calculate the Actual Power Level

1. Calculate and record the Actual Power Level as the sum of the Power Meter Reading for -15 dBm and the Spectrum Analyzer's Marker value.

For example:

- Power Meter Reading for -15 dBm at 2.516 MHz = -14.95 dBm
- Spectrum Analyzer Marker 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

Table 3-3 Power Level Accuracy Measurement Points for Setup 2

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

| Frequency Setting | Power Level Setting | Power Meter Reading for -15 dBm | Spectrum Analyzer Marker (dB) | Lower Limit | Actual Power Level | Upper Limit |
|--------------------------|----------------------------|--|--------------------------------------|--------------------|---------------------------|--------------------|
| 2.516 MHz | -15 dBm | | 0 (Ref) | N/A | N/A | N/A |
| | -25 dBm | | | -26 | | -24 |
| | -35 dBm | | | -36 | | -34 |
| | -45 dBm | | | -46 | | -44 |
| | -55 dBm | | | -56 | | -54 |
| | -65 dBm | | | -66 | | -64 |
| | -75 dBm | | | -76 | | -74 |
| | -85 dBm | | | -86 | | -84 |
| 270.1 MHz | -15 dBm | | 0 (Ref) | N/A | N/A | N/A |
| | -25 dBm | | | -26 | | -24 |
| | -35 dBm | | | -36 | | -34 |
| | -45 dBm | | | -46 | | -44 |
| | -55 dBm | | | -56 | | -54 |
| | -65 dBm | | | -66 | | -64 |
| | -75 dBm | | | -76 | | -74 |
| | -85 dBm | | | -86 | | -84 |
| 510.1 MHz | -15 dBm | | 0 (Ref) | N/A | N/A | N/A |
| | -25 dBm | | | -26 | | -24 |
| | -35 dBm | | | -36 | | -34 |
| | -45 dBm | | | -46 | | -44 |
| | -55 dBm | | | -56 | | -54 |
| | -65 dBm | | | -66 | | -64 |
| | -75 dBm | | | -76 | | -74 |
| | -85 dBm | | | -86 | | -84 |
| 990.1 MHz | -15 dBm | | 0 (Ref) | N/A | N/A | N/A |
| | -25 dBm | | | -26 | | -24 |
| | -35 dBm | | | -36 | | -34 |
| | -45 dBm | | | -46 | | -44 |

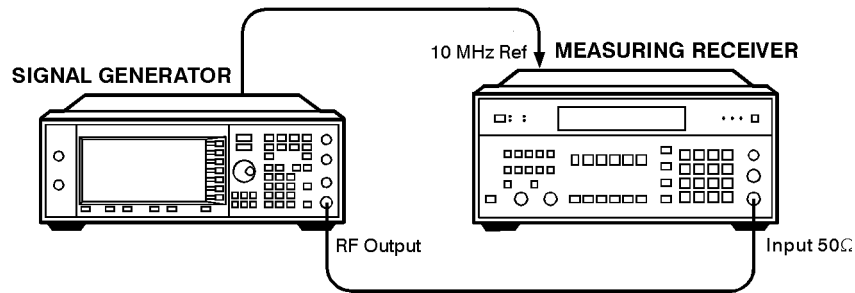
| Frequency Setting | Power Level Setting | Power Meter Reading for -15 dBm | Spectrum Analyzer Marker (dB) | Lower Limit | Actual Power Level | Upper Limit |
|--------------------------|----------------------------|--|--------------------------------------|--------------------|---------------------------|--------------------|
| | -55 dBm | | | -56 | | -54 |
| | -65 dBm | | | -66 | | -64 |
| | -75 dBm | | | -76 | | -74 |
| | -85 dBm | | | -86 | | -84 |
| 1350.1 MHz | -15 dBm | | 0 (Ref) | N/A | N/A | N/A |
| | -25 dBm | | | -26 | | -24 |
| | -35 dBm | | | -36 | | -34 |
| | -45 dBm | | | -46 | | -44 |
| | -55 dBm | | | -56 | | -54 |
| | -65 dBm | | | -66 | | -64 |
| | -75 dBm | | | -76 | | -74 |
| | -85 dBm | | | -86 | | -84 |
| 1950.1 MHz | -15 dBm | | 0 (Ref) | N/A | N/A | N/A |
| | -25 dBm | | | -26 | | -24 |
| | -35 dBm | | | -36 | | -34 |
| | -45 dBm | | | -46 | | -44 |
| | -55 dBm | | | -56 | | -54 |
| | -65 dBm | | | -66 | | -64 |
| | -75 dBm | | | -76 | | -74 |
| | -85 dBm | | | -86 | | -84 |
| 2310.1 MHz | -15 dBm | | 0 (Ref) | N/A | N/A | N/A |
| | -25 dBm | | | -26 | | -24 |
| | -35 dBm | | | -36 | | -34 |
| | -45 dBm | | | -46 | | -44 |
| | -55 dBm | | | -56 | | -54 |
| | -65 dBm | | | -66 | | -64 |
| | -75 dBm | | | -76 | | -74 |
| | -85 dBm | | | -86 | | -84 |

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

5. FM Accuracy Check

Connect the Test Equipment

Figure 3-4 FM Accuracy Equipment Setup



wk7109a

Configure the Signal Generator

1. Preset the signal generator to normal (factory-defined) preset conditions.
2. Enable FM. Press **FM/ΦM**, **FM Off On**. The **FM** annunciator should turn on.
3. Set the FM rate to 1 kHz. Press **FM Rate** and enter 1 kHz using the numeric keypad and pressing the **kHz** terminator softkey.
4. Set the FM deviation to 100 kHz. Press **FM Dev** and enter 100 kHz using the numeric keypad and pressing the **kHz** terminator softkey.
5. Set the amplitude to 7 dBm. Press **Amplitude** and enter 7 dBm using the numeric keypad and pressing the **dBm** terminator softkey.
6. Check to be sure that modulation is turned on. The **MOD ON** annunciator should be turned on. If it is not, press **Mod On/Off**.
7. Turn on the RF output. Press **RF On/Off**. The **RF ON** annunciator should be turned on.

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 3-4.
2. Record the deviations measured and compare them to the limits shown in Table 3-4.

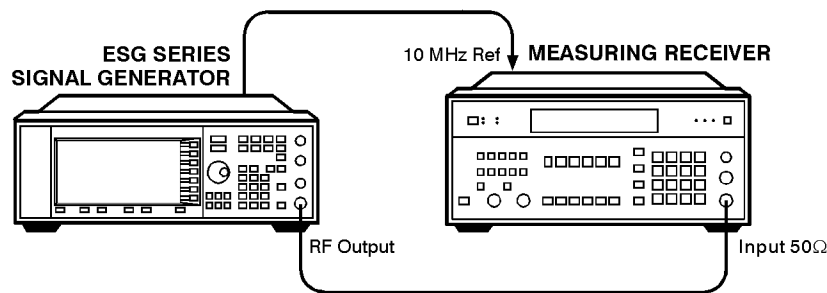
Table 3-4 FM Accuracy Measurement Points

| 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 |

6. AM Accuracy Check

Connect the Test Equipment

Figure 3-5 AM Accuracy Equipment Setup



wk719a

Configure the Signal Generator

1. Preset the signal generator to normal (factory-defined) preset conditions.
2. Enable AM. Press **AM**, **AM Off On**. The **AM** annunciator should turn on.
3. Set the AM rate to 1 kHz. Press **AM Rate** and enter 1 kHz using the numeric keypad and pressing the **kHz** terminator softkey.
4. Set the amplitude to +7 dBm. Press **Amplitude** and enter +7 dBm using the numeric keypad and pressing the **dBm** terminator softkey.
5. Check to be sure that modulation is turned on. The **MOD ON** annunciator should be turned on. If it is not, press **Mod On/Off**.
6. Turn on the RF output. Press **RF On/Off**. The **RF ON** annunciator should be turned on.

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 3-5.
2. Record the AM depths measured and compare them to the limits shown in Table 3-5.

Table 3-5 AM Accuracy Measurement Points

| 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 |

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

1. Preset the signal generator to normal (factory-defined) preset conditions.
2. Press I/Q, I/Q Calibration. If Calibration Type Full is not highlighted, toggle the softkey to select 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.

4 Service Software

The ESG Series 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 uninstalling the software. For a description of the individual performance tests and adjustments, refer to [Chapter 5, “Performance Tests,”](#) and [Chapter 6, “Adjustments.”](#)

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® ¹ 3.x or MS Windows 95 (This version of the service support software will *not* operate properly with MS Windows NT®².)
- 2 Button Mouse (optional)
- Printer, MS Windows-supported (for test results documentation)
- HP 82341C/D HP-IB Interface Card
 - HP SICL Libraries must be installed and configured.

NOTE No other MS Windows programs may be running during installation. Close any MS Windows programs that are currently running prior to starting the installation.

1. Microsoft Windows is a registered trademark of Microsoft Corporation.
2. Windows NT is a U.S. registered trademark of Microsoft Corporation.

Installing the ESG_B Service Software

NOTE If you are installing this software, ESG_B Service Software version A.03.00, on to a computer that already has an older version of the service software, you must first remove the old version before installing the new software.

Follow this procedure to install the ESG_B 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: 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 HP ESG Service Software’s Welcome screen is displayed.

4. Continue with the setup by selecting the Next button.
5. Once the Next button is selected, the HP ESG Service Software’s Important Information screen 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 on the computer monitor before continuing with the software installation!

| Button | Action |
|---------------|--|
| Next | Continue to the next step of the installation |
| Back | Step the installation one step back to the previous screen |
| Cancel | Stop the installation and return the computer to the main MS Windows screen. |

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

Once the Next button is selected, the Choose Destination Location screen is displayed. The default location for installing the software is `C:/HP_SVC/ESG_B`. You are strongly urged to use this as the software’s destination folder.

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

Once the Next button is selected, the HP ESG Service Software’s Select Program Folder screen 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 box or select a folder from the Existing Folders list. We suggest “HP ESG_B Service Software” as a good folder name.

NOTE This documentation refers to the folder name as “HP ESG_B Service Software” in the future, so if you use another name for the folder, be aware that you will have to note this difference.

8. Continue with the setup by selecting the **Next** button.

When this step is complete, the HP ESG_B 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.

NOTE This is the last point that you can cancel the installation. If you select the **Next** button, the installation proceeds until the software is completely installed.

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 on the left keeps you updated on the files that are being copied to the destination folder, and the progress of the installation.

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

10. Insert the next disk and select the **OK** button.

When the installation is complete, the Setup Complete screen 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.

12. The MS Windows program must be restarted before you can use the software. Select the **Yes, I want to restart my computer now** radio button. Then choose the **Finish** button to restart MS Windows.

If you do not want to restart MS Windows at this time, select the **No, I will restart my computer later** radio button. Remember, however, that you must restart MS Windows before you can use the software. When you select restart, the computer reboots and you can start using the software.

Uninstalling the Software

- MS Windows 95:
 1. Display the Control Panel program group by selecting 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_B Service Software, then select the Add/Remove button.
 4. 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, then 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 Series Support Software Administration

The following section shows you how to administer and run the ESG Series 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 Series test set, or maintenance releases of the current drivers.

Software Configuration

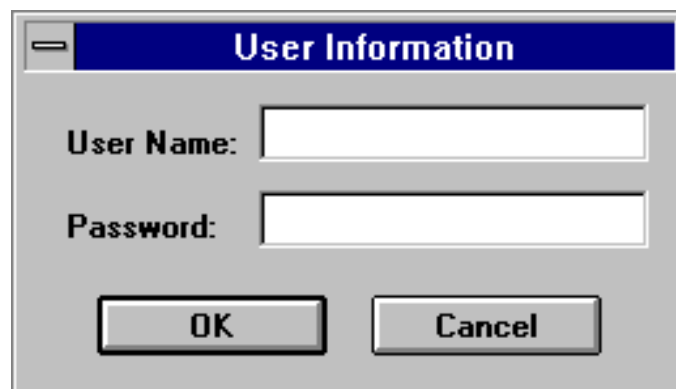
Follow the instructions below to configure the software to run in either User Mode or Administration Mode.

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



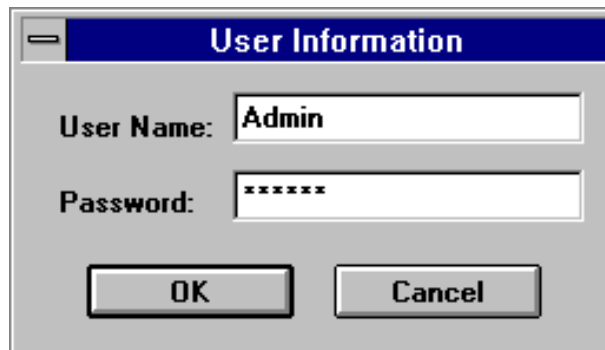
The User Configuration

Logging on in User Configuration only allows access to the instrument's performance tests and adjustments. Refer to "Starting the Software".

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

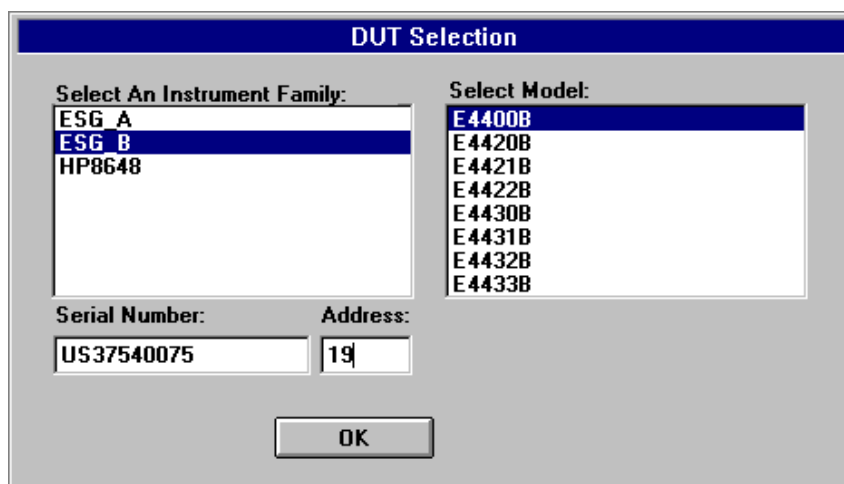


The image shows a dialog box titled "User Information". It contains two text input fields: "User Name:" with the text "Admin" entered, and "Password:" with "*****" entered. Below the fields are two buttons: "OK" and "Cancel".

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 is important.)
 - b. In the Password field, type in the word Falcon. (Case is important.)
2. Click OK. (Cancel closes the software application.)

Identifying the DUT

When the DUT Selection dialog box is displayed,



The image shows a dialog box titled "DUT Selection". It has two list boxes: "Select An Instrument Family:" with items "ESG A", "ESG B" (highlighted), and "HP8648"; and "Select Model:" with items "E4400B" (highlighted), "E4420B", "E4421B", "E4422B", "E4430B", "E4431B", "E4432B", and "E4433B". Below the list boxes are two text input fields: "Serial Number:" with "US37540075" and "Address:" with "19". An "OK" button is at the bottom.

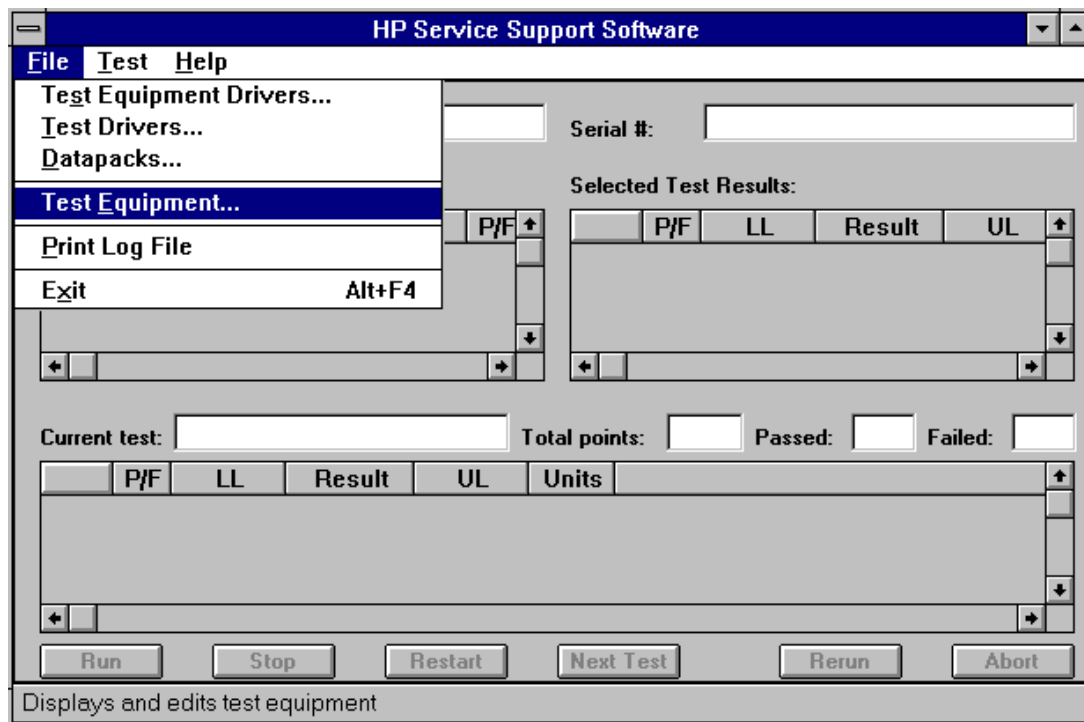
1. Make sure that ESG_B is selected in the Select an Instrument Family list.
2. In the Select Model list, select the instrument model of the DUT to be adjusted or tested.
3. In the Serial Number box, enter the complete serial number of the DUT.
4. In the Address box, enter the two-digit HP-IB address of the DUT. (To display the address on the signal generator, press **Utility, HP-IB/RS-232**. The **HP-IB 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, HP-IB 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:

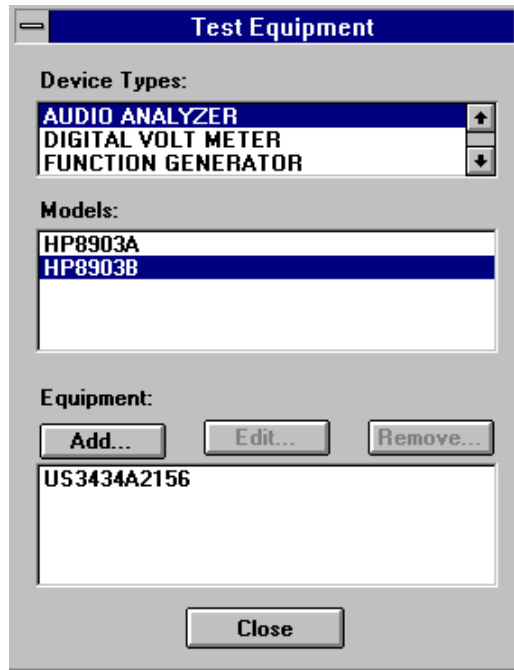
1. Refer to [Figure 4-2](#). In the File drop-down menu, select Test Equipment.

Figure 4-2 Test Equipment in the File Drop-Down Menu



2. Refer to [Figure 4-3](#). In the Test Equipment dialog box, select the Device Type for the new equipment you are adding.

Figure 4-3 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 4-4](#)), enter the following parameters into the appropriate box:

Serial Number of the new equipment.

HP-IB 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 HP-IB address -1 (negative 1).

Cal Due Date the projected calibration due date of the new equipment.

Trace Number the calibration tracking number. This is the last required item.

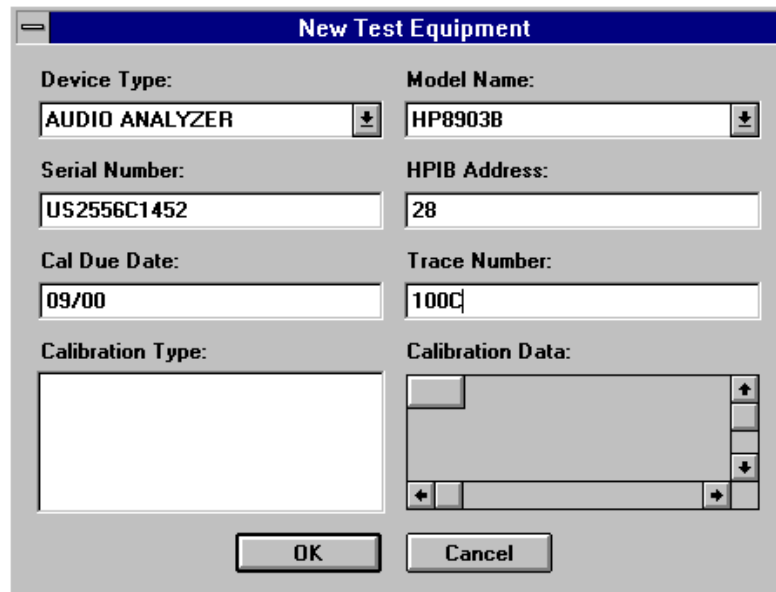
Calibration Type (optional) is used only when special calibration data is associated with the device being added, and only as a function setup by the factory for equipment requiring specific calibration data. The only devices currently requiring this feature are power sensors.

Table 4-1 is an example of the calibration information required to insure 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 4-4](#),

Table 4-1 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 4-4 Adding the Equipment Information Using the New Test Equipment Window



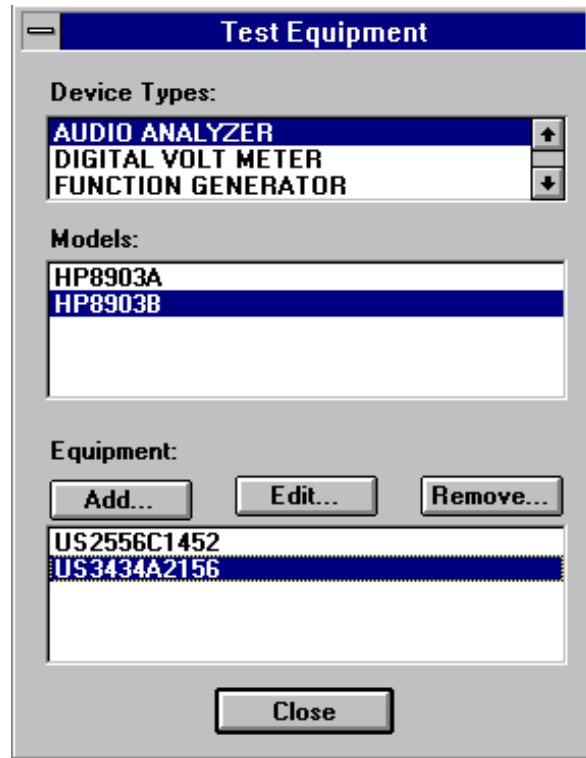
6. Click OK.

NOTE The serial number of the test equipment added will be displayed in the Equipment field of the Test Equipment dialog box (Figure 4-3).

Removing Test Equipment

Removal of test equipment is accomplished using the Test Equipment dialog box. Refer to Figure 4-5.

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

Figure 4-5 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 4-5](#).

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. Change the field parameters as necessary.
5. Click OK ([Figure 4-4](#)).
6. Click Close.

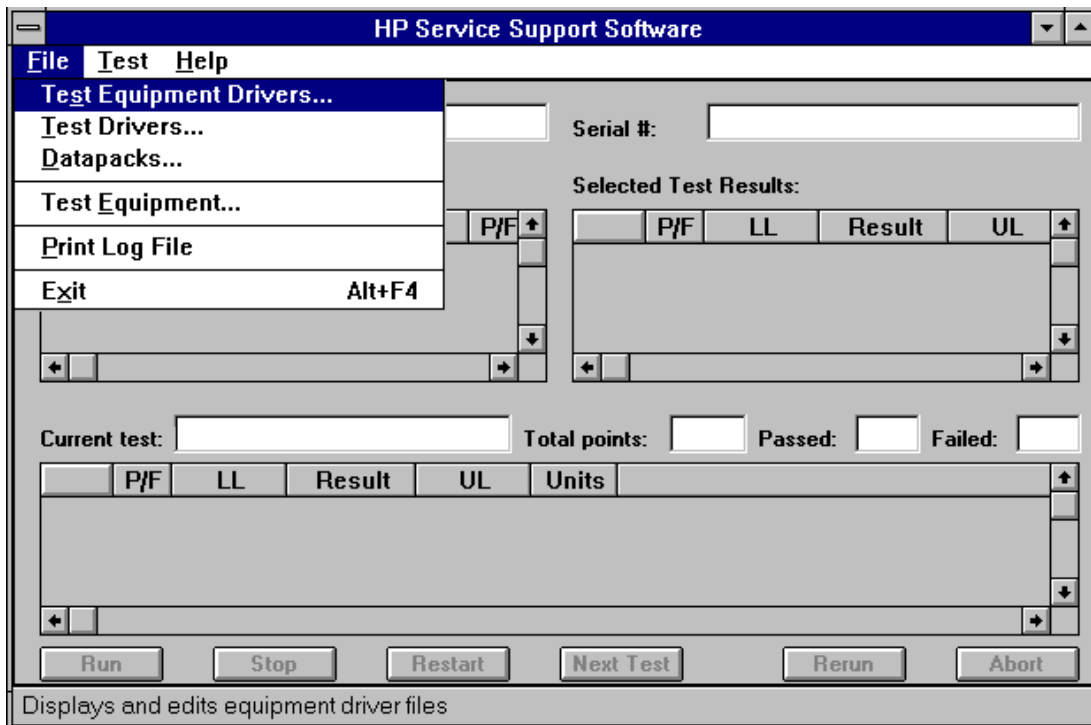
Adding Device Drivers

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

CAUTION The following three 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.

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 4-6](#). In the File drop-down menu, select Test Equipment Drivers.

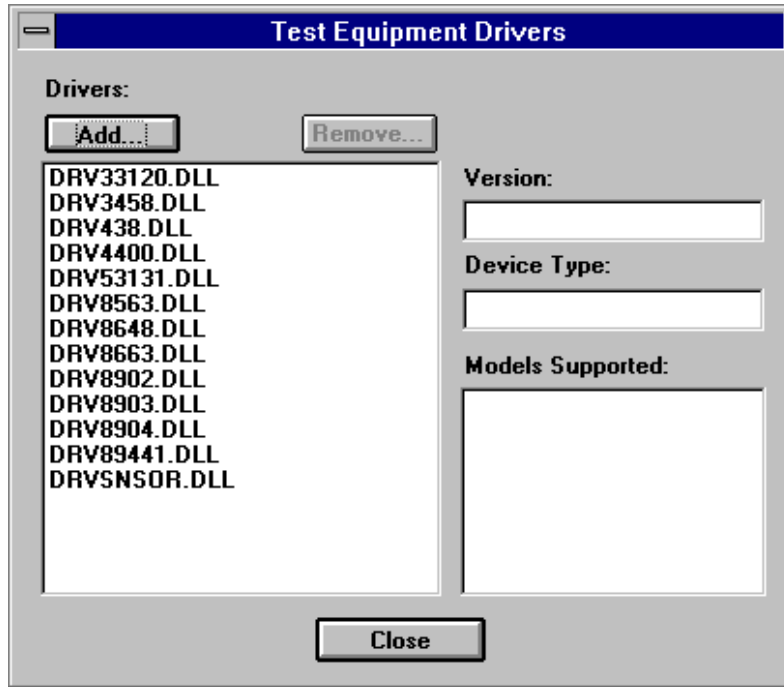
Figure 4-6 Test Equipment Drivers in the File Drop-Down Menu



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

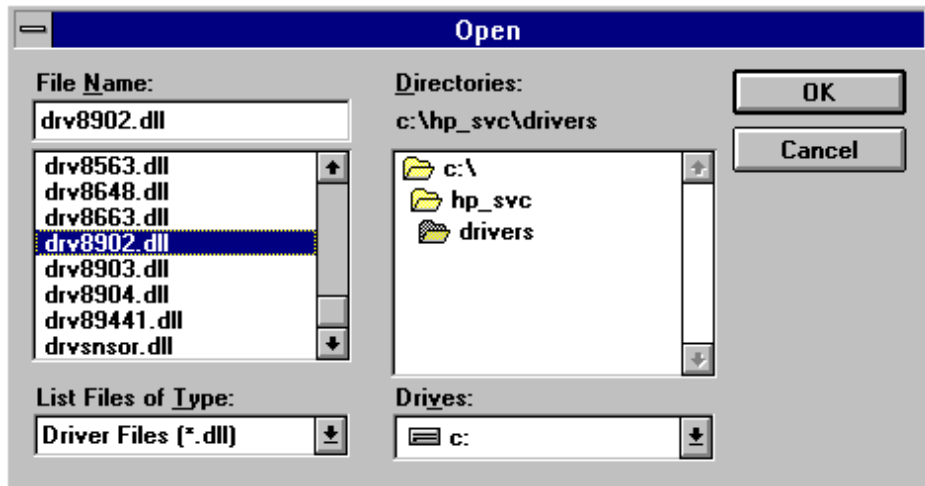
4. To add a device driver to the existing list of test equipment drivers, click Add ([Figure 4-7](#)).

Figure 4-7 Adding a Device Driver Using the Test Equipment Drivers Window



5. Refer to [Figure 4-8](#). Using the standard file search procedure, select the driver that you are adding and click OK.

Figure 4-8 Using the Open Dialog Box to Search for a Device Driver File to Add



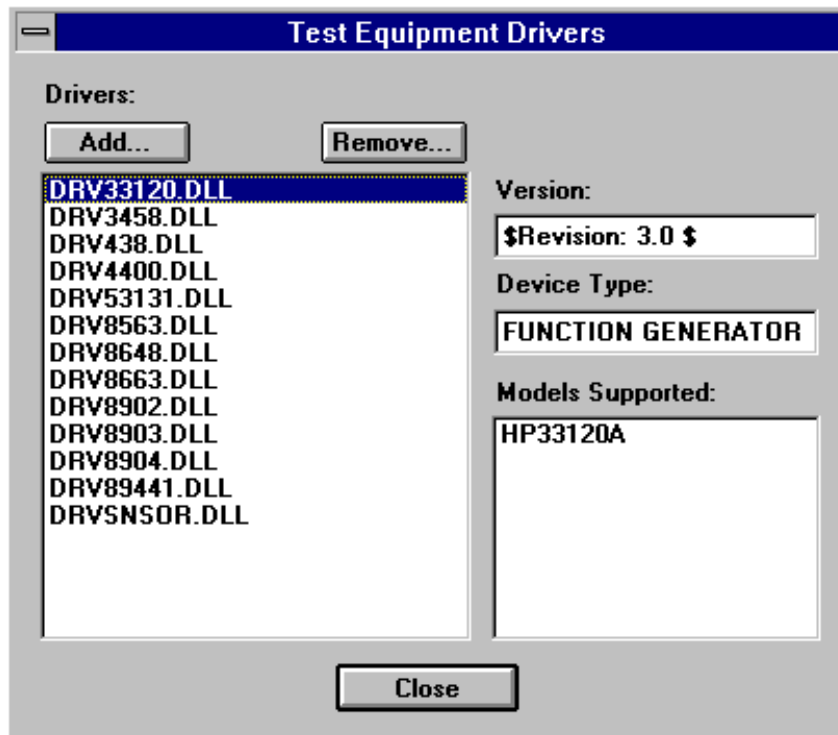
The selected driver should now be displayed in the Test Equipment Drivers dialog box, as seen in [Figure 4-9](#).

Removing Device Drivers

Removing device drivers is accomplished using the Test Equipment Drivers dialog box. Refer to [Figure 4-9](#).

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

Figure 4-9 Removing a Device Driver Using the Test Equipment Drivers Window



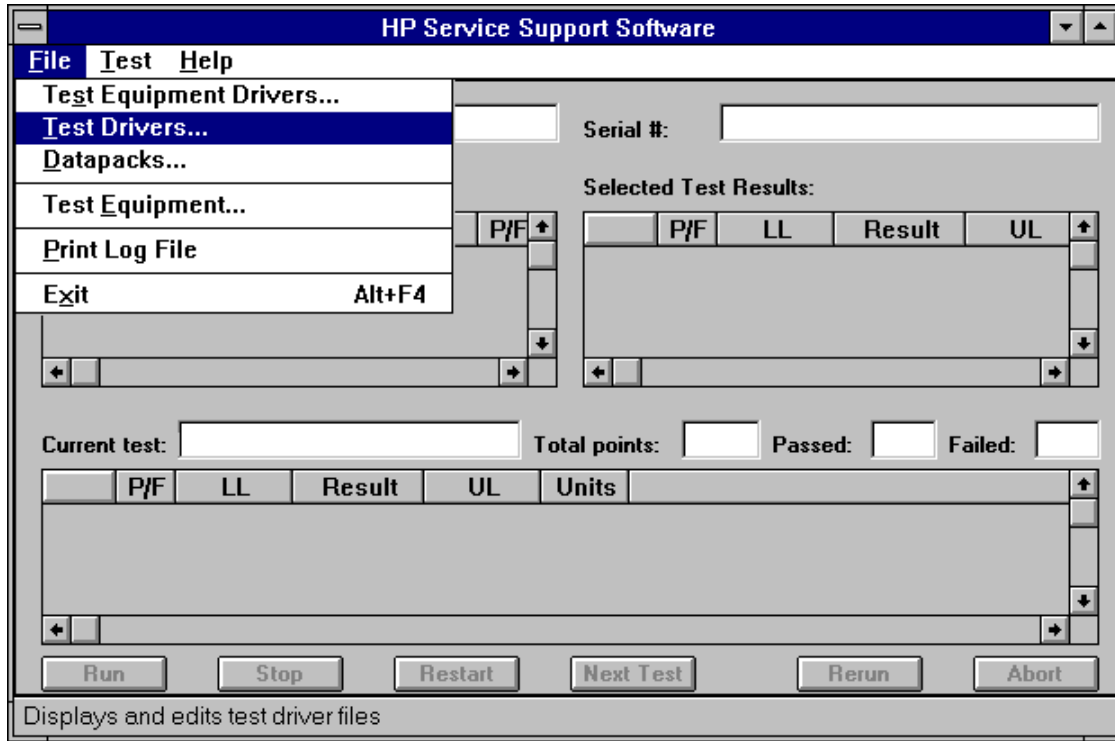
2. Ensure that the information displayed in the Version, Device Type, and Models Supported fields reflects the correct information for the selected driver being removed.
3. Click Remove.
4. Click Close ([Figure 4-7](#)).

Adding Test Drivers

Adding software drivers is accomplished using the Test Drivers window.

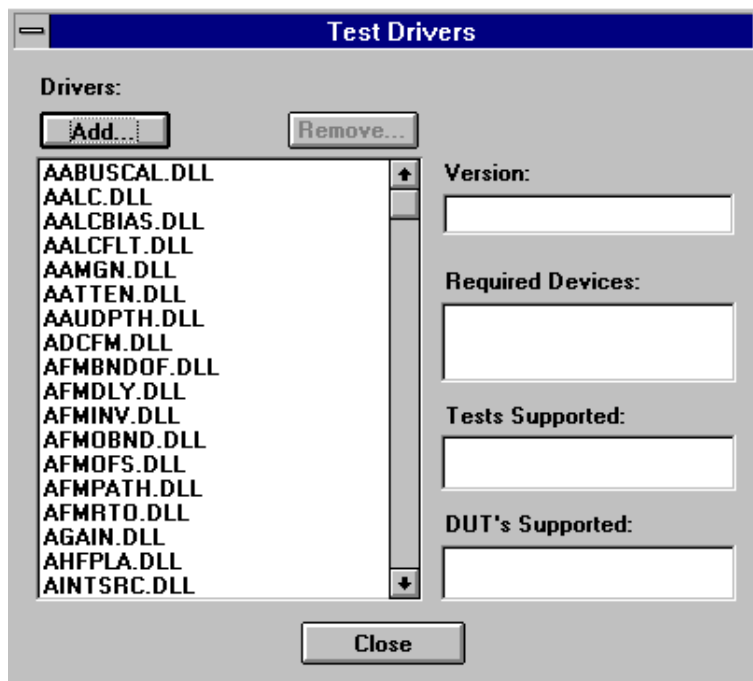
1. Refer to [Figure 4-10](#). In the File drop-down menu, select Test Drivers.

Figure 4-10 Test Drivers in the File Drop-Down Menu



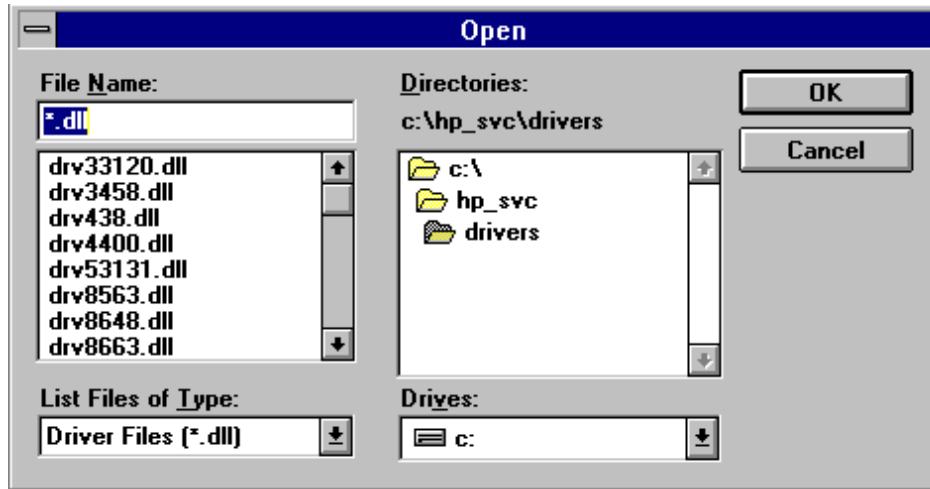
- 2. Refer to [Figure 4-11](#). To add a test driver to the existing list of test drivers, click Add.

Figure 4-11 Adding a Test Driver Using the Test Drivers Window



3. Refer to [Figure 4-12](#). Using the standard file search procedure, select the test driver that you are adding and click OK.

Figure 4-12 Using the Open Dialog Box to Search for a Test Driver File to Add



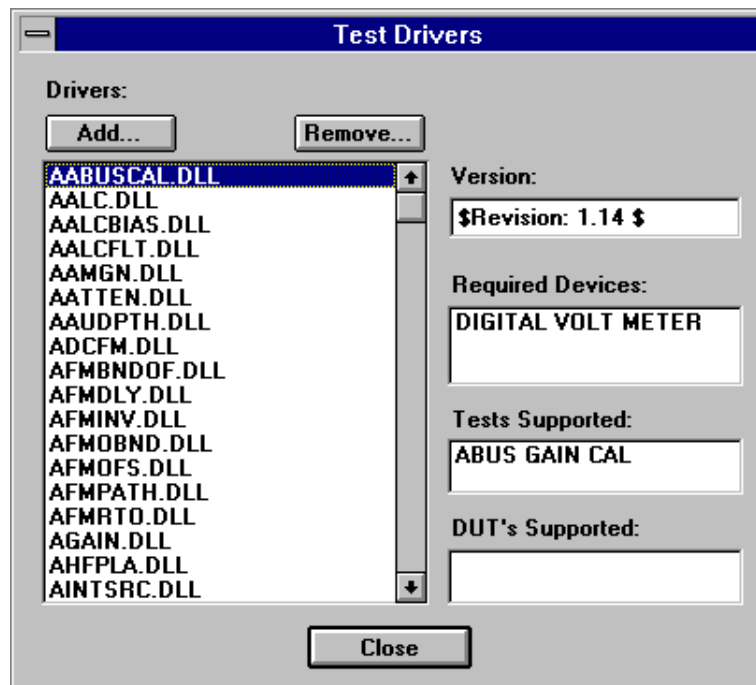
The selected driver should now be displayed in the Test Drivers dialog box, as seen in [Figure 4-11](#).

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

Removing Test Drivers

Removing test drivers is accomplished using the Test Drivers dialog box. Refer to [Figure 4-13](#).

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

Figure 4-13 Removing a Test Driver Using the Test Drivers Window

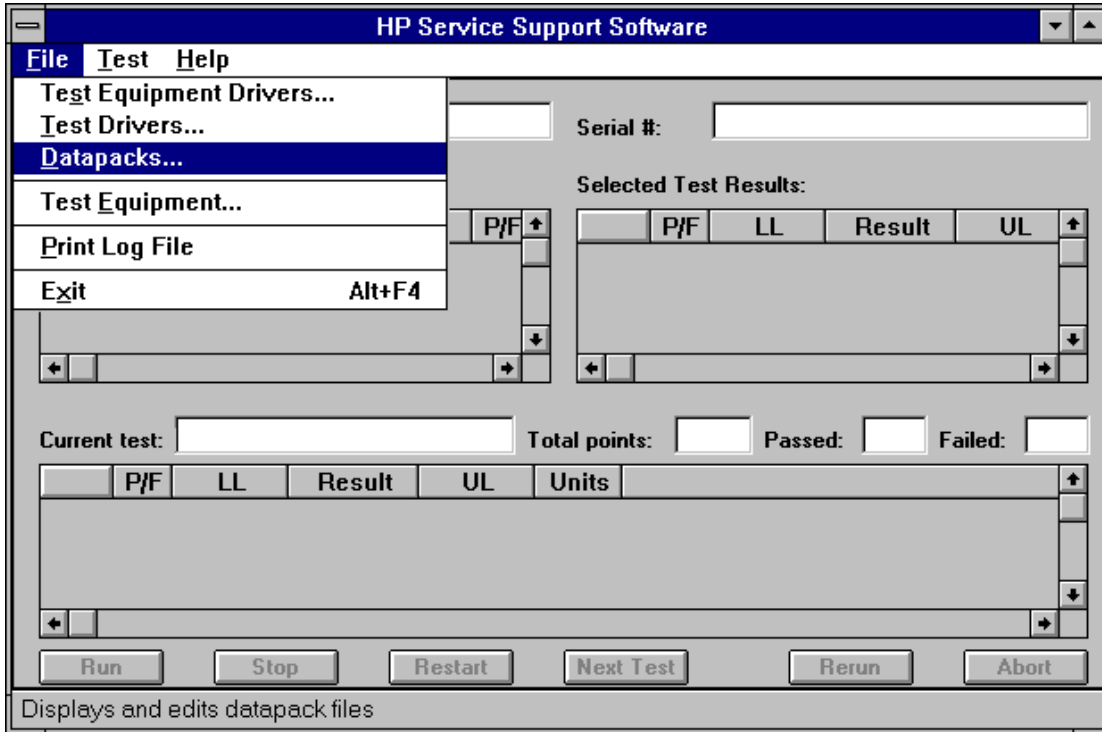
2. Ensure that the information displayed in the Version, Device Type, and Models Supported fields reflects the correct information for the selected driver being removed.
3. Click Remove.
4. Click Close.

Adding Datapacks

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

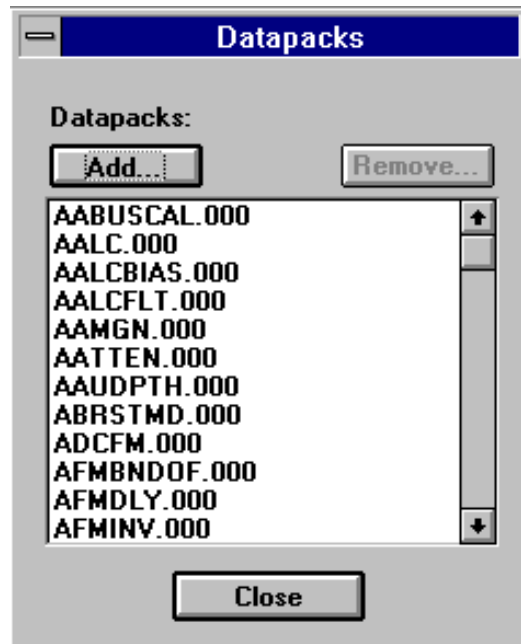
1. Refer to [Figure 4-14](#). In the File drop-down menu, select Datapacks.

Figure 4-14 Datapacks in the File Drop-Down Menu



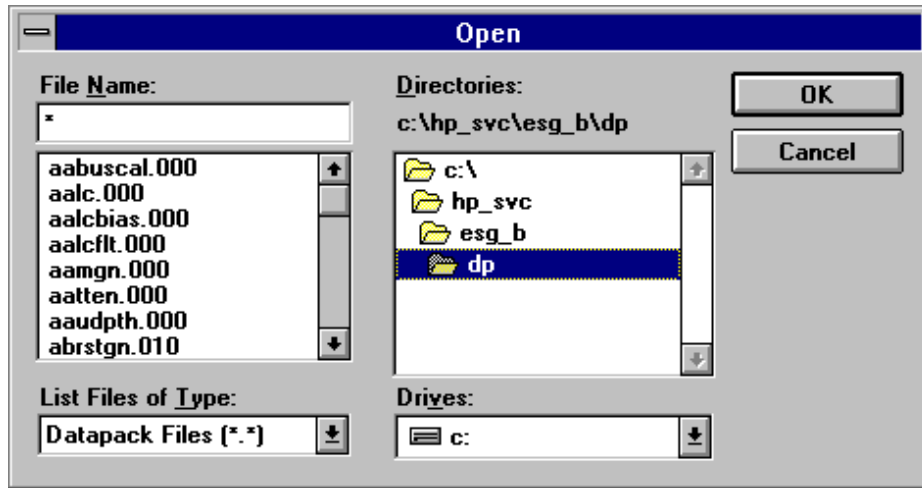
2. Refer to [Figure 4-15](#). To add a datapack to the existing list of datapacks, click Add.

Figure 4-15 Adding a Datapack Using the Datapacks Window



3. Refer to [Figure 4-16](#). Using the standard file search procedure, select the datapack that you are adding and click OK.

Figure 4-16 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 4-15](#).

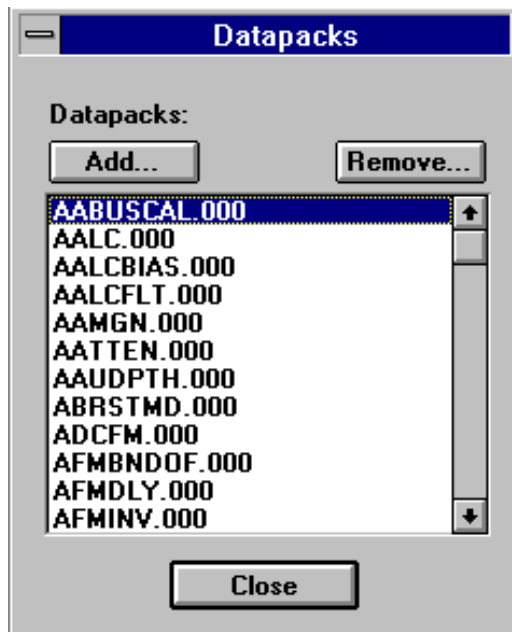
4. Click Close ([Figure 4-15](#)).

Removing Datapacks

Removing datapacks is accomplished using the Datapacks dialog box. Refer to [Figure 4-17](#).

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

Figure 4-17 Removing a Datapack Using the Datapacks Window

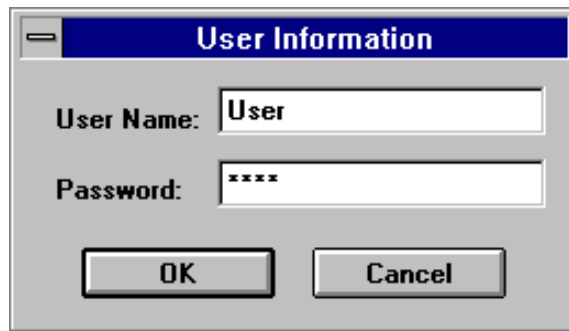


2. Click Remove.
3. Click Close.

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 is important.)
- b. In the Password box, enter User. (Case is important.)
- c. Click OK.

Identifying the DUT

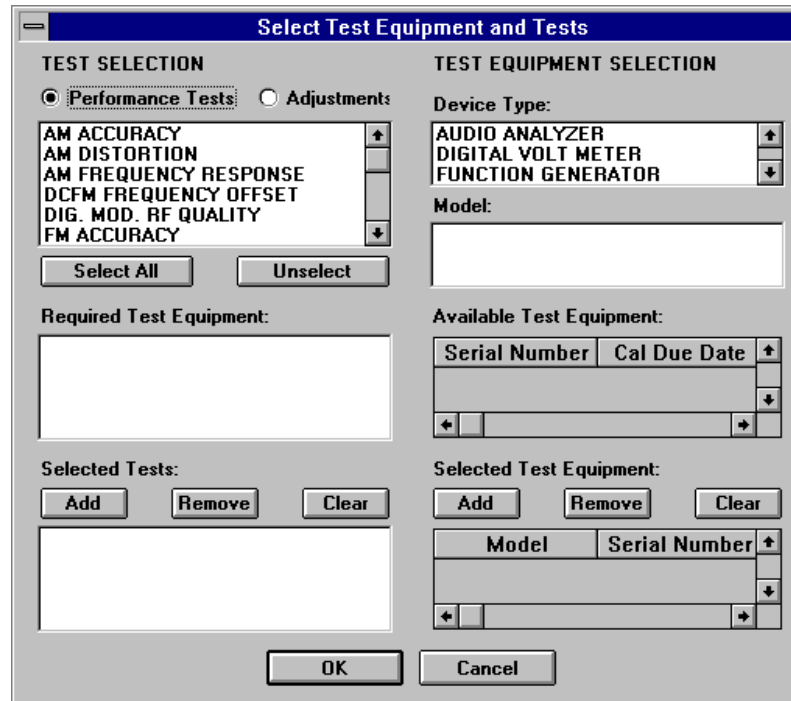
When the DUT Selection dialog box is displayed,

The screenshot shows a dialog box titled "DUT Selection". It has two list boxes. The first list box is labeled "Select An Instrument Family:" and contains three items: "ESG A", "ESG B" (which is highlighted with a blue background), and "HP8648". The second list box is labeled "Select Model:" and contains eight items: "E4400B" (highlighted with a blue background), "E4420B", "E4421B", "E4422B", "E4430B", "E4431B", "E4432B", and "E4433B". Below the list boxes are two text input fields. The first is labeled "Serial Number:" and contains the text "US37540075". The second is labeled "Address:" and contains the text "19". At the bottom center of the dialog is an "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 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 HP-IB address of the DUT. (To display the address on the signal generator, press Utility, HP-IB/RS-232. The HP-IB Address softkey shows the current address.)
5. Select the OK button.

Selecting the Performance Test or Adjustments and the Test Equipment

When the Select Test Equipment and Tests window is displayed,



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 you will perform on the DUT. Select the test name by clicking on it. The selected tests are highlighted.

You can select all of the performance tests or adjustments by selecting the Select All button. You can unselect all of the selected tests or adjustments by selecting 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. For this example, you will use the DC FM Offset test.

3. Once the test is highlighted, identify all test equipment listed in the Required Test Equipment box. To identify a test equipment instrument:
 - 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 devices 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:

| Button | Action |
|---------------|---|
| Add | Copies the test equipment highlighted in the Available Test Equipment box to the Selected Test Equipment box. |
| Remove | Removes the highlighted test equipment from the Selected Test Equipment box. |
| Clear | Removes all of the test equipment from the Selected Test Equipment box. |

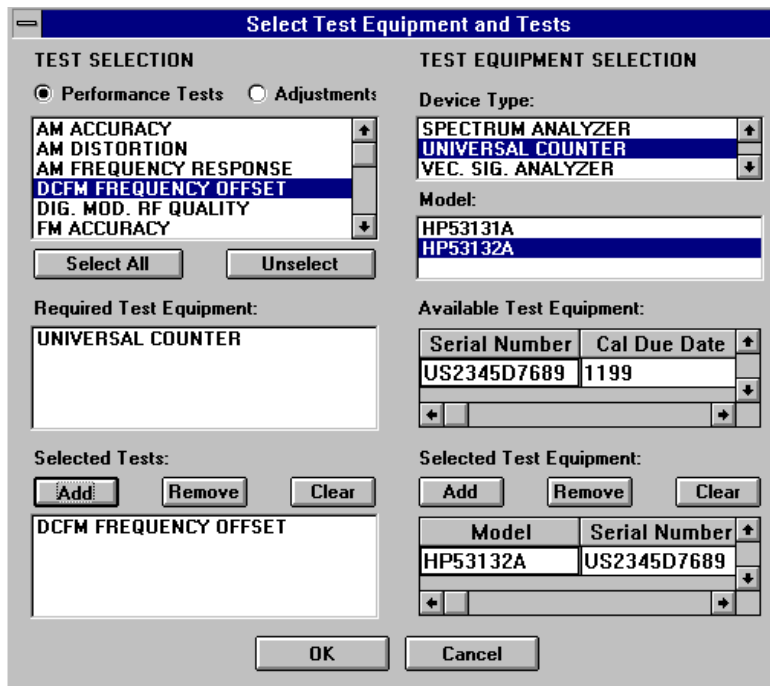
| | |
|-------------|--|
| NOTE | If necessary, the test equipment HP-IB address can be changed after it is added to the Selected Test Equipment box. Change the HP-IB address by pressing the right arrow on the keyboard until the HPIB address selection in the Selected Test Equipment box is selected. (The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

- 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:

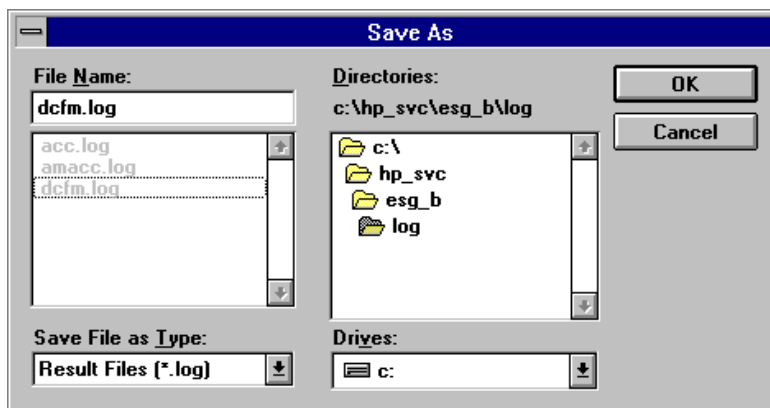
| Button | Action |
|---------------|--|
| Add | Copies the tests and adjustments highlighted in the list of tests and adjustments to the Selected Tests box. |
| Remove | Removes the highlighted tests and adjustments from the Selected Tests box. |
| Clear | Removes all of the tests and adjustments from the Selected Tests box. |

5. 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.



Defining the Location where the Test Results are Saved

1. 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.

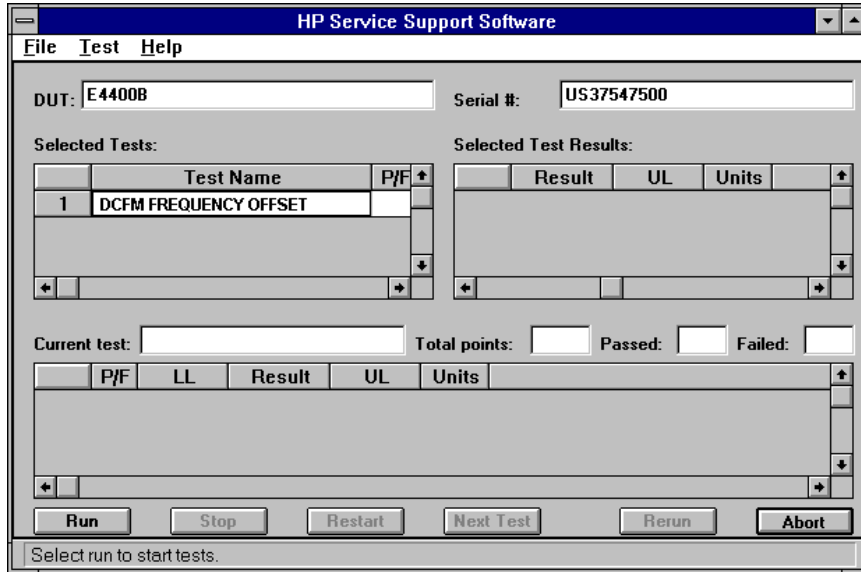


The results file name suffix is .log. The results are saved automatically to the .log file. You may select the directory into which you would like to save the file by changing the drive and folder in this window. This file is a text file and can be viewed using many text editors. Notepad, a standard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

- 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,



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

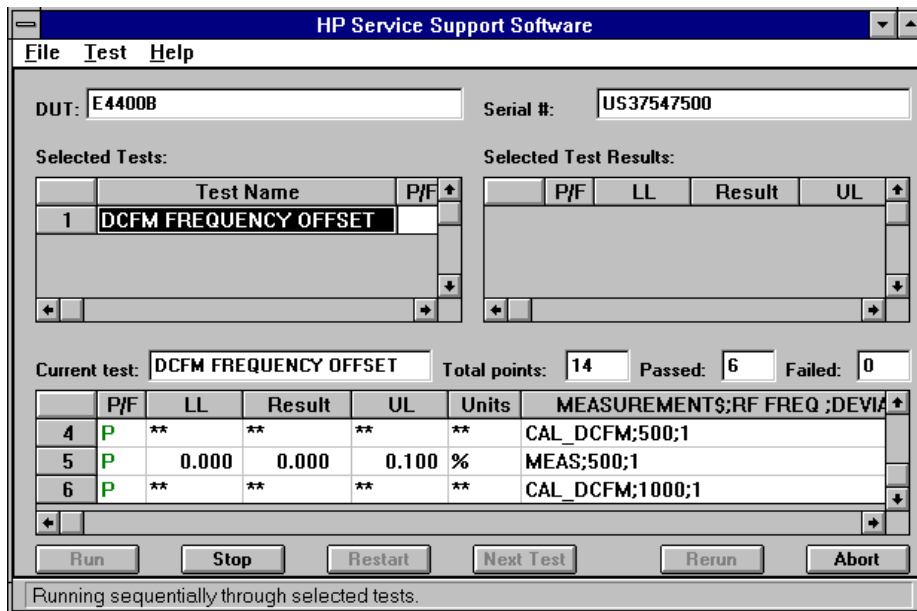
The software steps through the tests or adjustments sequentially.

- Follow the instructions displayed on the PC.

A description for each automated performance test or adjustment can be found in the chapters titled, "Performance Tests" and "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.



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.

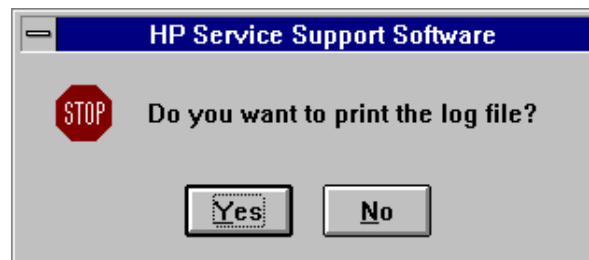
Button Action

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. |

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.

5 Performance Tests

The procedures in this chapter 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

Using the ESG Series Support Software, you can print a test record that contains the results of the automated performance tests. For the two manual performance tests, “Timebase Aging Rate” and “Modulation Source Frequency Accuracy,” a performance test record is located at the end of this chapter where you can record the test results.

Recommended Test Equipment

The recommended test equipment table, located in Chapter 2, is the complete list of equipment required to perform the procedures in this chapter. Test equipment is also listed with each test description and 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 HP-IB 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 Table 2-1. For the adjustment procedure, no equipment substitutions are available.

Support Software

The ESG Series Support Software runs performance tests and generates reports that document the results of the tests. The following performance tests are manual tests and *cannot* be run with the software:

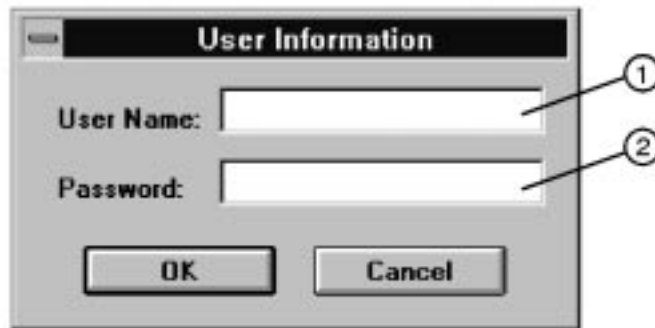
- Timebase Aging Rate
- Modulation Source Frequency Accuracy

This chapter shows how to run the software to test and verify the performance of a signal generator. [Chapter 4, “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 4, “Service Software,”](#) for installation instructions.
2. Click on the installed support software icon.
3. Fill in the fields in the User Information window ([Figure 5-1](#)):
 - a. In the User Name field (item 1), enter User. (Case is important.)
 - b. In the Password field (item 2), enter User. (Case is important.)
4. Click OK.

Figure 5-1 **The User Information Window**

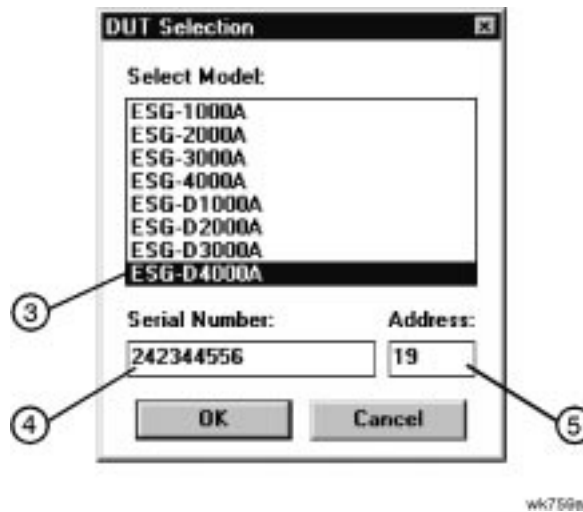


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- a. In the Select Model list (item 3), choose the correct model number of your signal generator.
- b. In the Serial Number box (item 4), enter the complete serial number of the DUT.
- c. In the Address box (item 5), enter the two-digit HP-IB address of the signal generator. (To display the address on the signal generator, press **Utility, HP-IB/RS-232, HP-IB Address**. The **HP-IB Address** softkey shows the current address.)

6. Click OK.

Figure 5-2 The DUT Selection Window

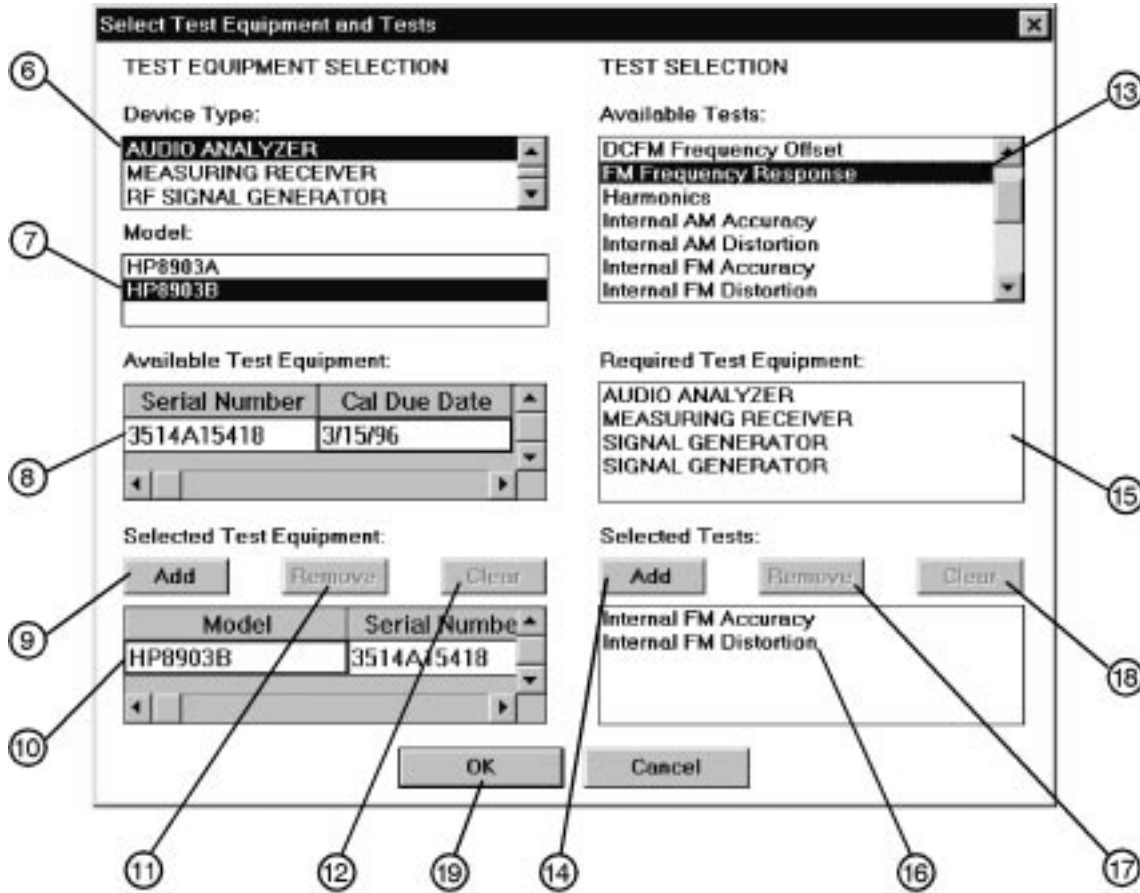


7. In the Select Test Equipment and Tests window (Figure 5-3), create a list of test equipment that will verify the signal generator's performance:
 - a. In the Device Type list (item 6), select a device type that you want to add to the equipment list.
 - b. In the Model list (item 7), select the model 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.

NOTE You can correct mistakes while you are entering instruments in the test equipment list:

- 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).
- To delete the entire list of equipment, click Clear (item 12).

Figure 5-3 The Select Test Equipment and Tests Window



wk760a

8. Create a list of performance tests that you want the software to run (Figure 5-3):

- 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).

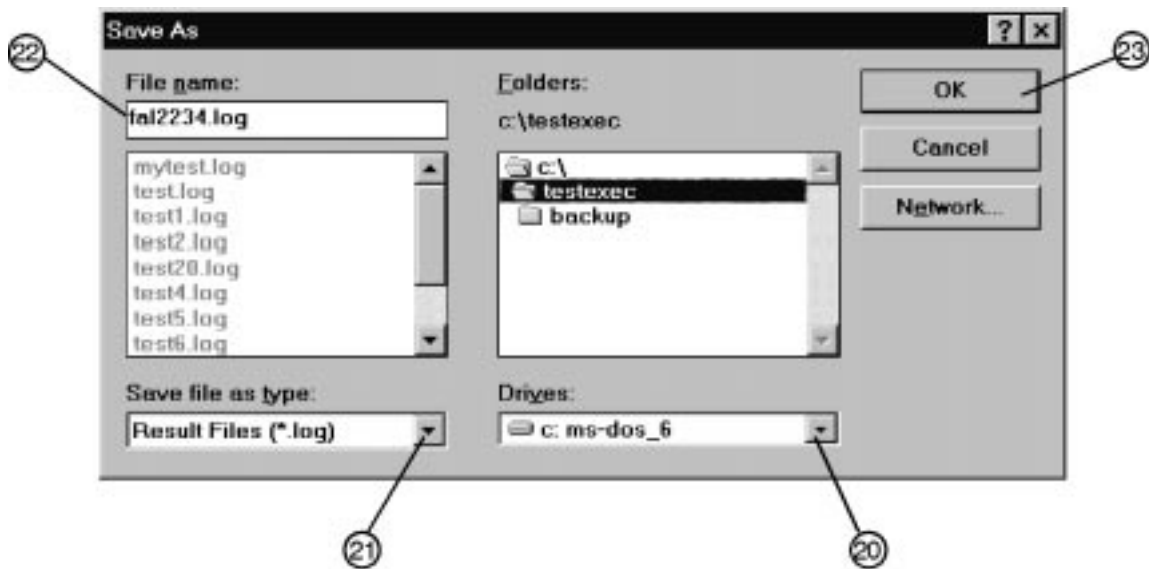
9. When you are done, click OK (item 19).

10. To save the test results to a file, make the following selections (Figure 5-4):

- 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 5-4 The Save As Window



wk782a

12. In the Main Test and Results window (Figure 5-5), 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.

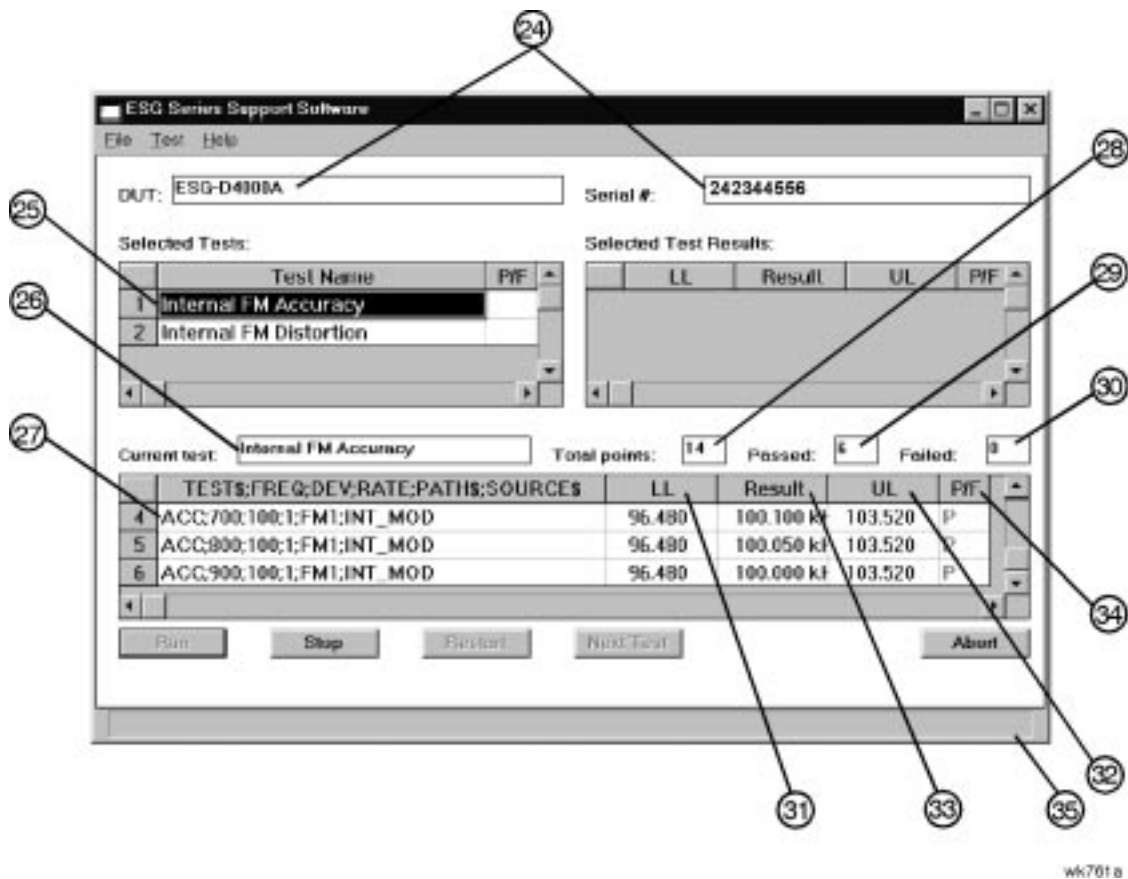
During the testing sequence the window shows the following information:

- 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 during the test sequence:

- Run starts the test sequence, or continues the test that was running when you clicked Stop.
- Stop halts the test sequence.
- Restart goes to the beginning of the test that was running when you clicked Stop.
- Next Test jumps to the test that is next in the sequence and runs the remaining tests.
- Abort clears all information from this window. 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 5-5 The Main Test and Results Window



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 Performance Tests

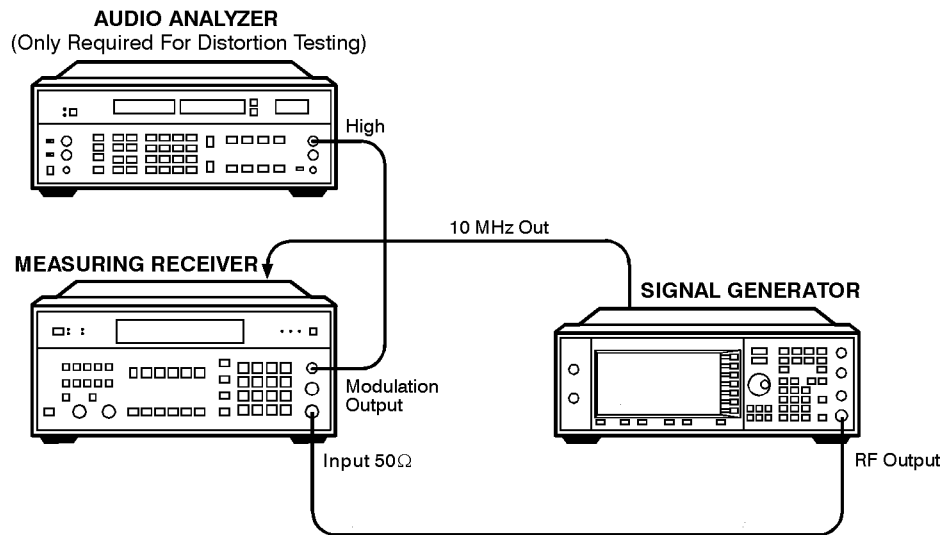
These automated tests verify the FM accuracy and distortion specifications. Accuracy is verified directly with a measuring receiver, and distortion is verified by measuring the demodulated output of the measuring receiver, using the audio analyzer. The audio analyzer provides a more accurate verification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

Recommended Equipment

- HP 8902A Measuring Receiver
- HP 8903B Audio Analyzer

To Set Up the Equipment

Figure 5-6 Internal FM Accuracy and Distortion Performance Tests Setup



wk7110a

2. Internal AM Accuracy and Distortion Performance Tests

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.

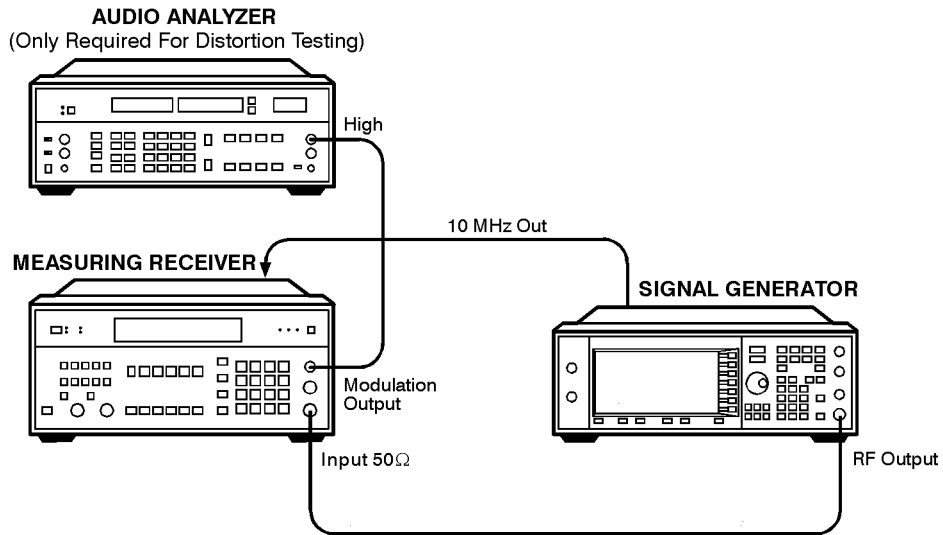
For a frequency of 4 GHz, verification is accomplished by covering two different frequency spans through the use of two mixers.

Recommended Equipment

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

To Set Up the Equipment for Accuracy/Distortion for AM ≤ 1300 MHz

Figure 5-7 Accuracy and Distortion for AM ≤ 1300 MHz Performance Test Setup

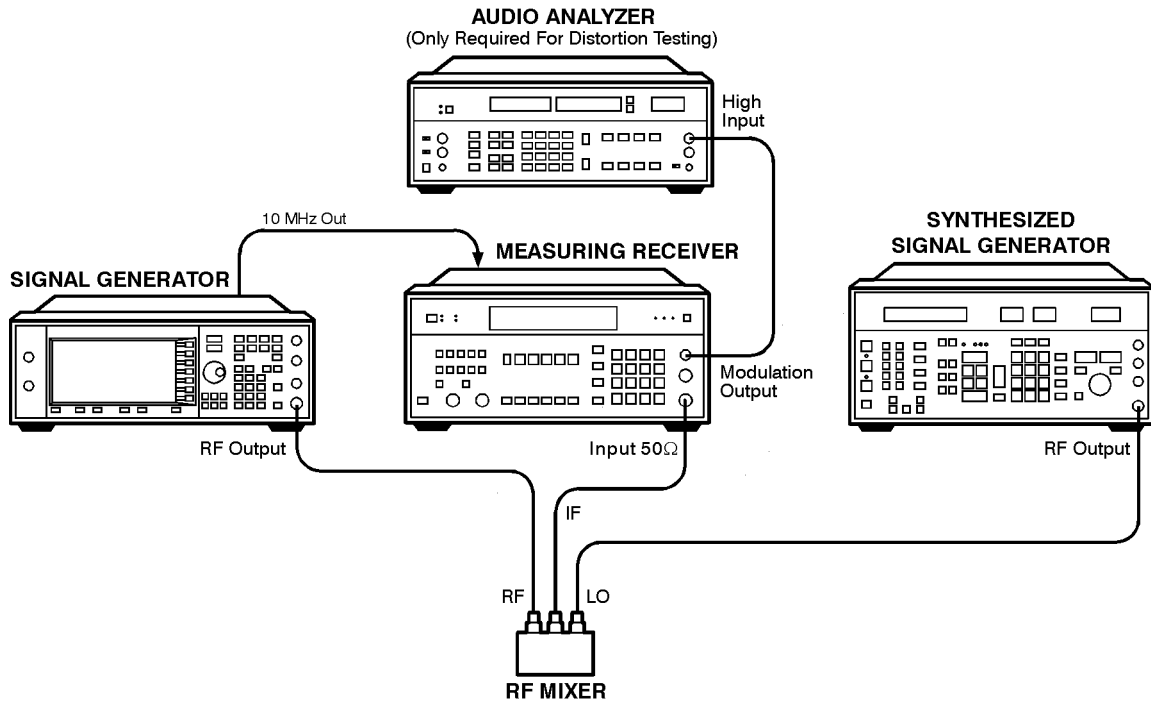


wk7110a

2. Internal AM Accuracy and Distortion Performance Tests

To Set Up the Equipment for Accuracy and Distortion for AM $>1300\text{ MHz} \leq 2500\text{ MHz}$

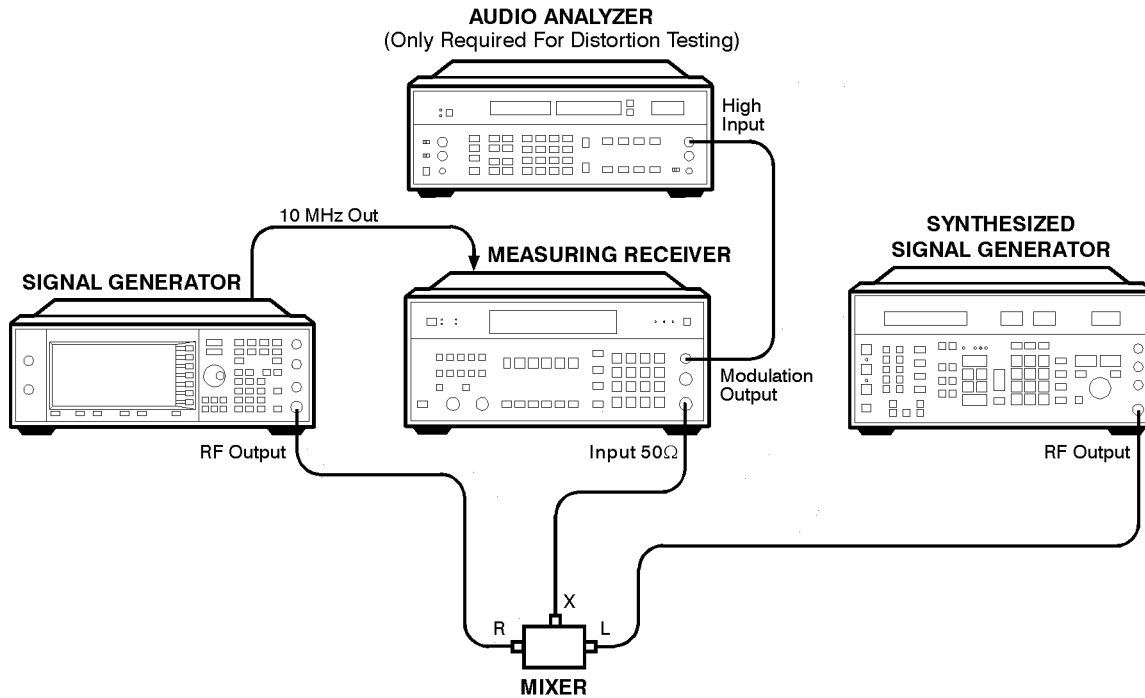
Figure 5-8 Accuracy and Distortion for AM $>1300\text{ MHz} \leq 2500\text{ MHz}$ Performance Test Setup



wk7111a

To Set Up the Equipment for Accuracy and Distortion for AM >2500 MHz

Figure 5-9 Accuracy and Distortion for AM >2500 MHz Performance Test Setup



wk7112a

3. Phase Modulation Accuracy and Distortion Performance Tests

3. Phase Modulation Accuracy and Distortion Performance Tests

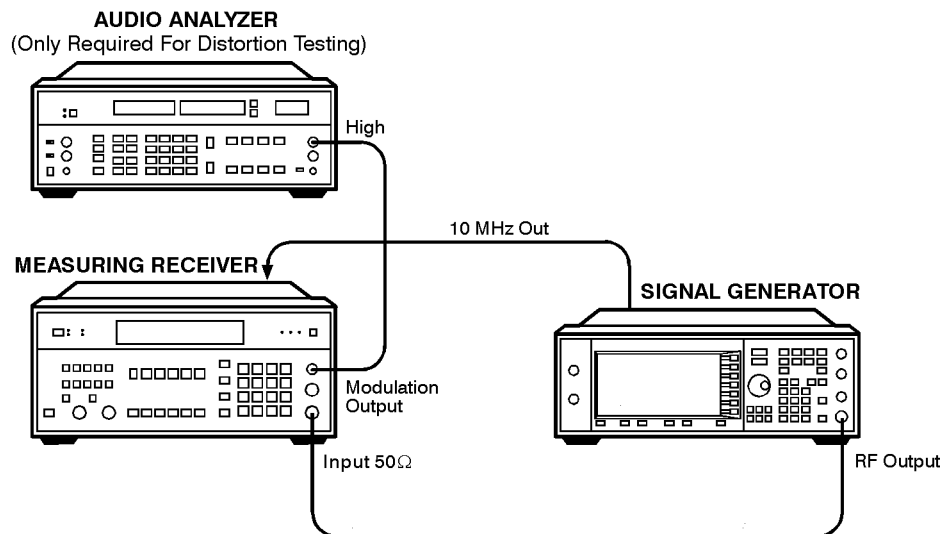
These automated tests verify the phase modulation accuracy and distortion specifications. Accuracy is verified directly with a measuring receiver, and distortion is verified by measuring the demodulated output from the measuring receiver, using the audio analyzer. The audio analyzer provides a more accurate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

Recommended Equipment

- HP 8902A Measuring Receiver
- HP 8903A Audio Analyzer

To Set Up the Equipment

Figure 5-10 Accuracy and Distortion for Phase Modulation Performance Tests Setup



wk7110a

4. FM Frequency Response Performance Test

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.

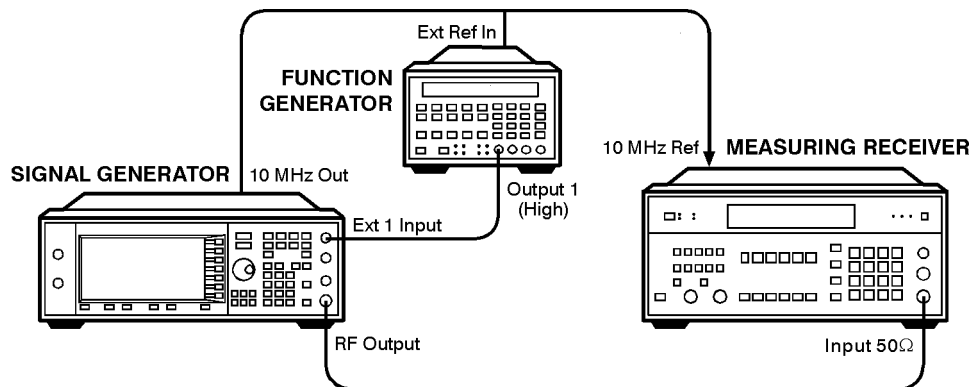
The comparison is a calculation of the difference in the deviations relative to the reference rate. The relative value is the FM frequency response.

Recommended Equipment

- HP 8902A Measuring Receiver
- HP 8904A Function Generator

To Set Up the Equipment

Figure 5-11 FM Frequency Response Performance Tests Setup



wk7113a

5. AM Frequency Response Performance Test

5. AM Frequency Response Performance Test

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.

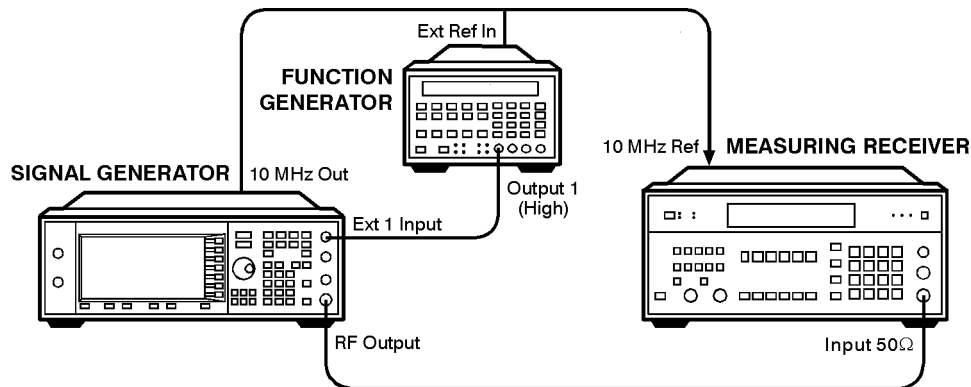
The comparison is a calculation of the difference in the depths relative to the reference rate. The relative value is the AM Frequency Response.

Recommended Equipment

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

To Set Up the Equipment for Frequency Response for AM ≤ 1300 MHz

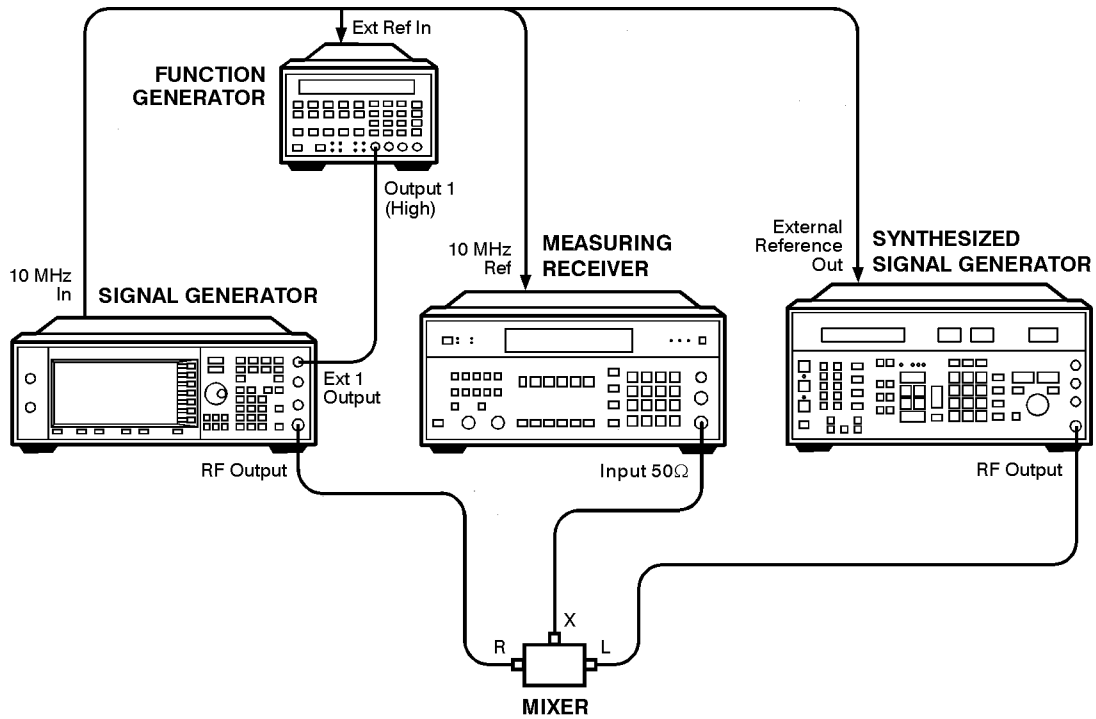
Figure 5-12 Frequency Response for AM ≤ 1300 MHz Performance Test Setup



wk7113a

To Set Up the Equipment for Frequency Response for AM >1300 MHz

Figure 5-13 Frequency Response for AM >1300 MHz Performance Test Setup



wk7114a

6. Phase Modulation Frequency Response Performance Test

6. Phase Modulation Frequency Response Performance Test

This automated test verifies the phase modulation frequency response specifications. The equipment measures the variations in phase deviations due to changes in the applied Φ 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.

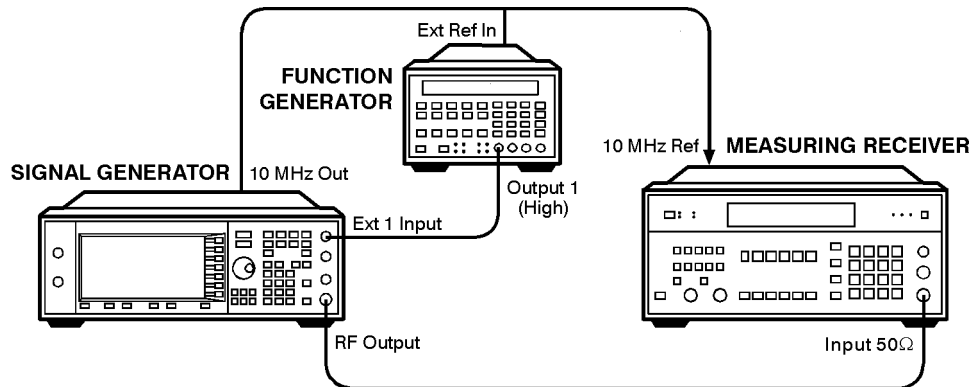
The comparison is a calculation of the difference in the deviations relative to the reference rate. The relative value is the Φ M frequency response.

Recommended Equipment

- HP 8902A Measuring Receiver
- HP 8904A Function Generator

To Set Up the Equipment

Figure 5-14 Phase Modulation Frequency Response Performance Test Setup



wk7113a

7. DCFM Frequency Offset Relative to CW Performance Test

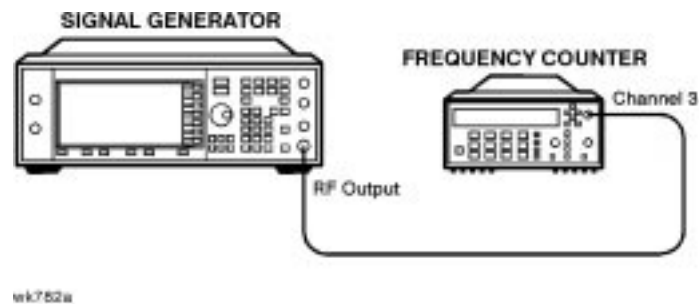
This automated test verifies the carrier frequency offset, relative to CW. The equipment measures the RF output frequency. For each test point, a comparison is made between a CW reference frequency without DCFM selected, and then with the DCFM selected; the difference is the carrier frequency offset.

Recommended Equipment

- HP 53132A Frequency Counter
- HP 11667A Splitter

To Set Up the Equipment

Figure 5-15 DC FM Frequency Offset Performance Test Setup



8. Residual FM Performance Test

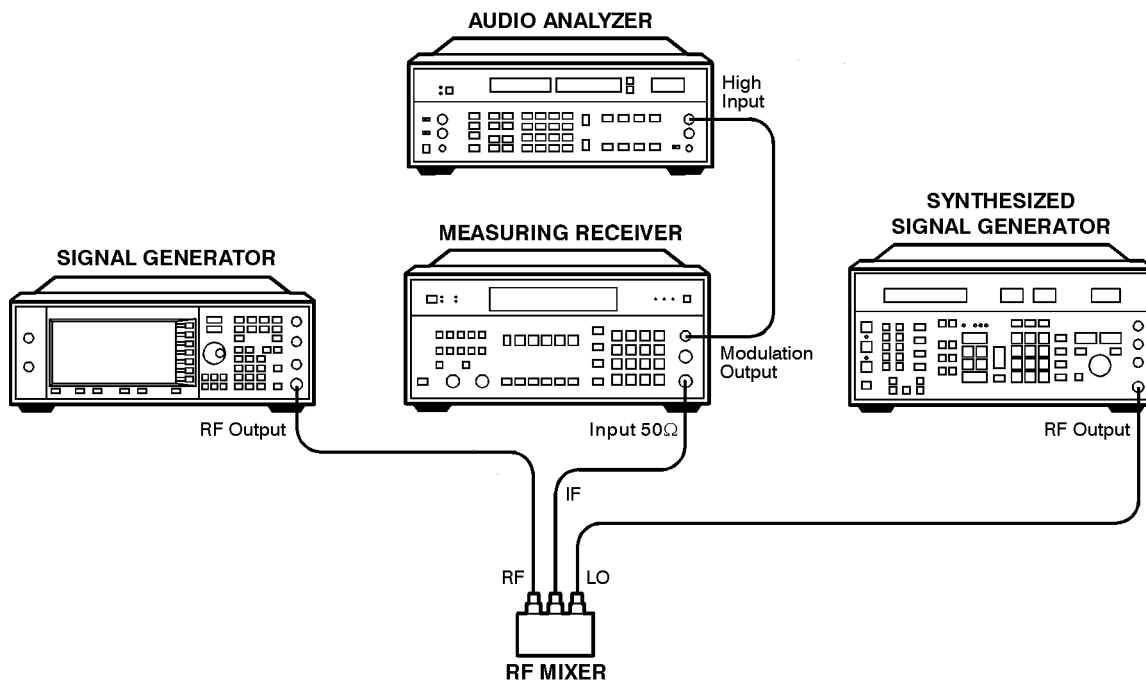
This automated test verifies the residual frequency modulation (FM) specification. The signal generator's RF output signal is mixed with a signal from a low noise external LO. The resultant IF signal is demodulated as it passes through the measuring receiver, bypassing the measuring receiver's internal 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 8902A Measuring Receiver
- HP 8903B Audio Analyzer
- HP 8663A Signal Generator
- MD/MDC-174 Mixer (1 to 2800 MHz)
- MD/MDC-164 Mixer (0.5 to 9 GHz)

To Set Up the Equipment for Frequencies ≤ 2500 MHz

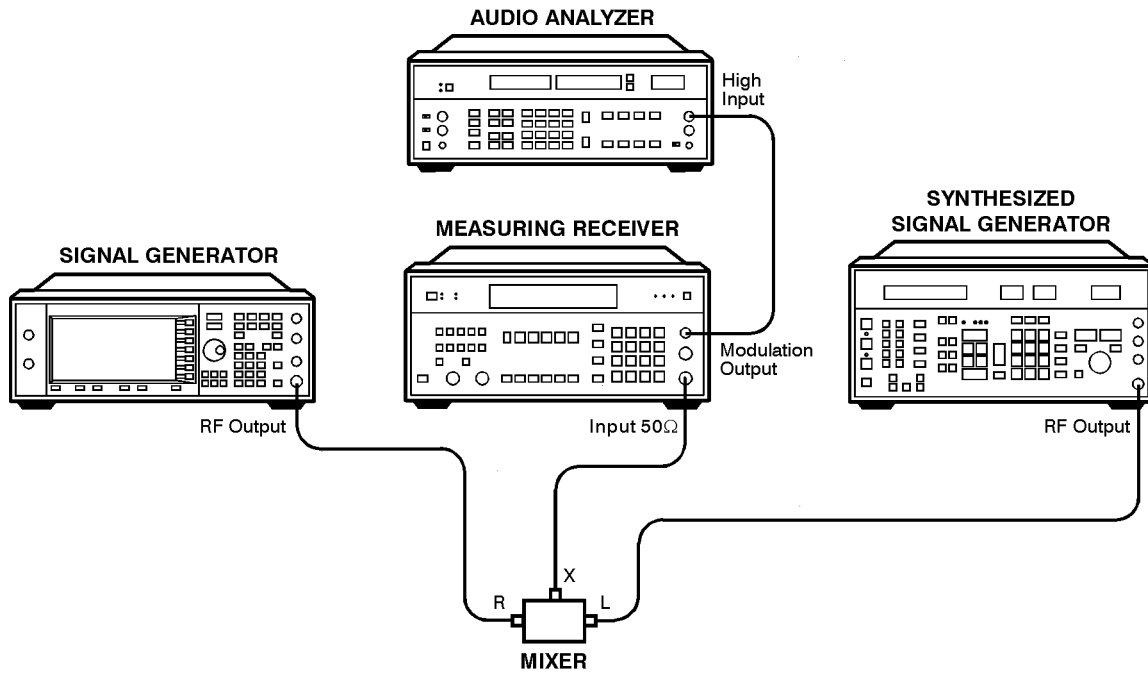
Figure 5-16 Residual FM ≤ 2500 MHz Performance Test Setup



wk7116a

To Set Up the Equipment for Frequencies >2500 MHz

Figure 5-17 Residual FM >2500 MHz Performance Test Setup



wk7117a

9. Harmonic, Subharmonic, and Nonharmonic Spurious Signals Performance Tests

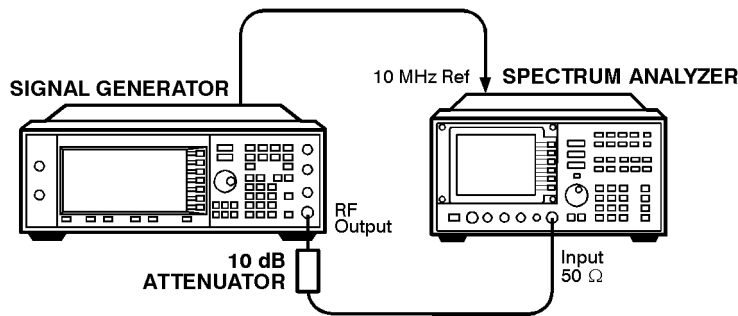
These automated tests verify that the harmonic, subharmonic, and nonharmonic spurious signals are within specifications. The signal generator's output signal is set to values where harmonic and spurious signal performance problems are most likely to occur. Then the spectrum analyzer checks the level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

Recommended Equipment

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

To Set Up the Equipment

Figure 5-18 Harmonic, Subharmonic, and Nonharmonic Spurious Signals Performance Tests Setup



wk7118a

10. Power Level Accuracy Performance Test

Conducting this check provides a high level of confidence and a verification that the signal generator's power level circuitry is functioning correctly. The check does not test the signal generator to warranted specifications. Test limits are degraded to take into account measurement uncertainties involved with commercially available test equipment. To have the signal generator tested to warranted specifications, a complete power level accuracy performance test is required. Contact your nearest HP service center for information concerning calibration. The accuracy is measured over the full frequency and power level range of the signal generator.

For power levels ≥ -10 dBm, a power meter makes the measurement. A reference is set at -10 dBm for comparisons to subsequent power measurements. For power levels < -10 dBm and > -70 dBm, a spectrum analyzer makes the measurement. With -10 dBm RF output from the signal generator, a reference of 0 dB is set on the spectrum analyzer. The marker delta function measures the relative power level down to -70 dBm. The absolute power level is calculated by summing the power meter measurement at -10 dBm with the relative spectrum analyzer measurement. For power levels < -70 dBm, an amplifier is inserted between the signal generator and spectrum analyzer, ensuring the signal level is kept well above the spectrum analyzer noise floor. A new reference is set at -70 dBm and the marker delta function measures relative power down to -127 dBm. Again the absolute power level is calculated by summing the power meter measurement at -10 dBm with the relative spectrum analyzer measurement.

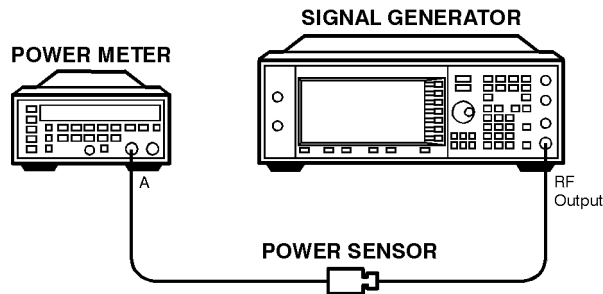
For power levels < -95 dBm, the spectrum analyzer uses video averaging to minimize effects of random noise in the measurement system.

| | |
|-------------|--|
| NOTE | <p>Power level measurements are made at extremely low power levels. Results may be affected by unrelated low level signals picked up by the measurement receiver. These could be the result of RF leakage within the device under test or external signals that are at the same tested frequencies. To protect against errors at low power levels, take the following precautions:</p> <ul style="list-style-type: none">• Use a semi-rigid cable between the 6 dB attenuator and the spectrum analyzer. Connect the 6 dB attenuator directly to the spectrum analyzer. Make sure all the connections are tight. Inspect the cable for any deterioration or cracks.• Position the signal generator and spectrum analyzer side-by-side and at least 30 cm apart, minimizing the possibility of RF leakage. Do NOT position the two instruments with the front panels or rear panels facing each other.• If RF leakage is suspected, move the signal generator and spectrum analyzer further apart. If the problem is RF leakage between the instruments, the measurement should change with changes in orientation between the two instruments. If the problem is RF leakage inside the device under test, then changes in equipment orientation will have no effect. |
|-------------|--|

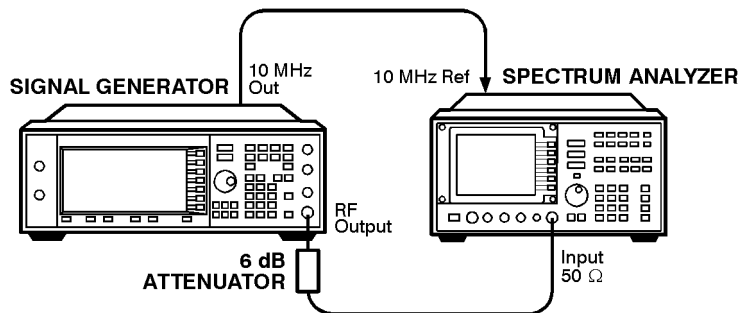
10. Power Level Accuracy Performance Test

Recommended Equipment

- HP 438A Power Meter
- HP 8482A Power Sensor
- HP 8563E Spectrum Analyzer
- HP 8491A/B Option 006 Attenuator (6 dB)
- HP 8447F Option 010 Preamplifier-Amplifier
- HP 8449B Preamplifier

To Set Up the Equipment for High Power Level Accuracy**Figure 5-19** Power Level Accuracy Performance Test Setup

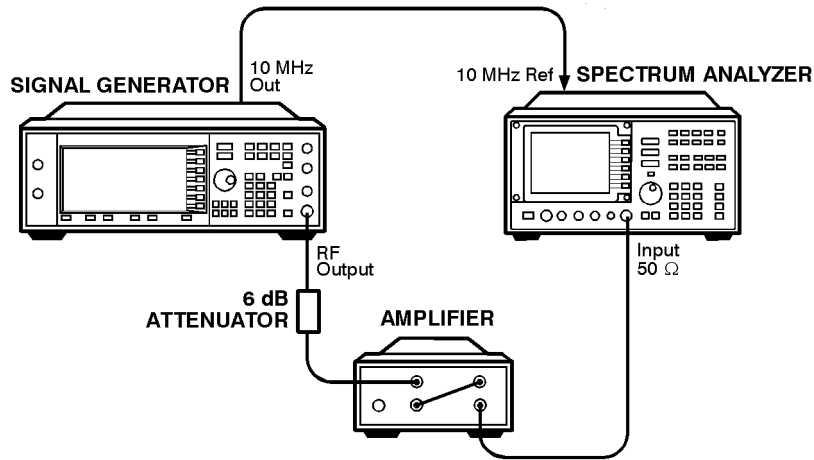
wk780a

To Set Up the Equipment for High Power Level Accuracy for Levels -10 to -70 dBm**Figure 5-20** High Power Level Accuracy (-10 to -70 dBm) Performance Test Setup

wk7108a

Power Level Accuracy for Power Levels <-70 dBm and ≤1300 MHz

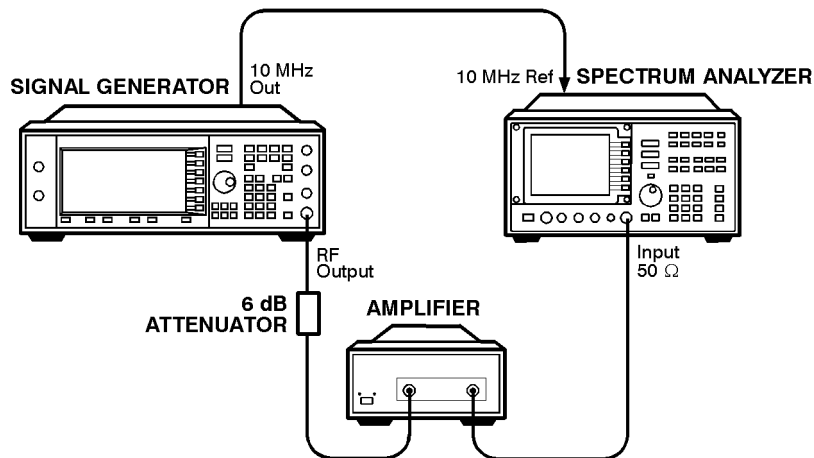
Figure 5-21 Power Level Accuracy (<-70 dBm and ≤1300 MHz) Performance Test Setup



wk7119a

Power Level Accuracy for Power Levels <-70 dBm and >1300 MHz

Figure 5-22 Power Level Accuracy (<-70 dBm and >1300 MHz) Performance Test Setup



wk7120a

11. Timebase Aging Rate Performance Test

NOTE This test is only required for instruments with Option 1E5.

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 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 ± 1 Hz of the original frequency.

NOTE The internal timebase can be tested after the AC power is reconnected for 10 minutes. Yet, for best accuracy, test again after the instrument is on for 24 hours.

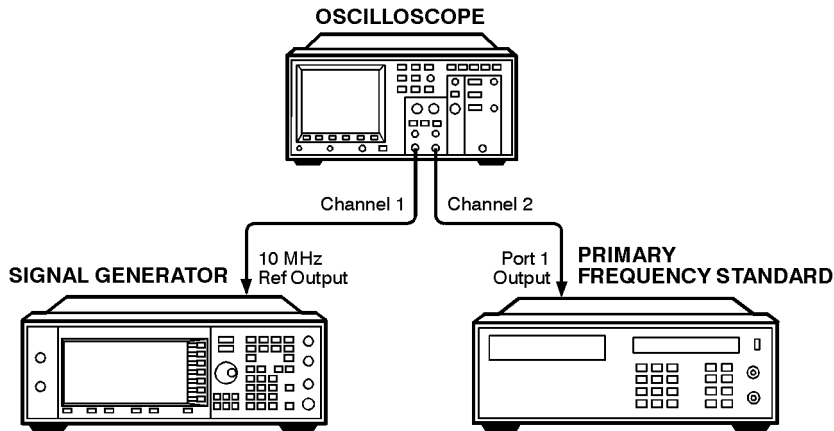
Frequency changes due to either a change in orientation, with respect to the earth's magnetic field, or to a change in altitude usually go away when the instrument is returned to its original position. A frequency change due to mechanical shock usually appears as a fixed frequency error.

Recommended Equipment

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

To Set Up the Equipment

Figure 5-23 Timebase Aging Rate Performance Test Setup



wk7121a

To Perform the Test

1. Preset all instruments and let them warm up for at least one hour.
2. If the oscilloscope does not have a 50Ω input impedance, connect channel 1 through a 50Ω 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

11. Timebase Aging Rate Performance Test

- Trigger Level: 0V
4. If the signal drifts a full cycle (360°) in less than 2 minutes, refer to [Chapter 6, “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 seconds

T2 = 3 hours

T3 = 349 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.

NOTE 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°.

12. Digital Modulation Level Accuracy Performance Test

The 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.

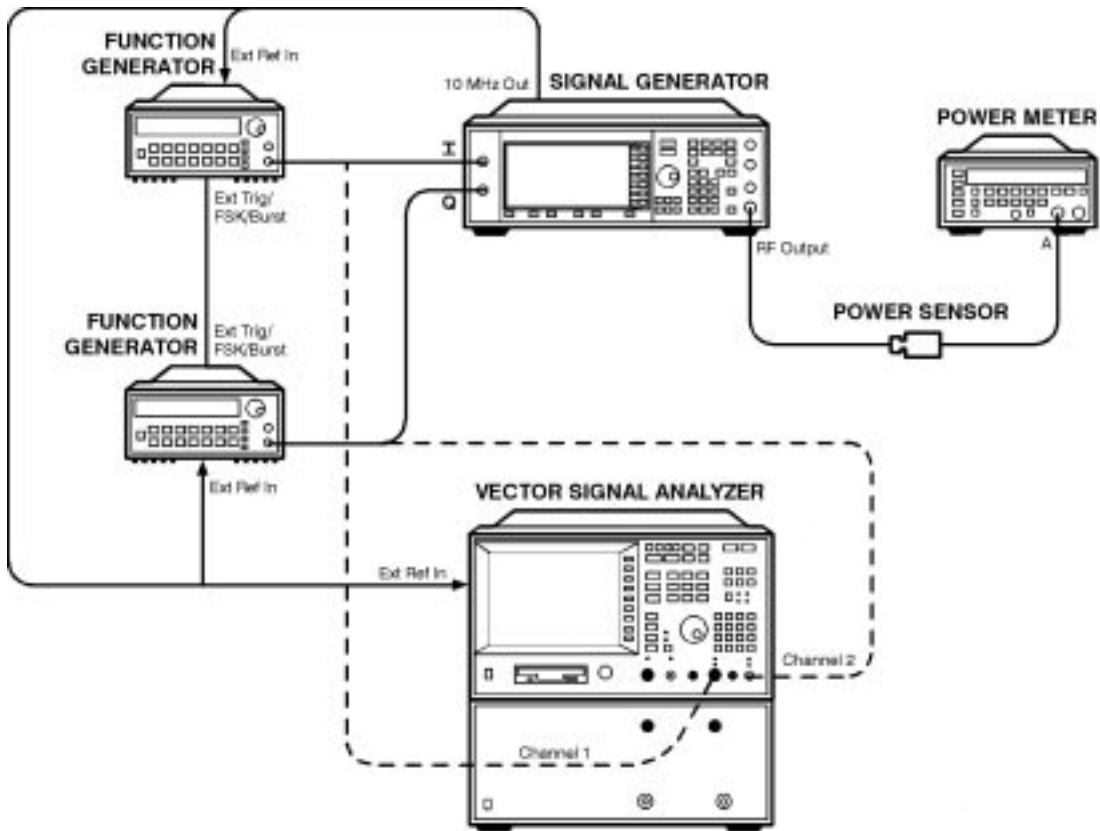
Recommended Equipment

- HP 438A Power Meter
- HP 8482A Power Sensor
- HP 33120A Option 001 Arbitrary Waveform Generator (2)
- HP 89441A Vector Signal Analyzer

12. Digital Modulation Level Accuracy Performance Test

To Set Up the Equipment

Figure 5-24 Digital Modulation Level Accuracy Performance Test Setup



wk745a

13. Internal Digital Modulation Quality Performance Test

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

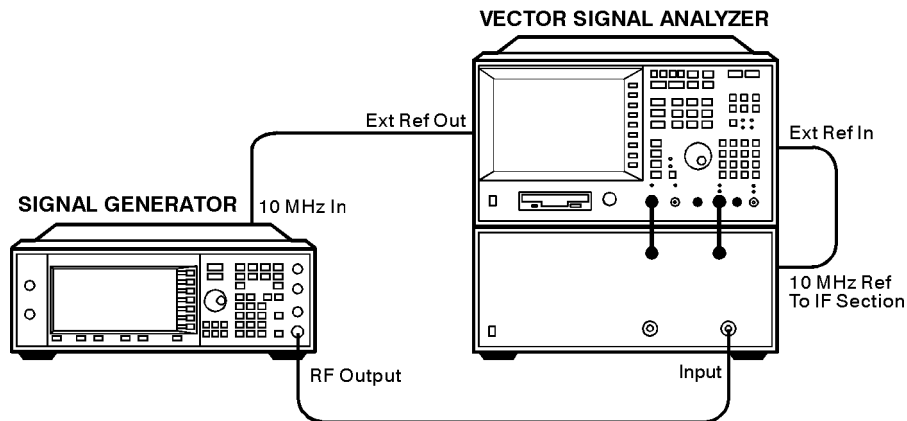
This automated test verifies the RF modulation quality of the signal generator's internal I/Q modulation. A vector signal analyzer is connected to the signal generator's RF output. The internal baseband generator modulates the RF carrier in each of the available digital modulation formats. The vector 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 89441A Options AYA, AY7, AY9, UFG, AY9 Vector Signal Analyzer

To Set Up the Equipment

Figure 5-25 Internal Digital Modulation Quality Performance Test Setup



wk7122a

14. Custom I/Q RF Modulation Quality (OptionUN8 Only)

14. Custom I/Q RF Modulation Quality (OptionUN8 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 generator 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

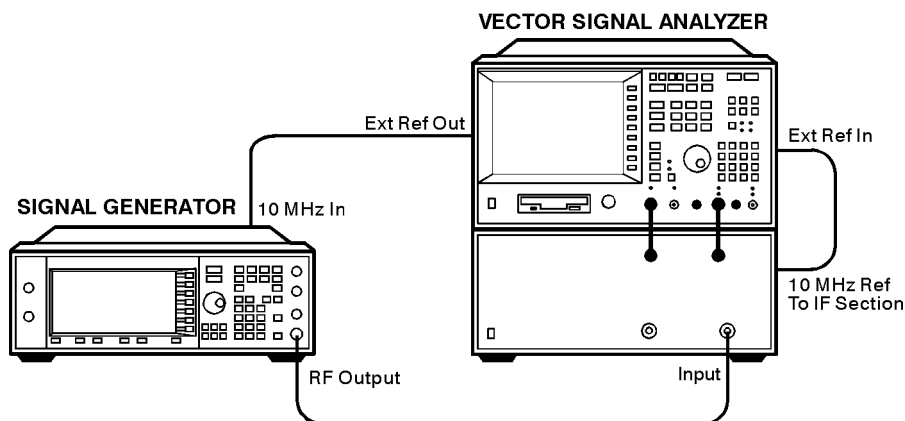
Recommended Equipment

- HP 89441A Vector Signal Analyzer

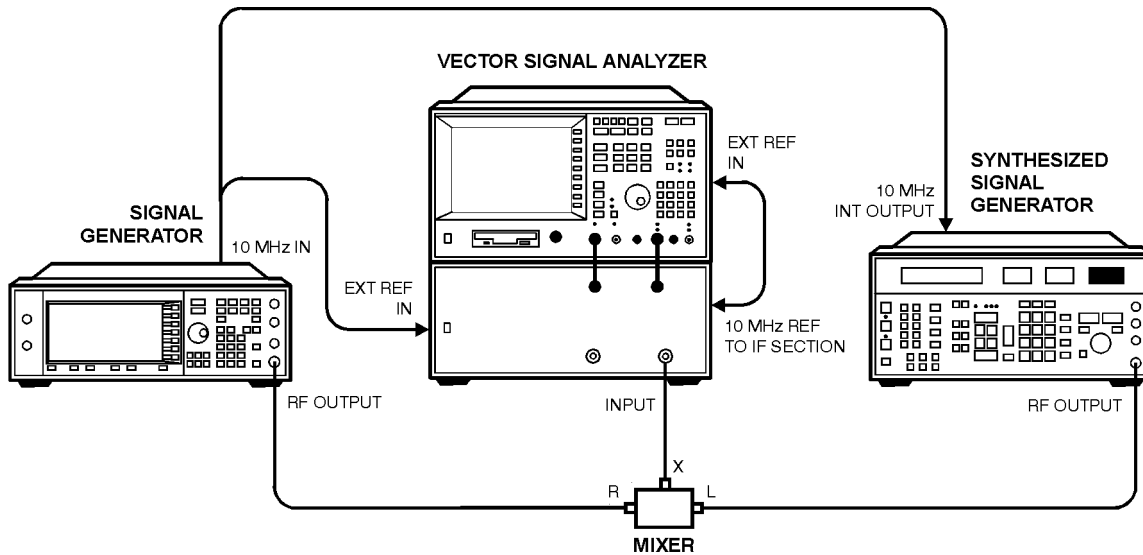
NOTE The HP 89441A requires Option AYH Digital Video Modulation Analysis for this test. This option is required in addition to the options required for the other Digital Modulation Quality test.

Connect the Test Equipment

Figure 5-26 Custom I/Q RF Modulation Quality (< 2000 MHz) Test Setup



wk7122a

Figure 5-27 Custom I/Q RF Modulation Quality (> 2000 MHz) Test Setup

wk77b

To Perform the Procedure

1. Connect the equipment as shown in [“Custom I/Q RF Modulation Quality \(< 2000 MHz\) Test Setup”](#) on page 5-34.
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 or UN8)

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

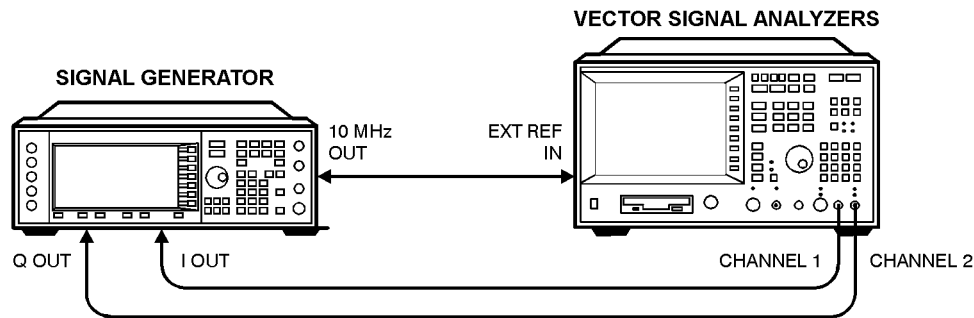
This test measures the accuracy of the rear-panel I and Q output signals created by the internal baseband generator in Option UN3, UN4, or UN8 signal generators. The vector signal analyzer is configured to measure the I and Q baseband signals and demodulate each modulation type separately.

Recommended Equipment

- HP 89441A Vector Signal Analyzer

Connect the Test Equipment

Figure 5-28 I/Q Modulation Quality Test Setup



wk76b

To Perform the Procedure

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.

16. Pulse Modulation On/Off Ratio Performance Test

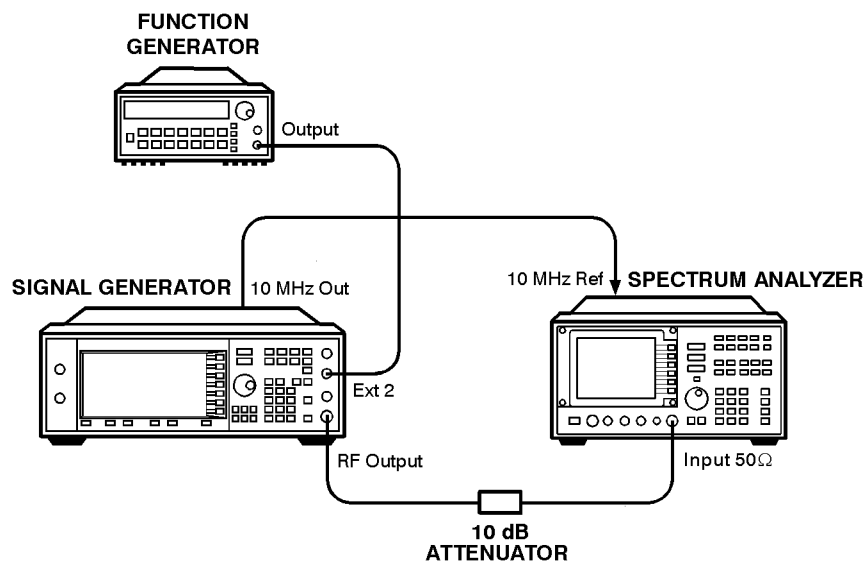
This automated test verifies the pulse modulation on/off ratio. The signal generator is configured for an external pulse input. The spectrum analyzer measures the RF output power with and without the external pulse applied. The power difference is the on/off ratio.

Recommended Equipment

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

To Set Up the Equipment

Figure 5-29 Pulse Modulation On/Off Ratio Performance Test Setup



wk7123a

17. Burst Modulation On/Off Ratio Performance Test (HP ESG-D Only)

17. Burst Modulation On/Off Ratio Performance Test (HP ESG-D Only)

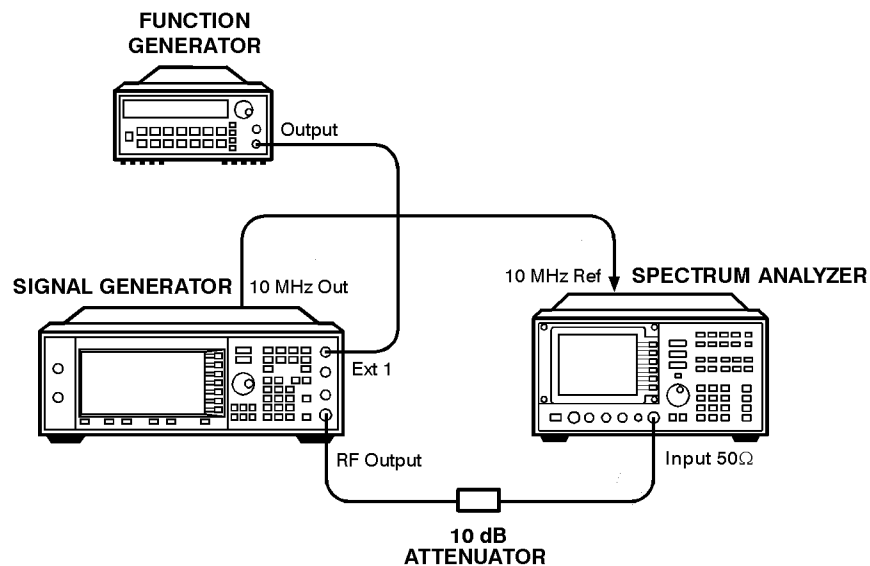
This automated test verifies the burst modulation on/off ratio. The signal generator is configured for an external burst input. The spectrum analyzer measures the RF output power with and without the external burst applied. The power difference is the on/off ratio.

Recommended Equipment

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

To Set Up the Equipment

Figure 5-30 Burst Modulation On/Off Ratio Performance Test Setup



wk7124a

18. CDMA Adjacent Channel Power Performance Test (Option UN5 Only)

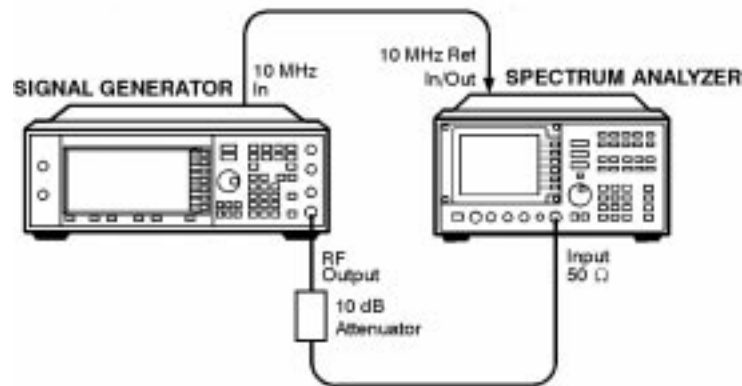
This automated test verifies the energy at an offset to the main channel relative to the total energy in the main channel. Post-processing averaging techniques are used to improve repeatability.

Recommended Equipment

- HP 8563E Spectrum Analyzer
- HP 8491A/B Option 010 Attenuator

To Set Up the Equipment

Figure 5-31 Adjacent Channel Power Performance Test Setup



hk73b

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

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

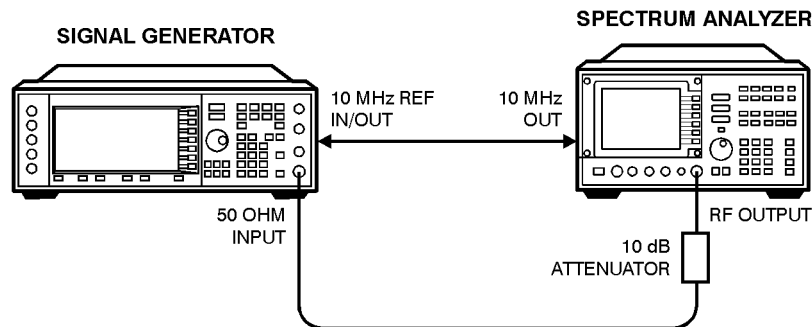
This test measures the time required for a waveform envelope to settle within the tolerance of its final amplitude after a sharp amplitude transition provided by the Alternate Timeslot Power feature (Option UNA). Settling time is the result of heating and cooling effects in the step attenuator and ALC 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 8563E Spectrum Analyzer with Option 007 Digitized Fast Time Domain Sweeps

Connect the Test Equipment

Figure 5-32 Alternate Timeslot Power Settling Time Test Setup



wk73b

To Perform the Procedure

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.

20. 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.

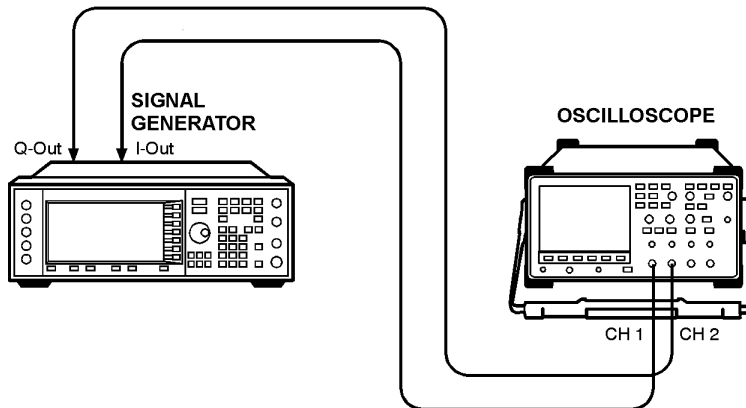
NOTE This is *not* a performance test. This check is only provided to insure that the dual arbitrary waveform generator is operational. There are no specifications for this check.

Recommended Equipment

- An oscilloscope with 2 input channels

Connect the Test Equipment

Figure 5-33 Dual Arbitrary Waveform Generator Equipment Setup



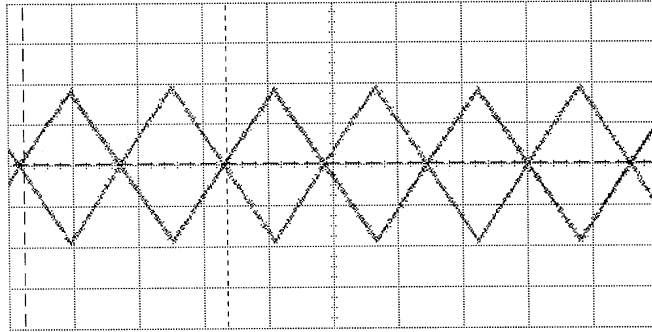
wk71b

To Perform the Procedure

1. Connect the test equipment as shown. The oscilloscope is not connected to HP-IB; 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

20. 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 $1.9 V_{p-p}$.
- Both waveforms are symmetrical around 0 volts (the average voltage is approximately 0V).

Performance Test Records

A performance test record for the “Timebase Aging Rate” manual performance test is located next in this chapter. Keep this copy as a master and use a photocopy for each calibration.

Using the ESG Series Support Software, you can print out a test record that contains the results of the automated performance tests.

Table 5-1 HP ESG and ESG-D Series Performance Test Record

| Model _____ | Report Number _____ | | Date _____ |
|----------------------------------|---------------------|--------------|--------------|
| Test Equipment Used | Model Number | Trace Number | Cal Due Date |
| 1. Digital Oscilloscope | _____ | _____ | _____ |
| 2. Measuring Receiver | _____ | _____ | _____ |
| 3. Audio Analyzer | _____ | _____ | _____ |
| 4. Signal Generator | _____ | _____ | _____ |
| 5. Mixer 1-2800 MHz | _____ | _____ | _____ |
| 6. Mixer 0.5-9 GHz | _____ | _____ | _____ |
| 7. Function Generator | _____ | _____ | _____ |
| 8. Signal Generator | _____ | _____ | _____ |
| 9. Mixer (0.5 to 9 GHz) | _____ | _____ | _____ |
| 10. Mixer (.001 to 2.8 GHz) | _____ | _____ | _____ |
| 11. Power Splitter | _____ | _____ | _____ |
| 12. Spectrum Analyzer | _____ | _____ | _____ |
| 13. Attenuator (10 dB) | _____ | _____ | _____ |
| 14. Attenuator (6 dB) | _____ | _____ | _____ |
| 15. Power Sensor | _____ | _____ | _____ |
| 16. Power Meter | _____ | _____ | _____ |
| 17. Preamplifier-Amplifier | _____ | _____ | _____ |
| 20. Preamplifier | _____ | _____ | _____ |
| 21. Primary Frequency Standard | _____ | _____ | _____ |
| 22. Vector Signal Analyzer | _____ | _____ | _____ |
| 23. Arbitrary Waveform Generator | _____ | _____ | _____ |
| 24. _____ | _____ | _____ | _____ |

Table 5-2 HP ESG and ESG-D Series Performance Test Record

| | | | | |
|---|------------------------------|----------------|------------------------------|--------------------------------|
| Model: _____ | Report Number: _____ | | | Date: _____ |
| Test Description | Minimum Specification | Results | Maximum Specification | Measurement Uncertainty |
| Timebase Aging Rate: Option 1E5 Only | | _____ | < ±0.0005 ppm/day | 5.6×10^{-11} per day |

6 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 recently:

- 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 (*HP ESG-D only*)
- I/Q Impairment Adjustment (*HP 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

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
- DCFM Calibration

AM Accuracy Related Adjustments

- AM Audio Path Offset Calibration
- AM Gain Calibration

Burst Modulation Accuracy Related Adjustments

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

Power Level Range and Accuracy Related Adjustments

- Prelevel Calibration
- Gain Adjustment
- ALC Modulation Driver Bias Calibration
- VBLO Mixer Bias Calibration
- ALC Calibration
- Power Flatness Calibration
- Attenuator Calibration (Power Meter)
- Level Meter Calibration
- ALC Modulation Flatness Calibration

I/Q Modulation Accuracy Related Adjustments

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

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.

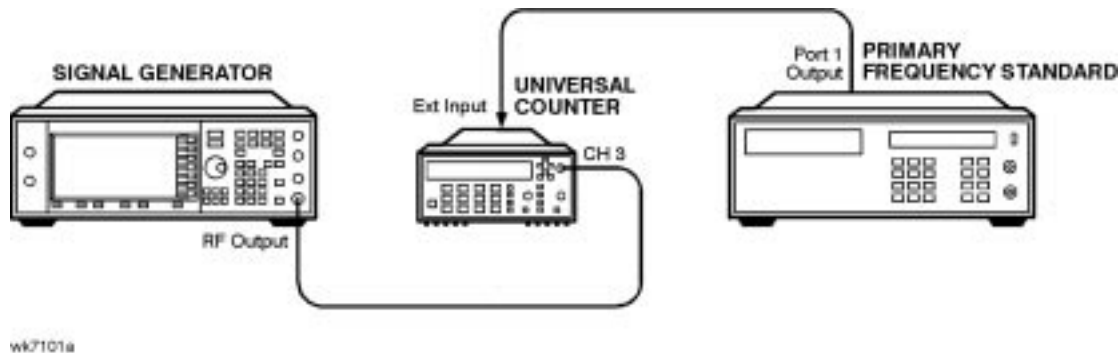
This is a manual adjustment. An automated version of this adjustment is also provided.

Required Test Equipment

- HP 53132A Universal Counter
- HP 5071A Primary Frequency Standard

Procedure

Figure 6-1 Internal Reference Oscillator Adjustment Test Setup



1. Connect the equipment as shown above.
2. Preset all of the equipment.
3. Set the universal counter input to 50 Ω .
4. On the signal generator, press the following keys:
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

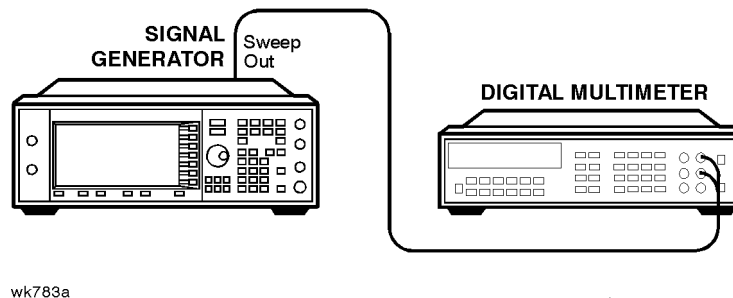
This test is used to calibrate the gain of the ABUS. The ABUS is connected to the ground node (ACOM) and the ADC is zeroed. The ABUS is then connected to the 10V reference and measured. The result of the measured value divided by the ideal value is the ABUS gain calibration constant. This value is then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

Required Test Equipment

- HP 3458A Digital Voltmeter

Procedure

Figure 6-2 Analog Bus ADC Calibration Test 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

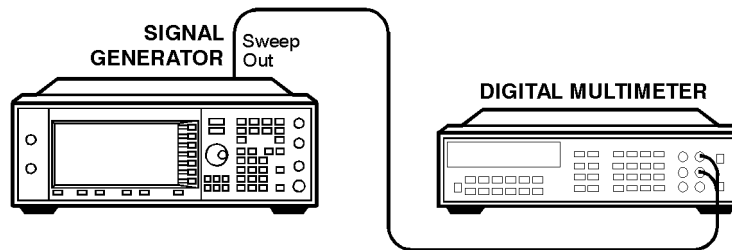
This test is used to calibrate the internal source amplitude versus frequency. The values for offset and gain are set to their default values in the internal source calibration arrays. Next, the offset calibration factor is determined by connecting the DVM to the ABUS and measuring the DC offset of the motherboard common ground ABUS node and the offset of the DSP ABUS node with the DSP set to $0V_{dc}$. 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 $2 V_{peak}$ 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 3458A Digital Voltmeter

Procedure

Figure 6-3 Internal Source Calibration Test Setup



wk783a

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 .77V to .80V drop.

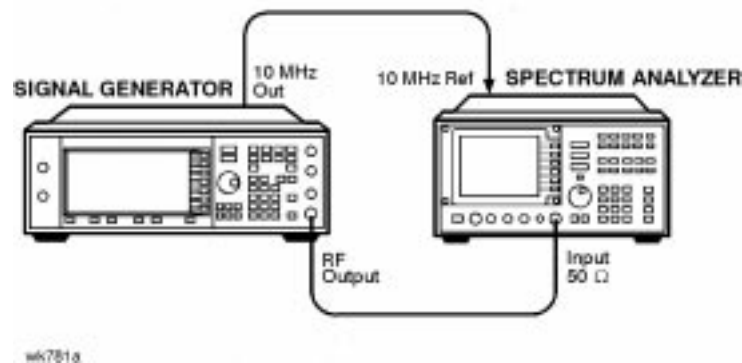
After you have performed this adjustment, you must perform the Lock Angle Potentiometer Adjustment on the following page.

Required Test Equipment

- HP 8563E Spectrum Analyzer

Procedure

Figure 6-4 VCO Bias Potentiometer Adjustment Test 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.

Lock Angle Potentiometer Adjustment

Description

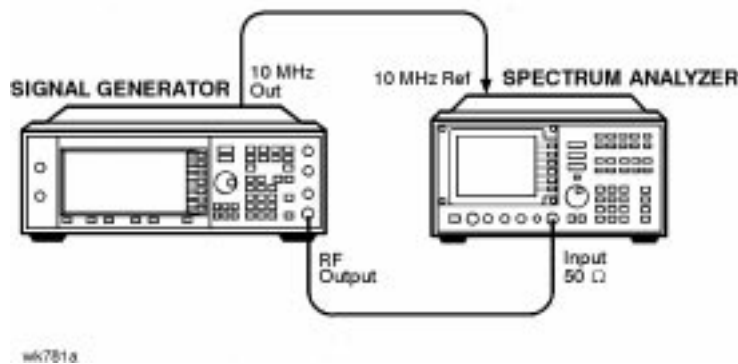
This test is used to optimize the phase detector sampling of the synthesizer phase-locked loop reference frequencies. The lock angle adjustment sets the time during the reference cycle when the ultra-quiet time phase detector measurement occurs. The phase detector needs to make its measurement at the 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 8563E Spectrum Analyzer

Procedure

Figure 6-5 Lock Angle Potentiometer Adjustment Test 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.

KV versus Frequency Calibration

Description

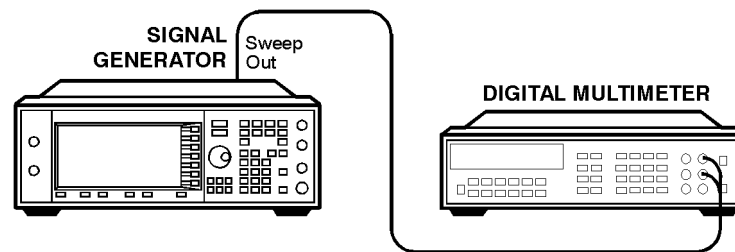
This test determines the tuning sensitivity of the synthesizer loop. To measure the sensitivity, the tuning voltage is measured as the frequency is stepped from 500 to 1000 MHz in 10 MHz steps. At each incremental frequency the tuning voltage is measured (Vtune1) and again at the incremental frequency +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 3458A Digital Voltmeter

Procedure

Figure 6-6 KV versus Frequency Calibration Test Setup



wk783a

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

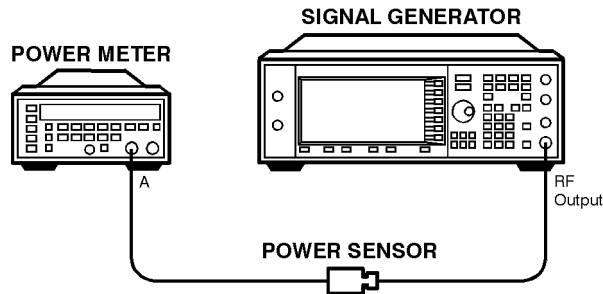
This test calibrates the AM path to remove any offset generated when LIN AM, LIN BURST, or LOG BURST are enabled. This test determines the ALC_REF_DAC delta value which is used to correct the offset when the modulation is enabled. This value is then stored in the appropriate calibration constant.

Required Test Equipment

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

Procedure

Figure 6-7 AM Audio Path Offset Calibration Test Setup



wk780a

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

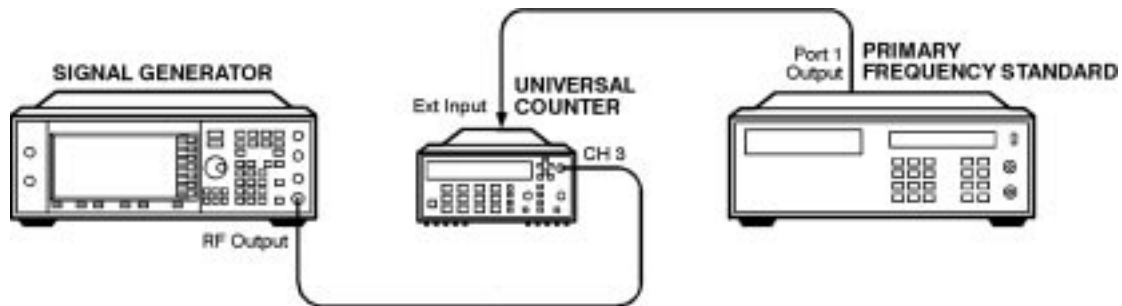
This test insures that the signal generator has warmed-up sufficiently and then adjusts the coarse and fine reference timebase DACs for minimum internal reference frequency error. The coarse and fine DAC calibration factors are then stored in the signal generator's firmware.

Required Test Equipment

- HP 53132A Universal Counter
- HP 5071A Primary Frequency Standard

Procedure

Figure 6-8 Timebase DAC Calibration Test 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

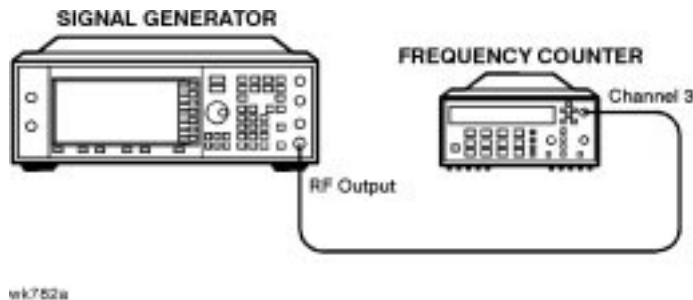
This test is used to remove the offset associated with the FM SCALE DAC operational amplifier located on the reference board. This calibration results in a DAC value for FM OFFSET DAC 2. After this DAC value has been properly adjusted, the effects of the FM SCALE DAC value on the offset will be minimized.

Required Test Equipment

- HP 53132A Universal Counter

Procedure

Figure 6-9 FM Scale 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 Path Offset Calibration

Description

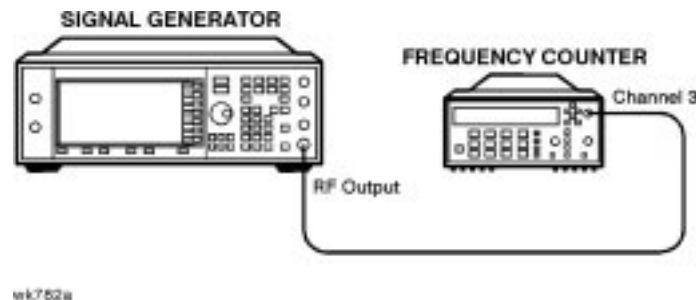
This test is used to remove the offsets associated with the various FM1 and FM2 audio paths on the reference board. When FM is enabled, voltage offsets on the reference and synthesizer boards appear as frequency shifts on the synthesizer VCO. By using a frequency counter to measure the frequency of the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

Required Test Equipment

- HP 53132A Universal Counter

Procedure

Figure 6-10 FM Path Offset Calibration Test 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

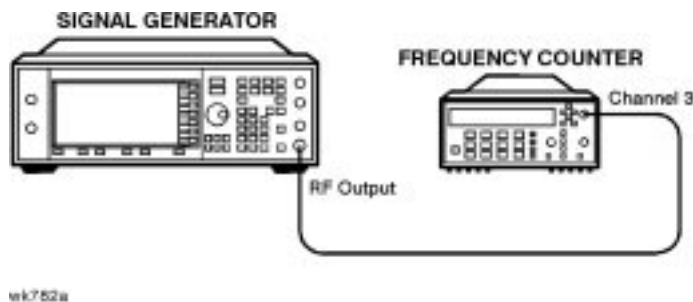
This test is used to remove the offset associated with the FM IN-BAND DAC located on the synthesizer board. The calibration determines the DAC value for the FM IN-BAND OFFSET DAC on the synthesizer board which will remove the offset associated with the FM IN-BAND DAC.

Required Test Equipment

- HP 53132A Universal Counter

Procedure

Figure 6-11 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

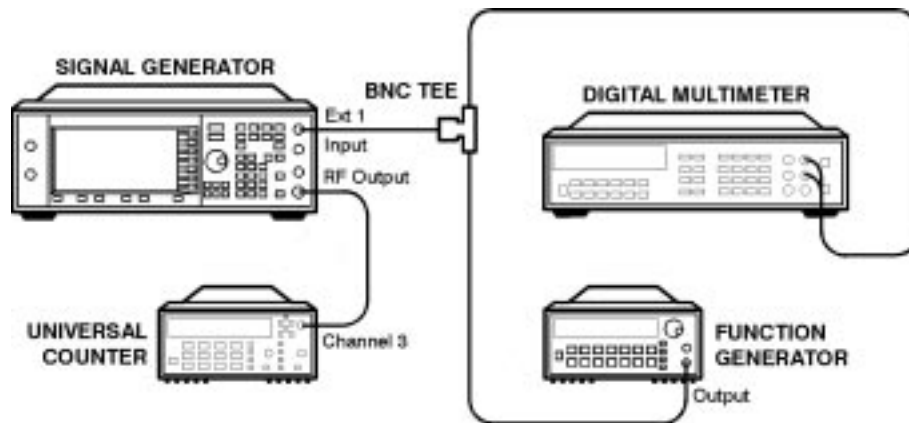
This test equalizes the gain between the FM1 and FM2 paths. The gain of the FM2 path is adjusted using the FM SCALE DAC and the resulting DAC value is stored in the signal generator's firmware. This calibration only affects source-independent gains. When uncalibrated sources feed into the paths, the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

Required Test Equipment

- HP 3458A Digital Voltmeter
- HP 53132A Universal Counter
- HP 33120A 15 MHz Function/Arbitrary Waveform Generator

Procedure

Figure 6-12 FM 1/2 Path Ratio Gain Calibration Test 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

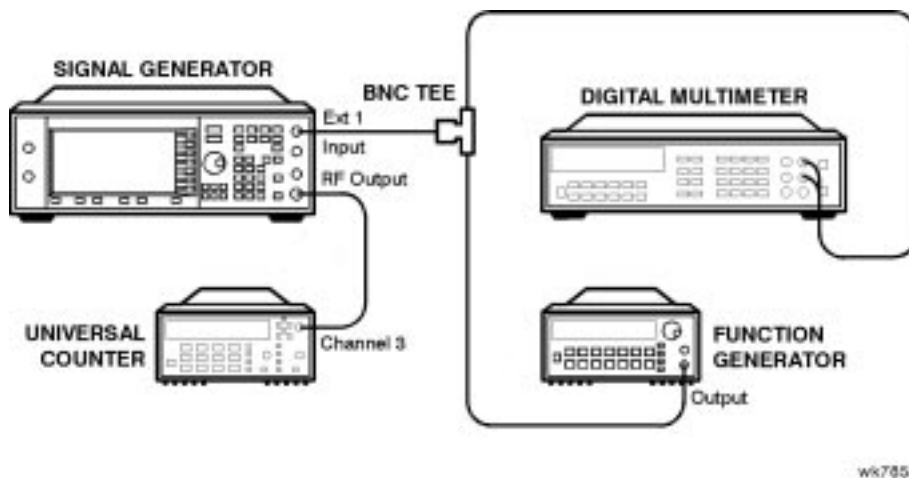
This test provides a scaling factor for all of the multiplexed FM modulation inputs. The scaling factor is used by the signal generator's firmware to scale the actual requested FM deviation from the synthesizer board when the corresponding input is selected. Three scaling factors (EXT1, EXT2, and INT1) 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 3458A Digital Voltmeter
- HP 53132A Universal Counter
- HP 33120A 15 MHz Function/Arbitrary Waveform Generator

Procedure

Figure 6-13 Modulation Source Relative Gain Compression Calibration Test 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 Out-of-Band Calibration

Description

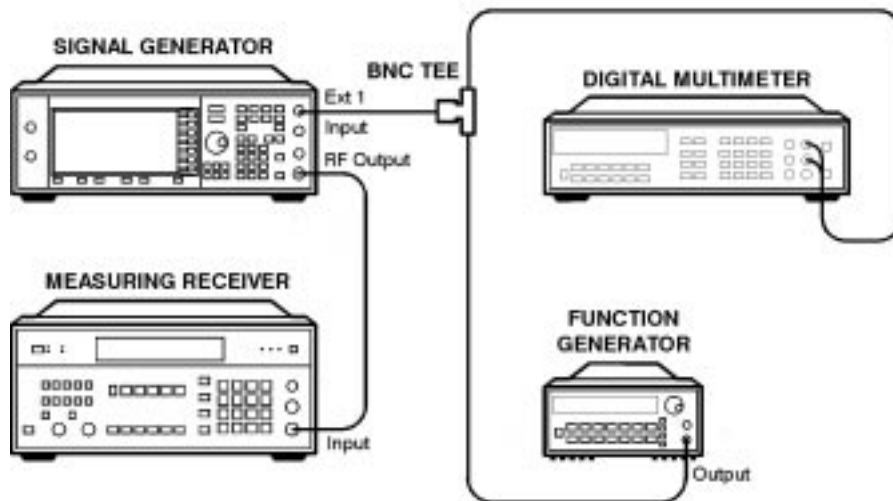
This test adjusts the FM out-of-band deviation to match the in-band FM deviation. It also determines the attenuation values of the out-of-band attenuators and sets the values of some other FM constants. The loop bandwidth of the synthesizer phase-locked loop is approximately 5 kHz. This calibration is 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 3458A Digital Voltmeter
- HP 8902A Measuring Receiver
- HP 33120A 15 MHz Function/Arbitrary Waveform Generator

Procedure

Figure 6-14 FM Out-of-Band Calibration Test 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

Description

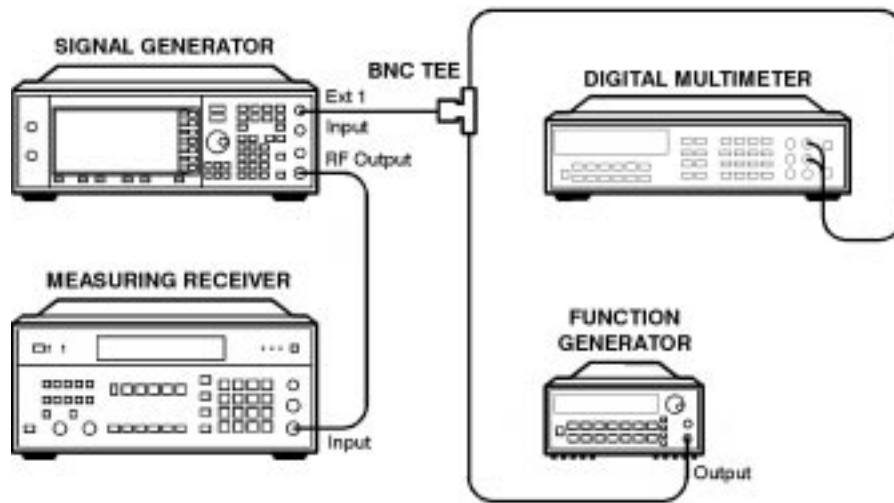
This test adjusts the match between the delay of the signal passing through the FM in-band path to the delay of the signal passing through the FM out-of-band path. This calibration is the final adjustment required to achieve good FM performance over a wide range of different rates. The FM delay potentiometer 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 3458A Digital Voltmeter
- HP 8902A Measuring Receiver
- HP 33120A 15 MHz Function/Arbitrary Waveform Generator

Procedure

Figure 6-15 FM Delay Potentiometer Adjustment Test 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.

Wide Bandwidth Phase Modulation Calibration

Description

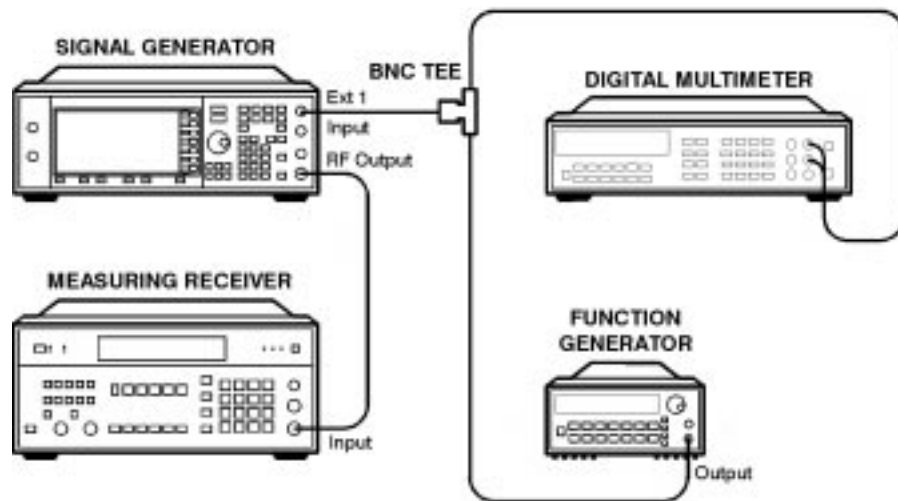
This test is used to calibrate the phase modulation circuitry on the synthesizer board. The phase modulation has two operational modes: normal and wide bandwidth. This calibration determines the attenuation correction factors for maximum deviation for each of the phase modulation out-of-band ranges for 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 3458A Digital Voltmeter
- HP 8902A Measuring Receiver
- HP 33120A 15 MHz Function/Arbitrary Waveform Generator

Procedure

Figure 6-16 Wide Bandwidth Phase Modulation Calibration Test Setup



wk705a

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

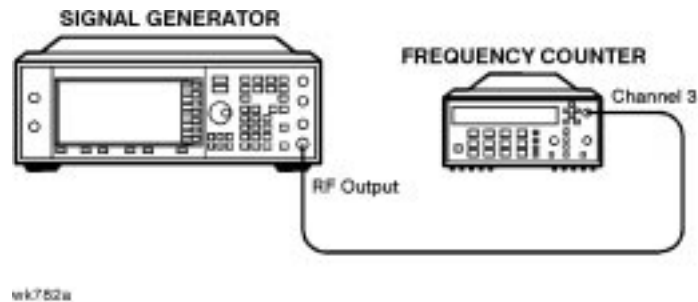
This test removes all of the DC offsets associated with the FM path while in DCFM mode. This test uses only the FM1 path to verify the functionality of the circuitry. The resulting values are stored in the signal generator's firmware.

Required Test Equipment

- HP 53132A Universal Counter

Procedure

Figure 6-17 DCFM Calibration Test 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

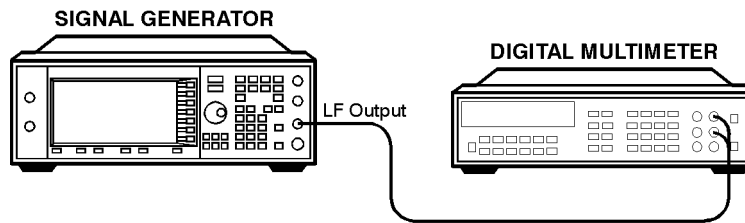
The LF output provides a calibrated audio frequency signal. This test is used to set the full-scale amplitude of the LF-OUT DAC on the reference board. When the calibration is complete, the voltage on the LF output should be equal to the input voltage, plus or minus 1 mV. The resulting DAC values are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

Required Test Equipment

- HP 3458A Digital Voltmeter

Procedure

Figure 6-18 Low Frequency (LF) Output Calibration Test Setup



wk787a

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

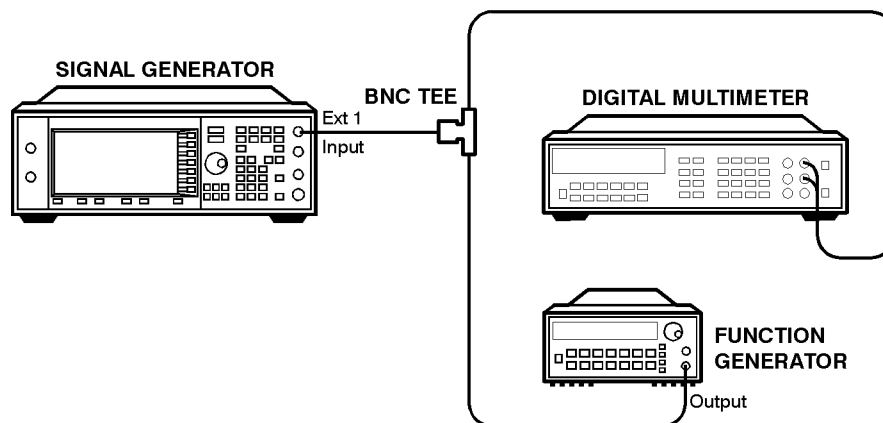
This test is used to calibrate the positive trip level of the EXT1 and EXT2 peak detectors located on the reference board. The calibration generates DAC values for the modulation comparator DACs which provide a voltage to the window comparator operational amplifiers. When the peak detector level DACs 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 3458A Digital Voltmeter
- HP 33120A 15 MHz Function/Arbitrary Waveform Generator

Procedure

Figure 6-19 External Input Peak Detector Calibration Test 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 (HP ESG-D Only)

Description

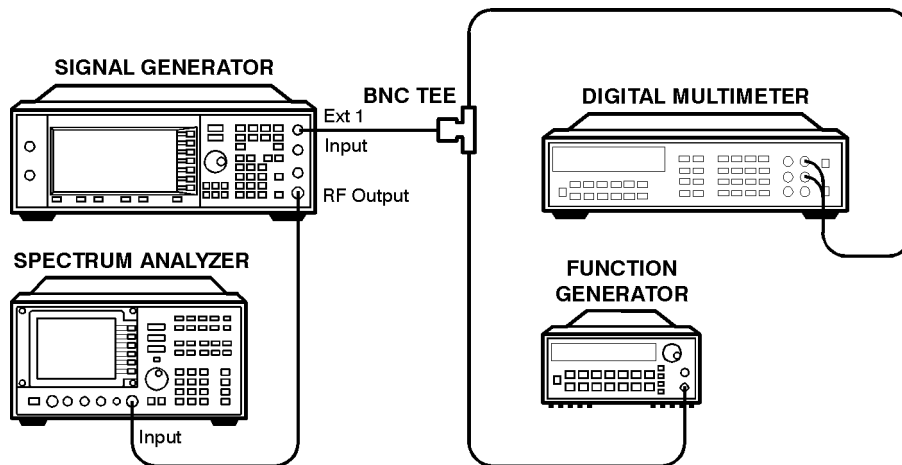
This test is used to adjust the bias modulator circuitry to provide an accurate logarithmic drop in power level for a linear input voltage. When properly adjusted, a one-volt signal on the input will result in a 10 dB drop in power level. The adjustment involves the adjustment of three DACs (BURST BIAS, 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 8904A Audio Source
- HP 8563E Spectrum Analyzer
- HP E4400-60073 Digital Test Card

Procedure

Figure 6-20 Burst Modulator Calibration Test 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

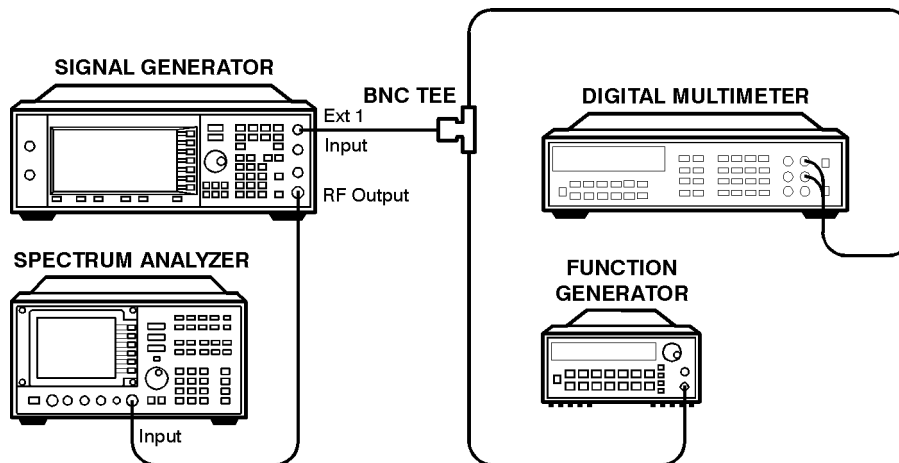
This test adjusts the scaling of the linear burst audio path until a $-0.99V_{dc}$ input to the EXT1 connector results in a 40 dB drop in power relative to $0.00V_{dc}$ input when linear burst is activated. The AM 1 DAC value is changed until this result is achieved and its value is stored as a calibration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

Required Test Equipment

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

Procedure

Figure 6-21 Burst Audio Path Gain Calibration Test 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

Description

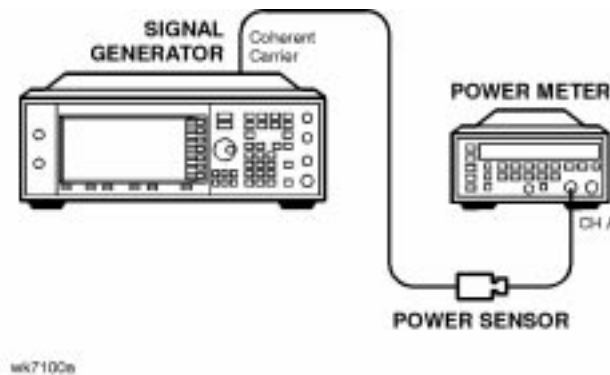
This test calibrates the PRE LEVEL REF DAC on the output board. This DAC is used to control the RF power level that is incident upon the marble I/Q modulator by setting the control point for the prelevel loop. The prelevel loop detector is on the output of the marble I/Q modulator, its drive circuitry 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 438A Power Meter
- HP 8482A Power Sensor

Procedure

Figure 6-22 Prelevel Calibration Test 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

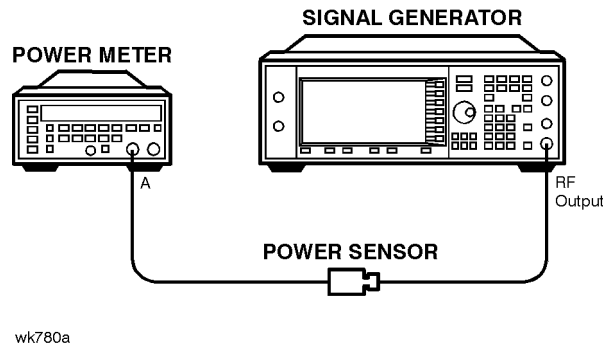
This test calibrates the GAIN ADJUST DAC on the output board. This DAC is used to control the RF power level that is incident upon the switched filters and subsequent RF amplifiers by setting the control point for the gain adjust modulator. This calibration ensures that there will be sufficient power 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 438A Power Meter
- HP 8482A Power Sensor

Procedure

Figure 6-23 Gain Adjust Calibration Test 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.

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.

Automatic Leveling Control (ALC) Calibration

Description

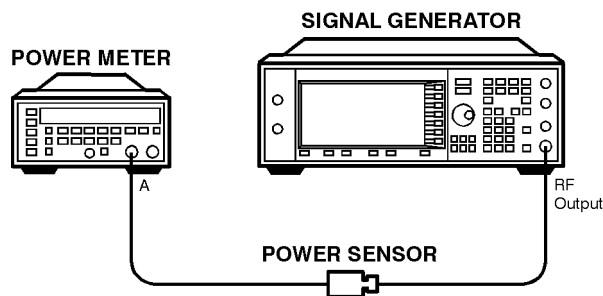
This test is used to achieve a four-point fit of power level accuracy over the ALC REF DAC settings of 1300, 1800, 2300, and 2700. Three calibration constants and the BULK R ADJ potentiometer are used to calibrate the ALC. Closed loop and open loop calibrations are adjusted separately. The resulting values are stored as calibration arrays in the signal generator's firmware.

Required Test Equipment

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

Procedure

Figure 6-24 Automatic Leveling Control Calibration Test Setup



wk780a

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.

Power Flatness Calibration

Description

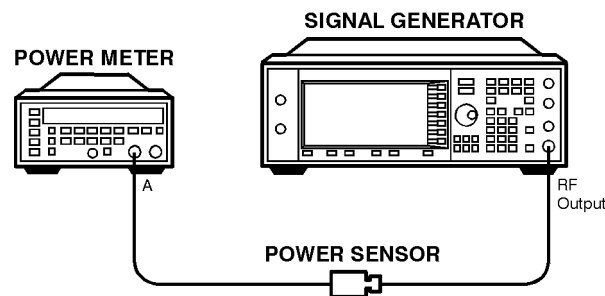
This test adjusts the output power to be flat across the signal generator's entire operating range. The ALC REF DAC is set to 2048, which nominally sets the power to 0 dBm at the RF output. The exact power level is then measured and a correction factor is generated which is then used to offset the ALC REF DAC until an output power level of 0 dBm is achieved. The results are stored as a calibration array in the signal generator's firmware.

Required Test Equipment

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

Procedure

Figure 6-25 Power Flatness Calibration Test Setup



wk780a

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.

Attenuator Calibration (Power Meter)

Description

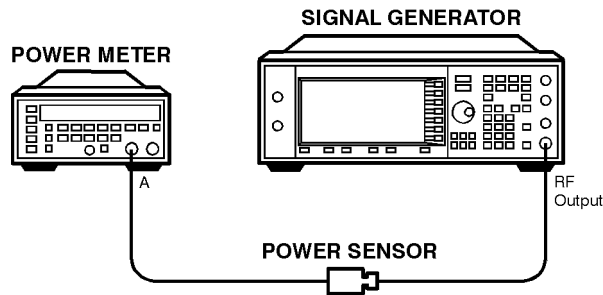
This test is used to calibrate the output power when the attenuator is set at -5, -10, and -15 dB. To calibrate each attenuator step, the attenuator is set to the correct internal attenuation using an internal attenuator latch command. Two power measurements are triggered: one without the attenuator and one with the attenuator. The difference between the expected attenuation and the measured attenuation is stored in the appropriate calibration array.

Required Test Equipment

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

Procedure

Figure 6-26 Attenuator Calibration (Power Meter) Test Setup



wk780a

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.

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

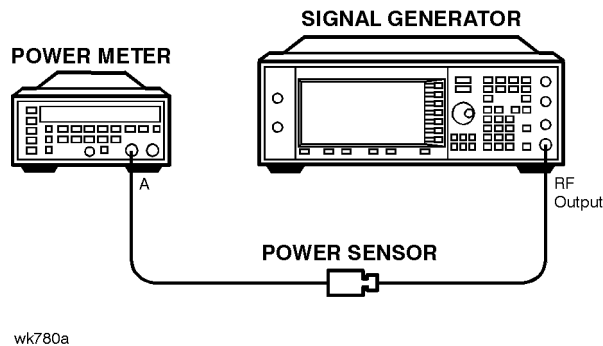
This test calibrates the ALC REF DAC corrections necessary to maintain power flatness in the ALC open-loop mode of operation. The nominal ALC REF DAC settings are adjusted to re-align the ALC open-loop power with the desired level. The resulting values are stored as calibration arrays in the signal generator's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

Required Test Equipment

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

Procedure

Figure 6-27 ALC Modulation Flatness Calibration Test 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

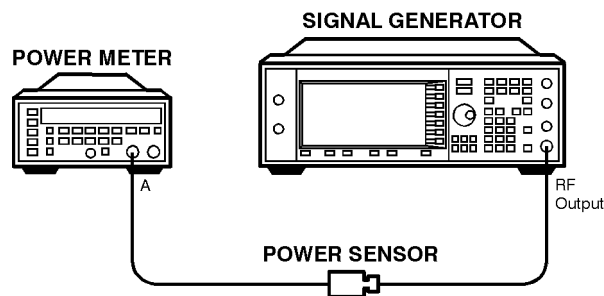
This test adjusts the gain of the AM circuitry to provide a 10 dB drop for a one-volt input signal. First a power level is set and a one-volt signal is connected to the input. AM is enabled and the AM DACs are adjusted for an exact 10 dB drop. The resulting DAC value is stored as a calibration array.

Required Test Equipment

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

Procedure

Figure 6-28 AM Gain Calibration Test Setup



wk780a

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 (HP 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 (HP 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.

Required Test Equipment

- None

Procedure

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

Baseband Generator I/Q Gain and Offset Adjustment (Options UN3 and UN4 Only)

Description

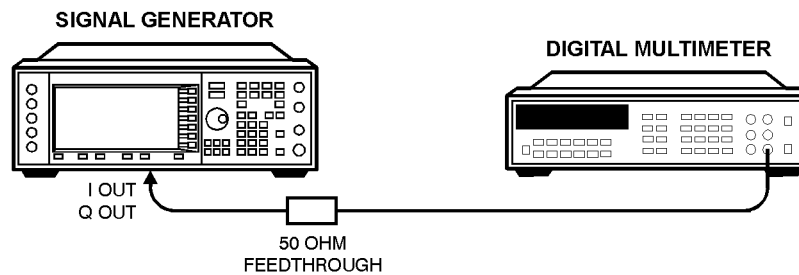
This adjustment uses a DVM to set the baseband generator's four potentiometers (I Gain, I Offset, Q Gain, and Q Offset) to minimize the DC offset and set the AC voltage level to $0.5 V_{pk}$ (into 50 ohms) at the rear-panel I and Q output connectors.

Required Test Equipment

- HP 3458A Digital Voltmeter

Procedure

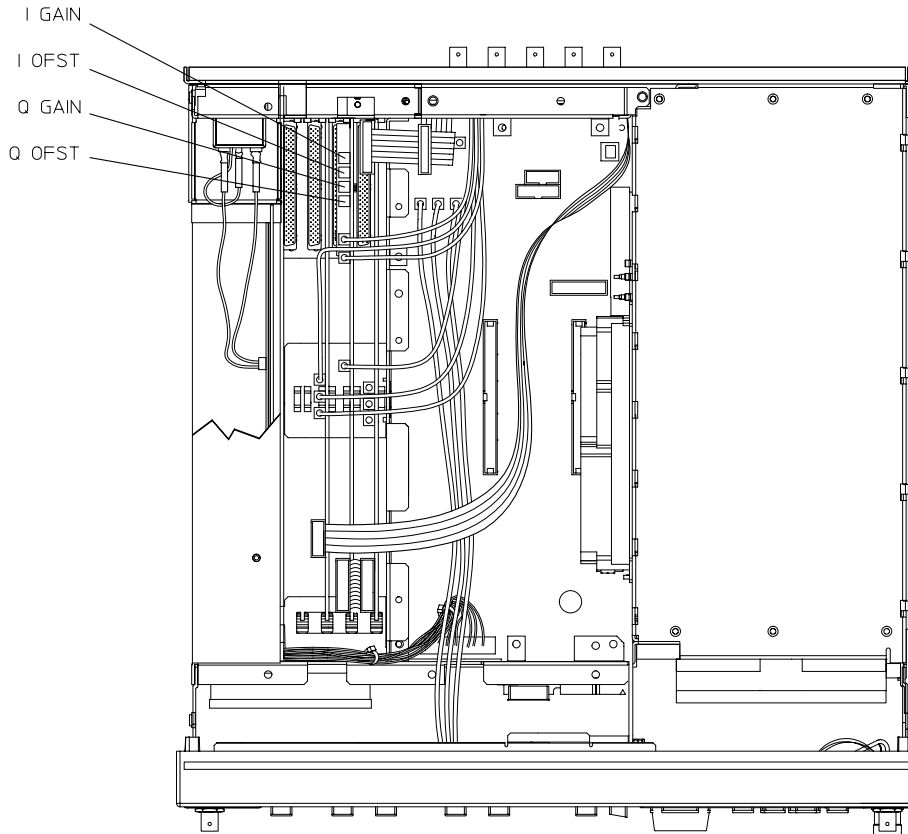
Figure 6-29 Baseband Generator I/Q Gain and Offset Adjustment Test Setup



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. The following figure shows the location of the adjustments.

Figure 6-30 Baseband Generator I/Q Gain and Offset Adjustment Location



wk75b

Low Level Step Attenuator Calibration

Description

| | |
|-------------|---|
| NOTE | The accuracy of this test depends on the accuracy of the Attenuator Calibration (Power Meter). You must perform the Attenuator Calibration (Power Meter) before you perform the following adjustment. |
|-------------|---|

Measurement accuracy at low power levels is dependent on a good signal-to-noise ratio (SNR). This adjustment first insures that the measurement system's noise floor is not above a specific level. During this verification, spectrum analyzer residuals are also checked. If a residual is found, the adjustment for that frequency is shifted 25 Hz to avoid the residual.

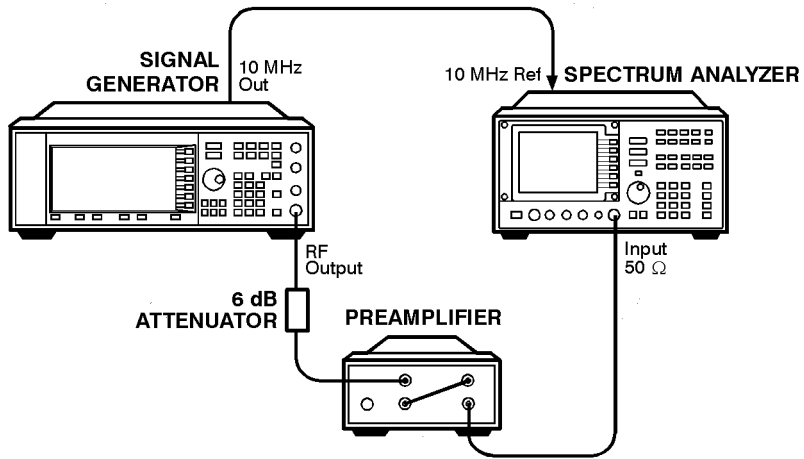
This calibration procedure is based on relative power measurements using a spectrum analyzer. The reference for all measurements is the -10 dBm level adjusted in the Attenuator Calibration (Power Meter) procedure. For signal levels below -70 dBm, low noise amplifiers are inserted to maximize the signal-to-noise ratio at low levels. Note that all subsequent measurements are relative to -70 dBm (the lowest signal level measured without the amplifiers). Note also that all attenuator calibration arrays for 20 dB and below are filled with zero after the noise floor measurement. If an adjustment is interrupted after the arrays are zeroed, low level power accuracy will be affected.

Required Test Equipment

- HP 8563E Spectrum Analyzer
- HP 8447D Option 011 .1 to 1300 MHz Dual Preamplifier
- HP 8449D 1 to 26.5 GHz Preamplifier
- HP 8491A/B Option 006 Attenuator (6 dB)

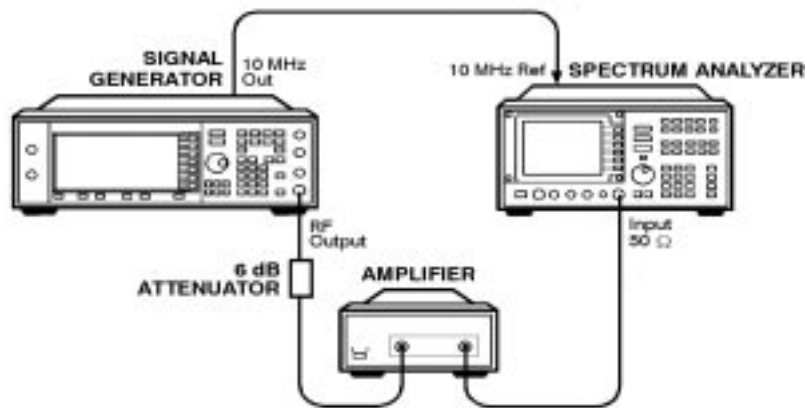
Procedure

Figure 6-31 Low Level Step Attenuator Calibration Test Setup 1



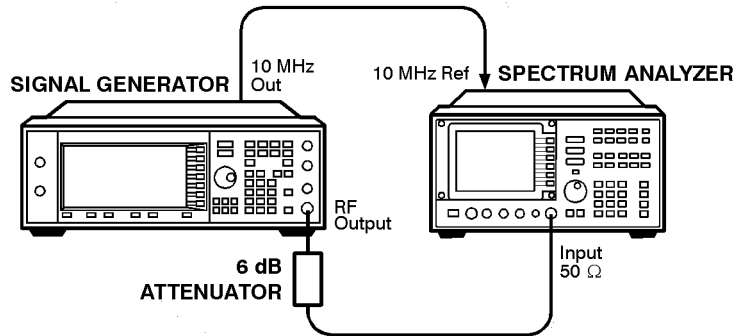
wk78b

Figure 6-32 Low Level Step Attenuator Calibration Test Setup 2



wk7109a

Low Level Step Attenuator Calibration

Figure 6-33 Low Level Step Attenuator Calibration Test Setup 3

wk7104a

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

7 Maintenance and Service

This chapter contains preventive maintenance procedures, and it explains how to return your signal generator to HP for service.

Preventive Maintenance Procedures

The HP ESG / ESG-D Series 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.

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 Your Signal Generator to HP

If you are returning your signal generator to HP 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 HP sales and service office. A list of sales and service offices follows on the next page.

HP Sales and Service Offices

Table 7-1 Hewlett-Packard Sales and Service Offices

| UNITED STATES | | |
|--|--|---|
| <p>Instrument Support Center Hewlett-Packard Company (800) 403-0801</p> | | |
| EUROPEAN FIELD OPERATIONS | | |
| <p>Headquarters Hewlett-Packard S.A. 150, Route du Nant-d'Avril 1217 Meyrin 2/ Geneva Switzerland (41 22) 780.8111</p> | <p>France Hewlett-Packard France 1 Avenue Du Canada Zone D'Activite De Courtaboeuf F-91947 Les Ulis Cedex France (33 1) 69 82 60 60</p> | <p>Germany Hewlett-Packard GmbH Hewlett-Packard Strasse 61352 Bad Homburg v.d.H Germany (49 6172) 16-0</p> |
| <p>Great Britain Hewlett-Packard Ltd. Eskdale Road, Winnersh Triangle Wokingham, Berkshire RG41 5DZ England (44 734) 696622</p> | | |
| INTERCON FIELD OPERATIONS | | |
| <p>Headquarters Hewlett-Packard Company 3495 Deer Creek Rd. Palo Alto, CA 94304-1316 USA (415) 857-5027</p> | <p>Australia Hewlett-Packard Australia Ltd. 31-41 Joseph Street Blackburn, Victoria 3130 (61 3) 895-2895</p> | <p>Canada Hewlett-Packard (Canada) Ltd. 17500 South Service Road Trans-Canada Highway Kirkland, Quebec H9J 2X8 Canada (514) 697-4232</p> |
| <p>Japan Hewlett-Packard Japan, Ltd. 9-1 Takakura-Cho, Hachioji Tokyo 192, Japan (81 426) 60-2111</p> | <p>Singapore Hewlett-Packard Singapore (Pte.) Ltd. 150 Beach Road #29-00 Gateway West Singapore 0718 (65) 291-9088</p> | <p>Taiwan Hewlett-Packard Taiwan 8th Floor, H-P Building 337 Fu Hsing North Road Taipei, Taiwan (886 2) 712-0404</p> |
| <p>China China Hewlett-Packard Co. 38 Bei San Huan X1 Road Shuang Yu Shu Hai Dian District Beijing, China (86 1) 256-6888</p> | | |

8 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.

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.

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.

WARNING **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.**

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.



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)

General Safety Considerations

WARNING **No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.**

WARNING **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.**

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.

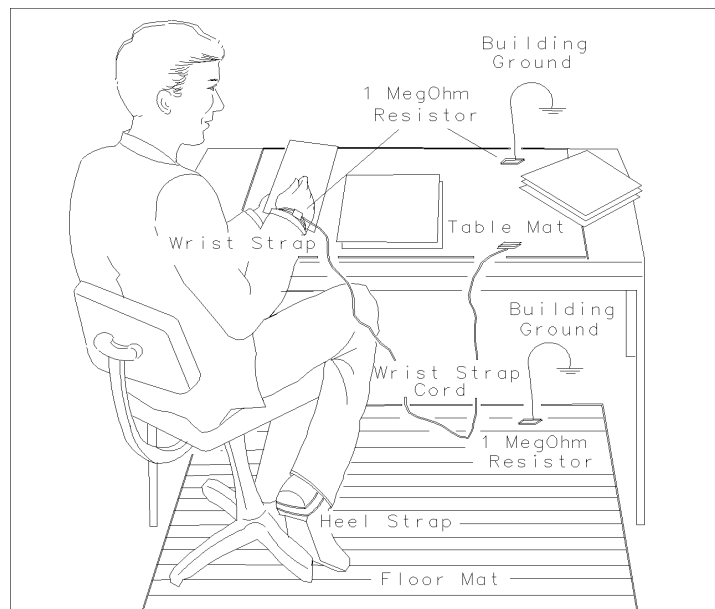
Electrostatic Discharge

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 8-1](#) 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 8-1 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.

Warranty

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of three years from date of shipment. During the warranty period, Hewlett-Packard Company 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 Hewlett-Packard. Buyer shall prepay shipping charges to Hewlett-Packard and Hewlett-Packard shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to Hewlett-Packard from another country.

Hewlett-Packard warrants that its software and firmware designated by Hewlett-Packard for use with an instrument will execute its programming instructions when properly installed on that instrument. Hewlett-Packard 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. HEWLETT-PACKARD 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. HEWLETT-PACKARD SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

Assistance

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products. For any assistance, contact your nearest Hewlett-Packard sales and service office. Refer to the list of sales and service offices in [Chapter 8, “Safety and Regulatory.”](#)

Certification

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard 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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