User's Guide

HP ESG and HP ESG-D Series Signal Generators

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1 Preparing for Use

This chapter contains procedures that show you how to install your signal generator, and how to perform a functional check to verify signal generator operation.

Installing the Signal Generator

This section contains procedures for properly installing your signal generator:

- checking the shipment
- installing front handles and rack flange kits
- meeting electrical and environmental requirements
- adjusting the display
- selecting the signal generator's HP-IB address
- selecting the programming language

Checking the Shipment

1. Inspect the shipping container for damage.

   Look for signs of damage such as a dented or torn shipping container, or cushioning material that shows signs of unusual stress or compacting.

2. Carefully remove the contents from the shipping container and verify that your order is complete. Refer to Table 1-1 and Table 1-2 for a list of items that are shipped standard with the signal generator and for a list of options that you may also have ordered.

Table 1-1 Shipment Verification List

Part Number	Item Description	Option
Unique to Country	AC Power Cable	Standard
5063-9227	Front Handle Kit	1CN
5063-9214	Rack Flange Kit (without handles)	1CM
5063-9221	Rack Flange Kit (with handles)	1CP
E4400-90145	Manual Set for HP ESG-D Series	Standard
E4400-90141	Manual Set for HP ESG Series	Standard
E4400-90145 or E4400 90141	Additional Manual Set	OB1
E4400-90155	Service Guide	0BW, 0BX
E4400-90156	Component Level Information Guide	0BV, 0BX

The following table describes the localized versions of the manuals that you will receive if you have ordered the options listed. In most cases, a subset of the user's information from the manual listed is localized. These options are available at no charge at the time of your purchase of the signal generator. (Because the localization of these manuals is begun after the English version is written, the localized manuals will become available over a period of time. You may not receive all of the manuals listed.)

Table 1-2 Shipment Verification List for Localized Manuals

Part Number	Item Description	Language	Option
E4400-90172 E4400-90180 E4400-90187 E4400-90194 E4400-90201	HP ESG and ESG-D User's Guide Real-Time I/Q Baseband Generator Guide Dual Arbitrary Waveform Generator Guide DECT Guide GSM Guide	Chinese	AB2
E4400-90173 E4400-90181 E4400-90188 E4400-90195 E4400-90202	HP ESG and ESG-D User's Guide Real-Time I/Q Baseband Generator Guide Dual Arbitrary Waveform Generator Guide DECT Guide GSM Guide	Chinese for Taiwan	AB0
E4400-90174 E4400-90182 E4400-90189 E4400-90196 E4400-90203 E4400-90212	HP ESG and ESG-D User's Guide Real-Time I/Q Baseband Generator Guide Dual Arbitrary Waveform Generator Guide DECT Guide GSM Guide TETRA Guide	French	ABF
E4400-90175 E4400-90183 E4400-90190 E4400-90197 E4400-90204 E4400-90210	HP ESG and ESG-D User's Guide Real-Time I/Q Baseband Generator Guide Dual Arbitrary Waveform Generator Guide DECT Guide GSM Guide TETRA Guide	German	ABD
E4400-90176 E4400-90179 E4400-90184 E4400-90191 E4400-90198 E4400-90205 E4400-90208 E4400-90209	HP ESG and ESG-D User's Guide Bit Error Rate Test Guide Real-Time I/Q Baseband Generator Guide Dual Arbitrary Waveform Generator Guide DECT Guide PDC Guide PHS Guide GSM Guide	Japanese	ABJ
E4400-90177 E4400-90185 E4400-90192 E4400-90199 E4400-90206	HP ESG and ESG-D User's Guide Real-Time I/Q Baseband Generator Guide Dual Arbitrary Waveform Generator Guide DECT Guide GSM Guide	Korean	AB1
E4400-90178 E4400-90186 E4400-90193 E4400-90200 E4400-90207 E4400-90211	HP ESG and ESG-D User's Guide Real-Time I/Q Baseband Generator Guide Dual Arbitrary Waveform Generator Guide DECT Guide GSM Guide TETRA Guide	Spanish	ABE

Installing Front Handles and Rack Mount Flanges

You can attach handles to the front of the signal generator to facilitate transportation of the instrument. Handles are available in a kit which can be ordered when the signal generator is purchased (Option 1CN), or at any time afterward. Assembly instructions are included with the kit. The kit part number is listed in Table 1-3.

You can also rack mount the signal generator. Hardware is available in kits to install rack mount flanges on the signal generator without or with handles. These kits can be ordered when the signal generator is purchased (Options 1CM and 1CP), or at any time afterward. Assembly instructions are included with the kits. The kit part numbers are listed in Table 1-3.

Table 1-3 Front Handle and Rack Mount Flange Kits

Option	Description	HP Part Number
Option 1CN	Front Handle Kit	5063-9227
Option 1CM	Rack Mount Kit without Handles	5063-9214
Option 1CP	Rack Mount Kit with Handles	5063-9221

Providing Adequate Ventilation

CAUTION Ventilation Requirements: When installing the product in a cabinet, the convection into and out of the product must not be restricted. The ambient temperature (outside the cabinet) must be less than the maximum operating temperature of the product by 4 °C for every 100 watts dissipated in the cabinet. If the total power dissipated in the cabinet is greater than 800 watts, then forced convection must be used.

Cooling holes are located on the sides and bottom of the instrument cover and the rear panel of the instrument. Do not allow these holes to be obstructed as they allow air flow through the signal generator.

Meeting Electrical and Environmental Requirements

Line Settings

CAUTION This product has an autoranging line voltage input. Be sure that the supply voltage is within the specified range.

The available AC power source must meet the following requirements:

Voltage:

- 100/115 volts nominal (90-132 volt range)
- 230/240 volts nominal (198-254 volt range)

Frequency:

- for 100/115 volts: 50/60/400 Hz nominal
- for 230/240 volts: 50/60 Hz nominal

Power:

- 200 watts maximum

Verify that the power cable is not damaged and that the power source socket outlet provides a protective earth contact.

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.**

CAUTION Always use the three-prong AC power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord may cause product damage.

Environment

This product is designed for use in the following environmental conditions:

- indoor use
- < 15,000 feet (4,572 meters) altitude
- 0 to 55 °C temperature, unless specified differently
- maximum relative humidity 80% for temperatures up to 31 °C, decreasing linearly to 50% relative humidity at 40 °C

CAUTION This product is designed for use in INSTALLATION CATEGORY II and POLLUTION DEGREE 2, per IEC 1010 and 664 respectively.

WARNING **If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition only (in which all means for protection are intact).**

Cleaning the Signal Generator

Clean the instrument cabinet using a damp cloth only.

Adjusting the Display Contrast

You can adjust the contrast of the display by pressing the decrease contrast key or the increase contrast key . These keys are located on the front panel below the display.

Pressing the decrease contrast key and holding it down causes the display background to gradually darken in comparison to the text on the display. The minimum contrast setting is not a completely black display. Some contrast between the background and the text will still be visible.

Pressing the increase contrast key and holding it down causes the display background to gradually brighten in comparison to the text on the display. If the background does not appear to change, it is probably set to the maximum contrast.

Selecting Inverse Video

The normal display mode for the signal generator is dark text on a light background. To change to inverse video (light text on a dark background), press **Utility**, **Display** and set **Inverse Video Off On** to **On**. Inverse video is a persistent state; it is not affected by an instrument preset or by a power cycle.

Adjusting the Screen Saver

You can increase the life expectancy of the signal generator's display light by turning on the screen saver. Leaving the display lit for long periods of time or turning the display on and off frequently decreases the life of the bulb. With the screen saver on, the display light is turned off after a defined period of time with no input to the front panel. The display light turns on again when any front panel key is pressed or when a remote command is sent.

The screen saver is set to off at the factory. You can turn it on by pressing **Utility**, **Display**, **Screen Saver Off On**. Each time you press **Screen Saver Off On** the selection toggles between **Off** and **On**.

You can adjust the screen saver mode to turn the light on and off or to turn both the light and text on and off. Press **Utility**, **Display**, **Screen Saver Mode**. You can toggle between **Light Only** and **Light & Text**. Setting the mode to **Light Only** turns the display light off but leaves the text visible at a low intensity. To prevent the text from burning the display if you are leaving the display unchanged for long periods of time, set the mode to **Light & Text.** This mode turns off the display light and the text.

The screen saver delay is set to 1 hour at the factory. You can view and change the delay by pressing **Screen Saver Delay** in the same menu. The current screen saver delay is displayed in the softkey label and also in the active entry area. To change the delay, enter a new value using the numeric keypad and then press **Enter**, or rotate the front panel knob. The acceptable range of delay values is 1 through 12 hours in 1 hour increments.

The screen saver settings do not change when **Preset** is pressed, nor when power to the instrument is cycled.

Selecting the Signal Generator's HP-IB Address

The signal generator's HP-IB address is set to 19 at the factory. You can view and change the address by pressing **Utility**, **HP-IB/RS-232**, **HP-IB Address**. The current HP-IB address is displayed in the softkey label and also in the active entry area. To change the address, enter a new value using the numeric keypad and then press **Enter**, or rotate the front panel knob. The acceptable range of addresses is 0 through 30.

The HP-IB address is a persistent state; it is not affected by an instrument preset or by a power cycle.

Selecting the Signal Generator's Programming Language

The default programming language for the signal generator is Standard Commands for Programmable Instruments (SCPI). You can change this language selection by pressing **Utility**, **HP-IB/RS-232**, **Remote Language**. You can change this language selection by pressing **Utility**, **HP-IB/RS-232**, **Remote Language**. The Remote Language menu allows you to select between HP 8656/57-compatible language, HP 8648-compatible language, and SCPI language. If you have an HP ESG-D Series Option UN8, the Remote Language menu allows you to select between HP 8656/57-compatible language, HP 8657D language (NADC digital modulation capability), HP 8657D language (PDC digital modulation capability), and HP 8657J (PHS digital modulation capability). Press the softkey for the selection that you desire.

You can also change the language selection by sending the appropriate command over HP-IB. Refer to the programming guide for instructions for changing the language over HP-IB.

You can set the signal generator to default to a selected language as a persistent state (remains unchanged after an instrument preset or power cycle). Press **Utility**, **Power On/Preset**, **Preset Language**. The Preset Language menu allow you to select between SCPI, the HP 8656/57-compatible programming languages, and HP 8648-compatible language. Press the softkey for the selection that you desire.

Verifying Signal Generator Operation

The operator's check is appropriate as a daily functional check by users, or whenever the integrity of the signal generator is in question. Use the operator's check to verify proper operation of the signal generator. The operator's check does not ensure performance to specifications. To verify specifications, refer to the calibration guide.

Operator's Check

Perform the following tasks in order:

Power On the Signal Generator and Check for Error Messages

This procedure verifies that the signal generator powers up and that the internal instrument check identifies no errors.

1. Turn power on to the signal generator by pressing the power switch. The green LED will light. Let the instrument warm up for one hour.
2. Cycle the power to the signal generator. The green LED should again be lit and the instrument will perform a check.
3. When the display is lit, check to see if the ERR annunciator is turned on.
4. If the ERR annunciator is turned on, review the error messages in the queue by pressing **Utility**, **Error Info**. The first error message in the queue will be shown in the text area of the display. Refer to Chapter 3, "Troubleshooting," for information about the error message.

   If there is more than one error message (each message will be designated as 1 of *n*), press the **View Next Error Message** softkey until you have seen all of the messages.
5. When you have resolved all of the error messages, press **Clear Error Queue(s)** to delete the messages. Then restart this procedure at step two.

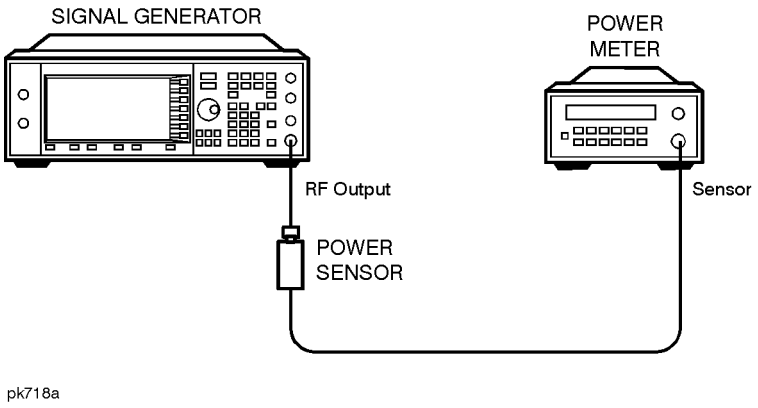
   Note: For instruments with Option 1E5, `ERROR 514, Reference Oven Cold` will occur whenever the signal generator is first connected to AC line power. The `OVEN COLD` annunciator and the ERR annunciator will both turn on. The `OVEN COLD` annunciator will automatically clear after approximately 5 minutes.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

Verify Maximum Specified Power is Available at the Maximum Frequency

This procedure verifies that there are no unleveled power indications or error messages at the maximum specified frequency and power level.

1. Calibrate the power meter with the power sensor. (Refer to the power meter's manual for assistance.)
2. Connect the power sensor to the signal generator's RF OUTPUT connector as shown in Figure 1-1.

Figure 1-1 Operator's Check Equipment Setup



3. Preset the signal generator to the factory-defined conditions:
   a. Press **Utility**, **Power On/Preset** and toggle **Preset** until **Normal** is highlighted.
   b. Press the front panel **Preset** key.
4. Set the signal generator to its maximum specified frequency:
   a. Press **Frequency**.
   b. Use the numeric keypad to enter the signal generator's maximum specified frequency as shown in Table 1-4.
   c. Terminate your entry by pressing the **GHz** softkey.
5. Set the signal generator to its maximum specified power level:
   a. Press **Amplitude**.
   b. Use the numeric keypad to enter the signal generator's maximum specified power level as shown in Table 1-4.
   c. Terminate your entry by pressing the **dBm** softkey.
6. Toggle the front panel **RF On/Off** key to turn on RF power to the RF OUTPUT connector. The display RF ON annunciator will turn on.
7. Verify that the power meter reads the maximum specified output power including the power level accuracy limits.
8. Check to see if the UNLEVEL or ERR display annunciators have turned on. If these annunciators are on, refer to the service guide for troubleshooting information.

Table 1-4 Frequency and Power Level Limits

Instrument Model	Maximum Specified Frequency	Maximum Specified Power	Power Level Accuracy Limits[1]
HP E4400B HP E4430B	1 GHz	+13 dBm	±0.7 dB
HP E4420B HP E4431B	2 GHz	+10 dBm	±0.7 dB
HP E4421B HP E4432B	3 GHz	+10 dBm	±1.0 dB
HP E4422B HP E4433B	4 GHz	+7 dBm	±1.0 dB

1. The values provided are confidence levels only; they are not specifications.

2 Using Functions

This chapter contains procedures that show you how to use some of the major functions of your signal generator including setting frequency and power levels, setting up modulations, creating step and list sweeps, saving and recalling instrument states, and enabling options.

Setting Frequency and Power Levels

Using these procedures, you will learn how to:

- set the RF frequency
- set a frequency reference and a frequency offset
- set the RF output power level
- set an amplitude reference and an amplitude offset

To Set the RF Frequency

1. Turn on power to the signal generator: press the power switch, ⏻, so that the green LED is on. The signal generator will perform an internal check.
2. Press the green **Preset** key. The signal generator will return to a set of factory-defined conditions.

NOTE You can change the preset conditions to a user-defined instrument state. However, for the purpose of these examples, use the factory-defined preset state (the **Preset Normal User** softkey in the Utility menu must be set to **Normal**).

3. Observe the frequency area of the display (in the upper left-hand corner). It should display the maximum specified frequency of your signal generator.
4. The signal generator is set to output an RF signal, however the **RF On/Off** key must be set to **On** before the RF signal is available at the RF OUTPUT connector. Press **RF On/Off**. Notice that the display annunciator changes from `RF OFF` to `RF ON`. The maximum specified frequency is now being output at the RF OUTPUT connector.
5. Change the frequency to 700 MHz by pressing **Frequency**. The current RF frequency is now displayed in the active entry area of the display. Using the numeric keypad, enter **700** and then press the **MHz** terminator softkey. The new 700 MHz RF frequency is now displayed in the frequency area of the display and also in the active entry area.
6. Frequency is still the active function until you press another front panel function key. Change the frequency again by pressing the up arrow key once. Each press of the up arrow key increases the frequency by the increment value last set with the **Incr Set** key. The increment value is displayed in the active entry area.

   The down arrow works like the up arrow. Practice stepping the frequency up and down in 1 MHz increments. Use the **Incr Set** key to change the increment value to 1 MHz, if necessary.
7. You can also adjust the RF frequency using the front panel knob. As long as frequency is the active function (the frequency is displayed in the active entry area), the front panel knob will increase and decrease the RF frequency. Use the front panel knob to adjust the frequency back to 700 MHz.

To Set a Frequency Reference and a Frequency Offset

The following procedure sets the RF output frequency as a reference frequency to which all other frequency parameters are relative. The frequency initially shown on the display will be 0 Hz (the frequency output by the hardware minus the reference frequency.) Although the display changes, the frequency output does not change. Any subsequent frequency changes are shown as incremental or decremental to 0 Hz.

1. Press **Preset** to return the signal generator to the factory-defined instrument state.
2. Set the RF frequency to 700 MHz.
3. Turn on frequency reference mode and set the current output frequency (700 MHz) as the reference value. Press **Freq**, **Freq Ref Set**. The frequency displayed is 0 Hz (the frequency output by the hardware, 700 MHz, minus the reference value, 700 MHz). Notice that the REF indicator is turned on and the **Freq Ref** softkey has toggled to **On**.
4. Set the **RF On/Off** key to **On**. Notice that the display annunciator has changed from RF OFF to RF ON. The RF frequency at the RF OUTPUT connector is 700 MHz.
5. Increment the output frequency by 1 MHz. Press the up arrow key. The frequency display changes to show 1 MHz (the frequency output by the hardware, 700 MHz + 1 MHz, minus the reference frequency, 700 MHz) and the output frequency changes to 701 MHz.
6. Enter a 1 MHz offset. Press the **Freq Offset** softkey and enter 1 MHz using the numeric keypad and pressing the **MHz** terminator softkey. The frequency display shows 2 MHz (the frequency output by the hardware, 701 MHz, minus the reference frequency, 700 MHz, plus the offset, 1 MHz.) Notice that the OFFSET indicator is turned on. The frequency at the RF OUTPUT connector is still 701 MHz.

To Set the RF Output Power Level

1. Press **Preset** to return the signal generator to the factory-defined instrument state.
2. Observe the amplitude area of the display (in the upper middle of the display). It should display –135 dBm. This is the normal preset RF output power level.
3. The signal generator is set to output an RF signal, however the **RF On/Off** key must be set to **On** before the RF signal is available at the RF OUTPUT connector. Press **RF On/Off**. Notice that the display annunciator changes from RF OFF to RF ON. The RF signal is now being output at a –135 dBm level at the RF OUTPUT connector.
4. Change the power level to –20 dBm. Press **Amplitude**. The current power level is now displayed in the active entry area of the display. Using the numeric keypad and the key, enter –**20** and then press the **dBm** softkey. The new –20 dBm RF output power is now displayed in the amplitude area of the display and also in the active entry area.
5. Amplitude is still the active function until you press another front panel function key. You can also change the amplitude using the up and down arrow keys and the front panel knob. Practice changing the amplitude using these methods also.

To Set an Amplitude Reference and an Amplitude Offset

The following procedure sets the RF output power as an amplitude reference to which all other amplitude parameters are relative. The amplitude initially shown on the display will be 0 dB (the power output by the hardware minus the reference power). Although the display changes, the output power does not change. Any subsequent power changes are shown as incremental or decremental to 0 dB.

1. Press **Preset** to return the signal generator to the factory-defined instrument state.
2. Set the RF output power to –20 dBm.
3. Turn on amplitude reference mode and set the current output power (–20 dBm) as the reference value. Press **Ampl**, **More (1 of 2)**, **Ampl Ref Set**. The amplitude displayed is 0 dB (the power output by the hardware, –20 dBm; minus the reference value, –20 dBm.) Notice that the REF indicator is turned on and the **Ampl Ref** softkey has toggled to **On**.
4. Set the **RF On/Off** key to **On**. Notice that the display annunciator has changed from RF OFF to RF ON. The power at the RF OUTPUT connector is –20 dBm.
5. Use the up arrow key to increase the output power by 10 dB. The amplitude display changes to show 10 dB (the power output by the hardware, –20 dBm; +10 dBm; minus the reference power, –20 dBm) and the output power changes to –10 dBm.
6. Enter a 10 dB offset. Press the **Ampl Offset** softkey and enter 10 dB using the numeric keypad. The amplitude display shows 20 dB (the power output by the hardware, –10 dBm; minus the reference power, –20 dBm; plus the offset, 10 dB). Notice that the OFFS indicator is turned on. The power at the RF OUTPUT connector is still –10 dBm.

Setting Up Internally Generated Amplitude Modulation

Using this procedure, you will learn how to generate an amplitude-modulated signal with the following characteristics:

- carrier frequency set to 1340 kHz
- power level set to 0 dBm
- AM depth set to 90%
- AM rate set to 10 kHz

Setting the Carrier Frequency

1. Preset the signal generator to the factory-defined instrument state.
2. Press the front panel **Frequency** key. Frequency becomes the active function and the normal preset value for frequency is displayed in the active entry area.
3. Enter 1340 kHz using the numeric keypad and pressing the **kHz** terminator softkey. The new carrier frequency is shown in the frequency area of the display. You should see `1.340 000 00 MHz`.

Setting the Power Level

1. Press the front panel **Amplitude** key. Amplitude becomes the active function and the normal preset value for amplitude is displayed in the active entry area.
2. Enter 0 dBm using the numeric keypad and pressing the **dBm** terminator softkey. The new power level is shown in the amplitude area of the display. You should see `0.00 dBm`.

Setting the AM Depth

1. Press the front panel **AM** key. The first level menu of softkeys is displayed.
2. Press the **AM Depth** softkey. AM depth becomes the active function and the normal preset value for AM depth is displayed in the active entry area.
3. Enter 90% using the numeric keypad and pressing the **%** terminator softkey. The new AM depth is displayed below the **AM Depth** softkey. You should see **90.0 %** in the second line of the softkey.

Setting the AM Rate

1. In the same AM menu, press the **AM Rate** softkey. AM rate becomes the active function and the normal preset value for AM rate is displayed in the active entry area.

2. Enter 10 kHz using the numeric keypad and pressing the **kHz** terminator softkey. The new AM rate is displayed below the **AM Rate** softkey. You should see **10.0000 kHz** in the second line of the softkey.

Turning On Amplitude Modulation

The signal generator is now configured to output a 0 dBm, amplitude-modulated carrier at 1340 kHz with the AM depth set to 90% and the AM rate set to 10 kHz. The shape of the waveform is a sinewave (notice that sine is the default for the **AM Waveform** softkey). Follow these remaining steps to output the amplitude-modulated signal.

1. In the same AM menu, press the **AM Off On** softkey. AM toggles from **Off** to **On**. Notice, also, that the AM display annunciator is turned on indicating that you have enabled amplitude modulation.
2. Press the front panel **RF On/Off** key to toggle RF on. Notice that the display annunciator changes from RF OFF to RF ON. The modulated signal is now available at the RF OUTPUT connector.

Setting Up Internally Generated Frequency Modulation

Using this procedure you will configure the signal generator to output a frequency-modulated signal with the following characteristics:

- carrier frequency set to 104.9 MHz
- power level set to 0 dBm
- FM deviation set to 75 kHz
- FM rate set to 10 kHz

Setting the Carrier Frequency

1. Preset the signal generator to the factory-defined instrument state.
2. Press the front panel **Frequency** key. Frequency becomes the active function and the normal preset value for frequency is displayed in the active entry area.
3. Enter 104.9 MHz using the numeric keypad and pressing the **MHz** terminator softkey. The new carrier frequency is shown in the frequency area of the display. You should see `104.900 000 00 MHz`.

Setting the Power Level

1. Press the front panel **Amplitude** key. Amplitude becomes the active function and the normal preset value for amplitude is displayed in the active entry area.
2. Enter 0 dBm using the numeric keypad and pressing the **dBm** terminator softkey. The new power level is shown in the amplitude area of the display. You should see `0.00 dBm`.

Setting the FM Deviation

1. Press the front panel **FM/ΦM** key. The first level menu of FM softkeys is displayed.
2. Press the **FM Dev** softkey. FM deviation becomes the active function and the normal preset value for FM deviation is displayed in the active entry area.
3. Enter 75 kHz using the numeric keypad and pressing the **kHz** terminator softkey. The new FM deviation is displayed below the **FM Dev** softkey. You should see **75.0000 kHz** in the second line of the softkey.

Setting the FM Rate

1. In the same FM menu, press the **FM Rate** softkey. FM rate becomes the active function and the normal preset value for FM rate is displayed in the active entry area.

2. Enter 10 kHz using the numeric keypad and pressing the **kHz** terminator softkey. The new FM rate is displayed below the **FM Rate** softkey. You should see **10.0000 kHz** in the second line of the softkey.

Turning On Frequency Modulation

The signal generator is now configured to output a 0 dBm, frequency-modulated carrier at 104.9 MHz with the FM deviation set to 75 kHz and the FM rate set to 10 kHz. The shape of the waveform is a sinewave. (Notice that sine is the default for the **FM Waveform** softkey. Press **More (1 of 2)** to see the softkey.) Follow these remaining steps to output the frequency-modulated signal.

1. In the same FM menu, press the **FM Off On** softkey. FM toggles from **Off** to **On**. Notice, also, that the FM display annunciator is turned on indicating that you have enabled frequency modulation.
2. Press the front panel **RF On/Off** key to toggle RF on. Notice that the display annunciator changes from RF OFF to RF ON. The modulated signal is now available at the RF OUTPUT connector.

Creating a Step Sweep and a List Sweep

Using this procedure, you will learn two ways to set up the signal generator to sweep a defined set of points. You will create a step sweep and then you will use these points as the basis for a new list sweep.

In the first procedure, you will create a step sweep with the following ten, equally spaced points:

- frequency range from 525 MHz to 600 MHz
- power level from –20 dBm to 0 dBm
- dwell time 500 ms at each point

In the second procedure, you will take the step sweep points and edit several points to change the sweep information.

Configuring a Step Sweep

1. Preset the signal generator to the factory-defined instrument state.
2. Press the front panel **Sweep/List** key. The first level of sweep softkeys is displayed. Toggle the **Sweep Type List Step** softkey to **Step**.
3. Press the **Configure Step Sweep** softkey. Another menu is displayed with softkeys that you will use to create the sweep points.
4. Change the start frequency of the step sweep. Press the **Freq Start** softkey. Enter 525 MHz using the numeric keypad and pressing the **MHz** terminator softkey.
5. Change the stop frequency of the step sweep. Press the **Freq Stop** softkey. Enter 600 MHz using the numeric keypad and pressing the **MHz** terminator softkey.
6. Set the power level for the start of the step sweep. Press the **Ampl Start** softkey. Enter –20 dBm using the numeric keypad and pressing the **dBm** terminator softkey.
7. Set the power level for the end of the step sweep. Press the **Ampl Stop** softkey. Enter 0 dBm using the numeric keypad and pressing the **dBm** terminator softkey.
8. Set the number of sweep points. Press the **# Points** softkey. Enter 10 by rotating the front panel knob until the number 10 is displayed.
9. Set the dwell time at each point. Press the **Step Dwell** softkey. Enter 500 ms using the numeric keypad and pressing the **msec** terminator softkey.

Turning On Continuous Step Sweep

1. Press **Return** to move up one menu level.
2. Press the **Sweep** softkey. Another menu is displayed showing you choices for sweeping either the frequency, amplitude, or frequency and amplitude data. Press the **Freq&Ampl** softkey. Selecting this softkey returns you to the previous menu and turns the sweep function on.

3. Press the **Sweep Repeat Single Cont** softkey to toggle from **Single** to **Cont**. Notice that the SWEEP display annunciator is turned on indicating that the signal generator is sweeping.
4. Press the front panel **RF On/Off** key to toggle RF on. Notice that the display annunciator changes from RF OFF to RF ON. The swept RF signal is now available at the RF OUTPUT connector.

Configuring a List Sweep Using Step Sweep Data

1. Press the **Sweep Type List Step** softkey to toggle from **Step** to **List**.
2. Press the **Configure List Sweep** softkey. Another menu is displayed with softkeys that you will use to create the sweep points. Notice that the display shows the current list data. (When no list has been previously created, the default is one point set to the signal generator's maximum frequency, –135 dBm, with a dwell time of 2 ms.)
3. Press **More (1 of 2)**, **Load List From Step Sweep**, **Confirm Load From Step Sweep**. The points you defined in the step sweep are automatically loaded into the list.

Editing List Sweep Points

1. Change the dwell time for point 1 to 100 ms. Press the right arrow key twice until the dwell time is highlighted. Press **More (2 of 2)**, **Edit Item**. The dwell time for point 1 becomes the active function. Enter 100 ms using the numeric keypad and pressing the **msec** terminator softkey. Notice that the next item in the table (in this case, the frequency value for point 2) becomes highlighted after pressing the terminator softkey.
2. Change the frequency for point 4 to 560 MHz. Press the down arrow key two times until the frequency is highlighted. Press the **Edit Item** softkey. The frequency for point 4 becomes the active function. Enter 560 MHz using the numeric keypad and pressing the **MHz** terminator softkey.
3. Add a new point between points 7 and 8. Press the down arrow until any column in the point 8 row is highlighted. Press the **Insert Row** softkey. A copy of point 8 has been placed between points 7 and 8, creating a new point 8, and renumbering the successive points.
4. Create a new point between points 10 and 11. Use the arrow keys to highlight the frequency for point 11. Press the **Edit Item** softkey. Enter 700 MHz using the numeric keypad and pressing the **MHz** terminator softkey. Notice that a new frequency item is placed at point 11 and the frequency item previously occupying that position has shifted down to point 12. The power and dwell time items do not shift down.

NOTE An informational ERR annunciator is turned on at this time indicating that the frequency and power lists are of unequal size. You will correct that problem in the following steps. The annunciator will not turn off until you clear the error queue in the Utility menu.

The power for point 11 should now be highlighted. Press the **Edit Item** softkey and enter 1 dBm using the numeric keypad and pressing the **dBm** terminator softkey. A new power item is placed at point 11 and the power item previously occupying that position has shifted down to point 12.

The dwell time for point 11 should now be highlighted. Press the **Edit Item** softkey. The dwell time from the previous point 11 has been copied into the new point 11. A new dwell time item is placed at point 11 and the dwell time item previously occupying that position has shifted down to point 12.

Turning On List Sweep for a Single Sweep

1. Press **Return** to move up one menu level.
2. Notice that the **Sweep** softkey is still set to sweep both frequency and amplitude data. You do not need to change it.
3. Press the **Sweep Repeat Single Cont** softkey to toggle from **Cont** to **Single**. Notice that the SWEEP display annunciator is turned off. The sweep will not occur until it is triggered.
4. Press **Single Sweep**. The signal generator will sweep the points in your list once. Notice that the SWEEP display annunciator is turned on during the sweep.
5. Change the sweep trigger to occur when you press the front panel **Trigger** key. Press **More (1 of 2)**, **Sweep Trigger**. Another menu is displayed showing you choices for triggering a sweep. Press the **Trigger Key** softkey.
6. Press **More (2 of 2)**, **Single Sweep** to arm the sweep. Notice that the ARMED display annunciator has turned on.
7. Press the front panel **Trigger** key. The signal generator will sweep the points in your list once and the SWEEP display annunciator is turned on during the sweep.

Saving and Recalling an Instrument State

Using this procedure, you will learn how to save instrument settings to a memory register and to recall the settings.

1. Preset the signal generator to the factory-defined instrument state.
2. Set up the signal generator with the following changes:
   a. Set the frequency to 800 MHz.
   b. Set the amplitude to 0 dBm.
   c. Enable amplitude modulation (AM display annunciator is on).
3. Save this instrument state in the signal generator memory in sequence 1, memory register 01. Press the front panel **Save** key and then press the **Select Seq** softkey. The sequence number becomes the active function. The signal generator will display the last sequence that you have used. Set the sequence to 1 using the arrow keys.

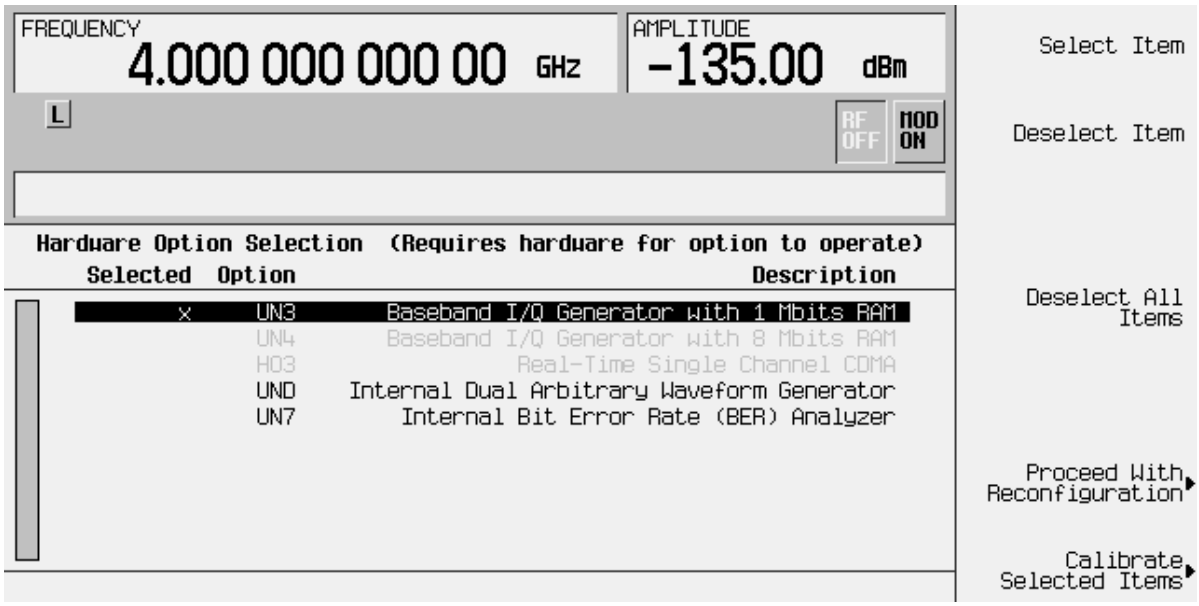
   Press the **Select Reg** softkey. The register number in sequence 1 becomes the active function. The signal generator will either display the last register used [accompanied by the text: (in use)] or, if no registers are in use, will display register 00 [accompanied by the text: (available)]. Use the arrow keys to select register 01.
4. Press the **Save Seq[1] Reg[01]** softkey. The current instrument settings including the frequency, amplitude, and modulation changes you made have been stored in signal generator memory.
5. Preset the signal generator to the factory-defined instrument state.
6. Recall your instrument state. Press the front panel **Recall** key. Notice that the **Select Seq** softkey shows sequence 1. (This is the last sequence that you have used.) You do not need to change the sequence. Press **RECALL Reg**. The register to be recalled in sequence 1 becomes the active function. Press the up arrow key once to select register 1. Notice that your stored instrument settings have been immediately recalled.

Enabling Options

The HP ESG and ESG-D Series Signal Generators are a highly flexible platform of instruments that you can retrofit after purchase to add many new capabilities. Some new optional features are implemented in hardware that you must install. Some options are implemented in software but require the presence of optional hardware in the instrument. This example shows you how to enable both hardware and software options.

Enabling a Hardware Option

1. When you purchase a new hardware option for your signal generator, the hardware and instructions for installing the hardware will be included in a kit that you receive. Follow the installation instructions to retrofit your signal generator with the new hardware.
2. Next, on the signal generator press **Utility**, **Instrument Adjustments**, **Hardware Options** to access the Hardware Options menu. An example of the signal generator display follows:



   The display indicates which options are currently enabled for the signal generator. In this case Option UN3 is enabled, as indicated by the X placed in the “Selected” column.

3. Highlight the new option that you have just installed. (Use the up/down arrow keys or the front panel knob.)
4. Press the **Select Item** softkey. An X will be placed in the “Selected” column.

   Two other selection keys are available in this menu to help you identify the proper options to be enabled. **Deselect Item** removes the X from the “Selected” column in the highlighted option. **Deselect All Items** removes all occurrences of the X from the “Selected” column.

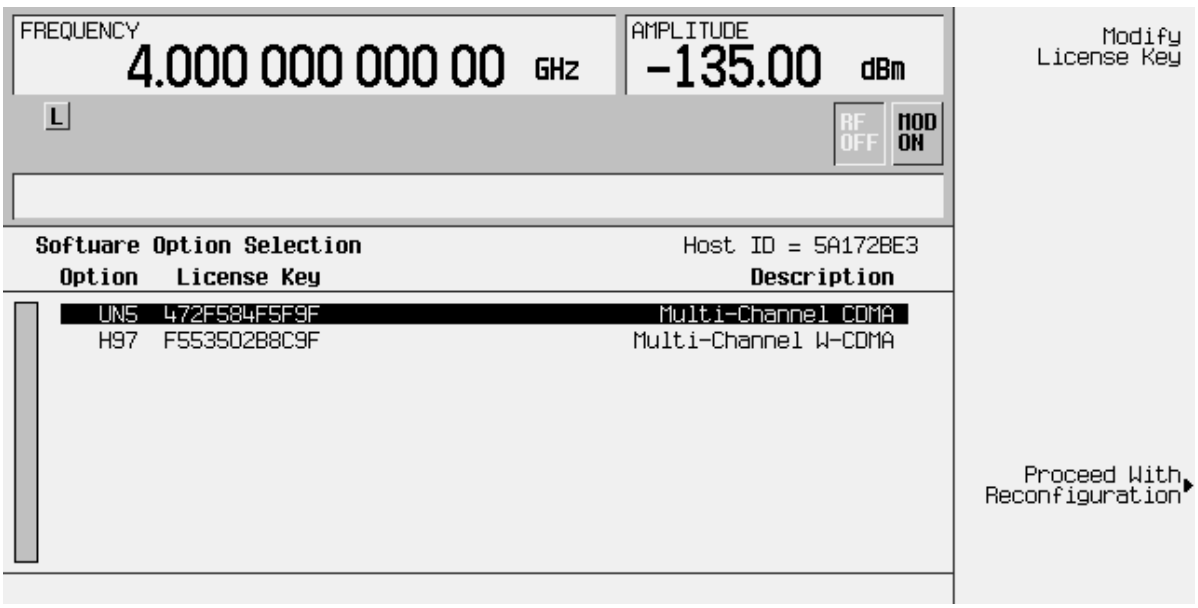
5. Press **Proceed With Configuration** to enable all selected options. After pressing this softkey, press the **Confirm Change** softkey to verify that you do want to reconfigure the signal generator with the options that you have selected. If you do not want to continue, press the **Return** key.

CAUTION If you enable an option that does not have the required hardware installed, the menus for that option will be activated but the option *cannot* operate, despite what the menus may seem to indicate.

6. Once you have installed optional hardware in your signal generator, perform a download of calibration data from the hardware into non-volatile memory by pressing **Calibrate Selected Items**. To confirm that you want to start the calibration, press the **Start Calibration and Store Results** softkey. The calibration takes several minutes. During the calibration, a message is displayed indicating the calibration is in progress and showing the percent complete. When the calibration is finished, the Hardware Options menu is returned.

Enabling a Software Option

1. A license key is required to enable each software option. This license key is provided on the license key certificate that you receive when you purchase the software option. Access the Software Options menu by pressing **Utility**, **Instrument Adjustments**, **Software Options**. An example of the signal generator display follows:



Verify that the host ID shown on the display matches the host ID on the license key certificate. The host ID is a unique number for every instrument. If the host ID on the license key certificate does not match your instrument, the license key cannot enable the software option.

2. On the display is a list of software options that are already enabled (if any) and the software options that can be enabled. Software options are linked to specific hardware options. Before a software option can be enabled, the appropriate hardware option must be installed. For example, Option UN5, Multi-Channel CDMA, requires that Option UND, Internal Dual Arbitrary Waveform Generator, be installed. If the software option that you intend to install is listed in a grey font, the required hardware may not be installed. (Look for an X in the "Selected" column of the appropriate hardware option in the Hardware Options menu.)
3. To enable the software option, highlight the desired option using the up/down arrow keys or the front panel knob.
4. Press **Modify License Key**. Enter the 12-character license key (from your license key certificate) using the softkeys and numeric keypad. When you have finished, press the **Enter** terminator softkey.
5. Press **Proceed With Reconfiguration**. Press the **Confirm Change** softkey to verify that you do want to reconfigure the signal generator with the options for which you have provided a license key. The instrument will enable the options and reboot.

3 Troubleshooting

This chapter contains instructions for troubleshooting problems you may encounter during operation of the signal generator, it explains error messages you might see, and it explains how to return your signal generator to HP for service.

If You Encounter a Problem

If the signal generator is not operating as you expected, look for help in the following list of symptoms and possible solutions. If you do not find a solution here, refer to the service guide.

No RF Output?

The front panel **RF On/Off** key must be set to **On** before the RF signal is available at the RF OUTPUT connector. Check the annunciator on the display. If it reads RF OFF, press the **RF On/Off** key once to toggle the RF output on.

RF Output Power too Low?

If the RF output power seems too low, look for an OFFSET or REF indicator in the amplitude area of the display.

OFFSET tells you that an amplitude offset has been set. An amplitude offset changes the value shown in the amplitude area of the display but does not affect the output power. The amplitude displayed is equal to the current power output by the signal generator hardware plus the value for the offset. To eliminate the offset, press **Ampl**, **Ampl Offset**. Enter **0** using the numeric keypad and press the **dB** terminator softkey.

REF tells you that the amplitude reference mode is turned on. When this mode is on, the displayed amplitude value is *not* the output power level; rather, it is the current power output by the signal generator hardware minus the reference value set by the **Ampl Ref Set** softkey. To exit the reference mode, press **Ampl** and toggle the **Ampl Ref** softkey to **Off**. You can then reset the output power to the desired level.

Optional Features are Not Working?

If you enable an option that does not have the required hardware installed, the menus for that option will be activated but the option *cannot* operate, despite what the menus may seem to indicate. Check to be sure that the required hardware is physically installed in the signal generator.

If a software option is disabled but should be enabled, try the following suggestions for resolution:

- Verify that the optional hardware is installed.
- Verify that the hardware option is enabled.
- Verify that the software option is enabled with the correct license key. Refer to your License Key Certificate for the correct license key or, if your option was installed by HP, contact your HP service office with the instrument model number, the host ID, and the software option that should be enabled.

No Modulation at the RF Output?

Although you can set up and enable various modulations, the RF carrier is modulated by the enabled modulation only when you have also set **Mod On/Off** to **On**. Check the annunciator on the display. If it reads `MOD OFF`, press the **Mod On/Off** key once to toggle the modulation on.

Can't Turn Off Sweep Mode?

In the sweep mode menu you can choose to set the sweep to various sweep types or to turn sweep off. Press **Sweep/List**, **Sweep** and choose **Off** from the sweep mode selections.

Recalled a Register and Sweep List is Missing?

Sweep information is not stored as part of the instrument state in a storage register. Only the current step and list sweep is available to the signal generator and it cannot be stored nor will it survive a factory preset.

All of the Registers Where You Previously Stored Instrument States are Empty?

The save/recall registers are backed-up by a battery when AC power to the signal generator is not connected. The battery may need to be replaced. To verify that the battery has failed, turn off line power to the signal generator and unplug it. Then plug in the instrument and cycle power on. If either error message –311 or –700 is stored in the error message queue, your battery has failed. Refer to the service guide for battery replacement instructions.

Saved an Instrument State in a Register but the Register is Empty or Contains the Wrong State?

If you have intentionally, or unintentionally, selected a register number that is greater than 99, the signal generator will automatically select register 99 to save your instrument state. If the register number you intended to use is empty or contains the wrong instrument state, recall register 99 as the instrument state may be saved there.

The Power Supply has Shut Down?

If the power supply is not working, it requires repair or replacement. There is no user-replaceable power supply fuse. Refer to the service guide for instructions.

Incorrect List Sweep Dwell Time?

If the signal generator does not dwell for the correct period of time at each sweep list point, first check the sweep list dwell values for accuracy. Press **Sweep/List**, **Configure List Sweep** and the sweep list values will be displayed. Edit the dwell values if they are incorrect. (Note: The effective dwell time at the RF OUTPUT connector is the sum of the value set for the dwell plus processing time, attenuator switching time, and settling time. This additional time added to the dwell is generally a few milli-seconds. The TTL output, however, available at the TRIGGER OUT connector, is asserted high only during the actual dwell time.)

If the list dwell values are correct, check to see if the **Dwell Type List Step** softkey is set to **Step**. When **Step** is selected, the signal generator will sweep the list points using the dwell time set for step sweep rather than the sweep list dwell values. To view the step sweep dwell time, press **Configure Step Sweep** and observe the value set for the **Step Dwell** softkey.

Can't Turn Off Help Mode?

There are two help modes (single and continuous) available on the signal generator. In single mode (the factory preset condition) when you press the **Help** key, help text is provided for your next key press. Now press any key and you will exit the help function and the function of the key you pressed is also executed. When you are in continuous help mode, when you press the **Help** key, help text is provided for your next key press and that key's function is also executed (except for the **Preset** key). You will stay in this help mode until you press the **Help** key again. To change from continuous to single mode, press **Utility**, **Instrument Info/Help Mode** and toggle the **Help Mode Single Cont** softkey to **Single**.

LF OUTPUT Signal is a Sinewave but the RF OUTPUT Signal is a Pulse Squarewave?

The LF OUTPUT connector will output a signal where the frequency and shape is set by the internal source as it is being used by a modulation. However, if you are generating a pulse squarewave, the LF OUTPUT signal is correctly output as a sinewave. That sinewave is later squared by the modulator to generate the pulse modulation.

Signal Generator is Locked Up?

If your signal generator is locked up, try the following suggestions for resolution:

- Make sure that the signal generator is not in remote mode. (The R annunciator will be turned on in the display.) Press the **Local** key to halt remote mode and return to listen mode.
- Make certain that the signal generator is not in a local lockout condition.
- Check for a progress bar on the signal generator display which indicates that an operation is in progress.
- Try an instrument preset.
- Try cycling power.

If none of the previous suggestions resolves the problem, you can try the fail-safe recovery sequence. This sequence should only be used as a last resort as it will reset the signal generator but the process will destroy all user files (instrument state, sequence files, data files), calibration data (unsaved I/Q calibrations, DCFM/DCΦM calibrations), and the persistent state. Do not attempt to perform any other front panel or remote operations during the fail-safe sequence.

To run the fail-safe sequence, hold down the **Preset** key while cycling power. Continue to hold down the **Preset** key until the ESG fail-safe recovery sequence message is displayed.

CAUTION Carefully read the entire message! It may list additional risks with the procedure beyond what is documented here.

Release the **Preset** key and press **Yes** to continue with the sequence (or **No** to abort with no lost files).

At the conclusion of the sequence, perform the following steps:

1. Cycle power once again. Cycling power restores all previously installed options. You should expect to see several error messages resulting from calibration files being restored from EEPROM.
2. Perform the DCFM/DCΦM calibration. (Refer to the **DCFM/DCΦM Cal** softkey description in Chapter 5, "Hardkey and Softkey Reference," in this manual.)
3. For HP ESG-D Series Signal Generators only, perform the I/Q calibration. (Refer to the **I/Q Calibration** softkey description in Chapter 5, "Hardkey and Softkey Reference," of this manual.)
4. Hewlett-Packard is interested in the circumstances that caused you to have to initiate this procedure. Please contact us at 1 800 452-4844. We'd like to help you eliminate any repeat occurrences.

Error Messages

If an error condition occurs in the signal generator, it is reported to both the front panel display error queue and the SCPI (remote interface) error queue. These two queues are viewed and managed separately.

NOTE When there is an unviewed message in the front panel error queue, the ERR annunciator appears on the signal generator's display.

Table 3-1 Characteristics of the Error Queues

Characteristic	Front Panel Display Error Queue	SCPI Remote Interface Error Queue
Capacity (#errors)	30	30
Overflow Handling	Circular (rotating). Drops oldest error as new error comes in.	Linear, first-in/first-out. Replaces newest error with: `-350,Queue overflow`
Viewing Entries	Press: **Utility**, **Error Info**, **View Next** (or **Previous**) **Error Message**	Use SCPI query `SYSTem:ERRor?` or `STATus:QUEue?`
Clearing the Queue	Press: **Utility**, **Error Info**, **Clear Error Queue(s)**	Power up Send a `*CLS` command Read last item in the queue
Permanent Errors (errors that must be resolved, for example: `unlock`, `ovencold`, and `hi/lo`)	Re-reported after queue is cleared.	Re-reported after queue is cleared.

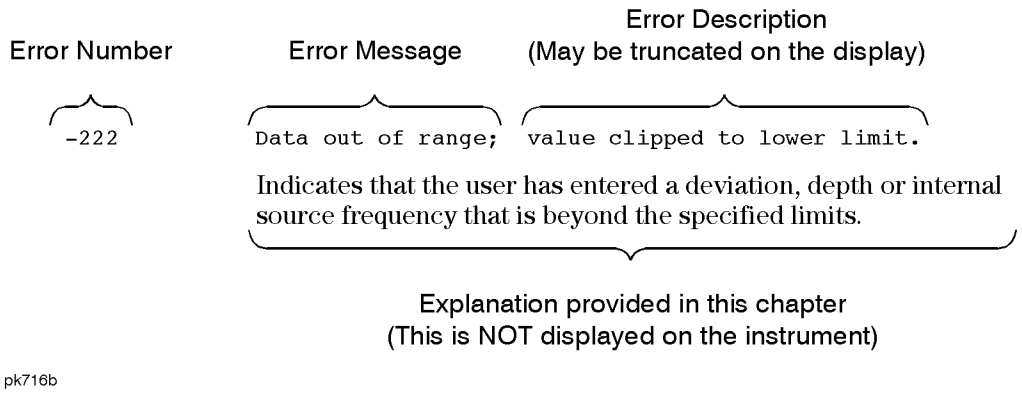
Error Message Format

The system-defined error numbers are chosen on an enumerated (“1 of N”) basis. The SCPI-defined error numbers and the <error_description> portions of the error query response are displayed on the instrument.

In this chapter, an explanation is included with each error to further clarify its meaning. The last error described in each class (for example, -400, -300, -200, -100) is a “generic” error. In selecting the proper error number to report, more specific error codes are preferred.

Error messages appear in the lower-left corner of the display.

Error Message Example



Error Message Types

Events do not generate more than one type of error. For example, an event that generates a query error will not generate a device-specific, execution, or command error.

-499 to -400: Query Errors indicate that the instrument's output queue control has detected a problem with the message exchange protocol described in IEEE 4888.2, chapter 6. Errors in this class set the query error bit (bit 2) in the event status register (IEEE 488.2, section 11.5.1). These errors correspond to message exchange protocol errors described in IEEE 488.2, 6.5. In this case:

- Either an attempt is being made to read data from the output queue when no output is either present or pending, or
- data in the output queue has been lost.

-399 to -300: Device-Specific Errors indicate that a device operation did not properly complete, possibly due to an abnormal hardware or firmware condition. These codes are also used for self-test response errors. Errors in this class set the device-specific error bit (bit 3) in the event status register (IEEE 488.2, section 11.5.1).

The <error_message> string for a *positive* error is not defined by SCPI. A positive error indicates that the instrument detected an error within the HP-IB system, within the instrument's firmware or hardware, during the transfer of block data, or during calibration.

-299 to -200: Execution Errors indicate that an error has been detected by the instrument's execution control block. Errors in this class set the execution error bit (bit 4) in the event status register (IEEE 488.2, section 11.5.1). In this case:

- Either a <PROGRAM DATA> element following a header was evaluated by the device as outside of its legal input range or is otherwise inconsistent with the device's capabilities, or
- a valid program message could not be properly executed due to some device condition.

Execution errors are reported *after* rounding and expression evaluation operations are completed. Rounding a numeric data element, for example, is not reported as an execution error.

-199 to -100: Command Errors indicate that the instrument's parser detected an IEEE 488.2 syntax error. Errors in this class set the command error bit (bit 5) in the event status register (IEEE 488.2, section 11.5.1)t. In this case:

- Either an IEEE 488.2 syntax error has been detected by the parser (a control-to-device message was received that is in violation of the IEEE 488.2 standard. Possible violations include a data element which violates device listening formats or whose type is unacceptable to the device.), or
- an unrecognized header was received. These include incorrect device-specific headers and incorrect or unimplemented IEEE 488.2 common commands.

0: No Error

0 `No error`

The queue is empty. Every error in the queue has been read or the queue was purposely cleared by power-on or `*CLS`.

-499 to -400: Query Errors

The instrument's output queue control has detected a problem with the message exchange protocol described in IEEE 4888.2, chapter 6. Errors in this class set the query error bit (bit 2) in the event status register (IEEE 488.2, section 11.5.1). These errors correspond to message exchange protocol errors described in IEEE 488.2, 6.5.

In this case, either an attempt is being made to read data from the output queue when no output is either present or pending, or data in the output queue has been lost.

-440 `Query UNTERMINATED after indefinite response`

Indicates that a query was received in the same program message after a query requesting an indefinite response was executed (see IEEE 488.2, 6.3.7.5).

-430 `Query DEADLOCKED`

Indicates that a SCPI output queue has filled, preventing further SCPI command execution, and there is no more room left in the corresponding SCPI input queue to accept a query to read from the output queue. The system automatically discards output to correct the deadlock.

`Query DEADLOCKED`

Indicates that a condition causing a DEADLOCKED query error occurred (see IEEE 488.2, 6.3.1.7). For example, both the input buffer and the output buffer are full and the device cannot continue.

-420 `Query UNTERMINATED`

Indicates that a condition causing an UNTERMINATED query error occurred (see IEEE 488.2, 6.3.2.2). For example, the device was addressed to talk and an incomplete program message was received.

-410 `Query INTERRUPTED`

Indicates that a condition causing an INTERRUPTED query error occurred (see IEEE 488.2, 6.3.2.7). For example, a query was followed by DAB or `GET` before a response was completely sent.

-400 `Query Error`

This is a generic query error for devices that cannot detect more specific errors. The code indicates only that a query error as defined in IEE 488.2, 11.5.1.1.7 and 6.3 has occurred.

-399 to -300: Device-Specific Errors

Some device operations did not properly complete, possibly due to an abnormal hardware or firmware condition. These codes are also used for self-test response errors. Errors in this class set the device-specific error bit (bit 3) in the event status register (IEEE 488.2, section 11.5.1).

-362 `Framing error in program message`

Indicates that a stop bit was not detected when data was received (for example, a baud rate mismatch).

-361 `Parity error in program message`

Indicates that the parity bit was not correct when data was received (for example, an incorrect parity bit on a serial port).

-360 `Communication error`

This is the generic communication error for devices that cannot detect the more specific errors described for errors -361 through -363.

-350 `Queue overflow`

This is a specific code entered into the queue in lieu of the code that caused the error. This message indicates that there is no more room in the queue and an error occurred but was not recorded.

-340 `Calibration failed`

Indicates that the device has detected a failure during its calibration procedure.

-330 `Self-test failed; Power supply self-test failure`

Indicates that the self-test for a particular power supply voltage has failed. The instrument is likely not functional. Report this error to the nearest Hewlett-Packard sales and service office.

`Self-test failed; EEPROM header checksum error <card_name>.`

Indicates that the card identification header for a hardware card is incorrect. If the card is not properly identified, the instrument is likely to be non-functional. Report this error to the nearest Hewlett-Packard sales and service office.

`Self-test failed; Data Generator Memory Test @ 0x____`

Indicates that the data generator memory failed. Modulation data produced by the data generator may not be correct. However, if an Unable to check Data Generator Memory error was also seen, this result is not conclusive. The address of the first location that failed is reported. Report this error to the nearest Hewlett-Packard sales and service office.

`Self-test failed; Burst Generator Memory Test @ 0x____`

Indicates that the burst generator memory failed. Modulation data produced by the burst generator may not be correct. However, if an `Unable to check Burst Generator Memory` error was also seen, this result is not conclusive. The address of the first location that failed is reported. Report this error to the nearest Hewlett-Packard sales and service office.

`Self-test failed; Bad address position @ 0x____`

Indicates that the data generator memory failed. Modulation data produced by the data generator may not be correct. An address that appeared to have a failed address line was reported. Report this error to the nearest Hewlett-Packard sales and service office.

`Self-test failed; Chips ___, ___ aliased @ 0x____`

Indicates that the data generator memory failed. Modulation data produced by the data generator may not be correct. An address that appeared to be aliased across multiple memory chips has been reported. Report this error to the nearest Hewlett-Packard sales and service office.

`Self-test failed`

Indicates that the device has detected a failure during its self-test procedure.

-321 `Out of memory; The table editor cannot function properly until more memory is available.`

Indicates that there is insufficient working memory available. Reduce the size of any sweep lists and try again.

`Out of memory; Unable to verify instrument state file.`

Indicates that an instrument state file could not be accessed and verified because of insufficient memory. Reduce the size of any sweep lists and try again.

`Out of memory; Memory catalog failed.`

Indicates that there is not enough memory to complete a catalog listing. Reduce the size of any sweep lists and try again.

`Out of memory; Unable to display timeslot window.`

Indicates that the instrument was unable to create part of the graphical user interface due to an inability to allocate memory (possibly due to fragmentation). Report this error to the nearest Hewlett-Packard sales and service office. The instrument is still functional.

`Out of memory; Unable to display protocol window.`

Indicates that the instrument was unable to create part of the graphical user interface due to an inability to allocate memory (possibly due to fragmentation). Report this error to the nearest Hewlett-Packard sales and service office. The instrument is still functional.

`Out of memory; Unable to display format window.`

Indicates that the instrument was unable to create part of the graphical user interface due to an inability to allocate memory (possibly due to fragmentation). Report this error to the nearest Hewlett-Packard sales and service office. The instrument is still functional.

`Out of memory; Cannot uncompress file.`

Indicates that a `STATE:` file cannot be uncompressed because there is not enough memory to run the decompression algorithm. Recall will fail and there will be no instrument state change. Reduce the size of any sweep lists and try again.

`Out of memory; Cannot precalculate frequencies. Try fewer frequencies.`

Indicates that memory was exhausted during frequency precalculation (used to speed the process of sweep/list mode). List mode cannot run until either fewer frequencies have been supplied or more memory becomes available and the same set of frequencies are sent again, `FREQ:MODE CW` is executed, or `:FREQ:MODE LIST` is executed.

`Out of memory; Object Memory Area`

Indicates that memory was exhausted during instrument power-on. Report this error to the nearest Hewlett-Packard sales and service office.

`Out of memory; List formation`

The device was unable to allocate space for a lookup table, such as for list mode precalculation. List mode cannot run until either fewer frequencies have been supplied or more memory becomes available and the same set of frequencies are sent again, `FREQ:MODE CW` is executed, or `:FREQ:MODE LIST` is executed.

`Out of memory; PRBS xx/xx`

There was not enough memory to apply a scramble to data for the baseband generator. In this case, the scramble is not applied to the generator.

`Out of memory; Display system out of memory. An abnormal display may result. Memory consumption should be reduced.`

There was not enough memory in the system to properly update the display. Some inconsistencies may be seen. The size of any list/sweep should be reduced, and the source should be preset to clear up any inconsistencies. Report this error to the nearest Hewlett-Packard sales and service office.

`Out of memory; Unable to check Data Generator memory.`

Indicates that there was not enough memory in the system to properly complete the data generator memory test. This does *not* imply a data generator memory failure. Check all other error messages to identify possible causes, discontinue list/sweep mode to free some memory, and repeat the test.

`Out of memory; Insufficient RAM`

Indicates that a memory comparison between a shadow RAM data area and the corresponding EEPROM data area could not be performed due to insufficient working RAM. This does *not* necessarily imply a memory problem, since this comparison is only used in stringent diagnostic situations.

`Out of memory; Cannot create memory manager`

Indicates that a file system memory manager detected an internal error condition. Report this error to the nearest Hewlett-Packard sales and service office.

`Out of memory; Memory request failed, out of indices. Memory request greater than total memory size.`

Indicates that a file system memory manager detected an internal error condition. Report this error to the nearest Hewlett-Packard sales and service office.

`Out of memory; File exceeds digital modulation memory size.`

Indicates that a digital modulation input file would result in more pattern data being generated than can fit in the pattern memory.

`Out of memory; There is insufficient memory to copy the current pattern. The secondary pattern is unchanged.`

Indicates that there was insufficient room to copy or create the current data generation pattern data in order to make it a secondary pattern. To avoid this, set up the smaller of the two patterns first.

`Out of memory; There is insufficient memory to store the secondary frame in Pattern RAM. The secondary frame has been turned off.`

Indicates that there was insufficient room to copy or create the current data generation pattern data in order to make it a secondary pattern. To avoid this, set up the smaller of the two patterns first.

`Out of memory; The table editor cannot function properly until more memory is available.`

Indicates that there is insufficient working memory available. Reduce the size of any sweep lists and try again.

`Out of memory; Pattern exceeds digital modulation memory size. If a user file is selected, it may be too large.`

Indicates that the user has specified a data file or other generation parameters that would require more data generation pattern memory than is available with the particular data generator installed in the instrument.

`Out of memory; ARB communication failed.`

Indicates that there was insufficient memory to complete the dual arbitrary waveform generator (Option UND) communications. Report this error to the nearest Hewlett-Packard sales and service office.

`Out of memory; FIR system unable to operate.`

Indicates that there is insufficient working memory available.

`Out of memory; Burst shape RAM cannot hold specified burst shape.`

Indicates that there is insufficient working memory available. Report this error to the nearest Hewlett-Packard sales and service office.

`Out of memory; Histogram display cannot function.`

Indicates that there is insufficient working memory available. Report this error to the nearest Hewlett-Packard sales and service office.

`Out of memory; Impulse response display cannot function.`

Indicates that there is insufficient working memory available. Report this error to the nearest Hewlett-Packard sales and service office.

`Out of memory`

Indicates that there is insufficient working memory available. Report this error to the nearest Hewlett-Packard sales and service office.

`Out of memory; FFT subsystem cannot function.`

Indicates that there is insufficient working memory available. Report this error to the nearest Hewlett-Packard sales and service office.

`Out of memory; FFT display cannot function.`

Indicates that there is insufficient working memory available. Report this error to the nearest Hewlett-Packard sales and service office.

`Out of memory; Complementary Cumulative Distribution. Display cannot function.`

Indicates that there is insufficient working memory available. Report this error to the nearest Hewlett-Packard sales and service office.

`Out of memory; I/Q map display cannot function.`

Indicates that there is insufficient working memory available. Report this error to the nearest Hewlett-Packard sales and service office.

`Out of memory; Graph subsystem cannot function.`

Indicates that there is insufficient working memory available. Report this error to the nearest Hewlett-Packard sales and service office.

`Out of memory; FIR subsystem generated more coefficients than the hardware can handle.`

Indicates that there is insufficient working memory available. Report this error to the nearest Hewlett-Packard sales and service office.

`Out of memory; Modulation subsystem unable to operate.`

Indicates that there is insufficient working memory available. Report this error to the nearest Hewlett-Packard sales and service office.

`Out of memory`

Insufficient working memory during arbitrary waveform generation. Report this error to the nearest Hewlett-Packard sales and service office.

`Out of memory`

Indicates that an internal operation needed more memory than was available.

`Out of memory`

Indicates that there was insufficient working memory during data generation pattern calculations. Reduce the size of any sweep lists and try again.

`Out of memory`

If this occurs during a memory catalog display, it means the system did not have enough free RAM to prepare the catalog.

`Out of memory; The table editor cannot function properly until more memory is available.`

There is insufficient memory to the ARB to generate the requested waveform.

`Out of memory; ARB is not functional.`

There is insufficient memory to the ARB to generate the requested waveform.

-320 `Storage fault`

Indicates that the firmware detected a fault when using data storage. This error is not an indication of physical damage or failure of any mass storage element.

-315 `Configuration memory lost; Persistent state preset. Using factory defaults.`

Indicates that the persistent state has been forced to return to factory preset values.

`Configuration memory lost; Persistent state version is bad. Using factory defaults.`

Indicates that the persistent state version is not recognized as valid and is assumed to be corrupt. The persistent state is reinitialized with the factory preset values.

`Configuration memory lost; Persistent state checksum is bad. Using factory defaults.`

Indicates that the persistent state is corrupt and had to be reinitialized with the factory preset values.

`Configuration memory lost`

Indicates that non-volatile configuration data saved by the device has been lost. The meaning of this error is device-dependent.

-314 `Save/recall memory loss`

Indicates that the non-volatile data saved by the *SAV? command has been lost.

-313 `Calibration memory lost`

Indicates that non-volatile calibration data has been lost.

-312 `PUD memory lost`

Indicates that the protected user data saved by the *PUD command has been lost.

-311 `Memory error; Unable to configure Save Recall registers from non-volatile memory. Save Recall registers re-initialized.`

Indicates that saved states are no longer usable. Delete explicitly using Catalog.

`Memory error`

Indicates that an error was detected in the device's memory.

-310 `System error; RS232 buffer overflow: character lost.`

Indicates that the RS232 buffer has been exceeded. The most recent character has been dropped.

`System error; Cannot change manual point until list mode error condition cleared.`

An error is keeping the sweep/list from being able to set the frequency and/or power. Until the problem is addressed, the manual point cannot be changed.

`System error; Unable to determine which attenuator is installed.`

Indicates that an invalid attenuator identification code has been detected. Possible causes include a loose attenuator control cable. The instrument will likely not produce the proper output power levels. Report this error to the nearest Hewlett-Packard sales and service office.

`System Error; FIR subsystem generated more coefficients than the hardware can handle.`

Indicates that the maximum number of coefficients for a given set of hardware has been exceeded. The filter must be created with fewer coefficients.

-300 `Device-specific error`

This is a generic device-dependent error for devices that cannot detect more specific errors. The code indicates only that a device-dependent error as defined in IEEE 488.2, 11.5.1.1.6 has occurred.

-299 to -200: Execution Errors

An error has been detected by the instrument's execution control block. Errors in this class set the execution error bit (bit 4) in the event status register (IEEE 488.2, section 11.5.1). In this case:

- Either a <PROGRAM DATA> element following a header was evaluated by the device as outside of its legal input range or is otherwise inconsistent with the device's capabilities, or
- a valid program message could not be properly executed due to some device condition.

Execution errors are reported *after* rounding and expression evaluation operations are completed. Rounding a numeric data element, for example, is not reported as an execution error.

-294 `Incompatible type`

Indicates that the type or structure of a memory item is inadequate.

-293 `Referenced name already exists`

A downloaded program attempted to define an element (a variable, constant, filename, etc.) that had already been defined.

-292 `Referenced name does not exist`

A downloaded program attempted to access an undefined element (a variable, constant, filename, etc.).

-291 `Out of memory`

A downloaded program required more memory than was available in the instrument.

-290 `Memory use error`

Indicates that a user request has directly or indirectly caused an error related to memory or <data_handles>. This is not the same as "bad" memory.

-286 `Program runtime error; Floating-Point Exception`

Indicates that a floating-point math error (such as a divide by zero) has been detected. The system will attempt to recover automatically. Report this error to the nearest Hewlett-Packard sales and service office.

`Program runtime error`

Indicates that a runtime error was detected in a downloaded program.

-285 `Program syntax error`

Indicates that a syntax error appears within a downloaded program. The syntax used when parsing a downloaded program is device-specific.

-284 `Program currently running`

Indicates that certain operation related to programs may be illegal while the program is running. For example, deleting a running program may be illegal.

-283 `Illegal variable name`

Indicates that an attempt was made to reference a nonexistent variable.

-282 `Illegal program name`

Indicates that the name used to reference a program was invalid. For example, redefining an existing program, deleting a nonexistent program, or in general, referencing a nonexistent program.

-281 `Cannot create program`

Indicates that an attempt to create a program was unsuccessful. This may be due to insufficient memory.

-280 `Program error`

Indicates that a downloaded program-related execution error occurred. This error message is used when the device cannot detect the more specific errors described for errors -281 through -289. The syntax used in a program and the mechanism for downloading a program is device-specific.

-278 `Macro header not found`

Indicates that a syntactically legal macro label in the `*GMC?` query could not be executed because the header was not previously defined.

-277 `Macro redefinition not allowed`

Indicates that the macro label defined in the `*DMC` command could not be executed because the macro label was already defined (see IEEE 488.2, 10.7.6.4).

-276 `Macro recursion error`

Indicates that a syntactically legal macro program data sequence could not be executed because the device found it to be recursive (see IEEE 488.2, 10.7.6.4).

-275 `Macro definition too long`

Indicates that a syntactically legal macro program data sequence could not be executed because the string or block contents were too long for the device to handle (see IEEE 488.2, 10.7.6.1).

-274 `Macro parameter error`

Indicates that the macro definition improperly used a macro parameter placeholder (see IEEE 488.2, 10.7.3).

-273 `Illegal macro label`

Indicates that the macro label defined in the `*DMC` command was a legal string syntax, but could not be accepted by the device (see IEEE 488.2, 10.7.3 and 10.7.6.2). For example, the label was too long, the same as a common command header, or contained invalid header syntax.

-272 `Macro execution error`

Indicates that a syntactically legal macro program data sequence could not be executed due to an error within the macro definition (see IEEE 488.2, 10.7.6.3).

-271 `Macro syntax error`

Indicates that a syntactically legal macro program data sequence, written in accordance with IEEE 488.2, 10.7.2, could not be executed due to a syntax error within the macro definition (see IEEE 488.2, 10.7.6.3).

-270 `Macro error`

Indicates that a macro-related execution error occurred. This error message is used when the device cannot detect the more specific errors described for errors -271 through -279.

-261 `Math error in expression`

Indicates that a syntactically legal expression program data element could not be executed due to a math error. For example, a divide-by-zero was attempted. The definition of a math error is device-specific.

-260 `Expression error`

Indicates that an expression data element-related error occurred. This error message is used when the device cannot detect the more specific errors described for errors -261 through -269.

-258 `Media protected`

Indicates that the device or user has attempted to write to a read-only memory subsystem (msus). The definition of a protected media is device-specific.

-257 `File name error; Delete empty sequence <sequence_name>. Delete sequence ignored.`

Indicates that the user has attempted to delete a sequence which is empty (all registers unused). This is informational only. Typically this error is reported (several times) when the “Delete All Sequences” command is executed.

`File name error; Delete a non-saved state register. Delete register ignored.`

Indicates that the user has attempted to delete a state which is empty (unused). This is informational only.

`File name error; Directory does not support extenders.`

Indicates that an extender, which is specified by an @ sign followed by a memory subsystem name, has been specified for an explicit memory subsystem which does not allow the @ notation. Only the default (:) memory subsystem allows extenders.

`File name error; Empty filename`

Indicates that a filename of “ “ was specified. This is not a legal filename.

`File name error; Illegal extender`

Indicates that an illegal memory subsystem name was used after the @.

`File name error; Illegal filename character`

Indicates that an illegal character was used within a filename. \, :, @ and all non-printable ASCII characters are illegal in filenames.

`File name error; Only one ":" is allowed.`

Indicates that only one colon is allowed in any filename specification. The text before the colon is a user memory subsystem.

`File name error; Only one "@" is allowed.`

Indicates that only one @ is allowed in any filename specification. It specifies the memory subsystem that a user file actually resides in.

`File name error`

Indicates that a legal program command or query could not be executed because a file name on the device media was in error. For example, an attempt was made to copy to a duplicate filename. The definition of what constitutes a file name error is device-specific.

-256 `File name not found; The internal list file was not found. There is no list data to return`

Indicates that the DWEL_FILE, FREQ_FILE, or POW_FILE has been lost, so a new one will have to be created. These files are the persistent information for list/sweep mode. They contain the dwell list, the frequency list, or the power list. Invoking the list editor will recreate the missing file to a length of one element.

`File name not found; <filename>`

Indicates that the user has attempted to delete a file that does not exist.

`File name not found; CDMA_DATA FILE`

One of the internal working CDMA channel table files is missing.

`File name not found; CDMA_WCODE FILE`

One of the internal working CDMA channel table files is missing.

`File name not found; CDMA_POW FILE`

One of the internal working CDMA channel table files is missing.

`File name not found; CDMA_PNOFS FILE`

One of the internal working CDMA channel table files is missing.

`File name not found`

Indicates that a legal program command or query could not be executed because the file name on the device media could not be found. For example, an attempt was made to read or copy a nonexistent file. The definition of what constitutes a file not being found is device-specific.

-255 `Directory full`

Indicates that a legal program command or query could not be executed because the media directory was full. The definition of what constitutes a full media directory is device-specific.

-254 `Media full; Unable to delete saved state from non-volatile memory. No instrument state change.`

Indicates that the state memory subsystem `STATE:` was unable to delete a register. You must free some memory by deleting a file or register using Catalog. Afterwards, try again.

`Media full; Save a state register ignored.`

Indicates that the state memory subsystem `STATE:` did not have enough room to save a register. You must free some memory by deleting a file or register using Catalog. Afterwards, try again.

`Media full; Save a state register failed. State marked available.`

Indicates that the state memory subsystem `STATE:` did not have enough room to save a register, so the register was lost and is now marked available. You must free some memory by deleting a file or register using Catalog. Afterwards, try again.

`Media full`

Indicates that a legal program command or query could not be executed because the media was full. For example, there is was no space left on the disk. The definition of what constitutes full media is device-specific.

-253 `Corrupt media; User File System`

Indicates that the main memory area, used for storing instrument states and sequences as well as other data files, is corrupt. The system will automatically clear and reconfigure this memory area. A potential cause is a failing backup battery. Another potential cause could be the loss of line power to the instrument in the middle of a write operation.

`Corrupt media; <media_name>`

Indicates that a source media (possibly EEPROM) for a data file is corrupt. This error is usually seen in conjunction with errors concerning a certain file.

`Corrupt media; Arb file system.`

Indicates that the Arb memory area, used for storing waveform files, is corrupt. The system will clear and reconfigure this memory area automatically. A potential cause is the loss of line power in the middle of a write operation.

`Corrupt media`

Indicates that a legal program command or query could not be executed because of corrupt media, for instance a bad disk or incorrect disk format. The definition of what constitutes corrupt media is device-specific.

-252 `Missing media`

Indicates that a legal program command or query could not be executed because of missing media, for instance no disk in the disk drive. The definition of what constitutes missing media is device-specific.

`Missing media`

If this occurs during a memory catalog display, it means the default memory system could not be located. The instrument is likely not functioning properly. Report this error to the nearest Hewlett-Packard sales and service office.

-250 `Mass storage error; EEPROM write timeout on <filename>.`

Indicates that the system was not able to program new data to an EEPROM. The system is still functional, but files written to EEPROM (such as updated calibration data) may be lost when the instrument's line power is cycled. Report this error to the nearest Hewlett-Packard sales and service office.

`Mass storage error`

Indicates that a mass storage error has occurred. This message is used when a device cannot detect the more specific errors described for errors -251 through -259.

-241 `Hardware missing; <card_name>`

Indicates that a test communication to a hardware card failed. The instrument is most likely not functional. Report this error to the nearest Hewlett-Packard sales and service office.

`Hardware missing; Installed option boards do not match configuration information.`

Indicates that a set of option boards have been installed that do not match the information that was given to the instrument as part of the installation. If this is the result of a customer installed option, the wrong option was specified during installation. If this is seen at any other time, the likely cause is an EEPROM failure on the option card.

`Hardware missing`

Indicates that a legal program command or query could not be executed because of missing device hardware. For example, an option was not installed.

-240 `Hardware error`

Indicates that a legal program command or query could not be executed because of a hardware problem in the device. The definition of what constitutes a hardware problem is completely device-specific. This error is used when the device cannot detect the more specific errors described for errors -241 through -249.

-233 `Invalid version`

Indicates that a legal program data element was parsed but could not be executed because the version of the data is incorrect to the device. This particular error is used when file or block data elements are recognized by the instrument, but cannot be executed for reasons of version incompatibility. For example, a non-supported file version or a non-supported instrument version.

-232 `Invalid format`

Indicates that a legal program data element was parsed but could not be executed because the data format or structure is inappropriate. For example, when loading memory tables or when sending a `SYSTem:SET` parameter for an unknown instrument.

-231 `Data questionable; RAM copy of <filename>.`

Indicates that the non-volatile RAM copy of a file has a correctable error. The system automatically performs the correction. A potential cause is a failing backup battery.

`Data questionable; EEPROM copy of <filename>.`

Indicates that the EEPROM copy of a file has a correctable error. The system automatically performs the correction. A potential cause is a failing EERPOM. Report this error to the nearest Hewlett-Packard sales and service office.

`Data questionable`

Indicates that the measurement accuracy is questionable.

-230 `Data corrupt or stale; RAM copy of <filename>.`

The non-volatile RAM copy of a file is either corrupt or is out of date with the EEPROM master copy (if one exists). The system automatically re-initializes the file from EEPROM (if appropriate) or from a default algorithm. A potential cause is a failing backup battery.

`Data corrupt or stale; EEPROM copy of <filename>.`

The EEPROM copy of a file is either corrupt or otherwise unusable. The system automatically updates the non-volatile RAM copy of the EEPROM copy using a default initialization. The actual EEPROM file is left as it is. Report this error to the nearest Hewlett-Packard sales and service office.

`Data corrupt or stale; <NAME> differs offset 0x<VALUE>: NVRAM 0x<VALUE>, EEPROM 0x<VALUE>.`

This message can only occur if full power-on EEPROM comparison mode is set by the factory. If this mode is set, this message indicates that the data that was retained by the EEPROM did not match the shadow data that was retained by the shadow non-volatile RAM, even though no uncorrectable errors or CRC mismatch was found in the shadow memory. This error usually indicates that the instrument lost power during EEPROM programming. If the instrument was quiescent when it was powered off, report this error to the nearest Hewlett-Packard sales and service office.

Data corrupt or stale; EEPROM @ offset 0x<VALUE>: wrote 0x<VALUE>, read 0x<VALUE>.

After writing shadow RAM data to EEPROM, a memory comparison detected a difference. The EEPROM may not be retaining data properly. Report this error to the nearest Hewlett-Packard sales and service office.

Data corrupt or stale; file @ offset 0x<VALUE>: wrote 0x<VALUE>, retained 0x<VALUE>.

After writing shadow RAM data to EEPROM, a memory comparison detected a difference. The EEPROM may not be retaining data properly. Report this error to the nearest Hewlett-Packard sales and service office.

Data corrupt or stale; License file is obsolete, missing entries defaulted.

This error can only occur during the instrument's first power up after having downloaded new firmware. It indicates that the software license file is missing entries for options supported by the current revision of firmware. The missing entries have been added to the file, and their license key values have been defaulted to zero. This error will occurs during the first power up after downloading new firmware into the instrument.

Data corrupt or stale

Possibly invalid data. A new reading was started but not completed since last access.

-226 Lists not same length

Attempted to use LIST structure having individual LISTs of unequal length.

-225 Out of memory

The device has insufficient memory to perform the requested operation.

-224 Illegal parameter value

Used where exact value, from a list of possibilities, was expected.

Illegal parameter value; Command requires at lease one data value.

A modulation type cannot be created without data.

-223 `Too Much Data; The number of list points exceeds the maximum allowed.`

Indicates that some tables have a maximum number of entries. Sweep/List can only have 401 points, for example.

Option UN8 cannot use an I/Q map that has more than 16 unique values for both I and Q. You can use global search and replace to replace all occurrences of a given value (in both I and Q) with a different value.

`Too Much Data; The number of list points in the table exceeds the maximum allowed.`

Indicates that some tables have a maximum number of entries. Sweep/List can only have 401 points, for example.

`Too Much Data; PRAM download exceeds the size of PRAM memory. Download aborted.`

The user attempted to download a data block to PRAM memory that was larger than PRAM memory.

`Too Much Data; Only 16 distinct values are allowed for I and Q values.`

Although up to 256 I and Q pairs can be configured, only 16 unique I and 16 unique Q values are allowed. If there are more than 16 I and Q pairs, some of the pairs must use I and Q values that are also used by other pairs. For example, two I and two Q values can still define four unique I and Q pairs.

`Too much data; PRAM download exceeds the size of PRAM memory. Download aborted.`

This indicates that the downloaded pattern is larger than available PRAM memory. Either use a smaller pattern or get more memory by ordering the appropriate hardware option.

`Too much data; The number of points in the table exceeds the maximum allowed.`

This occurs when you try to create a table that is too big. For example, if you enter a list in SCPI that is longer than the maximum allowed length, or if you attempt to expand a table and the table is already at its maximum length.

`Too much data; User filter has too many symbols.`

Option UN8 cannot use a filter that has more than 32 symbols. You may have specified an incorrect over-sample ratio in the filter table editor.

`Too much data; Only 16 distinct values are allowed for I and Q values.`

Option UN8 cannot use an I/Q map that has more than 16 unique values defined for I and Q (distinct values are listed in the I/Q table editor).

You can use global search and replace to replace all occurrences of a given value (in both I and Q) with a different value.

`Too much data; The number of CDMA channels exceeds the maximum allowed.`

The maximum number of CDMA channels is defined in Chapter 9, "Specifications," of the User's Guide.

`Too much data; The number of CDMA carriers exceeds the maximum allowed.`

The maximum number of CDMA carriers is defined in Chapter 9, "Specifications," of the User's Guide.

`Too much data`

Indicates that a legal program data element of block, expression or string type was received that contained more data than the device could handle due to memory or related device-specific requirements.

-222 `Data out of range; value clipped to lower limit.`

Indicates that an input value is below the minimum value allowed. Examples are: frequency setting, reference, or offset; output power; power reference and offset; modulation depth, deviation, or modulation source frequency; number of points and start/stop values for list mode; start/stop values for internal I/Q calibration; sequence or register values (save/recall); dwell time.

`Data out of range; value clipped to upper limit.`

Indicates that an input value is above the maximum value allowed. Examples are: frequency setting, reference, or offset; output power; power reference and offset; modulation depth, deviation, or modulation source frequency; number of points and start/stop values for list mode; start/stop values for internal I/Q calibration; sequence or register values (save/recall); dwell time.

`Data out of range; Synthesizer: Frequency out of bounds.`

Indicates that the instrument received an internal request for a frequency outside of its supported frequency range. Report this error to the nearest Hewlett-Packard sales and service office.

`Data out of range; Manual point exceeds list sizes. Limiting to maximum point.`

Indicates that the sweep/list manual point has been reassigned to a smaller number value due to the longest list decreasing in size or being turned off. Its new value is the length of the longest enabled list (frequency or power).

`Data out of range; Manual point exceeds frequency list size. Limiting to maximum point.`

Indicates that the sweep/list manual point has been reassigned to a smaller number value due to the longest list decreasing in size or being turned off. Its new value is the length of the frequency list which is the longest enabled list.

`Data out of range; Manual point exceeds power list size. Limiting to maximum point.`

Indicates that the sweep/list manual point has been reassigned to a smaller number value due to the longest list shrinking, or being turned off. Its new value is the length of the power list, which is the longest enabled list.

`Data out of range; The specified filter has too many symbols. The baseband cannot function.`

The filter is in a state that is inappropriate for the hardware. Although no damage to the hardware will occur, the output is in an unknown state. Report this error to the nearest Hewlett-Packard sales and service office.

`Data out of range`

Indicates that a legal program data element was parsed but could not be executed because the interpreted value was outside the legal range defined by the device (see IEEE 488.2 11.5.1.1.5).

-221 `Settings conflict; Cannot have uplink protocols while the control frame is on. Frames 1-17 timeslots changed to downlink.`

Indicates that, in TETRA mode, some of the timeslots are set to uplink. When the control frame is turned on in TETRA, all timeslots in all frames must use downlink protocols. The instrument enforces this by reconfiguring the timeslots that are not using downlink protocols when the control frame is switched on.

`Settings conflict; Cannot select uplink protocols while the control frame is on. Selection changed to custom.`

Indicates that in TETRA mode, an attempt has been made to select uplink protocols while the control frame is switched on. TETRA requires that the control frame be switched off in order to select uplink protocols.

`Settings conflict; Continuous protocol timeslots cannot be turned off.`

Indicates that a continuous protocol timeslot is switched off while in TETRA mode. When a continuous protocol has been selected for a timeslot in TETRA mode, all of the timeslots must be switched on.

`Settings conflict; Continuous & Discontinuous setting conflict. All selected Continuous timeslots are now switched to Discontinuous.`

Indicates that while in TETRA mode, an attempt has been made to simultaneously assign continuous and discontinuous protocols to the timeslots. Continuous and discontinuous protocols cannot coexist in TETRA mode. If a discontinuous protocol is selected for any timeslot, all timeslots' protocols are changed to discontinuous protocols.

`Settings conflict; Discontinuous & Continuous setting conflict. All selected Discontinuous timeslots are now switched to Continuous.`

Indicates that while in TETRA mode, an attempt has been made to simultaneously assign discontinuous and continuous protocols to the timeslots. Discontinuous and continuous protocols cannot coexist in TETRA mode. If a continuous protocol is selected for any timeslot, all timeslots' protocols are changed to continuous protocols.

`Settings conflict; Frequency list and dwell list are of unequal size. Set one list equal to size one, or make their sizes equal.`

Indicates that the frequency list has more than one element and the dwell list has more than one element, and they are not of equal size. If any of the frequency, power, or dwell lists have more than one element, they must all have the same number of elements. A list of a single element is the same as a list of equal size with the single element repeated the necessary number of times.

`Settings conflict; Frequency list and power list are of unequal size. Turn one list off, set one to size one, or make their sizes equal.`

Indicates that the frequency list has more than one element and the power list has more than one element, and they are not of equal size. If any of the frequency, power, or dwell lists have more than one element, they must all have the same number of elements. A list of a single element is the same as a list of equal size with the single element repeated the necessary number of times.

`Settings conflict; Power list and dwell list are of unequal size. Set one to size one, or make their sizes equal.`

Indicates that the dwell list has more than one element and the power list has more than one element, and they are not of equal size. If any of the frequency, power, or dwell lists have more than one element, they must all have the same number of elements. A list of a single element is the same as a list of equal size with the single element repeated the necessary number of times.

`Settings conflict; The selected external trigger setting conflicts with the previous setting.`

Indicates that the external trigger has been set to positive edge for one trigger source and negative edge for another trigger source.

`Settings conflict; I/Q & AM WB cannot be on at the same time.`

The modulation types I/Q and AM WB cannot be used at the same time. This error is reported when the user attempts to activate one type of modulation while the other is activated. The modulation type that was most recently requested will be turned on and the modulation that was on at the time will be turned off.

`Settings conflict; FM2/PM2 value set greater than FM1/PM1 value. FM1/PM1 changed to match FM2/PM2 value.`

The deviation of FM2/PM2 must always be less than or equal to the deviation settings for FM1/PM1. This error will be reported to the queue when FM1/PM1 is enabled and FM2/PM2 is also enabled and an adjustment to either FM2/PM2 deviation causes the FM2 or PM2 deviation to be greater than the FM1 or PM1 deviation. It will also be reported when FM2/PM2 is being turned on, and the last FM1/PM1 deviation setting is less than the current FM2/PM2 deviation setting. In both cases the FM1/PM1 deviation will be adjusted to match the FM2/PM2 deviation.

`Settings conflict; FM1/PM1 value set less than FM2/PM2 value. FM2/PM2 changed to match FM1/PM1 value.`

The deviation of FM2/PM2 must always be less than or equal to the deviation settings for FM1/PM1. This error will be reported to the queue when FM2/PM2 is enabled and FM1/PM1 is also enabled and an adjustment to either FM1/PM1 deviation causes the FM1 or PM1 deviation to be less than the FM2 or PM2 deviation. It will also be reported when FM1/PM1 is being turned on, and the last FM2/PM2 deviation setting is greater than the current FM1/PM1 deviation setting. In both cases the FM2/PM2 deviation will be adjusted to match the FM1/PM1 deviation.

`Settings conflict; Enabled mod source conflicts with previously enabled mod source. Previous mod disabled.`

The signal generator has three sources: INT, EXT1, and EXT2 that are shared by the FM1/PM1, AM1/AM2, FM2/PM2, pulse (INT and EXT2), and burst envelope (EXT1 only). Each source can only be used by one of the modulations at a time. If a source is being used by an active modulation, and a request for the source is made by another modulation, the first modulation will be turned off, the second modulation will be turned on.

`Settings conflict; External burst cannot be on while using AM.`

Indicates that there is a hardware conflict for the burst envelope using the EXT1 source (I/Q menu) and AM1/AM2. The most recently requested modulation will be turned on, the previous modulation will be turned off.

`Settings conflict; FM & PM not allowed.`

Indicates that there is a hardware conflict between FM and PM. The most recently requested modulation will be turned on, the previous modulation will be turned off.

`Settings conflict; Pulse modulation cannot be on with internal burst.`

Indicates that there is a hardware conflict between pulse modulation and internal burst. The most recently requested modulation will be turned on, the previous modulation will be turned off.

`Settings conflict; Internal burst cannot be on with pulse modulation.`

Indicates that there is a hardware conflict between internal burst and pulse modulation. The most recently requested modulation will be turned on, the previous modulation will be turned off.

`Settings conflict; Uplink & Downlink setting conflict. All selected Uplink timeslots are now set to Downlink.`

Indicates that an Uplink timeslot type has been selected while another timeslot(s) has Downlink selected. In NADC and PDC digital modulation for bursted data, only either Uplink (base to mobile) or Downlink (mobile to base) Traffic Channel type can be selected for all timeslots at any one moment.To continue data transmission, all Uplink timeslots have been changed to the Downlink configuration.

`Settings conflict; Downlink & Uplink setting conflict. All selected Downlink timeslots are now set to Uplink.`

Indicates that an Downlink timeslot type has been selected while another timeslot(s) has Uplink selected. In NADC and PDC digital modulation for bursted data, only either Uplink (base to mobile) or Downlink (mobile to base) Traffic Channel type can be selected for all timeslots at any one moment.To continue data transmission, all Downlink timeslots have been changed to the Uplink configuration.

`Settings conflict; Pulse period set less than pulse width. Pulse width changed to match period value.`

Indicates that a pulse period has been entered which is smaller than the pulse width. The instrument automatically adjusts the pulse period to match the pulse width.

`Settings conflict; PDC and NADC Custom protocols are now uplink protocols, so the timeslots with Custom selected were changed to Downlink Custom.`

Indicates that, because PDC or NADC has downlink protocols selected and also has Custom in one or more timeslots, the timeslots with Custom are set to Downlink Custom. Otherwise, the timeslots with Custom are set to Uplink Custom. Downlink Custom has its own instrument state information for the Data type and Fix 4 value.

`Settings conflict; Frame in Pattern RAM is from a different format. The secondary frame is unchanged.`

Indicates that the secondary frame feature has many potential conflicts. Some of the conflicts leave the secondary pattern and its state as they were prior to the command that led to the error message, and some turn off the secondary state, since the primary state is not compatible and it has priority.

`Settings conflict; Cannot have a secondary frame with a non-framed data pattern. The secondary frame is unchanged.`

Indicates that the secondary frame feature has many potential conflicts. Some of the conflicts leave the secondary pattern and its state as they were prior to the command that led to the error message, and some turn off the secondary state, since the primary state is not compatible and it has priority.

`Settings conflict; Cannot have a secondary frame with all timeslots off. The secondary frame is unchanged.`

Indicates that the secondary frame feature has many potential conflicts. Some of the conflicts leave the secondary pattern and its state as they were prior to the command that led to the error message, and some turn off the secondary state, since the primary state is not compatible and it has priority.

`Settings conflict; Cannot have a secondary frame with alternate amplitude. The secondary frame is unchanged.`

Indicates that the secondary frame feature has many potential conflicts. Some of the conflicts leave the secondary pattern and its state as they were prior to the command that led to the error message, and some turn off the secondary state, since the primary state is not compatible and it has priority.

`Settings conflict; Cannot have a continuous and discontinuous frame at the same time. The secondary frame has been turned off.`

Indicates that the secondary frame feature has many potential conflicts. Some of the conflicts leave the secondary pattern and its state as they were prior to the command that led to the error message, and some turn off the secondary state, since the primary state is not compatible and it has priority.

`Settings conflict; Cannot have a secondary frame with a non-framed data pattern. The secondary frame has been turned off.`

Indicates that the secondary frame feature has many potential conflicts. Some of the conflicts leave the secondary pattern and its state as they were prior to the command that led to the error message, and some turn off the secondary state, since the primary state is not compatible and it has priority.

`Settings conflict; Cannot have a secondary frame with all timeslots off in the primary frame. The secondary frame has been turned off.`

Indicates that the secondary frame feature has many potential conflicts. Some of the conflicts leave the secondary pattern and its state as they were prior to the command that led to the error message, and some turn off the secondary state, since the primary state is not compatible and it has priority.

`Settings conflict; Cannot have a secondary frame while the primary frame has alternate amplitude. The secondary frame has been turned off.`

Indicates that the secondary frame feature has many potential conflicts. Some of the conflicts leave the secondary pattern and its state as they were prior to the command that led to the error message, and some turn off the secondary state, since the primary state is not compatible and it has priority.

`Settings conflict; Pattern repeat is changed to continuous because data source is external.`

Indicates that single is not a valid repeat setting for an external data source.

`Settings conflict; Frame repeat changed to continuous.`

Indicates that single is not a valid repeat setting for an external data source.

`Settings conflict; Current frame length does not have symbol boundary. End of frame has been patched with extra bits to allow an integer of symbols in a frame.`

With Option UN8, in TDMA format you can select from many different modulations with different bits per symbol. Because all TDMA formats have fixed frame size, in some modulations end-of-frame and end-of-symbol do not happen at the same time. This message indicates that end-of-frame has been patched with extra bits to allow an integer number of symbols per frame.

`Settings conflict; PHS or TETRA scramble can not be on when the currently selected modulation type has more than 2 bits per symbol.`

Option UN8 provides modulations with more than 2 bits/symbol. For these modulations, PHS and TETRA scramble are disabled.

`Settings conflict; Current file length does not have an integer number of symbols. User file size must have symbol boundary in order to transmit the file.`

A user-defined file must end with a symbol. If it does not, transmission is aborted.

`Settings conflict; User FSK file has deviations which are incompatible with the current symbol rate. The modulation type has been defaulted.`

A frequency in the selected user FSK file exceeds the maximum possible deviation for the current symbol rate. The default modulation type for the mode has been selected to resolve the conflict.

`Settings conflict; The symbol rate is too high for a > 16 symbol filter. Baseband cannot function.`

The filter is in a state that is inappropriate for the hardware. Although no damage to the hardware will occur, the output is in an unknown state. Report this error to the nearest Hewlett-Packard sales and service office.

`Settings conflict; Cannot have a secondary frame with a different modulation type than the primary frame. The secondary frame has been turned off.`

The primary and secondary frames must have the same modulation types. If they do not, the secondary frame is turned off.

`Settings conflict`

Indicates that a legal program data element was parsed but could not be executed due to the current device state (see IEEE 488.2 11.5.1.1.5).

-220 `Parameter error; <modulation file name>`

The specified file is not a modulation file type.

`Parameter error`

Indicates that a program data element related error has occurred. This particular error message is used if the device cannot detect a more specific error described for errors -221 through -229.

-215 `Arm deadlock`

Indicates that the arm source for the initiation of a measurement is set to `GET` and a subsequent measurement query is received. The measurement cannot begin until a `GET` is received, but the `GET` would cause an INTERRUPTED error.

-214 `Trigger deadlock`

Indicates that a trigger source for the initiation of a measurement is set to `GET` and a subsequent measurement query is received. The measurement cannot begin until a `GET` is received, but the `GET` would cause an INTERRUPTED error.

-213 `Init ignored; Unable to sweep due to sweep being in an error state. The sweep error should be fixed.`

Indicates that the number of list, power, and/or dwell points are in conflict, or a serious system error has occurred in list/sweep. A previous error report should have described the error that is stalling list/sweep.

`Init ignored; Cannot initiate sweep in manual mode.`

Indicates that the manual mode is on and therefore the instrument cannot sweep.

`Init ignored; Sweep is already initiated.`

Indicates that the list/sweep is currently initiated and sweeping, therefore the command is not legal according to SCPI.

`Init ignored; Sweep is already continuously initiated.`

Indicates that the list/sweep is continuously initiated and sweeping, therefore the command is not legal according to SCPI.

`Init ignored`

Indicates that a request for a measurement initiation was ignored as another measurement was already in progress.

-212 `Arm ignored`

Indicates that an arming signal was received and recognized by the device but was ignored.

-211 `Trigger ignored`

Indicates that a `GET`, `*TRG`, or triggering signal was received and recognized by the device, but was ignored because of device timing considerations. For example, the device was not ready to respond.

-210 `Trigger error`

Indicates that a `GET`, `*TRG`, or a triggering signal could not be executed due to an error.

-202 `Settings lost due to rtl`

Indicates that a setting associated with a hard local control (see IEEE 488.2, 5.6.15) was lost when the device changed to LOCS from REMS or to LWLS from RWLS.

-201 `Invalid while in local`

Indicates that a command is not executable while the device is in local mode due to a hard local control (see IEEE 488.2, 5.6.1.5). For example, a device with a rotary switch receives a message which would change the switch's state, but the device is in local so the message cannot be executed.

-200 `Execution Error`

This is a generic syntax error for devices that cannot detect more specific errors. The code indicates only that an execution error as defined in IEEE 488.2, 11.5.1.1.5 has occurred.

-199 to -100: Command Errors

The instrument's parser detected an IEEE 488.2 syntax error. Errors in this class set the command error bit (bit 5) in the event status register (IEEE 488.2, section 11.5.1)t. In this case:

- Either an IEEE 488.2 syntax error has been detected by the parser (a control-to-device message was received that is in violation of the IEEE 488.2 standard. Possible violations include a data element which violates device listening formats or whose type is unacceptable to the device.), or
- an unrecognized header was received. These include incorrect device-specific headers and incorrect or unimplemented IEEE 488.2 common commands.

-184 `Macro parameter error`

Indicates that a command inside the macro definition had the wrong number or type of parameters.

-183 `Invalid inside macro definition`

Indicates that the program message unit sequence, sent with a `*DDT` or a `*DMC` command, is syntactically invalid (see IEEE 488.2, 10.7.6.3).

-181 `Invalid outside macro definition`

Indicates that a macro parameter placeholder (`$<number`) was encountered outside of a macro definition.

-180 `Macro error`

This error, as well as errors -181 through -189, are generated when defining a macro or executing a macro. This particular error message is used if the device cannot detect a more specific error.

-178 `Expression data not allowed`

A legal expression data was encountered, but was not allowed by the device at this point in parsing.

-171 `Invalid expression`

The expression data element was invalid (see IEEE 488.2, 7.7.7.2). For example, unmatched parentheses or an illegal character.

-170 `Expression data error`

This error, as well as errors -171 through -179, are generated when parsing an expression data element. This particular error message is used if the device cannot detect a more specific error.

-168 `Block data not allowed`

A legal block data element was encountered, but not allowed by the device at this point in the parsing.

-161 `Invalid block data`

A block data element was expected, but was invalid (see IEEE 488.2, 7.7.6.2). For example, an `END` message was received before the end length was satisfied.

`Invalid block data; Arb file must be even length, file deleted`

An Arb waveform file must be an even number of bytes in length. Adjust the file length and repeat the download.

-160 `Block data error`

This error, as well as errors -161 through -169, are generated when parsing a block data element. This particular error message is used if the device cannot detect a more specific error.

-158 `String data not allowed`

A string data element was encountered, but not allowed by the device at this point in the parsing.

-151 `Invalid string data`

A string data element was expected, but was invalid (see IEEE 488.2, 7.7.5.2). For example, an `END` message was received before the terminal quote character.

`Invalid string data; filename exceeds maximum of 23 characters.`

Indicates that you have specified a filename that exceeds the maximum length.

`Invalid string data; filename plus msus exceeds maximum of 30 characters.`

Indicates that you have specified a filename that exceeds the maximum length.

-150 `String data error`

This error, as well as errors -151 through -159, are generated when parsing a string data element. This particular error message is used if the device cannot detect a more specific error.

-148 `Character data not allowed`

A legal character data element was encountered where prohibited by the device.

-144 `Character data too long`

The character data element contains more that twelve characters (see IEEE 488.2, 7.7.1.4).

-141 `Invalid character data`

Either the character data element contains an invalid character or the particular element received is not valid for the header.

-140 `Character data error`

This error, as well as errors -141 through -149, are generated when parsing a character data element. This particular error message is used if the device cannot detect a more specific error.

-138 `Suffix not allowed`

A suffix was encountered after a numeric element which does not allow suffixes.

-134 `Suffix too long`

The suffix contained more than twelve characters (see IEEE 488.2, 7.7.3.4).

-131 `Invalid suffix`

The suffix does not follow the syntax described in IEEE 488.2, 7.7.3.2, or the suffix is inappropriate for this device.

-130 `Suffix error`

This error, as well as errors -131 through -139, are generated when parsing a suffix. This particular error message is used if the device cannot detect a more specific error.

-128 `Numeric data not allowed`

A legal numeric data element was received, but the device does not accept one in this position for the header.

-124 `Too many digits`

The mantissa of a decimal-numeric data element contained more than 255 digits excluding leading zeros (see IEEE 488.2, 7.7.2.4.1).

-123 `Exponent too large`

The magnitude of an exponent was greater than 32000 (see IEEE 488.2, 7.7.2.4.1).

-121 `Invalid character in number`

An invalid character for the data type being parsed was encountered. For example, an alpha in a decimal numeric or a “9” in octal data.

-120 `Numeric data error`

This error, as well as errors -121 through -129, are generated when parsing a data element which appears to be numeric, including non-decimal numeric types. This particular error message is used if the device cannot detect a more specific error.

-114 `Header suffix out of range`

The value of a header suffix attached to a program mnemonic makes the header invalid.

-113 `Undefined header`

The header is syntactically correct, but it is undefined for this specific device. For example, `*XYZ` is not defined for any device.

-112 `Program mnemonic too long`

The header contains more than twelve characters (see IEEE 488.2, 7.6.1.4.1).

-111 `Header separator error`

A character which is not a legal header separator was encountered while parsing the header.

-110 `Command header error`

An error was detected in the header. This message is used when the device cannot detect the more specific errors described for errors -111 through -119.

-109 `Missing parameter`

Fewer parameters were received than required for the header. For example, the `*ESE` common command requires one parameter, so receiving `*ESE` is not allowed.

-108 `Parameter not allowed`

More parameters were received than expected for the header. For example, the `*ESE` common command only accepts one parameter, so receiving `*ESE 0,1` is not allowed.

-105 `GET not allowed`

A Group Execute Trigger was received within a program message (see IEEE 488.2, 7.7). Correct the HP-IB controller program so that the `GET` does not occur within a line of HP-IB program code.

-104 `Data type error`

The parser recognized a data element that is not allowed. For example, numeric or string data was expected, but block data was encountered.

-103 `Invalid separator`

The parser was expecting a separator and encountered an illegal character. For example, the semicolon was omitted after a program message unit.

-102 `Syntax error; Bad HP compatibility language character <character>.`

Indicates that, in HP 8656/57 compatibility mode, illegal language input was received.

`Syntax error; Bad HP compatibility language token <token>.`

Indicates that, in HP 8656/57 compatibility mode, a known command or termination specifier was received when it was not expected. For example, a termination specifier was received with no currently active function.

`Syntax error`

An unrecognized command or data type was encountered. For example, a string was received when the device does not accept strings.

-101 `Invalid character`

A syntactic command contains a character which is invalid for that type. For example, a header containing an ampersand, SETUP&. This error might be used in place of error numbers -114, -121, -141 and some others.

-100 `Command error; R0:No standby mode allowed.`

Indicates that, in HP 8656/57 compatibility mode, `R0` was received via HP-IB. This command is not supported by the compatibility mode.

`Command error; Remote active function DN/UP not available.`

Indicates that, in HP 8656/57 compatibility mode, either `DN` or `UP` was received via HP-IB. These commands are not supported by the compatibility mode.

`Command error; LO: No low bandwidth ALC mode allowed.`

Indicates that, in HP 8656/57 compatibility mode, `LO` was received via HP-IB. This command is not supported by the compatibility mode.

`Command error`

This is a generic syntax error for devices that cannot detect more specific errors. The code indicates only that a command error as defined in IEE 488.2, 11.5.1.1.4 has occurred.

201 to 702: Device-Specific Errors

Some device operations did not properly complete, possibly due to an abnormal hardware or firmware condition. These codes are also used for self-test response errors. Errors in this class set the device-specific error bit (bit 3) in the event status register (IEEE 488.2, section 11.5.1).

The <error_message> string for a *positive* error is not defined by SCPI. A positive error indicates that the instrument detected an error within the HP-IB system, within the instrument's firmware or hardware, during the transfer of block data, or during calibration.

201 `Bad file number; Unable to check Data Generator memory.`

Indicates that the instrument was not able to generate the pattern necessary to perform the data generator memory test. This does NOT imply a data generator memory failure. Report this error to the nearest Hewlett-Packard sales and service office.

208 `I/O error; Unable to delete saved state from non-volatile memory. No instrument state change.`

Indicates that a `STATe:` file could not be deleted due to the file not being found, file corruption, or another file-related problem. If the file is displayed by a memory catalog, delete it explicitly.

`I/O Error; <file name>`

Invalid file name.

`I/O error; Save a state register ignored.`

Indicates that a `STATe:` file could not be saved due to insufficient space, file corruption, or another related problem.

`I/O error; Delete empty sequence <sequence_name>. Delete sequence ignored.`

Indicates that the user has attempted to delete a sequence that is empty. This error message is informational only. Typically, this error is reported several times when the "Delete All Sequences" command is executed. If the file is displayed by Catalog, delete explicitly.

`I/O error; Delete a non-saved state register. Delete register ignored.`

Indicates that the user has attempted to delete an unused (empty) state. This error message is informational only.

`I/O error; Trailing zero found in <filename>. Fixing...`

Indicates that a compressed state file has a zero at its end. This is a sign of file corruption. The device fixes the problem by concealing the zero such that it no longer triggers an error message. The file may be corrupt or unusable.

`I/O error; Unable to recall from non-volatile memory. No instrument state change.`

Indicates that the state file is not readable and the recall was aborted.

214 `Not owner; Unable to delete saved state from non-volatile memory. No instrument state change.`

Indicates that the user has attempted to write to a read-only memory subsystem.

218 `I/O error; filename`

Indicates that an invalid file name was detected during ARB segment or sequence processing.

501 `Attenuator hold setting over range; Frequency change forced attenuator adjust.`

Indicates that the firmware has changed the attenuator setting because, while in attenuator hold mode, a change in frequency setting has forced the ALC beyond its range.

`Attenuator hold setting over range; Power set to lower limit.`

Indicates that the firmware has changed the power setting to a value other than the requested value due to the fact that, while in attenuator hold mode, the user has requested a power setting that is below the ALC range for the attenuator setting. The power has been set to the lower limit.

`Attenuator hold setting over range; Power set to upper limit.`

Indicates that the firmware has changed the power setting to a value other than the requested value due to the fact that, while in attenuator hold mode, the user has requested a power setting that is above the ALC range for the attenuator setting.

508 `Synthesizer unlocked`

Indicates that the synthesizer is unlocked. Service may be needed.

509 `Output Section input overdrive`

Internal error: report to factory.

510 `I/Q Modulator overdrive`

Internal error: report to factory.

511 `Output unleveled`

Indicates that the instrument's output is unleveled.

512 `Reference unlocked`

Indicates that the instrument's reference is unlocked. If an external reference is connected, check the frequency and power. It is possible for this to occur during a poor connection/disconnection of an external reference. If this error reoccurs when no external reference is connected, the instrument may require service.

513 `Het VCO unlocked`

Indicates that the VCO used to generate output frequencies below 250 MHz is unlocked. The instrument may require service.

514 `Reference Oven cold`

Indicates that the reference oven is not at the required operating temperature. This is normal if the instrument has been powered down for a while. If the error persists, the instrument may require service.

515 `Reference board: 10 Mhz reference signal bad or missing`

Indicates that the instrument's reference is unlocked. If an external reference is connected, check the frequency and power. It is possible for this to occur during a poor connection/disconnection of an external reference. If this error reoccurs when no external reference is connected, the instrument may require service.

516 `Baseband Generator unlocked; refer to manual.`

Indicates that the digital modulation board is unlocked. If this error occurs and the status indicator on the front panel is not on, the board is operational. There are legitimate reasons for the front panel indicator to be on: if External Data mode was selected and no clock was provided for the data clock input, or if there was an incorrect setting selected for data clock/symbol clock.

517 `Calibration failure; DCFM DC overrange`

Indicates that the instrument was unable to perform a DCFM or DCΦM calibration due to the input signal being outside of the offset range that can be calibrated for.

`Calibration failure; Upgrade calibration failed. Data not stored.`

Indicates that the calibration stage of the instrument upgrade was not executed successfully. The calibration data has not been stored. The upgrade is not functional. Report this error to the nearest Hewlett-Packard sales and service office.

`Calibration failure; Cal aborted by user.`

Indicates that, while executing the internal I/Q calibration, the user sent a DCAS over the HP-IB or pressed the **Abort** key on the front panel.

`Calibration failure; I/Q cal failed to allocate memory.`

Indicates that, while executing the internal I/Q calibration, the attempt to allocate memory for the calibration failed.

`Calibration failure; ‘Marble Cal’, ‘Offset Cal’, ‘Other Cal’, ‘Gain Cal’, ‘BBG Cal’, ‘ARB Cal’`

Indicates that, while executing the internal I/Q calibration, a failure occurred during the section indicated.

`Calibration failure; Baseband Generator Cal`

The Baseband Generator calibration portion of an internal I/Q calibration has failed.

518 `Arbitrary Waveform Generator unlocked; refer to manual.`

Indicates that the instrument's dual arbitrary waveform generator is unlocked. This error will occur when the **ARB Reference** key is set to **Ext** and there is no external signal applied to the instrument. It may also occur if there is a problem with the A5 dual arbitrary waveform generator board.

519 `Uncalibrated signal; IQ Adjustments not calibrated. Refer to manual.`

Indicates that a calibration is required to use the IQ adjustments feature. The I/Q adjustments may be functional, but are not guaranteed to meet specifications until an I/Q calibration is performed. Refer to the user's guide.

`Uncalibrated signal; Quadrature Skew Not Calibrated`

Indicates that a calibration is required to use the quadrature skew feature. The quadrature skew may be functional, but is not guaranteed to meet specifications until the I/Q impairment adjustment is performed. Refer to the calibration guide.

600 `RPP has tripped.`

Indicates that the reverse power protection circuit has been triggered. Repeated tripping of this circuit can cause damage to the instrument.

**** CAUTION ****
REVERSE POWER PROTECTION (RPP) TRIPPED

Repeated RPP tripping may damage the instrument!

Damage may occur if..
an external signal was applied at the RF Output or ESD was detected at RF Output.

Damage will not occur if..
a poor RF output port match exists when the power level is set beyond the specified range.

Indicates that the reverse power protection circuit has been triggered. Repeated tripping of this circuit can cause damage to the instrument.

601 `Power search failed.`

Indicates that, while executing power search, the level meter circuit failed to return a meaningful value. This event indicates that the power is in a range that the leveling loop cannot properly level. The power will be set to the last properly leveled power.

604 `DSP FW download failed.`

Indicates that an external bus download of a digital signal processor (DSP) program failed.

605 `DSP FW download failed.`

Indicates that the instrument's firmware was unable to successfully initialize the internal digital signal processor (DSP) on the A14 CPU/Motherboard. Report this error to the nearest Hewlett-Packard sales and service office.

`DSP FW download failed.`

Indicates that the instrument's firmware was unable to successfully initialize the internal digital signal processor (DSP) on the A6 bit error rate tester board (Option UN7). Report this error to the nearest Hewlett-Packard sales and service office.

606 `DSP times out.`

Indicates that the digital signal processor (DSP) on the A14 CPU/Motherboard failed to respond within the appropriate amount of time. Report this error to the nearest Hewlett-Packard sales and service office.

`DSP times out.`

Indicates that the digital signal processor (DSP) on the A6 bit error rate tester board (Option UN7) failed to respond within the appropriate amount of time. Report this error to the nearest Hewlett-Packard sales and service office.

`DSP times out; FPGA download failed: DUAL ARB BOARD`

Indicates that the initialization of hardware necessary for the operation of the dual arbitrary waveform generator (Option UND) failed. The dual arbitrary waveform generator is not functional. Report this error to the nearest Hewlett-Packard sales and service office.

`DSP times out; ARB communication failed`

Indicates that the communication to the dual arbitrary waveform generator (Option UND) failed. The dual arbitrary waveform generator may not be functional. Report this error to the nearest Hewlett-Packard sales and service office.

`DSP times out; FlexDG communication failed`

The instrument is unable to communicate with the FLEXDG data generator board. The baseband generator can not function.

607 `DSP returns error.`

Indicates that the digital signal processor (DSP) is in an indeterminate state. Report this error to the nearest Hewlett-Packard sales and service office.

`DSP returns error; ARB FLASH memory error (code)`

Indicates that the dual arbitrary waveform generator (Option UND) digital signal processor (DSP) detected an internal error when processing a command. The DSP specific error code is displayed in the parenthesis. Report this error to the nearest Hewlett-Packard sales and service office.

`DSP returns error; ARB data line error (code)`

Indicates that the dual arbitrary waveform generator (Option UND) digital signal processor (DSP) detected an internal error when processing a command. The DSP specific error code is displayed in the parenthesis. Report this error to the nearest Hewlett-Packard sales and service office.

`DSP returns error; ARB address line error (code)`

Indicates that the dual arbitrary waveform generator (Option UND) digital signal processor (DSP) detected an internal error when processing a command. The DSP specific error code is displayed in the parenthesis. Report this error to the nearest Hewlett-Packard sales and service office.

`DSP returns error; ARB self test error (code)`

Indicates that the dual arbitrary waveform generator (Option UND) digital signal processor (DSP) detected an internal error when processing a command. The DSP specific error code is displayed in the parenthesis. Report this error to the nearest Hewlett-Packard sales and service office.

`DSP returns error; ARB parameters error (code)`

Indicates that the dual arbitrary waveform generator (Option UND) digital signal processor (DSP) detected a communications error with the command sent to it. The DSP specific error code is displayed in the parenthesis. Report this error to the nearest Hewlett-Packard sales and service office.

`DSP returns error; ARB Command not recognized (code)`

Indicates that the dual arbitrary waveform generator (Option UND) digital signal processor (DSP) detected a communications error with the command sent to it. The DSP specific error code is displayed in the parenthesis. Report this error to the nearest Hewlett-Packard sales and service office.

`DSP returns error; ARB communications failed. (code)`

Indicates that the dual arbitrary waveform generator (Option UND) digital signal processor (DSP) detected an error and it is in an indeterminate state. The DSP specific error code is displayed in the parenthesis. Report this error to the nearest Hewlett-Packard sales and service office.

608 `DSP in use by other process.`

Indicates that the digital signal processor (DSP) is in an indeterminate state. Report this error to the nearest Hewlett-Packard sales and service office.

615 `New wave shape changes limit for internal frequency; frequency changed to new limit.`

When using the internal modulation source, the upper limit varies for the different waveforms. If the user changes the waveform when the internal source frequency is higher than that allowed for the new waveform, the frequency for the source will be changed, and the user informed of that change with this message.

616 `Configuration Error; Option reconfiguration failed.`

As a part of option reconfiguration, the instrument reboots. If the reconfiguration failed, it is reported when the instrument completes the reboot. Try repeating the option reconfiguration. Report this error to the nearest Hewlett-Packard sales and service office.

`Configuration Error; Attenuator configuration does not match actual installed attenuator type.`

Indicates that a mismatch was found between the configured and detected attenuator types. The instrument may not be fully functional. Report this error to the nearest Hewlett-Packard sales and service office.

617 `Configuration error; Data Generator Memory configuration does not match installed board.`

This indicates that the memory configuration for an option board does not match the known memory limits of the board. If this error has occurred as the result of a customer-installed option, uninstall all options and then reinstall the correct options. Report this error to the nearest Hewlett-Packard sales and service office.

`Configuration error; Invalid Data Generator memory configuration.`

This indicates that the memory configuration for an option board does not match the known memory limits of any supported option board. If this error has occurred as the result of a customer-installed option, uninstall all options and then reinstall the correct options. Report this error to the nearest Hewlett-Packard sales and service office.

`Configuration error; Invalid option board configuration.`

This indicates that an invalid combination of option boards has been configured. If this error has occurred as the result of a customer-installed option, uninstall all options and then reinstall the correct options. Report this error to the nearest Hewlett-Packard sales and service office.

`Configuration error; Installed board not supported.`

Indicates that an option board or board combination which is not supported by the installed firmware has been specified or detected. Be sure that you have the proper instrument and firmware to support the option board, and that you have specified a supported combination of options.

`Configuration error; Illegal combination of installed option boards.`

Indicates that an option board or board combination which is not supported by the installed firmware has been specified or detected. Be sure that you have the proper instrument and firmware to support the option board, and that you have specified a supported combination of options.

`Configuration error; Could not start license system.`

Indicates that the Software License System has failed to operate. The software option cannot be enabled. Report this error to the nearest Hewlett-Packard sales and service office.

`Configuration error; <OPTION>, Invalid (inconsistent) license key.`

Indicates that the License Key for the indicated software option is invalid. If the option has not been purchased, then enter a value of zero for its key to disable the option, otherwise enter the correct value from the License Key Certificate.

`Configuration error; Invalid file system configuration block size defaulted.`

This indicates that a block size configuration error was detected by the file system. A default value has been used. Report this error to the nearest Hewlett-Packard sales and service office.

`Configuration error; Invalid file system configuration max files defaulted.`

This indicates that a maximum files configuration error was detected by the file system. A default value has been used. Report this error to the nearest Hewlett-Packard sales and service office.

`Configuration error; Invalid file system configuration memory size defaulted.`

This indicates that a memory size configuration error was detected by the file system. A default value has been used. Report this error to the nearest Hewlett-Packard sales and service office.

`Configuration error; Old bootrom detected. File system and instrument state re-initialized due to firmware upgrade. Replace bootrom to avoid this in the future.`

The firmware has detected that the instrument contains an old bootrom version. As a result the user file system, arb file system (if present), and instrument states have been re-initialized. Instrument calibration files have not been affected. In the future, to avoid re-initialization of the file system and instrument states that will occur with firmware upgrades, return the instrument to Hewlett-Packard for bootrom replacement.

618 `RS232 times out; RS232 reset.`

Indicates that if further input is not received within the timeout time while a SCPI command is being processed, then the command is aborted and the input buffer is cleared.

619 `DSP code is invalid; Running boot code only.`
`ARB is not functional.`

The dual arbitrary waveform generator (Option UND) is running boot code only. The dual arbitrary waveform generator commands will not function. Report this error to the nearest Hewlett-Packard sales and service office.

`DSP code is invalid; Unrecognized version.`
`Some ARB commands may not function.`

Indicates that the dual arbitrary waveform generator (Option UND) is running an unsupported version of digital signal processor (DSP) code. The dual arbitrary waveform generator may not function correctly. Report this error to the nearest Hewlett-Packard sales and service office.

`DSP code is invalid; Unrecognized program.`
`ARB is not functional.`

Indicates that the dual arbitrary waveform generator (Option UND) is running an unknown digital signal processor (DSP) program. The dual arbitrary waveform generator commands will not function. Report this error to the nearest Hewlett-Packard sales and service office.

`DSP code is invalid; Flex DG DSP code is invalid.`

The version number of the DSP firmware in the FlexDG data generator is not the version expected by the instrument firmware. The instrument must be upgraded to a matching set of DSP and instrument firmware.

620 `Clock rate error.`

The input clock rate for the bit error rate was too fast. Maximum clock rate is 2 Mbps for the 2 Mbps mode, and 10 Mbps for the 10 Mbps mode.

621 `FPGA download failed.`

Indicates that the download of the field programmable gate array code to the RAM on the A6 bit error rate tester board failed. Report this error to the nearest Hewlett-Packard sales and service office.

622 `Sequence references self; <Sequence Name>.`

Indicates that the specified sequence is not allowed because it contains a reference to itself.

700 `State Save Recall Error; Recall aborted. Unable to recall the state from non-volatile memory.`

This indicates that the state file was not readable, so the recall was aborted. If state file exists, delete explicitly using the memory catalog.

`State Save Recall Error; Recalled state has a bad checksum. No instrument state change.`

This indicates that the state file was corrupt or out-of-date, so the recall was ignored. If state file exists, delete explicitly using the memory catalog.

`State Save Recall Error; Recall data different from FW revision. No instrument state change.`

Indicates that an attempt was made to recall a state that was saved with an incompatible version of the instrument firmware. This typically occurs when a state file is copied from an instrument with a newer version of firmware to an instrument with an older version of firmware. Newer versions of instrument firmware can read older state files.

`State Save Recall Error; Recall non-saved state register. Recall ignored.`

Indicates that a recall was attempted for a state register that is unused. If state file exists, delete explicitly using catalog.

`State Save Recall Error; Delete sequence <sequence_name> ignored.`

Indicates that a `STATE:` file in a sequence that is being deleted could not be deleted due to the file not being found, data corruption, etc. If state file exists, delete explicitly using the memory catalog.

`State Save Recall Error; The state file is from a different firmware revision that does not support comments.`

Indicates that an attempt was made to write a comment to a state file revision that does not support comments. Comments in saved state files are not supported by the A.01.00 and A.01.01 releases of the instrument firmware.

`State Save Recall Error; Unable to read the secondary frame instrument state file. The secondary frame has been turned off.`

Indicates that the format which is currently active needed the secondary frame instrument state file to generate the secondary frame in pattern RAM, but the instrument state file was either not previously saved or it was deleted. You must create and save a secondary frame instrument state.

702 `Load/Store Error; Unrecognized FIR file version.`

This indicates that the file is either corrupt or is not a FIR file.

`Load/Store Error; Operation not allowed in Fail-Safe Preset Mode.`

This informs you that software or hardware options cannot be configured while in Fail-Safe Preset Mode. Cycle the instrument power and try again.

`Load/Store Error; Operation not allowed in Fail-Safe Preset Mode.`

Indicates that a hardware option was installed while in fail-safe preset mode. After a fail-safe preset, the power must be cycled before a hardware option is installed.

`Load/Store Error; Unrecognized modulation file version.`

The user modulation file has an unrecognized version. The file is either corrupt or is not a modulation file.

`Load/Store Error; Invalid modulation file.`

The user modulation file is invalid. The file is either corrupt or is not a modulation file.

`Load/Store Error; Cannot create a filter with no coefficients.`

A filter must have at least one coefficient specified.

`Load/Store Error; Cannot create a Modulation with less than one bit per symbol.`

A modulation must have at least two states specified.

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

UNITED STATES

Instrument Support Center
Hewlett-Packard Company
(800) 403-0801

EUROPEAN FIELD OPERATIONS

Headquarters
Hewlett-Packard S.A.
150, Route du Nant-d'Avril
1217 Meyrin 2/ Geneva
Switzerland
(41 22) 780.8111

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

Germany
Hewlett-Packard GmbH
Hewlett-Packard Strasse
61352 Bad Homburg v.d.H
Germany
(49 6172) 16-0

Great Britain
Hewlett-Packard Ltd.
Eskdale Road, Winnersh Triangle
Wokingham, Berkshire RG41 5DZ
England
(44 734) 696622

INTERCON FIELD OPERATIONS

Headquarters
Hewlett-Packard Company
3495 Deer Creek Rd.
Palo Alto, CA 94304-1316
USA
(415) 857-5027

Australia
Hewlett-Packard Australia Ltd.
31-41 Joseph Street
Blackburn, Victoria 3130
(61 3) 895-2895

Canada
Hewlett-Packard (Canada) Ltd.
17500 South Service Road
Trans-Canada Highway
Kirkland, Quebec H9J 2X8
Canada
(514) 697-4232

Japan
Hewlett-Packard Japan, Ltd.
9-1 Takakura-Cho, Hachioji
Tokyo 192, Japan
(81 426) 60-2111

Singapore
Hewlett-Packard Singapore (Pte.) Ltd.
150 Beach Road
#29-00 Gateway West
Singapore 0718
(65) 291-9088

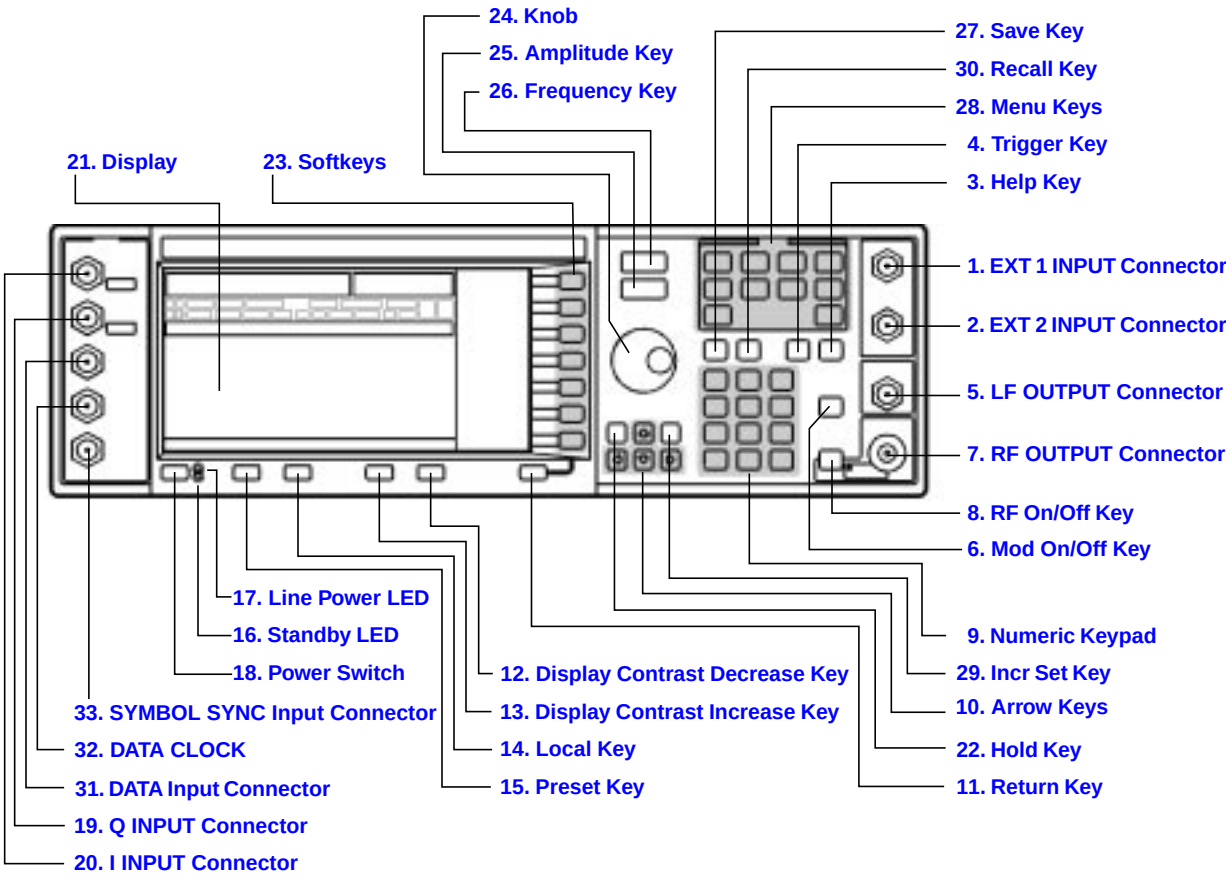
Taiwan
Hewlett-Packard Taiwan
8th Floor, H-P Building
337 Fu Hsing North Road
Taipei, Taiwan
(886 2) 712-0404

China
China Hewlett-Packard Co.
38 Bei San Huan X1 Road
Shuang Yu Shu
Hai Dian District
Beijing, China
(86 1) 256-6888

4 Front and Rear Panel

This chapter contains descriptions of the keys and connectors and other hardware on the front and rear panels. It also describes which information is displayed in the various parts of the display.

Front Panel Overview



1. EXT 1 INPUT Connector

This female BNC input connector accepts a 1-V_{pk} signal for FM, ΦM, and AM. For all these modulations, ±1 V_{pk} produces the indicated deviation or depth. When AC-coupled inputs are selected for FM, ΦM, or AM, HI/LO annunciators will light if the peak input voltage differs from 1.0 V by more than 3%. The input impedance is 50Ω. The damage levels are 5 V_{rms} and 10 V_{pk}. If you configure your signal generator with Option 1EM, this input is relocated to a rear panel, female BNC connector.

2. EXT 2 INPUT Connector

This female BNC input connector accepts a 1-V_{pk} signal for FM, ΦM, AM, and pulse modulation. With FM, ΦM, or AM, ±1 V_{pk} produces the indicated deviation or depth. With pulse modulation, +1 V is on and 0 V is off. When AC-coupled inputs are selected for FM, ΦM, or AM, HI/LO annunciators will light if the peak input voltage differs from 1.0 V by more than 3%. The input impedance is 50Ω. The damage levels are 5 V_{rms} and 10 V_{pk}. If you configure your signal generator with Option 1EM, this input is relocated to a rear panel, female BNC connector.

3. Help Key

Press this hardkey for a short textual description of the function of the front panel hardkeys and softkeys. Press this key again and you will be returned to normal instrument operation.

4. Trigger Key

Press this hardkey to begin an event (such as a step or list sweep). This key must first be selected as the method for activating an event by pressing the **Trigger Key** softkey, located in the softkey menus associated with the event

5. LF OUTPUT Connector

This female BNC connector is the output connector for modulation signals generated by the LF (low frequency) source function generator. You can also output signals where the frequency and shape are set by the internal source as it is being used by a modulation. For pulse modulation, however, the internal source is a sinewave that is later squared by the modulator to generate the pulse squarewave.

This output is capable of driving 3.5 V_{pk} into a 50Ω load. If you configure your signal generator with Option 1EM, this input is relocated to a rear panel, female BNC connector.

6. Mod On/Off Key

This hardkey toggles all modulation signals on and off. Although you can set up and enable various modulation states, the RF carrier is not modulated until **Mod On/Off** is set to **On**. An annunciator is always turned on in the display to indicate whether modulation is turned on or off.

7. RF OUTPUT Connector

This female Type-N connector is the output connector for RF signals. The source impedance is 50Ω. The damage levels are 50 Vdc, 50 W at ≤ 2 GHz, and 25 W at > 2 GHz maximum. The reverse power protection circuit will trip, however, at nominally 1 watt. If you configure your signal generator with Option 1EM, this output is relocated to a rear panel, female Type-N connector.

8. RF On/Off Key

This hardkey toggles the RF signal on and off at the RF OUTPUT connector. An annunciator is always turned on in the display to indicate whether RF is turned on or off.

9. Numeric Keypad

The numeric keypad consists of the digit keys (0 through 9), a decimal point key, and a backspace key, [+/-←]. The backspace key has dual functions for both backspacing and for changing the sign of a value between positive and negative. Use these keys whenever the active function requires a value input.

10. Arrow Keys

The up and down arrow keys increase or decrease a numeric value. You can also use these keys to scroll through displayed lists to select items. The left and right arrow keys choose the highlighted digit in the active function display; that digit can be modified by the up and down arrow keys or the knob. You can also use these keys in a list to select items in a row.

11. Return Key

The **Return** key cancels the current active function and moves you from your current softkey menu to the softkey menu that precedes it. It will back up through the menus of the current hardkey until you reach the first menu of that key.

12. Display Contrast Decrease Key

Press this key and hold it down to cause the display background to darken in comparison to the text on the display.

13. Display Contrast Increase Key

Press this key and hold it down to cause the display background to brighten in comparison to the text on the display.

14. Local Key

Press this key to return the signal generator to local (front panel) control from remote operation.

15. Preset Key

Press this key to set the signal generator to a known state (either the factory-defined state or a user-defined state).

16. Standby LED

This yellow LED lights when the instrument is in standby condition. In standby, the power switch is off but the instrument is still connected to the main power circuit by way of the power cord.

17. Line Power LED

This green LED lights when power is cycled on to the signal generator.

18. Power Switch

Press this hardkey to turn power to the signal generator either on (green LED on) or to standby (yellow LED on).

19. Q INPUT Connector

This connector accepts an externally supplied, analog, quadrature-phase component of I/Q modulation. The signal level is $\sqrt{I^2+Q^2}$ = 0.5 V_{rms} for a calibrated output level. The input impedance is 50Ω. The damage level is 1 V_{rms}. This female BNC connector is provided only on HP ESG-D Series Signal Generators. If you configure your instrument with Option 1EM, this input is relocated to a rear panel, female BNC connector.

20. I INPUT Connector

This connector accepts an externally supplied, analog, in-phase component of I/Q modulation. The signal level is $\sqrt{I^2+Q^2}$ = 0.5 V_{rms} for a calibrated output level. The input impedance is 50Ω. The damage level is 1 V_{rms}. This female BNC connector is provided only on HP ESG-D Series Signal Generators. If you configure your instrument with Option 1EM, this input is relocated to a rear panel, female BNC connector.

21. Display

The LCD display provides information on the current instrument state such as modulation status, frequency and amplitude settings, status indicators, and error messages. Softkey labels corresponding to their adjacent keys are located on the right-hand side of the display. For details about the display, see "Display Annotation" on page 4-8.

22. Hold Key

Press this hardkey to deactivate the currently active function and blank the softkey menu. Once **Hold** is pressed, the front panel knob, the arrow keys, and the numeric keypad have no effect. To return to normal operation, press a function or menu hardkey.

23. Softkeys

Press a softkey to activate the function indicated by the corresponding label on the display.

24. Knob

The knob increases or decreases a numeric value. Any of the values that can be set through the numeric keypad or the step keys can also be set by the knob.

25. Amplitude Key

Press this hardkey to activate the power level amplitude function so that you can change the amplitude of the RF output.

26. Frequency Key

Press this hardkey to activate the frequency function so that you can change the frequency of the RF output.

27. Save Key

This hardkey lets you save up to 100 different instrument states in a combination of 100 memory registers and 10 register sequences. The number of states you can save, however, is limited by the size of whatever else is stored in the file system.

28. Menu Keys

These hardkeys provide access to the signal generator's primary functionality. Press these keys for access to softkey menus where you can configure modulations, step and list sweeps, and various frequency and power capabilities.

29. Incr Set Key

Press this hardkey to toggle between the current active function and the increment size for that function. With increment size selected, you can change the current increment value.

30. Recall Key

This hardkey lets you restore any instrument state that you previously saved in a memory register. You can save up to 100 different instrument states in a combination of 100 memory registers and 10 register sequences. The number of states you can save, however, is limited by the size of whatever else is stored in the file system.

31. DATA Input Connector

The TTL/CMOS compatible DATA connector accepts an externally supplied data input for digital modulation applications. The expected input is a TTL or CMOS signal where a CMOS high is equivalent to a data 1 and a CMOS low is equivalent to a data 0.

The maximum input data rate is 1.152 Mb/s. The leading edges must be synchronous with the DATA CLOCK rising edges. The data must be valid on the DATA CLOCK falling edges. The damage levels are > +8 and < –4V.

This female BNC connector is provided on instruments with Option UN8. It is also present *but not functiona*l on instruments with Option UND. On instruments with Option 1EM, this input is relocated to a rear panel SMB connector.

32. DATA CLOCK Input Connector

The TTL/CMOS compatible DATA CLOCK connector accepts an externally supplied data-clock input for digital modulation applications. The expected input is a TTL or CMOS signal (either bit or symbol) where the rising edge is aligned with the beginning data bit. The CMOS falling edge is used to clock the DATA and SYMBOL SYNC signals.

The maximum clock rate is 1.152 MHz. The damage levels are > +8 and < –4V.

This female BNC connector is provided on instruments with Option UN8. It is also present *but not functiona*l on instruments with Option UND. On instruments with Option 1EM, this input is relocated to a rear panel SMB connector.

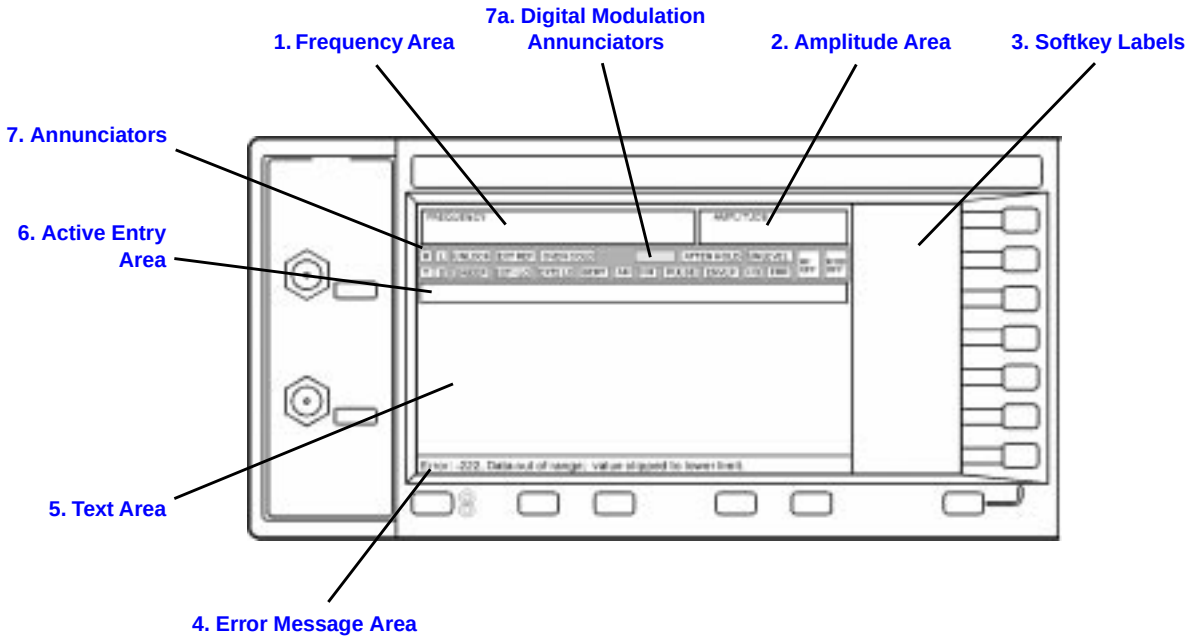
33. SYMBOL SYNC Input Connector

The CMOS compatible SYMBOL SYNC connector accepts the digital-modulation symbol synchronization signal from an external source. This signal synchronizes the serial multi-bit symbol transmission. The expected signal may be continuous or a single, one-bit wide pulse to synchronize the first bit of the first symbol. The CMOS rising edge must be synchronous with the DATA CLOCK rising edges. The synchronization signal must be valid on the DATA CLOCK falling edges.

The damage levels are > +8 and < –4V.

This female BNC connector is provided on instruments with Option UN8. It is also present *but not functiona*l on instruments with Option UND. On instruments with Option 1EM, this input is relocated to a rear panel SMB connector.

Display Annotation



1. Frequency Area

The current CW frequency setting is shown in this portion of the display. Indicators are also displayed in this area when a frequency offset or multiplier is set or if frequency reference mode is turned on.

2. Amplitude Area

The current output power level setting is shown in this portion of the display. Indicators are also displayed in this area when an amplitude offset is set or if amplitude reference mode is turned on.

3. Softkey Labels

These labels define the function of the corresponding softkeys immediately to the right of the label.

4. Error Message Area

Abbreviated error messages are reported in this space. When multiple error messages occur, only the most recent message remains displayed. All of the reported error messages with details can be viewed by pressing **Utility**, **Error Info**, **View Next Error Message**.

5. Text Area

This area is used to display status information about the signal generator such as the modulation status, to enter information such as creating sweep lists, and to manage information such as displaying the catalog of files and deleting unwanted files.

6. Active Entry Area

The current active function is shown in this area. For example, if frequency is the active function, the current setting will be displayed in the active entry area and that setting will change as you enter a new value. If the active function has an increment value associated with it, that value is displayed here also.

7. Annunciators

The display annunciators described in the following list show the status of some of the signal generator functions, and indicate any error conditions. In several cases, a position is used by more than one annunciator, as are those listed under "7a. Digital Modulation Annunciators" on page 4-11.

ΦM	This annunciator appears when phase modulation is turned on. A second annunciator, FM, will appear in the same position if frequency modulation is turned on. Frequency modulation and phase modulation cannot be turned on at the same time, so the two annunciators will never conflict.
ALC OFF	This annunciator appears when the automatic leveling control (ALC) circuit is disabled. A second annunciator, UNLEVEL, will appear in the same position if the signal generator's automatic level control is unable to maintain the output level. When the ALC is disabled, the unleveled annunciator has no meaning, so these annunciators will never conflict.
AM	This annunciator appears when amplitude modulation is turned on.
ARMED	This annunciator appears when a sweep has been initiated and the signal generator is waiting for the sweep trigger event.
ATTEN HOLD	This annunciator appears when the attenuator hold function is turned on. When this function is on, the attenuator is frozen at its current setting.
BERT	This annunciator appears when the bit-error-rate test (BERT) function is turned on. This annunciator is present only on instruments with Option UN7.
ENVLP	This annunciator appears if the burst envelope modulation is turned on. This annunciator is present only on HP ESG-D Series Signal Generators.
ERR	This annunciator appears when an error message is placed in the error queue. This annunciator will not turn off until you have either viewed all of the error messages or cleared the error queue. You can view and delete error messages using the **Utility** menu.

EXT1 LO/HI — This annunciator toggles between EXT1 LO and EXT1 HI. This annunciator appears if the AC-coupled signal to the EXT 1 input is less than 0.97 V_{pk} or greater than 1.03 V_{pk}.

EXT2 LO/HI — This annunciator toggles between EXT2 LO and EXT2 HI. This annunciator appears if the AC-coupled signal to the EXT 2 input is less than 0.97 V_{pk} or greater than 1.03 V_{pk}.

EXT REF — This annunciator appears when an external 1, 2, 5, or 10 MHz frequency reference is in use.

FM — This annunciator appears when frequency modulation is turned on. A second annunciator, ΦM, will appear in the same position if phase modulation is turned on. Frequency modulation and phase modulation cannot be turned on at the same time, so the two annunciators will never conflict.

I/Q — This annunciator appears when I/Q modulation is turned on. This annunciator is present only on HP ESG-D Series Signal Generators.

L — The L annunciator appears when the signal generator is in the listen mode and receiving information or commands over the HP-IB or RS-232.

MOD OFF — This annunciator toggles between MOD OFF and MOD ON and is always visible in the display. This annunciator indicates whether the modulations that you have enabled are modulating the RF carrier.

OVEN COLD — This annunciator appears when the temperature of the internal ovenized reference oscillator (Option 1E5) has dropped below an acceptable level. When this annunciator is on, frequency accuracy is degraded. This condition should occur only if the signal generator is disconnected from line power. The annunciator is timed, and automatically turns off after a specified period.

PULSE — This annunciator appears when pulse modulation is turned on.

R — The R annunciator appears when the signal generator is in remote HP-IB operation.

RF OFF — This annunciator toggles between RF OFF and RF ON and is always visible in the display. This annunciator indicates whether the RF signal is present at the RF OUTPUT connector.

S — The S annunciator appears when the signal generator has generated a service request (SRQ) over the HP-IB.

SWEEP — This annunciator appears when the signal generator is sweeping in list or step mode.

T — The T annunciator appears when the signal generator is in the talk mode and is transmitting information over the HP-IB or RS-232.

UNLEVEL — This annunciator appears when the signal generator is unable to maintain the correct output level. The UNLEVEL annunciator is not necessarily an indication of instrument failure. Unleveled conditions can occur during

normal operation, for example if I/Q modulation is turned on and no I/Q signals are connected. A second annunciator, ALC OFF, will appear in the same position when the automatic leveling control circuit is disabled. When the ALC is disabled, the UNLEVEL annunciator has no meaning, so these annunciators will never conflict.

UNLOCK — This annunciator appears when any of the signal generator's phase locked loops are unable to maintain phase lock. You can determine which loop is unlocked by interrogating the error messages.

7a. Digital Modulation Annunciators

The following annunciators all appear in the same position, but there is no conflict because only one of these functions can be on at any given time.

ARB — This annunciator appears when the arbitrary waveform generator is turned on. This annunciator is present only on instruments with Option UND.

Custom — This annunciator appears when real-time I/Q baseband custom modulation is turned on. This annunciator is present only on instruments with Option UN8.

CDMA — This annunciator appears when CDMA modulation is turned on. This annunciator is present only on instruments with Options UND and UN5.

DECT — This annunciator appears when DECT modulation is turned on. This annunciator is present only on instruments with Option UN8.

GSM — This annunciator appears when GSM modulation is turned on. This annunciator is present only on instruments with Option UN8.

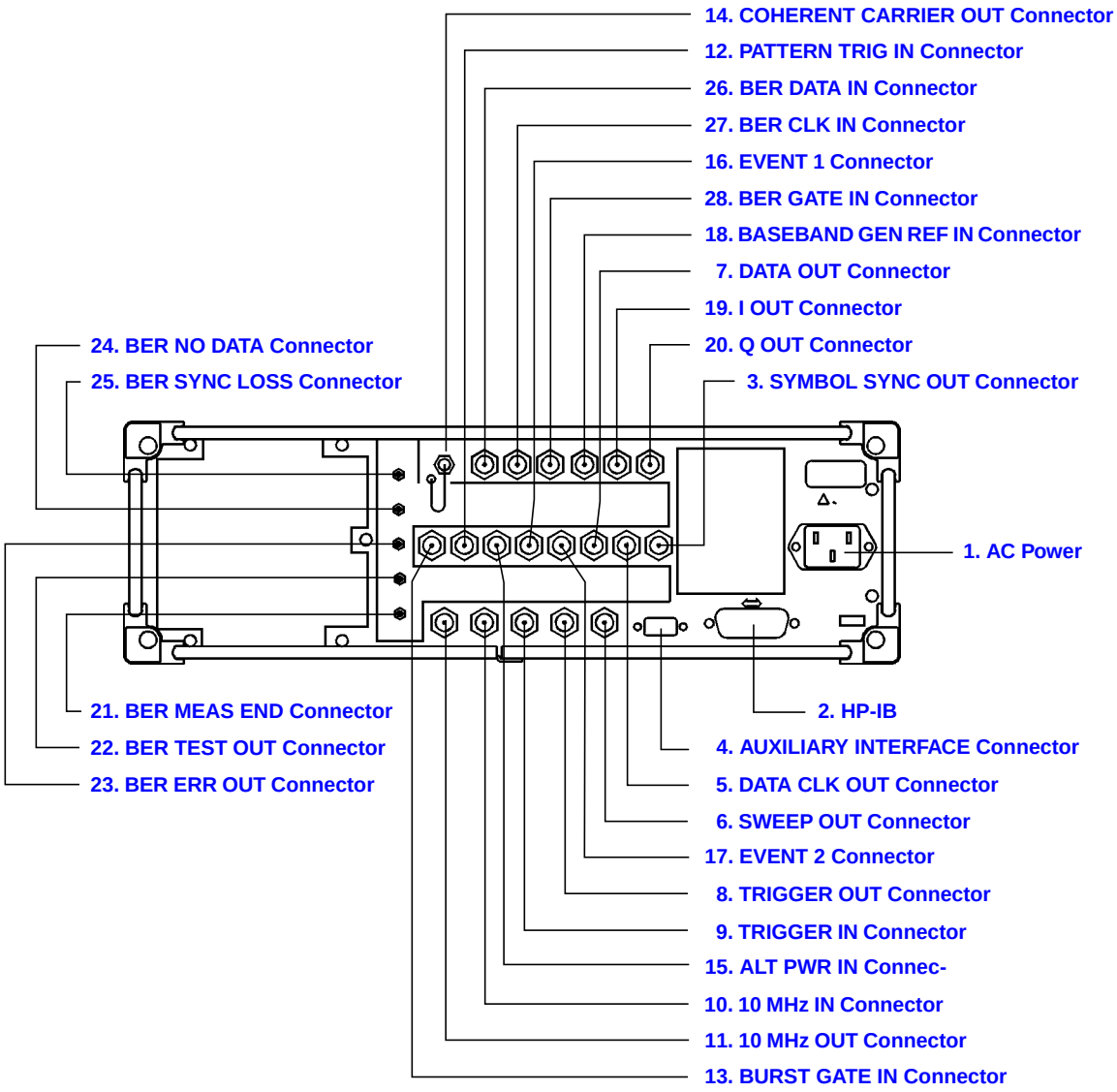
NADC — This annunciator appears when NADC modulation is turned on. This annunciator is present only on instruments with Option UN8.

PDC — This annunciator appears when PDC modulation is turned on. This annunciator is present only on instruments with Option UN8.

PHS — This annunciator appears when PHS modulation is turned on. This annunciator is present only on instruments with Option UN8.

TETRA — This annunciator appears when TETRA modulation is turned on. This annunciator is present only on instruments with Option UN8.

Rear Panel Overview



1. AC Power Receptacle

The power cord receptacle accepts a three-pronged cable that is shipped with the instrument. The line voltage is connected here.

2. HP-IB Connector

The HP-IB connector allows communications with compatible devices such as external controllers. It is functionally equivalent to the AUXILIARY INTERFACE connector.

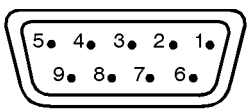
3. SYMBOL SYNC OUT Connector

The TTL/CMOS compatible SYMBOL SYNC OUT connector outputs a symbol synchronization pulse, one data clock period wide, for use in digital modulation applications. The pulse output is synchronized with the first symbol in the internal pattern generator sequence. The damage levels are > +8 and < –4 V. This female BNC connector is provided only on instruments with Option UND or UN8. If you configure your instrument with Option 1EM, this output is changed from a BNC to an SMB connector.

4. AUXILIARY INTERFACE Connector

This male DB-9 connector is an RS-232 serial port that can be used for controlling the signal generator remotely. It is functionally equivalent to the HP-IB connector. The following table shows the description of the pinouts.

Pin Number	Signal Description	Signal Name
1	No Connection	
2	Receive Data	RECV
3	Transmit Data	XMIT
4	+5 V	
5	Ground, 0 V	
6	No Connection	
7	Request to Send	RTS
8	Clear to Send	CTS
9	No Connection	



View looking into
rear panel connector

pk763a

5. DATA CLK OUT Connector

The DATA CLK OUT connector outputs a clock signal for digital modulation data. The output signal level is TTL or CMOS with the rising edge aligned with the beginning of the data bit and the falling edge occurring when the data and symbol synchronization signal are valid. The damage levels are > +8 and < –4 V. This female BNC connector is provided only on instruments with Option UND or UN8. If you configure your instrument with Option 1EM, this output is changed from a BNC to an SMB connector.

6. SWEEP OUT Connector

This female BNC connector provides a voltage range of 0 to +10 V. When the signal generator is sweeping, the SWEEP OUT signal ranges from 0 V at the beginning of the sweep to +10 V at the end of the sweep regardless of the sweep width. In CW mode this connector has no output. The output impedance is less than 1Ω and can drive 2 kΩ.

7. DATA OUT Connector

The DATA OUT connector outputs digital modulation data sourced from an externally supplied signal at the DATA input or from the internal pattern generator. The output signal level is a TTL or CMOS signal where a CMOS high is equivalent to a data 1 and a CMOS low is equivalent to a data 0. This female BNC connector is provided only on instruments with Option UND or UN8. If you configure your instrument with Option 1EM, this output is changed from a BNC to an SMB connector.

8. TRIGGER OUT Connector

This female BNC connector outputs a TTL signal that is asserted high at the start of a dwell sequence, or at the start of waiting for the point trigger in manual sweep mode, and low when the dwell is over, or when the point trigger is received, or once per sweep during an LF sweep. The logic polarity can be reversed.

9. TRIGGER IN Connector

This female BNC connector accepts a TTL signal for triggering operations, such as point-to-point in manual sweep mode or an LF sweep in external sweep mode. Triggering can occur on either the positive or negative edge. The damage level is ≥ +10 V or ≤ –4 V.

10. 10 MHz IN Connector

This female BNC connector accepts a –3.5 to +20 dBm signal from an external timebase reference that is within ±10 ppm (standard timebase) or ±1 ppm (high stability timebase). The nominal input impedance is 50Ω. The signal generator detects when a valid reference signal is present at this connector and automatically switches from internal to external reference operation.

11. 10 MHz OUT Connector

This female BNC connector provides a nominal signal level of +7 dBm ±2 dB, and an output impedance of 50Ω. The accuracy is determined by the timebase used.

12. PATTERN TRIG IN Connector

This input can accept either a TTL/CMOS low to TTL/CMOS high or TTL/CMOS high to TTL/CMOS low edge trigger. The minimum trigger input pulse width, high or low, is 100 ns. The damage levels are > +8 and < –4 V. This female BNC connector is provided only on instruments with Option UN8 or UND. If you configure your instrument with Option 1EM, this input is changed from a BNC to an SMB connector.

With Option UN8 turned on, the input to the PATTERN TRIG IN connector is used to trigger the internal digital modulation pattern generator to start a single pattern output or to stop and re-synchronize a pattern that is being continuously output. The trigger edge is latched and then sampled by the falling edge of the internal data bit clock to synchronize the trigger with the data bit clock timing. The minimum delay from the trigger edge to the first bit of the frame is 1.5 to 2.5 bit clock periods. For more information on pattern triggering, refer to the "Operation" chapters in the user's and programming guides.

With Option UND turned on, this connector is the source for the external trigger for all of the ARB waveform generator triggers.

13. BURST GATE IN Connector

The BURST GATE IN connector accepts a TTL or CMOS signal for gating burst power in digital modulation applications. The burst gating is used when you are externally supplying data and clock information. The input signal must be synchronized with the external data input that will be output during the burst. The burst power envelope and modulated data are internally delayed and re-synchronized. The input signal must be CMOS high for normal burst RF power or CW RF output power and CMOS low for RF off. The leading edges must be synchronous with the DATA CLOCK rising edges. The signal level must be valid on the DATA CLOCK falling edge. The damage levels are > +8 and < –4 V. This female BNC connector is provided only on instruments with Option UND or UN8. If you configure your instrument with Option 1EM, this output is changed from a BNC to an SMB connector.

14. COHERENT CARRIER OUT Connector

This connector outputs RF that is not modulated with AM, pulse, or I/Q modulation, but is modulated with FM or ΦM. The output power is nominally 0 dBm ±5 dB. The output frequency range is from 249.99900001 MHz to the maximum specified frequency of your signal generator. If the RF output frequency is below this range, the COHERENT CARRIER OUT signal will have the following frequency: Frequency of coherent carrier = (1E9 – Frequency of RF output) in Hz. The damage levels are 20 Vdc and 13 dBm reverse RF power. This SMA connector is present only on HP ESG-D Series Signal Generators.

15. ALT PWR IN Connector

This BNC connector accepts a CMOS signal for synchronization of external data and alternate power signal timing. Damage levels are > +8 V and < –4 V. This connector is active only with Option UNA.

16. EVENT 1 Connector

With Option UN8 turned on, this TTL/CMOS compatible connector outputs a pulse that can be used to trigger the start of a data pattern, frame, or timeslot. It is adjustable to within plus or minus one timeslot with one bit of resolution. With Option UN5 turned on (Option UN5 requires Option UND hardware), an even second output is generated. A marker is output every two seconds indicating the beginning of each short code sequence for use in synchronizing CDMA analysis instruments.

With Option UND turned on, there is a marker on/off condition associated with each waveform point. A marker (TTL high when positive polarity is selected; TTL low when negative polarity is selected) is output on the EVENT 1 connector whenever a Marker 1 is turned on in the waveform. (Markers are automatically turned on whenever you set them in a waveform segment. When you combine waveform segments that contain Marker 1 into a sequence, the markers are automatically turned off until you toggle them on in either the Edit Selected Waveform Sequence menu or in the Build New Waveform Sequence menu.)

The damage levels for this connector are > +8 V and < –4V. This female BNC connector is provided only on instruments with Option UN8 or UND. If you configure your instrument with Option 1EM, this output is changed from a BNC to an SMB connector.

17. EVENT 2 Connector

With Option UN8 turned on, this TTL/CMOS compatible connector outputs a data enable signal for gating external equipment. The output is applicable when the external data is clocked into internally generated timeslots. Data is enabled when the signal is low. With Option UN5 turned on (Option UN5 requires Option UND hardware), a marker is output on the EVENT 2 connector every 26.67 milliseconds, corresponding to the start of each short code.

With Option UND turned on, there is a marker on/off condition associated with each waveform point. A marker (TTL high when positive polarity is selected; TTL low when negative polarity is selected) is output on the EVENT 2 connector whenever a Marker 2 is turned on in the waveform. (Markers are automatically turned on whenever you set them in a waveform segment. When you combine waveform segments that contain Marker 2 into a sequence, the markers are automatically turned off until you toggle them on in either the Edit Selected Waveform Sequence menu or in the Build New Waveform Sequence menu.)

The damage levels are > +8V and < –4V. This female BNC connector is provided only on instruments with Option UN8 or UND. On instruments with Option 1EM, this output is changed from a BNC to an SMB connector.

18. BASEBAND GEN REF IN Connector

With Option UN8 enabled, the BASEBAND GEN REF IN connector accepts a 0 to +20-dBm sinewave or TTL squarewave signal from an external 13-MHz timebase reference. This digital modulation reference clock is used by the internal pattern generator in GSM applications (only the *internal* digital data generator can be locked to this external reference; the RF frequency remains locked to the 10-MHz reference). The nominal input impedance is 50Ω at 13 MHz, AC-coupled.

With Option UND enabled, this connector accepts a TTL or > –10-dBm sinewave external reference at rates from 250 kHz through 20 MHz. The internal clock for the arbitrary waveform generator is locked to this signal when external reference is selected in the ARB setup. The minimum pulse width must be > 10 ns. The damage levels are > +8V and < –8V.

This female BNC connector is provided only on instruments with Options UND or UN8. On instruments with Option 1EM, this output is changed from a BNC to an SMB connector.

19. I OUT Connector

The I OUT connector outputs the analog, in-phase component of I/Q modulation from the internal baseband generator. The nominal output impedance of this connector is 50Ω, DC-coupled. The damage levels are > +2 V and < –2 V. The DC origin offset is typically < 10 mV. The output signal levels into a 50Ω load are as follows:

- 0.5 V_{pk}, typical, corresponds to one unit length of the I/Q vector.
- 0.69 V_{pk} (2.84 dB), typical, maximum crest factor for peaks for π/4 DQPSK with alpha = 0.5.
- 0.71 V_{pk} (3.08 dB), typical, maximum crest factor for peaks for π/4 DQPSK with alpha = 0.35.
- Typically 1 V_{p-p} maximum (Option UND only).

This female BNC connector is provided only on instruments with Option UND or UN8. If you configure your instrument with Option 1EM, this output is relocated from a BNC to an SMB connector.

20. Q OUT Connector

The Q OUT connector outputs the analog, quadrature-phase component of I/Q modulation from the internal baseband generator. The nominal output impedance of this connector is 50Ω, DC-coupled. The damage levels are > +2 V and < –2 V. The DC origin offset is typically < 10 mV. The output signal levels into a 50Ω load are as follows:

- 0.5 V_{pk}, typical, corresponds to one unit length of the I/Q vector.
- 0.69 V_{pk} (2.84 dB), typical, maximum crest factor for peaks for π/4 DQPSK with alpha = 0.5.
- 0.71 V_{pk} (3.08 dB), typical, maximum crest factor for peaks for π/4 DQPSK with alpha = 0.35.
- Typically 1 V_{p-p} maximum (Option UND only).

This female BNC connector is provided only on instruments with Option UND or UN8. If you configure your instrument with Option 1EM, this output is relocated from a BNC to an SMB connector.

21. BER MEAS END Connector

The BER MEAS END connector outputs a signal that indicates the status of the bit-error-rate (BER) measurements. BER measurements are being executed when the signal is high. The damage levels are > +8 and < –4 V. This female SMB connector is provided only on instruments with Option UN7.

22. BER TEST OUT Connector

The BER TEST OUT connector outputs a signal that indicates the test result of the pass/fail judgement of the bit-error-rate measurements. The result is guaranteed at the falling edge of the signal of the MEAS END connector. The result is pass when the signal is low; the result is fail when the signal is high. The signal is also high when the pass/fail judgement is set to off. The damage levels are > +8 and < –4 V. This female SMB connector is provided only on instruments with Option UN7.

23. BER ERR OUT Connector

The output of the BER ERR OUT connector is normally low. When the maximum data rate mode is set to 2 Mbps, the BER ERR OUT connector outputs pulse signals that indicate errors. One pulse with a width of about 80 ns indicates one error bit. Pulses indicating errors are asynchronous to the BER CLK IN and are only valid during BER measurements (when BER MEAS END is high). The damage levels are > +8 and < –4 V. This female SMB connector is provided only on instruments with Option UN7.

24. BER NO DATA Connector

The BER NO DATA connector outputs a signal that indicates the no data status. The no data status is reported when there has been no clock input for more than 3 seconds or there has been no data change for more than 200 bits. This signal is valid only when the signal of the BER MEAS END connector is high. No data status is detected when the signal is low. The damage levels are > +8 and < –4 V. This female SMB connector is provided only on instruments with Option UN7.

25. BER SYNC LOSS Connector

The BER SYNC LOSS connector outputs a signal that indicates the synchronization loss state. This signal is only valid when the signal of the BER MEAS END connector is high. Synchronization loss state is detected when the signal is low. The damage levels are > +8 and < –4 V. This female SMB connector is provided only on instruments with Option UN7.

26. BER DATA IN Connector

Use this connector to input the data streams for the bit-error-rate measurements. The rising (positive) or falling (negative) edge of the BER CLK IN signal (selected by the softkey or the HP-IB command) is used to trigger to reading of the data. The damage levels are > +8 and < –4 V. This connector must be terminated with a TTL-compatible high impedance or 75Ω load. If you configure your instrument with Option 1EM, this input is changed from a BNC to an SMB connector. This female BNC connector is provided only on instruments with Option UN7.

27. BER CLK IN Connector

Use this connector to input the clock signal for the bit-error-rate measurements. The rising (positive) or falling (negative) edge of the signal (selected either by softkey or HP-IB command) causes data on the BER DATA IN connector to be sampled. The damage levels are > +8 and < –4 V. This connector must be terminated with a TTL-compatible high impedance or 75Ω load. If your instrument is configured with Option 1EM, this input changes from a BNC to an SMB connector. This female BNC connector is provided only on instruments with Option UN7.

28. BER GATE IN Connector

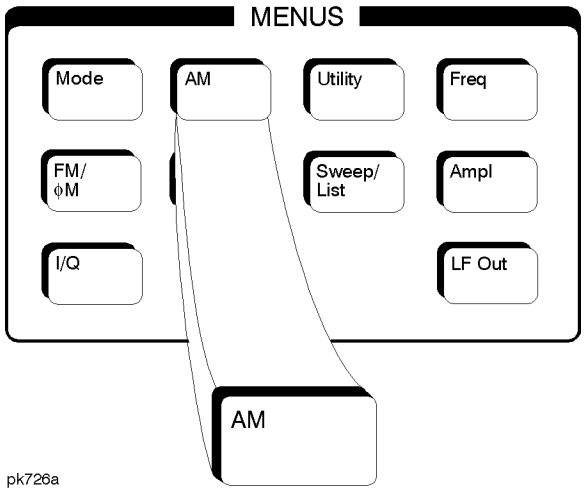
Use this connector to input the clock gate signal for the bit-error-rate measurements. The clock signal to the BER CLK IN connector is valid only when the signal to this connector is a high or low, depending on your softkey selection or HP-IB command. The damage levels are > +8 and < –4 V. This connector must be terminated with a TTL-compatible high impedance or 75Ω load. This connector can be enabled or disabled by a softkey or an HP-IB command. This female BNC connector is provided only on instruments with Option UN7.

5 Hardkey and Softkey Reference

This chapter describes each front panel hardkey and each softkey associated with the hardkey. The SCPI programming commands are listed in addition to normal preset and power-on conditions. The chapter is organized alphabetically by front panel hardkey.

AM

Pressing the front panel **AM** key reveals a menu of softkeys. These softkeys are described in this section in alphabetical order.



AM Depth

This softkey sets the amplitude modulation depth, in percent, for the **AM Path 1** and **AM Path 2** configurations. To change the value of the AM depth, press the softkey once. The current value for AM depth is displayed in the active entry area. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **%** terminator softkey. The range of values allowed is 0.1 to 100%. The minimum increment allowed is 0.1%. Notice that the new value of AM depth applies only to whichever AM path configuration (**AM Path 1** or **AM Path 2**) you have currently selected.

Softkey Location: Press **AM**, **AM Depth**
or press **AM**, **AM Waveform**, **Dual-Sine**, **AM Depth**

Status after Normal Preset: 0.1%

SCPI Commands:

```
[:SOURce]:AM[1]|2[:DEPTh] <val><unit>

[:SOURce]:AM[1]|2[:DEPTh]?
```

AM Depth Couple Off On

This softkey toggles the AM depth coupling on and off. AM depth coupling links the AM depth values of AM Path 1 and AM Path 2. When the values are coupled, any change you make to one AM depth value is applied to both AM depth values.

Softkey Location: Press **AM**, **AM Depth Couple Off On**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:AM[1]|2[:DEPTh]:TRACk ON|OFF|1|0
[:SOURce]:AM[1]|2[:DEPTh]:TRACk?
```

AM Off On

This softkey enables the amplitude modulation for whichever AM path configuration you have selected, **AM Path 1**, **AM Path 2**, or **AM Path WB, in the case of a digitally equipped model.** Notice, however, that although you can enable amplitude modulation with this softkey, the RF carrier is modulated by the enabled modulation only when you have also set **Mod On/Off** to **On**. Whenever amplitude modulation is enabled, the AM annunciator is turned on in the display.

There are two paths for AM modulation which can be simultaneously enabled as long as they use different sources (Int, Ext1, or Ext2). The modulation signals from both paths are summed internally for composite modulation.

Softkey Location: Press **AM**, **AM Off On**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:AM[1]|2:STATe ON|OFF|1|0
[:SOURce]:AM[1]|2:STATe?
```

AM Path 1 2 WB

NOTE For the analog ESG Series , this softkey is **AM Path 1 2**. Wideband AM is not available on the ESG Series.

Use **AM Path 1** and **AM Path 2** to define two unique amplitude modulation configurations. For example, select **AM Path 1**. (**AM Path 1** is the default after a normal preset. If **AM Path 1** is not highlighted, press the **AM Path 1 2 WB** softkey until the selection toggles to **AM Path 1**.) Configure the modulation characteristics (such as depth, source, rate, and waveform) using the remaining softkeys in the AM menu. Then enable AM by setting **AM Off On** to **On**.

To configure a second amplitude modulation configuration, toggle to **AM Path 2**. Define the modulation characteristics for this second configuration and enable AM by setting **AM Off On** to **On**.

The RF carrier is available at the RF OUTPUT connector when you set **RF On/Off** to **On**. Set **Mod On/Off** to **On** to modulate the RF carrier with the modulations that you have enabled.

AM Path 1 and **AM Path 2** are summed internally for composite modulation. Either path can be switched to any one of the modulation sources: Int, Ext1, or Ext2. All modulation types can be simultaneously enabled, except FM with ΦM, AM with external burst source, and wideband AM with I/Q. AM, FM, and ΦM can sum simultaneous inputs from any two sources (Int, Ext1, and Ext2). Any given source (Int, Ext1, or Ext2) can only be routed to one activated modulation type.

The wideband AM selection (**AM Path WB**) eliminates the bandwidth limitations of the ALC loop thereby increasing the bandwidth beyond that of the standard amplitude modulation. Typical rates for wideband AM are listed in Chapter 9, "Specifications." When you select **AM Path WB** in the AM menu, you must apply your modulating signal to the I input. The sensitivity is 0.5 V = 100% AM depth. With **AM Path WB** selected, the modulated RF signal will be available at the RF OUTPUT connector when you turn on both **Mod On/Off** and **RF On/Off**.

Softkey Location: Press **AM**, **AM Path 1 2 WB**

Status after Normal Preset: AM Path 1

SCPI Commands:

```
[:SOURce]:AM:WIDeband:STATe ON|OFF|1|0
[:SOURce]:AM:WIDeband:STATe?
```

AM Rate

Use this softkey to change the internal modulation frequency for the **AM Path 1** and **AM Path 2** configurations. To change the value, press the softkey once. The current value for AM rate is displayed in the active entry area. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Hz** or **kHz** terminator softkey. The range of values allowed is 0.1 Hz to 10 kHz. (0.1 Hz to 50 kHz is the range allowed if sinewave is selected as the internal waveform.) The minimum increment allowed is 0.1 Hz. Notice that the new value of AM rate applies only to whichever AM configuration (**AM Path 1** or **AM Path 2**) you have currently selected.

Softkey Location: Press **AM**, **AM Rate**

Status after Normal Preset: 400 Hz

SCPI Commands:

```
[:SOURce]:AM[1]|2:INTernal[1]:FREQuency <val><unit>
[:SOURce]:AM[1]|2:INTernal[1]:FREQuency?
```

AM Source

Pressing this softkey reveals a menu of choices for amplitude modulation sources. You can choose internally-generated amplitude modulation or select an externally-applied signal from either the EXT 1 INPUT or EXT 2 INPUT connectors. The internal modulation is always AC-coupled. For the externally-applied signals, you can choose between AC- and DC-coupled modulation. A 1.0 Vpk input is required for calibrated AM depth settings. The `EXT 1 LO/HI` and `EXT 2 LO/HI` display annunciators will turn on if the peak input voltage differs from 1.0 Vpk by more than 3%. (The LO/HI annunciators only function for AC-coupled external inputs.)

The internal and external 1 and 2 sources have multiple uses. You can use them for amplitude, frequency, and phase modulation. For burst modulation, you can only use the external 1 source and you must use the external 2 source for pulse modulation. However, any given source can only be routed to one enabled modulation at a time. If, for example, you were using the external 1 source in a frequency modulation configuration for **FM Path 1**, and then you configured **AM Path 2** to also use the external 1 source, the signal generator would turn off **FM Path 1** and assign the external 1 source to your **AM Path 2** configuration. Notice that for these purposes the external 1 AC-coupled source is the same as the external 1 DC-coupled source and the external 2 AC-coupled source is the same as the external 2 DC-coupled source.

Softkey Location: Press **AM**, **AM Source**

Status after Normal Preset: INT

SCPI Commands:

```
[:SOURce]:AM[1]|2:SOURce INT[1]|EXT1|EXT2

[:SOURce]:AM[1]|2:SOURce?
```

AM Start Rate

Use this softkey to change the starting internal modulation frequency for swept-sine amplitude modulation. To change the value, press the softkey once. The current value for the AM start rate is displayed in the active entry area. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Hz** or **kHz** terminator softkey. The range of values allowed is 0.1 Hz to 50 kHz. The minimum increment allowed is 0.1 Hz.

This softkey is coupled to the **AM Rate** softkey in the initial AM Menu and the **AM Tone 1 Rate** softkey in the AM Dual-Sine Menu. Any value set for **AM Start Rate** is reflected in the **AM Rate** and **AM Tone 1 Rate** softkeys. Conversely, if you change the value for either the **AM Rate** softkey or the **AM Tone 1 Rate** softkey, the value for **AM Start Rate** is changed to match.

Softkey Location: Press **AM**, **AM Waveform**, **Swept-Sine**, **AM Start Rate**

Status after Normal Preset: 400.0 Hz

SCPI Commands:

```
[:SOURce]:AM[1]|2:INTernal[1]:FREQuency <val><unit>
[:SOURce]:AM[1]|2:INTernal[1]:FREQuency?
```

AM Stop Rate

Use this softkey to change the ending internal modulation frequency for swept-sine amplitude modulation. To change the value, press the softkey once. The current value for the AM stop rate is displayed in the active entry area. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Hz** or **kHz** terminator softkey. The range of values allowed is 0.1 Hz to 50 kHz. The minimum increment allowed is 0.1 Hz.

This softkey is coupled to the **AM Tone 2 Rate** softkey in the AM Dual-Sine Menu. Any value set for **AM Stop Rate** is reflected in the **AM Tone 2 Rate** softkey. Conversely, if you change the value for the **AM Tone 2 Rate** softkey, the value for **AM Stop Rate** is changed to match.

Softkey Location: Press **AM**, **AM Waveform**, **Swept-Sine**, **AM Stop Rate**

Status after Normal Preset: 400.0 Hz

SCPI Commands:

```
[:SOURce]:AM[1]|2:INTernal[1]:FREQuency
:ALTernate <val><unit>
[:SOURce]:AM[1]|2:INTernal[1]:FREQuency:ALTernate?
```

AM Sweep Time

Press this softkey to set the sweep time for swept-sine amplitude modulation. The signal generator will vary the AM rate from the specified start rate to the stop rate in the time set with this softkey. Enter the desired sweep time using the up and down arrow keys, the front panel knob, or enter a value using the numeric keypad and press the **sec** or **msec** terminator softkey. The range of values allowed is 1 ms through 65.535 s. The minimum increment allowed is 1 ms.

Softkey Location: Press **AM**, **AM Waveform**, **Swept-Sine**, **AM Sweep Time**

Status after Normal Preset: 100.0 msec

SCPI Commands:

```
[:SOURce]:AM[1]|2:INTernal[1]:SWEep:TIME <val><unit>
[:SOURce]:AM[1]|2:INTernal[1]:SWEep:TIME?
```

AM Sweep Trigger

Pressing this softkey reveals a menu of choices for triggering swept-sine amplitude modulation. You can choose triggering that occurs immediately, triggering that is supplied by the HP-IB, triggering on either the positive or negative edge of a signal supplied to the TRIGGER IN connector, or triggering by the front panel **Trigger** key.

Softkey Location: Press **AM**, **AM Waveform**, **Swept-Sine**, **AM Sweep Trigger**

Status after Normal Preset: Immediate

SCPI Commands:

```
:TRIGger[:SEQuence]:SOURce BUS|IMMediate|EXTernal|KEY
:TRIGger[:SEQuence]:SOURce?
```

AM Tone 1 Rate

Press this softkey to set the internal modulation frequency for the AM tone 1. Enter the desired rate using the up and down arrow keys, the front panel knob, or enter a value using the numeric keypad and press the **kHz** or **Hz** terminator softkey. The range of values allowed is 0.1 Hz through 50 kHz. The minimum increment allowed is 0.1 Hz.

This softkey is coupled to the **AM Rate** softkey in the initial AM Menu and the **AM Start Rate** softkey in the AM Swept-Sine Menu. Any value set for **AM Tone 1 Rate** is reflected in the **AM Rate** and **AM Start Rate** softkeys. Conversely, if you change the value for either the **AM Rate** softkey or the **AM Start Rate** softkey, the value for **AM Tone 1 Rate** is changed to match.

Softkey Location: Press **AM**, **AM Waveform**, **Dual-Sine**, **AM Tone 1 Rate**

Status after Normal Preset: 400.0 Hz

SCPI Commands:

```
[:SOURce]:AM[1]|2:INTernal[1]:FREQuency <val><unit>
[:SOURce]:AM[1]|2:INTernal[1]:FREQuency?
```

AM Tone 2 Ampl Percent Of Peak

Press this softkey to set the amplitude of the alternate frequency/rate as a percent of the peak LF analog modulation amplitude. The primary frequency/rate will make up the remaining amplitude. This softkey is for use with dual-sine modulation only.

For example, if the Tone 2 amplitude is 0%, then there would be no amplitude for Tone 2; all of the signal strength would be present in Tone 1. If **AM Tone 2 Ampl Percent Of Peak** is set to 50%, then Tone 2 and Tone 1 would have equal amplitudes, or half of the amplitude of both tones combined.

Status after Normal Preset: 50.0%

Softkey Location: Press **AM**, **AM Waveform**, **Dual-Sine**, **AM Tone 2 Ampl Percent Of Peak**

SCPI Commands:

```
[:SOURce]:AM[1]|2:INTernal[1]:FREQuency:ALTernate
:AMPLitude:PERCent <val><unit>

[:SOURce]:AM[1]|2:INTernal[1]:FREQuency:ALTernate
:AMPLitude:PERCent?
```

AM Tone 2 Rate

Press this softkey to set the internal modulation frequency for the AM tone 2. Enter the desired rate using the up and down arrow keys, the front panel knob, or enter a value using the numeric keypad and press the **kHz** or **Hz** terminator softkey. The range of values allowed is 0.1 Hz through 50 kHz. The minimum increment allowed is 0.1 Hz.

This softkey is coupled to the **AM Rate** softkey in the initial AM Menu and the **AM Stop Rate** softkey in the AM Swept-Sine Menu. Any value set for **AM Tone 2 Rate** is reflected in the **AM Rate** and **AM Stop Rate** softkeys. Conversely, if you change the value for either the **AM Rate** softkey or the **AM Stop Rate** softkey, the value for **AM Tone 2 Rate** is changed to match.

Softkey Location: Press **AM**, **AM Waveform**, **Dual-Sine**, **AM Tone 2 Rate**

Status after Normal Preset: 400.0 Hz

SCPI Commands:

```
[:SOURce]:AM[1]|2:INTernal[1]:FREQuency
:ALTernate <val><unit>

[:SOURce]:AM[1]|2:INTernal[1]:FREQuency:ALTernate?
```

AM Waveform

Pressing this softkey reveals a menu of AM waveform choices for your **AM Path 1** and **AM Path 2** configurations. Select from sine, triangle, square, ramp, noise, dual-sine, and swept-sine waveforms. Notice that your waveform selection applies only to whichever AM path configuration you have currently selected.

Softkey Location: Press **AM**, **AM Waveform**

Status after Normal Preset: Sine

SCPI Commands:

```
[:SOURce]:AM[1]|2:INTernal[1]:FUNCTion:SHAPe SINE|
TRIangle|RAMP|NOISe|DUALsine|SWEPtsine

[:SOURce]:AM[1]|2:INTernal[1]:FUNCTion:SHAPe?
```

Bus

This softkey is one of the choices in the AM Sweep Trigger menu. With **Bus** selected, you use the HP-IB to trigger single sweeps of swept-sine amplitude modulation.

Softkey Location: Press **AM**, **AM Waveform**, **Swept-Sine**, **AM Sweep Trigger**, **Bus**

Status after Normal Preset: AM sweep trigger is set to Immediate

SCPI Commands:

```
[:SOURce]:AM[1]|2:INTernal[1]:SWEep:TRIGger BUS
[:SOURce]:AM[1]|2:INTernal[1]:SWEep:TRIGger?
```

Dual-Sine

Pressing this softkey reveals a menu of choices for setting the dual-sine amplitude modulation parameters. In this menu you can set the AM rates for two separate tones. In addition, you can set the AM depth for **AM Path 1** and **AM Path 2** and also set a ratio of the tone 2 AM depth to the tone 1 AM depth.

Softkey Location: Press **AM**, **AM Waveform**, **Dual-Sine**

SCPI Commands:

```
[:SOURce]:AM[1]|2:INTernal[1]:FUNCtion:SHAPe DUALsine
[:SOURce]:AM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Ext

This softkey is one of the choices in the AM Sweep Trigger menu. Choosing **Ext** allows you to trigger swept-sine amplitude modulation using the signal applied to the TRIGGER IN rear panel connector. Set the polarity of the trigger signal using the **Trigger In Polarity Neg Pos** softkey.

Softkey Location: Press **AM**, **AM Waveform**, **Swept-Sine**, **AM Sweep Trigger**, **Ext**

Status after Normal Preset: AM sweep trigger is set to Immediate

SCPI Commands:

```
[:SOURce]:AM[1]|2:INTernal[1]:SWEep:TRIGger EXTernal
[:SOURce]:AM[1]|2:INTernal[1]:SWEep:TRIGger?
```

Ext 1 AC-Coupled

This softkey lets you input an external, AC-coupled, amplitude modulation signal to the EXT 1 INPUT connector. The modulation signal is tested for voltage and a display annunciator will report a high or low condition if the voltage is > ±3% of 1 Vpk.

The external 1 input has multiple uses but can be used for only one modulation at a time. If, for example, you were using the external 1 input in a frequency modulation configuration for **FM Path 1**, and then you configured **AM Path 2** to also use the external 1 input, the signal generator would turn off **FM Path 1** and assign the external 1 input to your **AM Path 2** configuration. (For the purpose of this discussion, the external 1 AC-coupled input is the same as the external 1 DC-coupled input.)

Softkey Location: Press **AM**, **AM Source**, **Ext 1 AC-Coupled**

Status after Normal Preset: AM Source is set to Internal

SCPI Commands:

```
[:SOURce]:AM[1]|2:SOURce EXTernal1
[:SOURce]:AM[1]|2:EXTernal[1]:COUPling AC
[:SOURce]:AM[1]|2:EXTernal[1]:COUPling?
```

Ext 1 DC-Coupled

This softkey lets you input an external, DC-coupled, amplitude modulation signal to the EXT 1 INPUT connector.

The external 1 input has multiple uses but can be used for only one modulation at a time. If, for example, you were using the external 1 input in a frequency modulation configuration for **FM Path 1**, and then you configured **AM Path 2** to also use the external 1 input, the signal generator would turn off **FM Path 1** and assign the external 1 input to your **AM Path 2** configuration. (For the purpose of this discussion, the external 1 AC-coupled input is the same as the external 1 DC-coupled input.)

Softkey Location: Press **AM**, **AM Source**, **Ext 1 DC-Coupled**

Status after Normal Preset: AM Source is set to Internal

SCPI Commands:

```
[:SOURce]:AM[1]|2:SOURce EXTernal1
[:SOURce]:AM[1]|2:EXTernal[1]:COUPling DC
[:SOURce]:AM[1]|2:EXTernal[1]:COUPling?
```

Ext 2 AC-Coupled

This softkey lets you input an external, AC-coupled, amplitude modulation signal to the EXT 2 INPUT connector. The modulation signal is tested for voltage and a display annunciator will report a high or low condition if the voltage is > ±3% of 1 Vpk.

The external 2 input has multiple uses, but can be used for only one modulation at a time. If, for example, you were using the external 2 input in a frequency modulation configuration for **FM Path 1**, and then you configured **AM Path 2** to also use the external 2 input, the signal generator would turn off **FM Path 1** and assign the external 2 input to your **AM Path 2** configuration. (For the purpose of this discussion, the external 2 AC-coupled input is the same as the external 2 DC-coupled input.)

Softkey Location: Press **AM**, **AM Source**, **Ext 2 AC-Coupled**

Status after Normal Preset: AM Source is set to Internal

SCPI Commands:

```
[:SOURce]:AM[1]|2:SOURce EXTernal2
[:SOURce]:AM[1]|2:EXTernal2:COUPling AC
[:SOURce]:AM[1]|2:EXTernal2:COUPling?
```

Ext 2 DC-Coupled

This softkey lets you input an external, DC-coupled, amplitude modulation signal to the EXT 2 INPUT connector.

The external 2 input has multiple uses but can be used for only one modulation at a time. If, for example, you were using the external 2 input in a frequency modulation configuration for **FM Path 1**, and then you configured **AM Path 2** to also use the external 2 input, the signal generator would turn off **FM Path 1** and assign the external 2 input to your **AM Path 2** configuration. (For the purpose of this discussion, the external 2 AC-coupled input is the same as the external 2 DC-coupled input.)

Softkey Location: Press **AM**, **AM Source**, **Ext 2 DC-Coupled**

Status after Normal Preset: AM Source is set to Internal

SCPI Commands:

```
[:SOURce]:AM[1]|2:SOURce EXTernal2
[:SOURce]:AM[1]|2:EXTernal2:COUPling DC
[:SOURce]:AM[1]|2:EXTernal2:COUPling?
```

Immediate

This softkey is one of the choices in the AM Sweep Trigger menu. Choosing **Immediate** immediately triggers swept-sine amplitude modulation in a continuous mode. To stop the sweep, choose a different trigger such as **Ext**, or set the waveform to something other than **Swept-Sine**.

Softkey Location: Press **AM**, **AM Waveform**, **Swept-Sine**, **AM Sweep Trigger**, **Immediate**

Status after Normal Preset: AM sweep trigger is set to Immediate

SCPI Commands:

```
[:SOURce]:AM[1]|2:INTernal[1]:SWEep:TRIGger IMMediate
[:SOURce]:AM[1]|2:INTernal[1]:SWEep:TRIGger?
```

Internal

This softkey lets you connect an internally-generated, calibrated signal to the AM modulator. The default state of the internal waveform generator is a 400 Hz sinewave with 0.1% depth.

The internal source has multiple uses but can be used for only one modulation at a time. If, for example, you were using the internal source in a frequency modulation configuration for **FM Path 1**, and then you configured **AM Path 2** to also use the internal source, the signal generator would turn off **FM Path 1** and assign the internal source to your **AM Path 2** configuration.

Softkey Location: Press **AM**, **AM Source**, **Internal**

SCPI Commands:

```
[:SOURce]:AM[1]|2:SOURce INT[1]
[:SOURce]:AM[1]|2:SOURce?
```

Noise

This softkey lets you specify noise as the amplitude modulation waveform for the **AM Path 1** and **AM Path 2** configurations. Notice that the selected waveform applies only to whichever AM path configuration you have currently selected.

Softkey Location: Press **AM**, **AM Waveform**, **Noise**

SCPI Commands:

```
[:SOURce]:AM[1]|2:INTernal[1]:FUNCtion:SHAPe NOISe
[:SOURce]:AM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Ramp

This softkey lets you specify ramp as the amplitude modulation waveform for the **AM Path 1** and **AM Path 2** configurations. Notice that the selected waveform applies only to whichever AM path configuration you have currently selected.

Softkey Location: Press **AM**, **AM Waveform**, **Ramp**

SCPI Commands:

```
[:SOURce]:AM[1]|2:INTernal[1]:FUNCtion:SHAPe RAMP
[:SOURce]:AM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Sine

This softkey lets you specify sine as the amplitude modulation waveform for the **AM Path 1** and **AM Path 2** configurations. Notice that the selected waveform applies only to whichever AM path configuration you have currently selected.

Softkey Location: Press **AM**, **AM Waveform**, **Sine**

SCPI Commands:

```
[:SOURce]:AM[1]|2:INTernal[1]:FUNCtion:SHAPe SINE
[:SOURce]:AM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Square

This softkey lets you specify square as the amplitude modulation waveform for the **AM Path 1** and **AM Path 2** configurations. Notice that the selected waveform applies only to whichever AM path configuration you have currently selected.

Softkey Location: Press **AM**, **AM Waveform**, **Square**

SCPI Commands:

```
[:SOURce]:AM[1]|2:INTernal[1]:FUNCtion:SHAPe SQUare
[:SOURce]:AM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Swept-Sine

Pressing this softkey reveals a menu of choices for setting the swept-sine amplitude modulation parameters. In this menu you can set the start and stop AM rate and the sweep time. You can set the signal generator to a single, externally-triggered sweep on either a negative or positive TTL level or you can choose continuous sweep, triggered immediately. In this menu you can also select either a positive or negative polarity for the TRIGGER OUT signal.

Softkey Location: Press **AM**, **AM Waveform**, **Swept-Sine**

SCPI Commands:

```
[:SOURce]:AM[1]|2:INTernal[1]:FUNCtion:SHAPe SWEPtsine
[:SOURce]:AM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Triangle

This softkey lets you specify triangle as the amplitude modulation waveform for the **AM Path 1** and **AM Path 2** configurations. Notice that the selected waveform applies only to whichever AM path configuration you have currently selected.

Softkey Location: Press **AM**, **AM Waveform**, **Triangle**

SCPI Commands:

```
[:SOURce]:AM[1]|2:INTernal[1]:FUNCtion:SHAPe TRIangle
[:SOURce]:AM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Trigger In Polarity Neg Pos

Press this softkey to toggle between a negative TTL level trigger (0 V) and a positive TTL level trigger (+5 V) for externally triggering swept-sine amplitude modulation.

This softkey is coupled to the **Trigger In Polarity Neg Pos** softkey for swept-sine FM, ΦM, and LF Out, and to the **Ext Neg** and **Ext Pos** sweep trigger selections in the Sweep/List Menu. If you set the **Trigger In Polarity Neg Pos** softkey in the AM Swept-Sine Menu to **Neg**, the **Trigger In Polarity Neg Pos** softkey is also set to **Neg** for swept-sine FM, ΦM, and LF Out. In addition, if the step or list sweep is set to externally trigger, the selection will automatically be set to **Ext Neg**. The same softkeys will toggle to **Pos** or to **Ext Pos** if you select **Pos** in the Swept-Sine AM Menu.

Conversely, if the **Trigger In Slope Neg Pos** softkey is toggled in the swept-sine FM, ΦM, or LF Out menus, it will cause the swept-sine AM softkey to toggle also. This is also true for the **Ext Neg** and **Ext Pos** step or list sweep trigger selections.

Softkey Location: Press **AM**, **AM Waveform**, **Swept-Sine**, **Trigger In Polarity Neg Pos**

Status after Normal Preset: Pos

SCPI Commands:

```
:TRIGger[:SEQuence]:SLOPe POSitive|NEGative
:TRIGger[:SEQuence]:SLOPe?
```

Trigger Key

This softkey is one of the choices in the AM Sweep Trigger menu. With **Trigger Key** selected, when you press the **Trigger** front panel key you immediately trigger a single sweep of swept-sine amplitude modulation.

The **Trigger** key has autorepeat capability. Hold it down and you will repeatedly trigger sweeps until you release the key.

Softkey Location: Press **AM**, **AM Waveform**, **Swept-Sine**, **AM Sweep Trigger**, **Trigger Key**

Status after Normal Preset: AM sweep trigger is set to Immediate

SCPI Commands:

```
[:SOURce]:AM[1]|2:INTernal[1]:SWEep:TRIGger KEY

[:SOURce]:AM[1]|2:INTernal[1]:SWEep:TRIGger?
```

Trigger Out Polarity Neg Pos

This softkey toggles the polarity of the TTL signal that is output at the rear panel TRIGGER OUT connector. When **Trigger Out Polarity Neg Pos** is set to **Pos**, the output signal is asserted high (+5 V) at the start of the swept-sine amplitude modulation sweep and low (0 V) when the sweep is concluded. Setting **Trigger Out Polarity Neg Pos** to **Neg** reverses the polarity, where a high is 0 V and a low is +5 V.

This softkey is coupled to the **Trigger Out Polarity Neg Pos** softkey in the swept-sine FM, ΦM, and LF Out menus and the sweep/list menu. When the polarity is toggled for this softkey in any one of these menus, it affects all locations of the softkey.

Softkey Location: Press **AM**, **AM Waveform**, **Swept-Sine**, **Trigger Out Polarity Neg Pos**

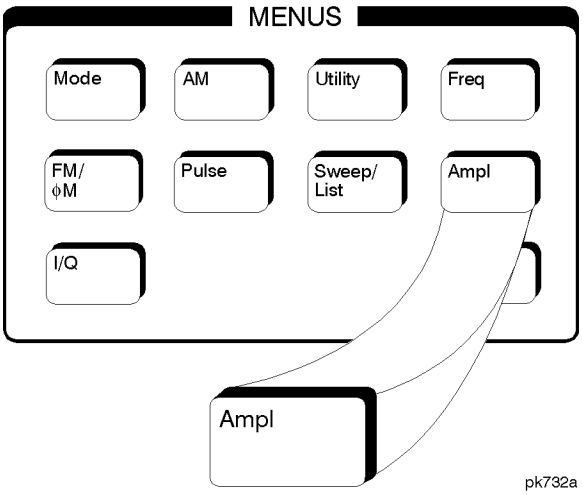
Status after Normal Preset: Pos

SCPI Commands:

```
:TRIGger:OUTPut:POLarity POSitive|NEGative

:TRIGger:OUTPut:POLarity?
```

Ampl

Pressing the front panel **Ampl** key reveals a menu of softkeys. These softkeys are described in this section in alphabetical order.



ALC BW Normal Narrow

Press this softkey to toggle between ALC normal and narrow bandwidth modes. The bandwidth is automatically set to narrow when external I/Q modulation is turned on, and automatically set to normal when I/Q modulation is turned off. Setting **ALC BW Normal Narrow** to **Narrow** limits the bandwidth to 100 Hz which can improve EVM. Narrow bandwidth mode may, however, also slow the settling time for frequency changes to as much as 40 ms. This softkey is inactive when internal I/Q modulation is turned on.

Softkey Location: Press **Ampl**, **ALC BW Normal Narrow**

Status after Normal Preset: Normal

SCPI Commands:

```
[:SOURce]:POWer:ALC:BWIDth|BANDwidth NORMal|NARRow

[:SOURce]:POWer:ALC:BWIDth|BANDwidth?
```

ALC Off On

This softkey toggles the automatic leveling control (ALC) circuit off and on.

The ALC is normally on. The RF output power of the signal generator is constantly monitored and controlled by the ALC circuit. Its purpose is to hold output power at its desired level in spite of drift due to temperature and time.

There are some modulation conditions which the ALC circuit cannot handle properly which lead to output level errors. In these conditions, better power level accuracy can be obtained by turning the ALC off and using power search. (Refer to the **Power Search Manual Auto** softkey documented in this section for more information about power search.) ALC Off is useful with pulse modulation with a pulse width narrower than 2 µs and with certain external I/Q modulation.

Pulse modulation is accomplished using a modulator which precedes the ALC detector. The ALC must, therefore, measure a pulsed signal, and it is able to do this if the pulse width exceeds 2 µs. For narrower pulses, set the **ALC** softkey to **Off**.

With external I/Q modulation, the ALC loop acts to hold the signal generator's average output power constant, in spite of variations in the I/Q input power ($I^2 + Q^2$). Rapid variations of ($I^2 + Q^2$) propagate to the output, while slow variations are removed by the ALC loop, with a high-pass corner of 1 kHz. If you do not want this high-pass filtering, set the **ALC Off On** softkey to **Off**. With ALC off, the I/Q modulation will be DC-coupled. Using power search, power level accuracy is preserved if $\sqrt{I^2 + Q^2} = 0.5\ V_{rms}$.

When ALC is off, the `ALC OFF` display annunciator will turn on.

NOTE An alternative to setting the ALC off is to set the ALC bandwidth to narrow. See the **ALC BW Normal Narrow** softkey in the this section.

Softkey Location: Press **Ampl**, **ALC Off On**

Status after Normal Preset: On

SCPI Commands:

```
[:SOURce]:POWer:ALC[:STATe] ON|OFF|1|0

[:SOURce]:POWer:ALC[:STATe]?
```

Alternate Amplitude (Option UNA Only)

Pressing this softkey reveals a menu used to configure the alternate amplitude function. The menu includes softkeys for configuring the alternate amplitude state (on or off), delta (-1 to +155 dB), triggering (internal, external, or manual), and subsequently, manual triggering between the main and alternate amplitudes. This softkey and its subfunctions are only available with the Alternate Amplitude Option.

Softkey Location: Press **Ampl**, **Alternate Amplitude**

Alt Ampl Delta (Option UNA Only)

Press this softkey to set the delta value for the alternate amplitude function. Acceptable input values range from -1.00 dB to 155.00 dB. The actual alternate amplitude is equal to the delta value plus the main RF output amplitude plus the amplitude offset value minus the amplitude reference value.

Softkey Location: Press **Ampl**, **Alternate Amplitude**, **Alt Ampl Delta**

Status after Normal Preset: 0.00 dB

SCPI Commands:

```
[:SOURce]:POWer:ALTernate:AMPLitude <val><unit>
[:SOURce]:POWer:ALTernate:AMPLitude?
```

Alt Ampl Off On (Option UNA Only)

Press this softkey to toggle the operating state of the alternate amplitude function between off and on. The alternate amplitude mode must be turned on in order to switch the RF output power between main and alternate amplitudes.

Softkey Location: Press **Ampl**, **Alternate Amplitude**, **Alt Ampl Off On**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:POWer:ALTernate:STATe ON|OFf|1|0
[:SOURce]:POWer:ALTernate:STATe?
```

Alt Ampl Trigger (Option UNA Only)

Press this softkey to reveal a menu of choices for the alternate amplitude trigger source. These choices include Int (internal from the baseband generator), Ext (external source provided at the rear panel TRIGGER IN connector), and Manual (softkey-driven) triggering.

Internal triggering is mainly used during framed-data generation. Each timeslot is allowed to output power with a user-selected main or alternate amplitude. For instruments without baseband generators, the Int softkey will be nonfunctional.

For instruments containing baseband generators, internal triggering is automatically selected during framed data transmission with at least one activated timeslot with alternate amplitude, or during non-framed external data generation.

In cases regarding non-framed external data generation, an external trigger to the ALT PWR IN rear panel connector is required. This external trigger input is routed to the data generator for processing.

Softkey Location: Press **Ampl**, **Alternate Amplitude**, **Alt Ampl Trigger**

Status after Normal Preset: Manual

SCPI Commands:

```
[:SOURce]:POWer:ALTernate:AMPLitude:TRIGger
[:SOURce] INTernal|EXTernal|MANual
[:SOURce]:POWer:ALTernate:AMPLitude:TRIGger[:SOURce]?
```

Ampl Offset

Press this softkey to set a value for amplitude offset. An amplitude offset changes the value shown in the amplitude area of the display but does not affect the output power. For example, if the current output power is 0 dBm and you enter an amplitude offset of –3 dBm, the output power will remain at 0 dBm but the display will show an amplitude of –3 dBm. This feature lets you simulate the power level at a test point beyond the RF OUTPUT connector.

An amplitude offset can be entered at any time during normal operation and also when you are operating in amplitude reference mode. To enter an offset, press **Ampl Offset** and enter the desired offset value using the up and down arrow keys, the front panel knob, or enter a value using the numeric keypad and press the **dB** terminator softkey. When a non-zero offset has been entered, the OFFSET indicator is turned on in the amplitude area of the display.

Softkey Location: Press **Ampl**, **More 1 of 2**, **Ampl Offset**

Status after Normal Preset: 0.00 dB

SCPI Commands:

```
[:SOURce]:POWer[:LEVel][:IMMediate]:OFFSet <val><unit>
[:SOURce]:POWer[:LEVel][:IMMediate]:OFFSet?
```

Ampl Ref Set

This softkey sets the current output power as an amplitude reference value. It also causes the **Ampl Ref Off On** softkey to toggle to the **On** position, turning on amplitude reference mode. All amplitude parameters are then set as relative to the reference value.

Softkey Location: **Ampl**, **More 1 of 2**, **Ampl Ref Set**

Status after Normal Preset: 0.0 dBm

SCPI Commands:

```
[:SOURce]:POWer:REFerence <val><unit>
[:SOURce]:POWer:REFerence?
```

Ampl Ref Off On

This softkey toggles the amplitude reference mode on and off. When amplitude reference mode is turned on, the amplitude value displayed is equal to the current hardware output power minus the reference value set by the **Ampl Ref Set** softkey. (The **Ampl Ref Set** softkey sets the reference value equal to the current output power. If you have not yet set the reference value, the normal preset value for amplitude reference is 0 dBm.) The REF indicator is turned on in the amplitude area of the display. All amplitude parameters will now be set as relative to the reference value.

Amplitude offsets can be used with amplitude reference mode. In this situation, the display will show the amplitude calculated as the current hardware output power minus the reference value plus the amplitude offset.

Amplitude reference mode only changes the display; it does not change the RF output power. For example, if you set your RF output power to –20 dBm, set your reference value, and then turn amplitude reference mode on, your display shows your amplitude as 0 dB but your output power remains at –20 dBm.

Softkey Location: Press **Ampl**, **More 1 of 2**, **Ampl Ref Off On**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:POWer:REFerence:STATe ON|OFF|1|0

[:SOURce]:POWer:REFerence:STATe?
```

Atten Hold Off On

This softkey toggles the attenuator hold function on and off. Turn attenuator hold on to freeze the attenuator at its current setting. The ATTN HOLD display annunciator will turn on. Use this function at any time you want to guarantee that there will be no power discontinuity normally associated with the attenuator switching during power adjustments. (When the attenuator is held, only a frequency change will change the attenuator setting. There will be no attenuator switching during power adjustments.) With attenuator hold on, the maximum power adjustment range will vary. However, you will have at least +4 dB and at least –13 dB range.

Softkey Location: Press **Ampl**, **Atten Hold Off On**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:POWer:ATTenuation:AUTO ON|OFF|1|0

[:SOURce]:POWer:ATTenuation:AUTO?
```

Do Power Search

Press this softkey to execute the power search routine one time. Power search is an internal calibration routine used to achieve calibrated output power when the ALC is off. You can execute a power search at any time by pressing this softkey. If you are using external I/Q modulation, the power search routine assumes that the I/Q input level is $\sqrt{I^2 + Q^2}$ = 0.5 V_{rms}.

Actual output amplitude will scale directly with $\sqrt{I^2 + Q^2}$.

The **ALC Off On** softkey must be set to **Off** in order to execute the power search routine.

Softkey Location: Press **Ampl**, toggle **ALC Off On** softkey to **Off**, press **Do Power Search**

SCPI Commands:

```
[:SOURce]:POWer:ALC:SEARch ONCE
```

Manual Trigger Main Delta

Press this softkey to toggle the RF output power between main and alternate (delta). When Main is highlighted, the main power is present at the RF output and when Delta is highlighted, the alternate power is present at the RF output.

Softkey Location: Press **Ampl**, **Alternate Amplitude**, **Manual Trigger Main Delta**

Status after Normal Preset: Main

SCPI Commands:

```
[:SOURce]:POWer:ALTernate:MANual MAIN|ALTernate
```

```
[:SOURce]:POWer:ALTernate:MANual?
```

Power Search Manual Auto

This softkey toggles between the auto and manual modes of power search mode. Power search is an internal calibration routine used to achieve calibrated output power when the ALC is off. When you set **Power Search Manual Auto** to **Auto**, power search will execute automatically with each change to the RF frequency or power, and also with each change to the AM, burst, pulse, or I/Q modulation state. If you are using external I/Q modulation, the power search routine assumes that the I/Q input level is $\sqrt{I^2 + Q^2}$ = 0.5 V_{rms}.

Actual output amplitude will scale directly with $\sqrt{I^2 + Q^2}$.

When you set **Power Search Manual Auto** to **Manual**, the power search routine is not run until the **Do Power Search** softkey is pressed.

The **ALC Off On** softkey must be set to **Off** in order to engage either power search mode.

Softkey Location: Press **Ampl**, toggle **ALC Off On** softkey to **Off**, press **Power Search Manual Auto**

Status after Normal Preset: Manual

SCPI Commands:

```
[:SOURce]:POWer:ALC:SEARch ON|OFF|1|0|ONCE
[:SOURce]:POWer:ALC:SEARch?
```

Power Search Reference Fixed Modulated

This softkey toggles between fixed and modulated modes of power search. Power search is an internal calibration routine used to achieve calibrated output power when the ALC is off. When you set **Power Search Reference Fixed Modulated** to **Fixed**, power search uses a 0.5 Volt reference. When you set **Power Search Reference Fixed Modulated** to **Modulated**, the current I/Q modulation remains active and the reference is the RMS value of the current I/Q modulation.

The **ALC Off On** softkey must be set to **Off** in order to engage either power search reference.

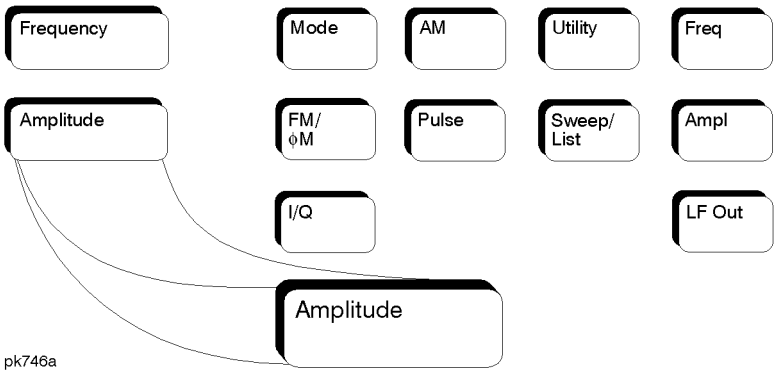
Softkey Location: Press **Ampl**, toggle **ALC Off On** softkey to **Off**, press **Power Search**, toggle **Power Search Reference** to **Fixed** or **Modulated**.

Status after Normal Preset: Fixed

SCPI Commands:

```
[:SOURce]:POWer:ALC:SEARch:REFerence FIXed|MODulated
[:SOURce]:POWer:ALC:SEARch:REFerence?
```

Amplitude



Press this front panel hardkey to change the RF output power. Amplitude becomes the active function and the current value is shown in the active entry area of the display. To enter a new value for amplitude, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **dBm**, **dBuV**, **dBuVemf**, **mV**, **uV**, **mVemf**, or **uVemf** terminator softkey. The output power range allowed depends on your instrument model. Refer to Chapter 9, "Specifications."

The current RF output power level is always shown in the amplitude area of the display except under the following conditions:

- amplitude reference mode is turned on
- an offset is applied
- a step or list amplitude sweep is in process
- the RF Off On front panel key is off

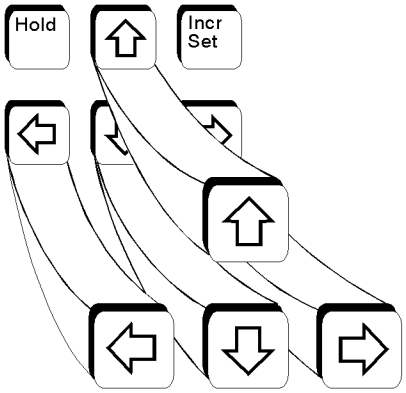
The amplitude area of the display is blanked whenever an amplitude sweep is selected.

Status after Normal Preset: –135 dBm

SCPI Commands:

```
[:SOURce]:POWer[:LEVel][:IMMediate]
[:AMPLitude] <val><unit>

[:SOURce]:POWer[:LEVel][:IMMediate][:AMPLitude]?
```

Arrow Keys



pk750a

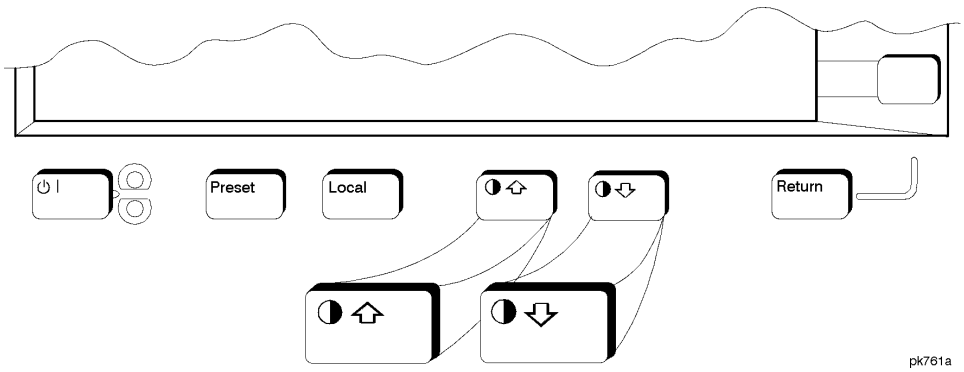
Use the up and down arrow keys to increase and decrease the value of a numeric parameter by the increment value. For example, when frequency is the active function, if the current frequency setting is 1 MHz and the increment value set is 1 kHz, pressing the up and down arrow keys will increase and decrease the 1 MHz frequency in 1 kHz steps.

In addition, you can use the up and down arrow keys to scroll through displayed lists to select items.

The left and right arrow keys choose the highlighted digit in the active entry area, which is modified by the up and down arrow keys. When a digit is highlighted it overrides the increment value used with the up and down arrow keys. This override remains in effect until the **Incr Set** key is pressed, an instrument preset occurs, or power is cycled. For example, if frequency is the active parameter and you press the right arrow key until the 1 kHz position is highlighted, the up and down arrow keys will increase and decrease the frequency in 1 kHz increments no matter where the **Incr Set** key has been set.

The arrow keys have autorepeat capability. Hold a key down and its function is continuously executed until you release it.

Display Contrast Keys



You can adjust the contrast of the display by pressing the decrease contrast key [◑⇩] or the increase contrast key [◑⇧].

Pressing the decrease contrast key and holding it down causes the display background to gradually darken in comparison to the text on the display. The minimum contrast setting is not a completely black display. Some contrast between the background and the text will still be visible.

Pressing the increase contrast key and holding it down causes the display background to gradually brighten in comparison to the text on the display. If the background does not appear to change, it is probably set to the maximum contrast.

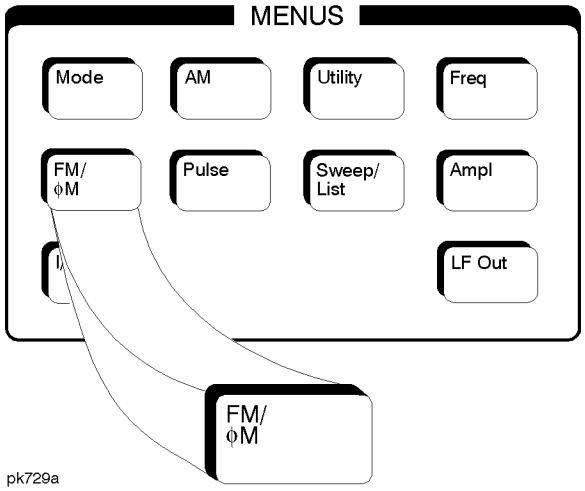
Display contrast is a persistent state; it is not affected by an instrument preset or by a power cycle.

SCPI Commands:

```
:DISPlay:CONTrast <value>

:DISPlay:CONTrast?
```

FM

Pressing the front panel **FM/ΦM** key reveals a menu of softkeys. The softkeys for FM are described in this section in alphabetical order. For a description of the ΦM softkeys, refer to the "Phase Modulation" section in this chapter.



Bus

This softkey is one of the choices in the FM Sweep Trigger menu. With **Bus** selected, you use the HP-IB to trigger single sweeps of swept-sine frequency modulation.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **FM Waveform**, **Swept-Sine**, **FM Sweep Trigger**, **Bus**

Status after Normal Preset: FM sweep trigger is set to Immediate

SCPI Commands:

```
[:SOURce]:FM[1]|2:INTernal[1]:SWEep:TRIGger BUS
[:SOURce]:FM[1]|2:INTernal[1]:SWEep:TRIGger?
```

DCFM/DCΦM Cal

Pressing this softkey initiates a DCFM calibration. This calibration eliminates the offset in DC FM so that the carrier frequency remains the same with no modulation applied. External, DC-coupled FM must be active when this calibration is executed.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **DCFM/DCΦM Cal**

SCPI Commands:

```
:CALibration:DCFM
```

Dual-Sine

Pressing this softkey reveals a menu of choices for setting the dual-sine frequency modulation parameters. In this menu you can set the FM rates for two separate tones. In addition, you can set the FM deviation for **FM Path 1** and **FM Path 2** and also set a ratio of the tone 2 FM deviation to the tone 1 FM deviation.

Softkey Location: Press **FM/ΦM**, **More 1 of 2**, **FM Waveform**, **Dual-Sine**

SCPI Commands:

```
[:SOURce]:FM[1]|2:INTernal[1]:FUNCtion:SHAPe DUALsine
[:SOURce]:FM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Ext

This softkey is one of the choices in the FM Sweep Trigger menu. Choosing **Ext** allows you to trigger swept-sine frequency modulation using a signal applied to the TRIGGER IN rear panel connector. Set the polarity of the trigger signal using the **Trigger In Polarity Neg Pos** softkey.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **FM Waveform**, **Swept-Sine**, **FM Sweep Trigger**, **Ext**

Status after Normal Preset: FM sweep trigger is set to Immediate

SCPI Commands:

```
[:SOURce]:FM[1]|2:INTernal[1]:SWEep:TRIGger EXTernal
[:SOURce]:FM[1]|2:INTernal[1]:SWEep:TRIGger?
```

Ext 1 AC-Coupled

This softkey lets you input an external, AC-coupled, frequency modulation signal to the EXT 1 INPUT connector. The modulation signal is tested for voltage and a display annunciator will report a high or low condition if the voltage is > ±3% of 1 Vpk.

The external 1 input has multiple uses but can be used for only one modulation at a time. If, for example, you were using the external 1 input in an amplitude modulation configuration for **AM Path 1**, and then you configured **FM Path 2** to also use the external 1 input, the signal generator would turn off **AM Path 1** and assign the external 1 input to your **FM Path 2** configuration. For the purposes of this discussion, the external 1 AC-coupled input is the same as the external 1 DC-coupled source.

Softkey Location: Press **FM/ΦM**, **FM Source**, **Ext 1 AC-Coupled**

SCPI Commands:

```
[:SOURce]:FM[1]|2:SOURce EXTernal1
[:SOURce]:FM[1]|2:EXTernal[1]:COUPling AC
[:SOURce]:FM[1]|2:EXTernal[1]:COUPling?
```

Ext 1 DC-Coupled

This softkey lets you input an external, DC-coupled, frequency modulation signal to the EXT 1 INPUT connector.

The external 1 input has multiple uses but can be used for only one modulation at a time. If, for example, you were using the external 1 input in an amplitude modulation configuration for **AM Path 1**, and then you configured **FM Path 2** to also use the external 1 input, the signal generator would turn off **AM Path 1** and assign the external 1 input to your **FM Path 2** configuration. For the purposes of this discussion, the external 1 AC-coupled input is the same as the external 1 DC-coupled source.

Softkey Location: Press **FM/ΦM**, **FM Source**, **Ext 1 DC-Coupled**

SCPI Commands:

```
[:SOURce]:FM[1]|2:SOURce EXTernal1
[:SOURce]:FM[1]|2:EXTernal[1]:COUPling DC
[:SOURce]:FM[1]|2:EXTernal[1]:COUPling?
```

Ext 2 AC-Coupled

This softkey lets you input an external, AC-coupled, frequency modulation signal to the EXT 2 INPUT connector. The modulation signal is tested for voltage and a display annunciator will report a high or low condition if the voltage is > ±3% of 1 Vpk.

The external 2 input has multiple uses but can be used for only one modulation at a time. If, for example, you were using the external 2 input in an amplitude modulation configuration for **AM Path 1**, and then you configured **FM Path 2** to also use the external 2 input, the signal generator would turn off **AM Path 1** and assign the external 2 input to your **FM Path 2** configuration. For the purposes of this discussion, the external 2 AC-coupled input is the same as the external 2 DC-coupled source.

Softkey Location: Press **FM/ΦM**, **FM Source**, **Ext 2 AC-Coupled**

SCPI Commands:

```
[:SOURce]:FM[1]|2:SOURce EXTernal2
[:SOURce]:FM[1]|2:EXTernal[2]:COUPling AC
[:SOURce]:FM[1]|2:EXTernal[2]:COUPling?
```

Ext 2 DC-Coupled

This softkey lets you input an external, DC-coupled, frequency modulation signal to the EXT 2 INPUT connector.

The external 2 input has multiple uses but can be used for only one modulation at a time. If, for example, you were using the external 2 input in an amplitude modulation configuration for **AM Path 1**, and then you configured **FM Path 2** to also use the external 2 input, the signal generator would turn off **AM Path 1** and assign the external 2 input to your **FM Path 2** configuration. For the purposes of this discussion, the external 2 AC-coupled input is the same as the external 2C-coupled source.

Softkey Location: Press **FM/ΦM**, **FM Source**, **Ext 2 DC-Coupled**

SCPI Commands:

```
[:SOURce]:FM[1]|2:SOURce EXTernal2

[:SOURce]:FM[1]|2:EXTernal[2]:COUPling DC

[:SOURce]:FM[1]|2:EXTernal[2]:COUPling?
```

FM/ΦM

This softkey toggles between the menus for FM, normal ΦM, and wideband ΦM. Refer to the "Phase Modulation" section for a discussion of the differences between normal ΦM, and wideband ΦM.

Softkey Location: Press the **FM/ΦM** hardkey, then press the **FM/ΦM** softkey.

Status after Normal Preset: FM

FM Dev

Use this softkey to set the frequency modulation deviation for the **FM Path 1** and **FM Path 2** configurations. To change the value of the FM deviation, press the softkey once. The current value for FM deviation is displayed in the active entry area. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Hz**, **kHz**, **MHz**, or **GHz** terminator softkey. The range of values allowed depends on the carrier frequency. The maximum peak deviation for a frequency is calculated by multiplying N times 10 MHz. (Table 5-1 lists the values for N and the resulting maximum peak deviations.)

Table 5-1 Maximum Deviation Values for Frequency Modulation

Carrier Frequency	N	Maximum Peak Deviation
250 kHz to ≤ 249.999 MHz	1	10 MHz
> 249.999 MHz to ≤ 500 MHz	0.5	5 MHz
> 500 MHz to ≤ 1 GHz	1	10 MHz
> 1 GHz to ≤ 2 GHz	2	20 MHz
> 2 GHz to 4 GHz	4	40 MHz

For example, if you choose a carrier frequency of 400 MHz, multiply 0.5 times 10 MHz resulting in a 5 MHz maximum peak deviation.

Notice that the new value of FM deviation applies only to whichever FM path configuration you have currently selected. Also, whenever **FM Path 1** is used with **FM Path 2**, the deviation for **FM Path 1** must be greater than or equal to the deviation for **FM Path 2**.

Softkey Location: Press **FM/ΦM**, **FM Dev**
or press **FM/ΦM**, **More 1 of 2**, **FM Waveform**, **Dual-Sine**, **FM Dev**

Status after Normal Preset: 1 kHz

SCPI Commands:

```
[:SOURce]:FM[1]|2[:DEViation] <val><unit>

[:SOURce]:FM[1]|2[:DEViation]?
```

FM Dev Couple Off On

This softkey toggles the FM deviation coupling on and off. Turning on FM deviation coupling links the FM deviation values of **FM Path 1** and **FM Path 2**. When the values are coupled, any change you make to one FM deviation value is applied to both FM deviation values.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **FM Dev Couple Off On**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:FM[1]|2[:DEViation]:TRACk ON|OFF|1|0|

[:SOURce]:FM[1]|2[:DEViation] :TRACk?
```

FM Off On

This softkey toggles the frequency modulation on or off for whichever FM path configuration (**FM Path 1** or **FM Path 2**) you have selected. Notice, however that although you can turn on frequency modulation with this softkey, the RF carrier is modulated by the enabled modulation only when you have also set **Mod On/Off** to **On**. Whenever frequency modulation is enabled, the FM annunciator is turned on in the display.

There are two paths for FM modulation which can be simultaneously enabled as long as they use different sources (Int, Ext1, or Ext2). **FM Path 2** is limited to a maximum rate of 1 MHz. **FM Path 2** must be set to a deviation less than or equal to **FM Path 1**. The modulation signals from both paths are summed internally for composite modulation.

Softkey Location: Press **FM/ΦM**, **FM Off On**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:FM[1]|2:STATe ON|OFF|1|0

[:SOURce]:FM[1]|2:STATe?
```

FM Path 1 2

Use **FM Path 1** and **FM Path 2** to define two unique frequency modulation configurations. For example, select **FM Path 1**. (**FM Path 1** is the default after a normal preset. If **FM Path 1** is not highlighted, press the softkey until the selection toggles to **FM Path 1**.) Configure the modulation characteristics (such as deviation, source, rate, and waveform) using the remaining softkeys in the FM menu. Then enable FM by setting **FM Off On** to **On**.

To configure a second frequency modulation configuration, toggle to **FM Path 2**. Define the modulation characteristics for this second configuration and enable FM by setting **FM Off On** to **On**.

The RF carrier is available at the RF OUTPUT connector when you set **RF On/Off** to **On**. Set **Mod On/Off** to **On** to modulate the RF carrier with the modulations that you have enabled.

FM Path 1 and **FM Path 2** are summed internally for composite modulation. Either path can be switched to any one of the modulation sources: Int, Ext1, or Ext2. All modulation types can be simultaneously enabled, except FM with ΦM, AM with external burst source, and wideband AM with I/Q. AM, FM, and ΦM can sum simultaneous inputs from any two sources (Int, Ext1, and Ext2). Any given source (Int, Ext1, or Ext2) can only be routed to one activated modulation type.

Softkey Location: Press **FM/ΦM**, **FM Path 1 2**

Status after Normal Preset: FM Path 1

FM Rate

Use this softkey to change the internal modulation frequency for the **FM Path 1** and **FM Path 2** configurations. To change the value, press the softkey once. The current value for FM rate is displayed in the active entry area. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Hz** or **kHz** terminator softkey. The range of values allowed is 0.1 Hz to 10 kHz. (0.1 Hz to 50 kHz is the range allowed if sinewave is selected as the internal waveform.) The minimum increment allowed is 0.1 Hz. Notice that the new value of FM rate applies only to whichever FM path configuration you have currently selected.

Softkey Location: Press **FM/ΦM**, **FM Rate**

Status after Normal Preset: 400 Hz

SCPI Commands:

```
[:SOURce]:FM[1]|2:INTernal[1]:FREQuency <val><unit>

[:SOURce]:FM[1]|2:INTernal[1]:FREQuency?
```

FM Source

Pressing this softkey reveals a menu of choices for frequency modulation sources. You can choose internally-generated frequency modulation or select an externally-applied signal from either the EXT 1 INPUT or EXT 2 INPUT connectors. The internal modulation is always AC-coupled. For the externally-applied signals, you can choose between AC- and DC-coupled modulation. A 1.0 Vpk input is required for calibrated FM deviation settings. The `EXT 1 LO/HI` and `EXT 2 LO/HI` display annunciators will turn on if the peak input voltage differs from 1.0 Vpk by more than 3%. (The LO/HI annunciators only function for AC-coupled external inputs.)

The internal and external 1 and 2 sources have multiple uses. You can use them for amplitude, frequency, and phase modulation. For burst modulation, you can only use the external 1 source. You must use the external 2 source for pulse modulation. However, any given source can only be routed to one enabled modulation at a time. If, for example, you were using the external 1 source in a frequency modulation configuration for **FM Path 1**, and then you configured **AM Path 2** to also use the external 1 source, the signal generator would turn off **FM Path 1** and assign the external 1 source to your **AM Path 2** configuration. Notice that for these purposes the external 1 AC-coupled source is the same as the external 1 DC-coupled source and the external 2 AC-coupled source is the same as the external 2 DC-coupled source.

Softkey Location: Press **FM/ΦM**, **FM Source**

Status after Normal Preset: Internal

SCPI Commands:

```
[:SOURce]:FM[1]|2:SOURce INT[1]|EXT1|EXT2
[:SOURce]:FM[1]|2:SOURce?
```

FM Start Rate

Use this softkey to change the starting internal modulation frequency for swept-sine frequency modulation. To change the value, press the softkey once. The current value for the FM start rate is displayed in the active entry area. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Hz** or **kHz** terminator softkey. The range of values allowed is 0.1 Hz to 50 kHz. The minimum increment allowed is 0.1 Hz.

This softkey is coupled to the **FM Rate** softkey in the initial FM Menu and the **FM Tone 1 Rate** softkey in the FM Dual-Sine Menu. Any value set for **FM Start Rate** is reflected in the **FM Rate** and **FM Tone 1 Rate** softkeys. Conversely, if you change the value for either the **FM Rate** softkey or the **FM Tone 1 Rate** softkey, the value for **FM Start Rate** is changed to match.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **FM Waveform**, **Swept-Sine**, **FM Start Rate**

Status after Normal Preset: 400.0 Hz

SCPI Commands:

```
[:SOURce]:FM[1]|2:INTernal[1]:FREQuency <val><unit>
[:SOURce]:FM[1]|2:INTernal[1]:FREQuency?
```

FM Stop Rate

Use this softkey to change the ending internal modulation frequency for swept-sine frequency modulation. To change the value, press the softkey once. The current value for the FM stop rate is displayed in the active entry area. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Hz** or **kHz** terminator softkey. The range of values allowed is 0.1 Hz to 50 kHz. The minimum increment allowed is 0.1 Hz.

This softkey is coupled to the **FM Tone 2 Rate** softkey in the FM Dual-Sine Menu. Any value set for **FM Stop Rate** is reflected in the **FM Tone 2 Rate** softkey. Conversely, if you change the value for the **FM Tone 2 Rate** softkey, the value for **FM Stop Rate** is changed to match.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **FM Waveform**, **Swept-Sine**, **FM Stop Rate**

Status after Normal Preset: 400.0 Hz

SCPI Commands:

```
[:SOURce]:FM[1]|2:INTernal[1]:FREQuency
:ALTernate <val><unit>

[:SOURce]:FM[1]|2:INTernal[1]:FREQuency:ALTernate?
```

FM Sweep Time

Press this softkey to set the sweep time for swept-sine frequency modulation. The signal generator will vary the FM rate from the specified start rate to the stop rate in the time set with this softkey. Enter the desired sweep time using the up and down arrow keys, the front panel knob, or enter a value using the numeric keypad and press the **sec** or **msec** terminator softkey. The range of values allowed is 1 ms through 65.535 s. The minimum increment allowed is 1 ms.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **FM Waveform**, **Swept-Sine**, **FM Sweep Time**

Status after Normal Preset: 100.0 msec

SCPI Commands:

```
[:SOURce]:FM[1]|2:INTernal[1]:SWEep:TIME <val><unit>

[:SOURce]:FM[1]|2:INTernal[1]:SWEep:TIME?
```

FM Sweep Trigger

Pressing this softkey reveals a menu of choices for triggering swept-sine frequency modulation. You can choose triggering that occurs immediately, triggering that is supplied by the HP-IB, triggering on either the positive or negative edge of a signal supplied to the TRIGGER IN connector, or triggering by the front panel **Trigger** key.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **FM Waveform**, **Swept-Sine**, **FM Sweep Trigger**

Status after Normal Preset: Immediate

SCPI Commands:

```
:TRIGger[:SEQuence]:SOURce?
```

FM Tone 1 Rate

Press this softkey to set the internal modulation frequency for the FM tone 1. Enter the desired rate using the up and down arrow keys, the front panel knob, or enter a value using the numeric keypad and press the **kHz** or **Hz** terminator softkey. The range of values allowed is 0.1 Hz through 50 kHz. The minimum increment allowed is 0.1 Hz.

This softkey is coupled to the **FM Rate** softkey in the initial FM Menu and the **FM Start Rate** softkey in the FM Swept-Sine Menu. Any value set for **FM Tone 1 Rate** is reflected in the **FM Rate** and **FM Start Rate** softkeys. Conversely, if you change the value for either the **FM Rate** softkey or the **FM Start Rate** softkey, the value for **FM Tone 1 Rate** is changed to match.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **FM Waveform**, **Dual-Sine**, **FM Tone 1 Rate**

Status after Normal Preset: 400.0 Hz

SCPI Commands:

```
[:SOURce]:FM[1]|2:INTernal[1]:FREQuency <val><unit>
```

```
[:SOURce]:FM[1]|2:INTernal[1]:FREQuency?
```

FM Tone 2 Ampl Percent Of Peak

Press this softkey to set the amplitude of the alternate frequency/rate as a percent of the peak LF analog modulation amplitude. The primary frequency/rate will make up the remaining amplitude. This softkey is for use with dual-sine modulation only.

For example, if the Tone 2 amplitude is 0%, then there would be no amplitude for Tone 2; all of the signal strength would be present in Tone 1. If **FM Tone 2 Ampl Percent Of Peak** is set to 50%, then Tone 2 and Tone 1 would have equal amplitudes, or half of the amplitude of both tones combined.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **FM Waveform**, **Dual-Sine**, **FM Tone 2 Ampl Percent Of Peak**

Status after Normal Preset: 50.0%

SCPI Commands:

```
[:SOURce]:FM[1]|2:INTernal[1]:FREQuency:ALTernate
:AMPLitude:PERCent <val><unit>
```

```
[:SOURce]:FM[1]|2:INTernal[1]:FREQuency:ALTernate
:AMPLitude:PERCent?
```

FM Tone 2 Rate

Press this softkey to set the internal modulation frequency for the FM tone 2. Enter the desired rate using the up and down arrow keys, the front panel knob, or enter a value using the numeric keypad and press the **kHz** or **Hz** terminator softkey. The range of values allowed is 0.1 Hz through 50 kHz. The minimum increment allowed is 0.1 Hz.

This softkey is coupled to the **FM Stop Rate** softkey in the FM Swept-Sine Menu. Any value set for **FM Tone 2 Rate** is reflected in the **FM Stop Rate** softkey. Conversely, if you change the value for the **FM Stop Rate** softkey, the value for **FM Tone 2 Rate** is changed to match.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **FM Waveform**, **Dual-Sine**, **FM Tone 2 Rate**

Status after Normal Preset: 400.0 Hz

SCPI Commands:

```
[:SOURce]:FM[1]|2:INTernal[1]:FREQuency
:ALTernate <val><unit>

[:SOURce]:FM[1]|2:INTernal[1]:FREQuency:ALTernate?
```

FM Waveform

Pressing this softkey reveals a menu of FM waveform choices for your **FM Path 1** and **FM Path 2** configurations. Select from sine, triangle, square, ramp, noise, dual-sine, and swept-sine waveforms. Notice that your waveform selection applies only to whichever FM path configuration you have currently selected.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **FM Waveform**

Status after Normal Preset: Sine

SCPI Commands:

```
[:SOURce]:FM[1]|2:INTernal[1]:FUNCtion:SHAPe SINE|
TRIangle|RAMP|NOISe|DUALsine|SWEPtsine?

[:SOURce]:FM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Immediate

This softkey is one of the choices in the FM Sweep Trigger menu. Choosing **Immediate** immediately triggers swept-sine frequency modulation in a continuous mode. To stop the sweep, choose a different trigger such as **Ext**, or set the waveform to something other than **Swept-Sine**.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **FM Waveform**, **Swept-Sine**, **FM Sweep Trigger**, **Immediate**

Status after Normal Preset: FM sweep trigger is set to Immediate

SCPI Commands:

```
[:SOURce]:FM[1]|2:INTernal[1]:SWEep:TRIGger IMMediate

[:SOURce]:FM[1]|2:INTernal[1]:SWEep:TRIGger?
```

Internal

This softkey lets you internally generate an AC-coupled, frequency modulation signal.

The internal source has multiple uses but can be used for only one modulation at a time. If, for example you were using the internal source in an amplitude modulation configuration for **AM Path 1**, and then you configured **FM Path 2** to also use the internal source, the signal generator would turn off **AM Path 1** and assign the internal source to your **FM Path 2** configuration.

Softkey Location: Press **FM/ΦM**, **FM Source**, **Internal**

SCPI Commands:

```
[:SOURce]:FM[1]|2:SOURce INT[1]

[:SOURce]:FM[1]|2:SOURce?
```

Noise

This softkey lets you specify noise as the frequency modulation waveform for the **FM Path 1** and **FM Path 2** configurations. Notice that the selected waveform applies only to whichever FM path configuration you have currently selected.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **FM Waveform**, **Noise**

SCPI Commands:

```
[:SOURce]:FM[1]|2:INTernal[1]:FUNCtion:SHAPe NOISe

[:SOURce]:FM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Ramp

This softkey lets you specify ramp as the frequency modulation waveform for the **FM Path 1** and **FM Path 2** configurations. Notice that the selected waveform applies only to whichever FM path configuration you have currently selected.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **FM Waveform**, **Ramp**

SCPI Commands:

```
[:SOURce]:FM[1]|2:INTernal[1]:FUNCtion:SHAPe RAMP

[:SOURce]:FM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Sine

This softkey lets you specify sine as the frequency modulation waveform for the **FM Path 1** and **FM Path 2** configurations. Notice that the selected waveform applies only to whichever FM path configuration you have currently selected.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **FM Waveform**, **Sine**

SCPI Commands:

```
[:SOURce]:FM[1]|2:INTernal[1]:FUNCtion:SHAPe SINE
[:SOURce]:FM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Square

This softkey lets you specify square as the frequency modulation waveform for the **FM Path 1** and **FM Path 2** configurations. Notice that the selected waveform applies only to whichever FM path configuration you have currently selected.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **FM Waveform**, **Square**

SCPI Commands:

```
[:SOURce]:FM[1]|2:INTernal[1]:FUNCtion:SHAPe SQUare
[:SOURce]:FM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Swept-Sine

Pressing this softkey reveals a menu of choices for setting the swept-sine frequency modulation parameters. In this menu you can set the start and stop FM rate and the sweep time. You can set the signal generator to a single, externally-triggered sweep on either a negative or positive TTL level or you can choose continuous sweep, triggered immediately. In this menu you can also select either a positive or negative polarity for the TRIGGER OUT signal.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **FM Waveform**, **Swept-Sine**

SCPI Commands:

```
[:SOURce]:FM[1]|2:INTernal[1]:FUNCtion:SHAPe SWEPtsine
[:SOURce]:FM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Triangle

This softkey lets you specify triangle as the frequency modulation waveform for the **FM Path 1** and **FM Path 2** configurations. Notice that the selected waveform applies only to whichever FM path configuration you have currently selected.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **FM Waveform**, **Triangle**

SCPI Commands:

```
[:SOURce]:FM[1]|2:INTernal[1]:FUNCtion:SHAPe TRIangle
[:SOURce]:FM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Trigger In Polarity Neg Pos

Press this softkey to toggle between a negative TTL level trigger (0 V) and a positive TTL level trigger (+5 V) for externally triggering swept-sine frequency modulation.

This softkey is coupled to the **Trigger In Polarity Neg Pos** softkey for swept-sine AM, ΦM, and LF Out, and to the **Ext Neg** and **Ext Pos** sweep trigger selections in the Sweep/List Menu. If you set the **Trigger In Polarity Neg Pos** softkey in the FM Swept-Sine Menu to **Neg**, the **Trigger In Polarity Neg Pos** softkey is also set to **Neg** for swept-sine AM, ΦM, and LF Out. And, in addition, if the step or list sweep trigger is set to **Ext Pos**, the trigger selection will automatically be changed to **Ext Pos**. The same softkeys will toggle to **Pos** or to **Ext Pos** if you select **Pos** in the Swept-Sine FM Menu.

Conversely, if the **Trigger In Slope Neg Pos** softkey is toggled in the swept-sine AM, ΦM, or LF Out menus, it will cause the swept-sine FM softkey to toggle also. This is also true for the **Ext Neg** and **Ext Pos** step or list sweep trigger selections.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **FM Waveform**, **Swept-Sine**, **Trigger In Polarity Neg Pos**

Status after Normal Preset: Pos

SCPI Commands:

```
:TRIGger[:SEQuence]:SLOPe POSitive|NEGative
:TRIGger[:SEQuence]:SLOPe?
```

Trigger Key

This softkey is one of the choices in the FM Sweep Trigger menu. With **Trigger Key** selected, when you press the **Trigger** front panel key you immediately trigger a single sweep of swept-sine frequency modulation.

The **Trigger** key has autorepeat capability. Hold it down and you will repeatedly trigger sweeps until you release the key.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **FM Waveform**, **Swept-Sine**, **FM Sweep Trigger**, **Trigger Key**

Status after Normal Preset: FM sweep trigger is set to Immediate

SCPI Commands:

```
[:SOURce]:FM[1]|2:INTernal[1]:SWEep:TRIGger KEY
[:SOURce]:FM[1]|2:INTernal[1]:SWEep:TRIGger?
```

Trigger Out Polarity Neg Pos

This softkey toggles the polarity of the TTL signal that is output at the rear panel TRIGGER OUT connector. When **Trigger Out Polarity Neg Pos** is set to **Pos**, the output signal is asserted high (+5 V) at the start of the swept-sine frequency modulation sweep and low (0 V) when the sweep is concluded. Setting **Trigger Out Polarity Neg Pos** to **Neg** reverses the polarity, where a high is 0 V and a low is +5 V.

This softkey is coupled to the **Trigger Out Polarity Neg Pos** softkey in the swept-sine AM, ΦM, and LF Out menus and the sweep/list menu. When the polarity is toggled for this softkey in any one of these menus, it affects all locations of the softkey.

Softkey Location: Press **FM/ΦM**, **More (1 of 2)**, **FM Waveform**, **Swept-Sine**, **Trigger Out Polarity Neg Pos**

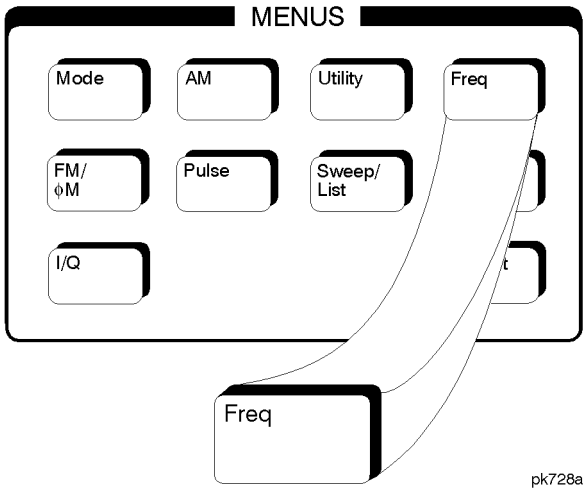
Status after Normal Preset: Pos

SCPI Commands:

```
:TRIGger:OUTPut:POLarity POSitive|NEGative
:TRIGger:OUTPut:POLarity?
```

Freq

Pressing the front panel **Freq** key reveals a menu of softkeys. These softkeys are described in this section in alphabetical order.



Adjust Phase

Use this softkey to change the phase of the RF OUTPUT signal. You can change the phase relative to whatever phase the signal generator locked to the last time it changed frequency. For this reason, the phase adjustment does not survive changes in frequency and must be readjusted. If you first press **Phase Ref Set**, the current output phase is set as a zero reference and any subsequent phase adjustment is displayed as relative to the zero reference. Phase adjustment cannot be used with frequency or phase modulation.

To change the phase, press the softkey once. Phase adjustment becomes the active function. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **rad** or **deg** terminator softkey. The range of values allowed is ±3.141 radians or ±180 degrees.

Softkey Location: Press **Freq**, **Adjust Phase**

Status after Normal Preset: 0 radians

SCPI Commands:

```
[:SOURce]:PHASe:[ADJust] <val><unit>

[:SOURce]:PHASe:[ADJust]?
```

Freq Multiplier

You can multiply the frequency shown on the display without changing the frequency output at the RF OUTPUT connector (simulating the frequency at the output of a harmonic multiplier). Press this softkey and enter a value from 1 through 50. Use the up and down arrow keys, the front panel knob, or enter a value using the numeric keypad and press the **Enter** terminator softkey. For example, set the output frequency to 1 MHz. Then press **Freq**, **Freq Multiplier**, **3**, **Enter**. The display will now show an output frequency of 3 MHz but the actual output frequency will remain at 1 MHz. For any multiplier greater than 1, the `MULT` indicator is shown in the frequency area of the display.

Softkey Location: Press **Freq**, **Freq Multiplier**

Status after Normal Preset: 1

SCPI Commands:

```
[:SOURce]:FREQuency:MULTiplier <val>
[:SOURce]:FREQuency:MULTiplier?
```

Freq Offset

Press this softkey to set a value for frequency offset. A frequency offset changes the value shown in the frequency area of the display but does not affect the output frequency. For example, if the current output frequency is 1 MHz and you enter a frequency offset of 3 MHz, the output frequency will remain at 1 MHz but the display will show a frequency of 4 MHz. This feature lets you simulate the frequency at the output of a frequency translating device.

A frequency offset can be entered at any time during normal operation and also when you are operating in frequency reference mode. To enter an offset, press **Freq Offset** and enter the desired frequency value using the up and down arrow keys, the front panel knob, or enter a value using the numeric keypad and press the **Hz**, **kHz**, **MHz**, or **GHz** terminator softkey. When an offset has been entered, the `OFFSET` indicator is turned on in the frequency area of the display.

Softkey Location: Press **Freq**, **Freq Offset**

Status after Normal Preset: 0 Hz

SCPI Commands:

```
[:SOURce]:FREQuency:OFFSet <val><unit>
[:SOURce]:FREQuency:OFFSet?
```

Freq Ref Off On

This softkey toggles the frequency reference mode on and off. When frequency reference mode is turned on, the frequency value displayed is equal to the current hardware output frequency minus the reference value set by the **Freq Ref Set** softkey. (The **Freq Ref Set** softkey sets the reference value equal to the current output frequency. If you have not yet set the reference value, the preset value for frequency reference is 0 Hz.) The REF indicator is turned on in the frequency area of the display. All frequency parameters will now be set as relative to the reference value.

Frequency offsets can be used with frequency reference mode. In this situation, the display will show the frequency calculated as the current hardware output frequency minus the reference value plus the frequency offset.

Frequency reference mode only changes the display; it does not change the RF output frequency. For example, if you set your RF output frequency to 700 MHz, set your reference value, and then turn frequency relative mode on, your display shows your frequency as 0 Hz but your output frequency remains at 700 MHz.

Softkey Location: Press **Freq**, **Freq Ref Off On**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:FREQuency:REFerence:STATe ON|OFF|1|0

[:SOURce]:FREQuency:REFerence:STATe?
```

Freq Ref Set

This softkey sets the current output frequency as a frequency reference value. It also causes the **Freq Ref Off On** softkey to toggle to the **On** position, turning on frequency reference mode. All frequency parameters are then set as relative to the reference value.

Softkey Location: Press **Freq**, **Freq Ref Set**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:FREQuency:REFerence <val><unit>

[:SOURce]:FREQuency:REFerence?
```

Mode 1 Optimize <10kHz Offset

Press this softkey to set the signal generator to mode 1 which optimizes phase noise at offsets below 10 kHz.

Softkey Location: Press **Freq**, **Optimize Φ Noise**, **Mode 1 Optimize <10kHz Offset**

SCPI Commands:

```
[:SOURce]:FREQuency:SYNThesis 1
[:SOURce]:FREQuency:SYNThesis?
```

Mode 2 Optimize >10kHz Offset

Press this softkey to set the signal generator to mode 2 which optimizes phase noise at offsets above 10 kHz.

Softkey Location: Press **Freq**, **Optimize Φ Noise**, **Mode 2 Optimize >10kHz Offset**

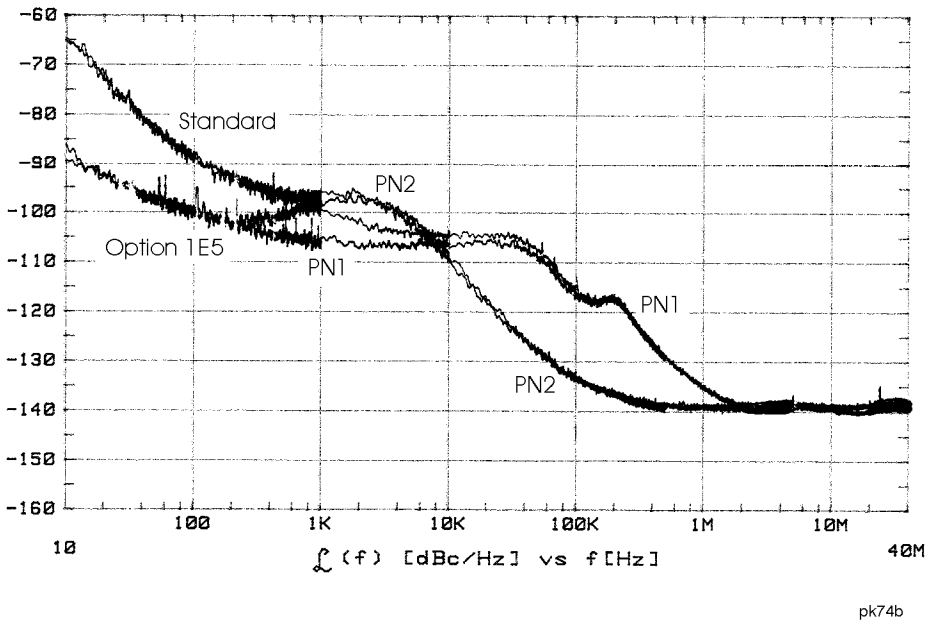
SCPI Commands:

```
[:SOURce]:FREQuency:SYNThesis 2
[:SOURce]:FREQuency:SYNThesis?
```

Optimize Φ Noise

Press this softkey for two choices in optimizing phase noise. You can choose to set the phase-lock loop bandwidth to optimize phase noise for offsets below or above 10 kHz offsets as shown in Figure 5-1.

Figure 5-1 Phase Noise Performance Mode 1 Versus Mode 2



Softkey Location: Press **Freq**, **Optimize Φ Noise**

Status after Normal Preset: Mode 2

Phase Ref Set

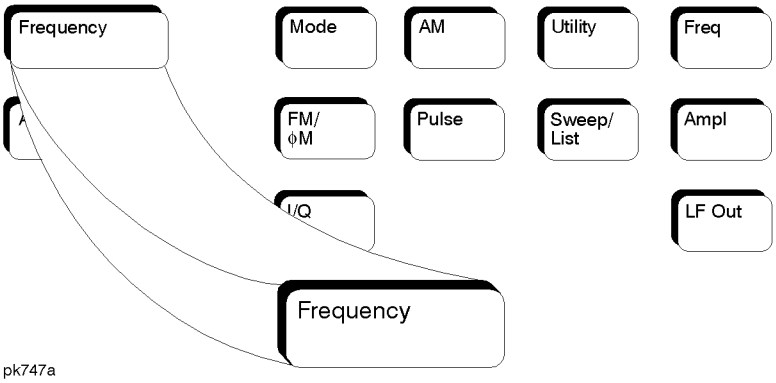
This softkey sets the current output phase as a zero reference. All phase parameters are then set as relative to the zero reference.

Softkey Location: Press **Freq**, **Phase Ref Set**

SCPI Commands:

```
[:SOURce]:PHASe:REFerence
```

Frequency



Press this front panel hardkey to change the RF output frequency. Frequency becomes the active function and the current value is also shown in the active entry area of the display. To enter a new value for frequency, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **GHz**, **MHz**, **kHz**, or **Hz** terminator softkey. The output frequency range allowed depends on your instrument model. Refer to Chapter 9, “Specifications,”

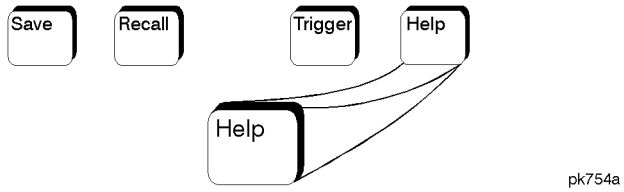
The current RF output frequency is always shown in the frequency area of the display (unless you have altered the display by turning on frequency reference mode or entering an offset or a multiplier). The frequency area of the display is blanked whenever a frequency sweep is selected.

Status after Normal Preset: Maximum specified output frequency

SCPI Commands:

```
[:SOURce]:FREQuency[:CW] <val><unit>

[:SOURce]:FREQuency[:CW]?

[:SOURce]:FREQuency:FIXed <val><unit>

[:SOURce]:FREQuency:FIXed?

[:SOURce]:FREQuency:MODE CW|FIXed|LIST

[:SOURce]:FREQuency:MODE?
```

Help



Press this hardkey for a short description of the function of any front panel hardkey or softkey. When you press the **Help** key, the following message is displayed:

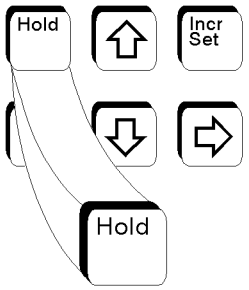
- `Press a key for help on that key.`

Press a front panel hardkey or a softkey and a short description of that key's function will be displayed. Press another key and you will be returned to normal instrument operation.

The **Help** key can be set to either single or continuous mode. In single mode, when you press the **Help** key, help text is provided only for the next key that you press and then you are returned to normal operation. In continuous mode, when you press the **Help** key, help text is provided for the next key that you press and that key's function is also executed (except for the **Preset** key). This help mode remains active until you press the **Help** key again.

Refer to the description of the **Help Mode Single Cont** softkey in the Utility section for instructions on changing the help mode from single to continuous.

Hold

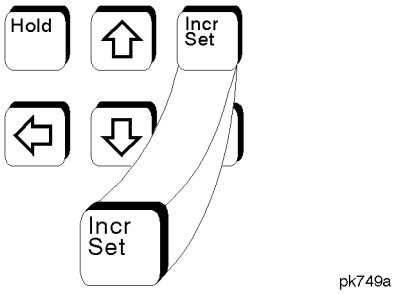


pk748a

Press this front panel hardkey to de-activate the current active function and blank the softkey menu. Once **Hold** is pressed, the front panel knob, the arrow keys, and the numeric keypad have no effect.

To return to normal operation, press any front panel hardkey.

Incr Set



Press this front panel hardkey to change the incremental value of the up and down arrow keys for the current active function. For example, press **Frequency** to make it the active function. The current frequency is shown in the active entry area. The incremental value for frequency is set to 1 MHz at the factory. Press **Incr Set** and the incremental value of the up and down arrow keys for frequency becomes the active function. You can change the value by using three different methods:

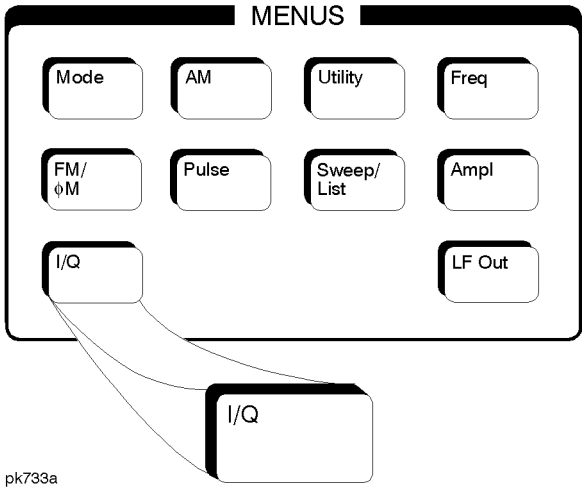
- Use the up and down arrow keys.The arrow keys will change the incremental value in steps equal to the current incremental value (in this example, these are 1 MHz steps.)
- Use the front panel knob.
- Use the numeric keypad and complete your entry with a terminator softkey.

Press **Incr Set** again and the active function toggles, making frequency the active function again.

Incremental values are persistent states; they are not affected by an instrument preset or by a power cycle.

I/Q

This front panel hardkey and its menus are only available on the HP ESG-D Series Signal Generators. The softkeys in the I/Q menus are described in this section in alphabetical order.



ALC Off On

This softkey toggles the automatic leveling control (ALC) circuit off and on.

The ALC is normally on. The RF output power of the signal generator is constantly monitored and controlled by the ALC circuit. Its purpose is to hold output power at its desired level in spite of drift due to temperature and time.

There are some modulation conditions which the ALC circuit cannot handle properly which lead to output level errors. In these conditions, better power level accuracy can be obtained by turning the ALC off and using power search. (Refer to the **Power Search Manual Auto** softkey documented in this section for more information about power search.) ALC off is useful with pulse modulation with a pulse width narrower than 2 µs and with certain external I/Q modulation.

Pulse modulation is accomplished using a modulator which precedes the ALC detector. The ALC must, therefore, measure a pulsed signal, and it is able to do this if the pulse width exceeds 2 µs. For narrower pulses, set the **ALC** softkey to **Off**.

With external I/Q modulation, the ALC loop acts to hold the signal generator's average output power constant, in spite of variations in the I/Q input power ($I^2 + Q^2$). Rapid variations of ($I^2 + Q^2$) propagate to the output, while slow variations are removed by the ALC loop, with a high-pass corner of 1 kHz. If you do not want this high-pass filtering,

set the **ALC Off On** softkey to **Off**. With ALC off, the I/Q modulation will be DC-coupled. Using power search, power level accuracy is preserved if $\sqrt{I^2 + Q^2} = 0.5\ V_{rms}$.

When ALC is off, the ALC OFF display annunciator will turn on.

Softkey Location: Press **I/Q**, **More (1 of 2)**, **ALC Off On**

Status after Normal Preset: On

SCPI Commands:

```
[:SOURce]:POWer:ALC[:STATe] ON|OFF|1|0
[:SOURce]:POWer:ALC[:STATe]?
```

Burst Envelope Off On

Press this softkey to toggle on and off the burst envelope modulator. The burst envelope modulator is used to burst the RF carrier. When the **Burst Source** softkey is set to **Ext1 DC**, the shape of the burst output is the same as the shape of the EXT 1 analog input. The **Burst Envelope Off On** softkey is toggled automatically to **On** when any enabled digital modulation format also has burst turned on (Option UN8). Whenever the burst envelope modulator is on, the ENVLP annunciator is turned on in the display.

Softkey Location: Press **I/Q**, **Burst Envelope Off On**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:BURSt:STATe ON|OFF|1|0
[:SOURce]:BURSt:STATe?
```

Burst Source

Press this softkey to change the source for burst modulation. If you do not have Option UN8, your only choice is a DC-coupled, analog input using the EXT 1 INPUT connector. Using this selection, the bursted output signal will have the same shape as the analog input. If you have Option UN8, this softkey will automatically toggle to **Int Burst** if you have turned on burst for an enabled digital modulation format. In this mode, the internal baseband generator bursts the RF carrier. You can override this automatic selection by selecting **Ext1 DC** as the **Burst Source**. As long as burst is turned on in an enabled digital modulation format, you can toggle between the internal and external burst sources.

Softkey Location: Press **I/Q**, **Burst Source**

Status after Normal Preset: Ext1 DC

SCPI Commands:

```
[:SOURce]:BURSt:SOURce EXTernal[1]|INTernal[1]
[:SOURce]:BURSt:SOURce?
```

Calibration Type User Full

Press this softkey to toggle between an I/Q calibration executed over the full frequency range of the signal generator (**Full**) or an I/Q calibration over a frequency range which you specify (**User**) using the **Start Frequency** and **Stop Frequency** softkeys. Once you have chosen either **Full** or **User**, and specified the frequency range, as required, press **Execute Cal** to start the I/Q calibration.

The I/Q calibration type is a persistent state; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **I/Q**, **More (1 of 2)**, **I/Q Calibration**, **Calibration Type User Full**

Do Power Search

Press this softkey to execute the power search routine one time. Power search is an internal calibration routine used to achieve calibrated output power when the ALC is off. You can execute a power search at any time by pressing this softkey. If you are using external I/Q modulation, the power search routine assumes that the I/Q input level is $\sqrt{I^2 + Q^2} = 0.5\ V_{rms}$. Actual output amplitude will scale directly with $\sqrt{I^2 + Q^2}$.

The **ALC Off On** softkey must be set to **Off** in order to execute the power search routine.

Softkey Location: Press **I/Q**, **More (1 of 2)**, toggle **ALC Off On** softkey to **Off**, press **Do Power Search**

SCPI Commands:

```
[:SOURce]:POWer:ALC:SEARch ONCE
```

Execute Cal

Press this softkey to begin the I/Q calibration for the frequency range that you have specified. The calibration can be aborted at any time during the procedure by pressing the **Abort Cal** softkey. If you do abort the calibration, the previous calibration is restored.

Softkey Location: Press **I/Q**, **More (1 of 2)**, **I/Q Calibration**, **Execute Cal**

SCPI Commands:

```
:Calibration:IQ
:Calibration:IQ:FULL
```

Ext1 DC

Press this softkey to change the burst source for modulation to a DC-coupled, analog input using the EXT 1 INPUT connector. Using this selection, the bursted output signal will have the same shape as the analog input. If you do not have Option UN8, this is the only burst source and it cannot be changed. If you have Option UN8, the burst source can also be set to an internal source (refer to the **Int Burst** softkey).

Softkey Location: Press **I/Q**, **Burst Source**, **Ext1 DC**

SCPI Commands:

```
[:SOURce]:BURSt:SOURce EXTernal[1]

[:SOURce]:BURSt:SOURce?
```

Ext I/Q

Press this softkey to change the I/Q source to externally supplied I and Q signals. Apply the in-phase and quadrature-phase signals to the I INPUT and Q INPUT connectors. The recommended signal level is $\sqrt{I^2 + Q^2}$ = 0.5 V_{rms}. With equal levels at I and Q, as is usually the case, this is equivalent to 0.35 V_{rms} simultaneously at I and Q. For typical π/4DQPSK signals, a 0.35 V_{rms} waveform will be approximately 1.3 Vp-p, whereas for GMSK it will be 1.0 Vp-p. If you do not have Option UN8, this is the only I/Q source and it cannot be changed. If you have Option UN8, the I/Q source can also be set to an internal I/Q source (refer to the **Int Burst** softkey).

Softkey Location: Press **I/Q**, **I/Q Source**, **Ext I/Q**

SCPI Commands:

```
[:SOURce]:DM:SOURce EXTernal

[:SOURce]:DM:SOURce?
```

Ext I/Q Phase Polarity Normal Invert

Press this softkey to toggle between the **Normal** and **Invert** settings for external I/Q phase polarity. In the inverted mode, the input applied to the I INPUT connector is physically routed to the Q input port of the internal I/Q modulator. In addition, the input applied to the Q INPUT connector is physically routed to the I input port of the internal I/Q modulator. This inverts the direction of phase rotation of the I/Q modulation. If you have enabled a digital modulation format (Option UN8 only), I/Q phase polarity will be automatically set to normal. You can override this setting with this key.

Softkey Location: Press **I/Q**, **More (1 of 2)**, **Ext I/Q Phase Polarity Normal Invert**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:DM:POLarity[:ALL] NORMal|INVerted
[:SOURce]:DM:POLarity[:ALL]?
```

High Crest Mode Off On

Press this softkey to toggle high crest mode off and on. Turn high crest mode on with externally-applied signals with high crest factors (such as CDMA). High crest mode allows the signal generator to process these signals with less distortion. With high crest factor signals, it is recommended that the I and Q inputs seldom exceed 1.0 Vp-p. Some output power and power level accuracy is sacrificed in this mode. This softkey is active only if the I/Q source is external and I/Q is turned on.

Softkey Location: Press **I/Q**, toggle **I/Q Off On** softkey to **On**, press **High Crest Mode Off On**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:DM:EXTernal:HICRest[:STATe] ON|OFF|1|0
[:SOURce]:DM:EXTernal:HICRest[:STATe]?
```

I Offset

Press this softkey to enter an origin offset voltage for internally-generated or externally-applied in-phase signals. Enter the value as a percentage of full scale (500 mV). The range of values allowed is –100% to +100%. Change the origin offset to adjust out imperfections in the in-phase signal or to introduce calibrated impairments. Set the origin offset as desired and then toggle the **I/Q Adjustments Off On** softkey to **On.**

Softkey Location: Press **I/Q**, **I/Q Adjustments**, **I Offset**

Status after Normal Preset: 0.0%

SCPI Commands:

```
[:SOURce]:DM:IQADjustment:IOFFset <val><unit>
[:SOURce]:DM:IQADjustment:IOFFset?
```

I/Q Adjustments

Pressing this softkey reveals a menu of I/Q adjustment choices for internally-generated or externally-applied I and Q signals. In this menu you can change the I to Q gain ratio, change the I and Q offset voltages, and turn on and off these I/Q adjustments.

Softkey Location: Press **I/Q**, **I/Q Adjustments**

Status after Normal Preset: Off

I/Q Adjustments Off On

Press this softkey to toggle off and on the I to Q gain ratio and the I and Q offset voltage adjustments. The values entered for the **I/Q Gain**, **I Offset**, and **Q Offset** are not applied to the I and Q signals until the **I/Q Adjustments Off On** softkey is set to **On**.

Softkey Location: Press **I/Q**, **I/Q Adjustments**, **I/Q Adjustments Off On**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:DM:IQADjustment[:STATe] ON|OFF|1|0

[:SOURce]:DM:IQADjustment[:STATe]?
```

I/Q Calibration

Pressing this softkey reveals a menu of choices for executing an I/Q calibration. An I/Q calibration should be performed approximately every 30 days, but it can be performed at any time to peak the performance of the I/Q modulator. You can set the start and stop frequency for a user-defined I/Q calibration, or choose an I/Q calibration over the signal generator's entire frequency range. In this menu, you can also restore the values for the I/Q calibration performed at the factory (the instrument discards the latest calibration data and uses the data installed by the factory).

Softkey Location: Press **I/Q**, **More (1 of 2)**, **I/Q Calibration**

I/Q Gain

Press this softkey to change the I to Q gain ratio. For example, if you enter in a value of +1 dB, the I signal will have 1 dB more amplitude than the Q signal. The range of gain adjustment values allowed is –4 dB to +4 dB. The gain ratio adjustment can be used with externally-applied I and Q signals or with internally-generated I and Q signals. Change the gain ratio to adjust out imperfections in I and Q or to introduce calibrated impairments. Set the gain ratio as desired and then toggle the **I/Q Adjustments Off On** softkey to **On**.

Softkey Location: Press **I/Q**, **I/Q Adjustments**, **I/Q Gain**

Status after Normal Preset: 0 dB

SCPI Commands:

```
[:SOURce]:DM:IQADjustment:GAIN <val><unit>

[:SOURce]:DM:IQADjustment:GAIN?
```

I/Q Off On

This softkey enables the I/Q modulation. Notice, however, that although you can enable I/Q modulation with this softkey, the RF carrier is modulated only when you have also set **Mod On/Off** to **On**. **I/Q Off/On** is also toggled automatically to **On** when any of the digital modulation formats are enabled (Option UN8). However, you can turn off the I/Q modulation with this softkey even though the digital modulation mode is enabled. With this configuration, the RF output signal would not be modulated but the I/Q signals will be present at the rear panel I/Q outputs. Whenever I/Q modulation is enabled, the `I/Q` annunciator is turned on in the display.

Softkey Location: Press **I/Q**, **I/Q Off On**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:DM:STATe ON|OFF|1|0
[:SOURce]:DM:STATe?
```

I/Q Source

Pressing this softkey reveals a menu of I/Q source choices. If you have enabled a digital modulation format (Option UN8 only), the signal generator is automatically set to internally generate I and Q signals (**Int I/Q**). You cannot use the internal source unless you have also enabled a digital modulation format. You can externally supply the I and Q signals via the I INPUT and Q INPUT connectors by pressing **Ext I/Q**. Apply the in-phase and quadrature-phase signals to the I and Q inputs. The signal level is $\sqrt{I^2 + Q^2}$ = 0.5 V_{rms}. (See the sections on Ext I/Q and High Crest Mode.)

Softkey Location: Press **I/Q**, **I/Q Source**

Status after Normal Preset: Ext I/Q

SCPI Commands:

```
[:SOURce]:DM:SOURce?
```

Int Burst

This softkey is automatically selected for the burst source when you have enabled one of the digital modulation formats with burst on (Option UN8 only). In this mode, the internal baseband generator bursts the RF carrier. You can override this automatic selection by selecting **Ext1 DC** as the **Burst Source**. As long as burst is turned on in an enabled digital modulation format, you can toggle between the internal and external burst sources.

Softkey Location: Press **I/Q**, **Burst Source**, **Int Burst**

SCPI Commands:

```
[:SOURce]:BURSt:SOURce INTernal[1]
[:SOURce]:BURSt:SOURce?
```

Int I/Q

This softkey is automatically selected for the I/Q source when you have enabled a digital modulation format (Option UN8 only). In this mode, the signal generator is automatically set to internally generate I and Q signals. You can override this selection by setting the **I/Q Source** to **Ext1 I/Q**. As long as digital modulation is enabled, you can toggle between the internal and external I/Q sources.

Softkey Location: Press **I/Q**, **I/Q Source**, **Int I/Q**

SCPI Commands:

```
[:SOURce]:DM:SOURce INTernal
[:SOURce]:DM:SOURce?
```

Power Search Manual Auto

This softkey toggles between the auto and manual modes of power search mode. Power search is an internal calibration routine used to achieve calibrated output power when the ALC is off. When you set **Power Search Manual Auto** to **Auto**, power search will execute automatically with each change to the RF frequency or power, and also with each change to the AM, burst, pulse, or I/Q modulation state. If you are using external I/Q modulation, the power search routine assumes that the I/Q input level is $\sqrt{I^2 + Q^2}$ = 0.5 V_{rms}. Actual output amplitude will scale directly with $\sqrt{I^2 + Q^2}$.

When you set **Power Search Manual Auto** to **Manual**, the power search routine is not run until the **Do Power Search** softkey is pressed.

The **ALC Off On** softkey must be set to **Off** in order to engage either power search mode.

Softkey Location: Press **I/Q**, **More (1 of 2)**, toggle **ALC Off On** softkey to **Off**, press **Power Search Manual Auto**

Status after Normal Preset: Manual

SCPI Commands:

```
[:SOURce]:POWer:ALC:SEARch ON|OFF|1|0|ONCE
[:SOURce]:POWer:ALC:SEARch?
```

Q Offset

Press this softkey to enter an origin offset voltage for internally-generated or externally-applied quadrature-phase signals. Enter the value as a percentage of full scale (500 mV). The range of values allowed is –100% to +100%. Change the origin offset to adjust out imperfections in the quadrature-phase signal or to introduce calibrated impairments. Set the origin offset as desired and then toggle the **I/Q Adjustments Off On** softkey to **On**.

Softkey Location: Press **I/Q**, **I/Q Adjustments**, **Q Offset**

Status after Normal Preset: 0.0%

SCPI Commands:

```
[:SOURce]:DM:IQADjustment:QOFFset <val><unit>
[:SOURce]:DM:IQADjustment:QOFFset?
```

Quadrature Skew

Press this softkey to adjust the phase angle between the I and Q vectors. When the quadrature skew is zero, the phase angle is 90 degrees. Positive skew increases the angle from 90 degrees while negative skew decreases the angle from 90 degrees. The range of values allowed is ±10 degrees with a minimum increment of 0.1 degrees. However, if you're operating the signal generator in the 3.3 to 4 GHz frequency range, quadrature skew settings greater than ±5 degrees will not be within specifications.

Softkey Location: Press **I/Q**, **I/Q Adjustments**, **Quadrature Skew**

Status after Normal Preset: 0.0 deg

SCPI Commands:

```
[:SOURce]:DM:IQADjustment:QSKew <val><unit>
[:SOURce]:DM:IQADjustment:QSKew?
```

Revert to Default Cal Settings

Press this softkey to restore the original factory calibration data for the internal I/Q modulator. The latest calibration data from the user calibration is discarded. Although the factory calibration data may not be optimized for the signal generator's present status, the data can be used as a starting point if the current data is lost (if the I/Q calibration is unable to execute).

Softkey Location: Press **I/Q**, **More (1 of 2)**, **I/Q Calibration**, **Revert to Default Cal Settings**

SCPI Commands:

```
:CALibration:IQ:DEFault
```

Start Frequency

Press this softkey in the I/Q Calibration menu to set the start frequency for executing an I/Q calibration. You can select a portion of the frequency range for an I/Q calibration by selecting **Calibration Type User** and setting new start and stop frequencies. Limiting the frequency range of the calibration will decrease the time required for the calibration to be executed. To enter a frequency, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Hz**, **kHz**, **MHz**, or **GHz** terminator softkey. This softkey is automatically set to the minimum specified frequency of the signal generator if you have set the **Calibration Type User Full** softkey to **Full** (entire frequency range of the signal generator). The **User** value for **Start Frequency** is not changed, however. If you toggle back to **User** from the **Full** setting, notice that the **User** value is unchanged.

Start Frequency is a persistent state; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **I/Q**, **More (1 of 2)**, **I/Q Calibration**, **Start Frequency**

SCPI Commands:

```
:CALibration:IQ:STARt <value><units>
```

```
:CALibration:IQ:STARt?
```

Stop Frequency

Press this softkey in the I/Q Calibration menu to set the stop frequency for executing an I/Q calibration. You can select a portion of the frequency range for an I/Q calibration by selecting **Calibration Type User** and setting new start and stop frequencies. Limiting the frequency range of the calibration will decrease the time required for the calibration to be executed. To enter a frequency, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Hz**, **kHz**, **MHz**, or **GHz** terminator softkey. This softkey is automatically set to the maximum specified frequency of the signal generator if you have set the **Calibration Type User Full** softkey to **Full** (entire frequency range of the signal generator.) The **User** value for **Stop Frequency** is not changed, however. If you toggle back to **User** from the **Full** setting, notice that the **User** value is unchanged.

Stop Frequency is a persistent state; it is not affected by an instrument preset or by a power cycle.

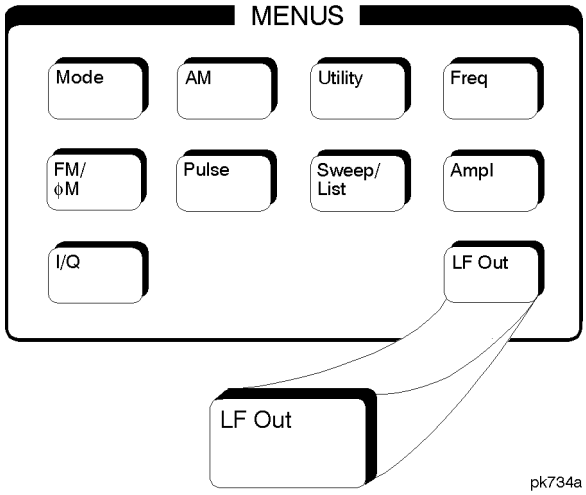
Softkey Location: Press **I/Q**, **More (1 of 2)**, **I/Q Calibration**, **Stop Frequency**

SCPI Commands:

```
:CALibration:IQ:STOP <value><units>
:CALibration:IQ:STOP?
```

LF Out

Pressing the front panel **LF Out** key reveals a menu of softkeys for configuring the internal low frequency generator. These softkeys are described in this section in alphabetical order.



Bus

This softkey is one of the choices in the LF Out Sweep Trigger menu. With **Bus** selected, you use the HP-IB to trigger single sweeps of swept-sine low frequency output.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **Swept-Sine**, **LF Out Sweep Trigger**, **Bus**

Status after Normal Preset: LF out sweep trigger is set to Immediate

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:SWEep:TRIGger BUS
[:SOURce]:LFOutput:FUNCtion:SWEep:TRIGger?
```

DC

This softkey lets you specify DC as the waveform for the LF output signal.

This softkey is only active when you have selected the internal source to operate as a function generator.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **More 1 of 2**, **DC**

Status after Normal Preset: LF Out Waveform is set to DC

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:SHAPe DC
[:SOURce]:LFOutput:FUNCtion:SHAPe?
```

Dual-Sine

Pressing this softkey reveals a menu of choices for setting the dual-sine low frequency output parameters. In this menu you can set the frequencies for two separate tones. In addition you can set a ratio of the tone 2 LF amplitude to the tone 1 LF amplitude.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **Dual-Sine**

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:SHAPe DUALsine
[:SOURce]:LFOutput:FUNCtion:SHAPe?
```

Ext

This softkey is one of the choices in the LF Output Sweep Trigger menu. Choosing **Ext** allows you to trigger swept-sine low frequency output using the signal applied to the TRIGGER IN rear panel connector. Set the polarity of the trigger signal using the **Trigger In Polarity Neg Pos** softkey.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **Swept-Sine**, **LF Out Sweep Trigger**, **Ext**

Status after Normal Preset: LF output sweep trigger is set to Immediate

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:SWEep:TRIGger EXTernal
[:SOURce]:LFOutput:FUNCtion:SWEep:TRIGger?
```

Function Generator

This softkey lets you set the **LF Out Source** to be a function generator. You can select a frequency and shape in addition to selecting the amplitude for a signal that is output at the LF OUTPUT front panel connector. When you use the internal source in this capacity, any modulation with the internal source selected is turned off.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**

Status after Normal Preset: LF Out Source is set to Internal Modulation

SCPI Commands:

```
[:SOURce]:LFOutput:SOURce FUNCtion
[:SOURce]:LFOutput:SOURce?
```

Immediate

This softkey is one of the choices in the LF Output Sweep Trigger menu. Choosing **Immediate** immediately triggers swept-sine low frequency output in a continuous mode. To stop the sweep, choose a different trigger such as **Ext**, or set the waveform to something other than **Swept-Sine**.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **Swept-Sine**, **LF Out Sweep Trigger**, **Immediate**

Status after Normal Preset: LF output sweep trigger is set to Immediate

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:SWEep:TRIGger IMMediate
[:SOURce]:LFOutput:FUNCtion:SWEep:TRIGger?
```

Internal Modulation

This softkey lets you output a signal at the LF OUTPUT connector where the frequency and shape of the signal is set by the internal source as it is being used by a modulation. For example, if the internal source is currently assigned to an AM path configuration and AM is turned on, the signal output at the LF OUTPUT connector will have the frequency and shape of the amplitude modulating signal. You can scale the amplitude of the output signal using the **LF Out Amplitude** softkey.

For internal square pulse modulation, the internal source is a sinewave which is later squared by the modulator to generate the pulse squarewave. The LF OUTPUT signal for this internal source, therefore, is a sinewave. For internal pulse modulation, a true variable-width pulse will be seen on the LF OUTPUT.

Softkey Location: Press **LF Out**, **LF Out Source**, **Internal Modulation**

Status after Normal Preset: LF Out Source is set to Internal Modulation

SCPI Commands:

```
[:SOURce]:LFOutput:SOURce INT[1]|FUNCtion
[:SOURce]:LFOutput:SOURce?
```

LF Out Amplitude

Use this softkey to scale the output of the signal at the LF OUTPUT connector. To change the value, press the softkey once. The current value for LF output amplitude is displayed in the active entry area. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **V**, or **mV** terminator softkey. The range of values allowed is 0 to 5 Vpk in increments from 1 mV to 5 V.

Softkey Location: Press **LF Out**, **LF Out Amplitude**

Status after Normal Preset: 0V

SCPI Commands:

```
[:SOURce]:LFOutput:AMPLitude <val><unit>

[:SOURce]:LFOutput:AMPLitude?
```

LF Out Freq

Use this softkey to set the modulating frequency for the LF output signal when you have selected the internal source as a function generator. To change the frequency, press the softkey once. The current modulating frequency is displayed in the active entry area. To enter a new frequency, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Hz** or **kHz** terminator softkey. The range of frequencies allowed is 0.1 Hz to 10 kHz. (0.1 Hz to 50 kHz is the range allowed if sinewave is selected as the internal waveform.)

This softkey is only active when you have selected the internal source to operate as a function generator.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Freq**

Status after Normal Preset: 400 Hz

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:FREQuency <val><unit>

[:SOURce]:LFOutput:FUNCtion:FREQuency?
```

LF Out Off On

This softkey toggles on and off the output of the selected source at the LF OUTPUT front panel connector. You can choose either the modulation signal generated by the internal source or you can use the low frequency source as a function generator and select that signal to

output at the LF OUTPUT connector. Refer to the description of the **LF Out Source** softkey in this section for more information on choosing the source.

Once you have toggled this state on, the signal is immediately available at the LF OUTPUT connector. The **Mod On/Off** and **RF On/Off** keys do not apply to this state.

Softkey Location: Press **LF Out**, **LF Out Off On**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:LFOutput:STATe ON|OFF|1|0
[:SOURce]:LFOutput:STATe?
```

LF Out Period

Use this softkey to change the pulse period for the pulsed low frequency waveform. To change the period, press the softkey once. The current value for pulse period is displayed in the active entry area. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **µsec** or **msec** terminator softkey. The range of values allowed is from 16 µs to 30 s. If you set the pulse period to a smaller value than the pulse width, an error message will be generated and the pulse width will be reduced to the value of the pulse period.

This softkey is only active when you have selected the internal source to operate as a function generator and when the LF Out waveform is specified as pulse.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **More 1 of 2**, **Pulse**, **LF Out Period**

Status after Normal Preset: 80 µs

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:PERiod <val><unit>
[:SOURce]:LFOutput:FUNCtion:PERiod?
```

LF Out Source

Pressing this softkey reveals a menu of choices for LF output sources. You can choose to output the signal from the internal source as it is being used by a modulation or you can use the internal source as a function generator and select that signal to output at the LF OUTPUT connector.

If you choose the internal source, the frequency and shape of the signal at the LF OUTPUT connector is set by the internal source as it is being used by a modulation. For example, if the internal source is currently assigned to an AM path configuration and AM is turned on, the signal output at the LF OUTPUT connector will have the frequency and shape of the amplitude modulating signal. You can scale the amplitude of the output signal using the **LF Out Amplitude** softkey.

If you choose to set the internal source as a function generator, you can select a frequency and shape in addition to selecting the amplitude for the LF output signal. When you use the internal source in this capacity, any modulation with the internal source selected is turned off.

Softkey Location: Press **LF Out**, **LF Out Source**

Status after Normal Preset: Internal Modulation

SCPI Commands:

```
[:SOURce]:LFOutput:SOURce?
```

LF Out Start Freq

Use this softkey to change the starting frequency for swept-sine low frequency output. To change the value, press the softkey once. The current value for the LF Out start frequency is displayed in the active entry area. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Hz** or **kHz** terminator softkey. The range of values allowed is 0.1 Hz to 50 kHz. The minimum increment allowed is 0.1 Hz.

This softkey is coupled to the **LF Out Freq** softkey in the initial LF Out Menu and the **LF Out Tone 1 Freq** softkey in the LF Out Dual-Sine Menu. Any value set for **LF Out Start Freq** is reflected in the **LF Out Freq** and **LF Out Tone 1 Freq** softkeys. Conversely, if you change the value for either the **LF Out Freq** softkey or the **LF Out Tone 1 Freq** softkey, the value for **LF Out Start Freq** is changed to match.

This softkey is only active when you have selected the internal source to operate as a function generator.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **Swept-Sine**, **LF Out Start Freq**

Status after Normal Preset: 400.0 Hz

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:FREQuency <val><unit>

[:SOURce]:LFOutput:FUNCtion:FREQuency?
```

LF Out Stop Freq

Use this softkey to change the ending frequency for swept-sine low frequency output. To change the value, press the softkey once. The current value for the LF Out stop frequency is displayed in the active entry area. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Hz** or **kHz** terminator softkey. The range of values allowed is 0.1 Hz to 50 kHz. The minimum increment allowed is 0.1 Hz.

This softkey is coupled to the **LF Out Tone 2 Freq** softkey in the LF Out Dual-Sine Menu. Any value set for **LF Out Stop Freq** is reflected in the **LF Out Tone 2 Freq** softkey. Conversely, if you change the value for the **LF Out Tone 2 Freq** softkey, the value for **LF Out Stop Freq** is changed to match.

This softkey is only active when you have selected the internal source to operate as a function generator.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **Swept-Sine**, **LF Out Stop Freq**

Status after Normal Preset: 400.0 Hz

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:FREQuency
:ALTernate <val><unit>

[:SOURce]:LFOutput:FUNCtion:FREQuency:ALTernate?
```

LF Out Sweep Time

Press this softkey to set the sweep time for low frequency swept-sine output. The signal generator will sweep from the specified start frequency to the stop frequency in the time set with this softkey. Enter the desired sweep time using the up and down arrow keys, the front panel knob, or enter a value using the numeric keypad and press the **sec** or **msec** terminator softkey. The range of values allowed is 1 ms through 65.535 s. The minimum increment allowed is 1 ms.

This softkey is only active when you have selected the internal source to operate as a function generator.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **Swept-Sine**, **LF Out Sweep Time**

Status after Normal Preset: 100.0 msec

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:SWEep:TIME <val><unit>

[:SOURce]:LFOutput:FUNCtion:SWEep:TIME?
```

LF Out Sweep Trigger

Pressing this softkey reveals a menu of choices for triggering swept-sine low frequency output. You can choose triggering that occurs immediately, triggering that is supplied by the HP-IB, triggering on either a positive or negative level of a signal supplied to the TRIGGER IN connector, or triggering by the front panel **Trigger** key.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **Swept-Sine**, **LF Out Sweep Trigger**

Status after Normal Preset: Immediate

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:SWEep:TRIGger IMMediate|BUS|
EXTernal|KEY
```

```
[:SOURce]:LFOutput:FUNCtion:SWEep:TRIGger?
```

LF Out Tone 1 Freq

Press this softkey to set the frequency for the LF Out tone 1. Enter the desired frequency using the up and down arrow keys, the front panel knob, or enter a value using the numeric keypad and press the **kHz** or **Hz** terminator softkey. The range of values allowed is 0.1 Hz through 50 kHz. The minimum increment allowed is 0.1 Hz.

This softkey is coupled to the **LF Out Freq** softkey in the initial LF Out Menu and the **LF Out Start Freq** softkey in the LF Out Swept-Sine Menu. Any value set for **LF Out Tone 1 Freq** is reflected in the **LF Out Freq** and **LF Out Start Freq** softkeys. Conversely, if you change the value for either the **LF Out Freq** softkey or the **LF Out Start Freq** softkey, the value for **LF Out Tone 1 Freq** is changed to match.

This softkey is only active when you have selected the internal source to operate as a function generator.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **Dual-Sine**, **LF Out Tone 1 Freq**

Status after Normal Preset: 400.0 Hz

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:FREQuency <val><unit>
```

```
[:SOURce]:LFOutput:FUNCtion:FREQuency?
```

LF Out Tone 2 Ampl % Of Peak

Press this softkey to set the ratio of the peak amplitude of LF Out tone 2 to the peak amplitude of LF Out as a percent. The range of values allowed is 0 to 100%. The minimum increment allowed is 0.1%.

The sum of the two LF Out amplitudes results in the total LF Out amplitude (set by the **LF Out Amplitude** softkey in the initial LF Out Menu.

For example, if the total LF Out amplitude is 300 mVp and you set **LF Out Tone 2 Ampl % Of Peak** to 33%, then the amplitude of LF Out tone 1 will be 200 mVp and the amplitude of LF Out tone 2 will be 100 mVp (33% of 300 mVp) so that the amplitude of the two tones adds up to 300 mVp (200 mVp plus 100 mVp).

This softkey is only active when you have selected the internal source to operate as a function generator.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **Dual-Sine**, **LF Out Tone 2 Ampl % Of Peak**

Status after Normal Preset: 50.0%

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:FREQuency:ALTernate
:AMPLitude:PERCent <val><unit>

[:SOURce]:LFOutput:FUNCtion:FREQuency:ALTernate:AMPLitud
:PERCent?
```

LF Out Tone 2 Freq

Press this softkey to set the frequency for the LF Out tone 2. Enter the desired frequency using the up and down arrow keys, the front panel knob, or enter a value using the numeric keypad and press the **kHz** or **Hz** terminator softkey. The range of values allowed is 0.1 Hz through 50 kHz. The minimum increment allowed is 0.1 Hz.

This softkey is coupled to the **LF Out Freq** softkey in the initial LF Out Menu and the **LF Out Stop Freq** softkey in the LF Out Swept-Sine Menu. Any value set for **LF Out Tone 2 Freq** is reflected in the **LF Out Freq** and **LF Out Stop Freq** softkeys. Conversely, if you change the value for either the **LF Out Freq** softkey or the **LF Out Stop Freq** softkey, the value for **LF Out Tone 2 Freq** is changed to match.

This softkey is only active when you have selected the internal source to operate as a function generator.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **Dual-Sine**, **LF Out Tone 2 Freq**

Status after Normal Preset: 400.0 Hz

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:FREQuency
:ALTernate <val><unit>

[:SOURce]:LFOutput:FUNCtion:FREQuency:ALTernate?
```

LF Out Waveform

Pressing this softkey reveals a menu of LF output waveform choices for your LF function generator. Select from sine, dual-sine, swept-sine, triangle, ramp, square, pulse, noise, and DC waveforms.

This softkey is only active when you have selected the internal source to operate as a function generator.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**

Status after Normal Preset: Sine

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:SHAPe?
```

LF Out Width

Use this softkey to change the pulse width for the pulsed low frequency waveform. To change the width, press the softkey once. The current value for pulse width is displayed in the active entry area. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **µsec** or **msec** terminator softkey. The range of values allowed is from 8 µs to a maximum of the value for the pulse period.

This softkey is only active when you have selected the internal source to operate as a function generator and when the LF Out waveform is specified as pulse.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **More 1 of 2**, **Pulse**, **LF Out Width**

Status after Normal Preset: 40 µs

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:PWIDth <val><unit>

[:SOURce]:LFOutput:FUNCtion:PWIDth?
```

Noise

This softkey lets you specify noise as the waveform for the LF output signal.

This softkey is only active when you have selected the internal source to operate as a function generator.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **More 1 of 2**, **Noise**

Status after Normal Preset: LF Out Waveform is set to Sine

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:SHAPe NOISe
[:SOURce]:LFOutput:FUNCtion:SHAPe?
```

Pulse

This softkey lets you specify pulse as the waveform for the LF output signal. The signal shape can only be specified when you have selected the internal source to operate as a function generator. Use the **LF Out Period** and **LF Out Width** softkeys to define the pulse shape.

This softkey is only active when you have selected the internal source to operate as a function generator.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **More 1 of 2**, **Pulse**

Status after Normal Preset: LF Out Waveform is set to Sine

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:SHAPe PULSe
[:SOURce]:LFOutput:FUNCtion:SHAPe?
```

Ramp

This softkey lets you specify ramp as the waveform for the LF output signal.

This softkey is only active when you have selected the internal source to operate as a function generator.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **Ramp**

Status after Normal Preset: LF Out Waveform is set to Sine

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:SHAPe RAMP
[:SOURce]:LFOutput:FUNCtion:SHAPe?
```

Sine

This softkey lets you specify sine as the waveform for the LF output signal.

This softkey is only active when you have selected the internal source to operate as a function generator.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **Sine**

Status after Normal Preset: LF Out Waveform is set to Sine

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:SHAPe SINe
[:SOURce]:LFOutput:FUNCtion:SHAPe?
```

Square

This softkey lets you specify square as the waveform for the LF output signal.

This softkey is only active when you have selected the internal source to operate as a function generator.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **More 1 of 2**, **Square**

Status after Normal Preset: LF Out Waveform is set to Sine

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:SHAPe SQUare
[:SOURce]:LFOutput:FUNCtion:SHAPe?
```

Swept-Sine

Pressing this softkey reveals a menu of choices for setting the swept-sine low frequency output. In this menu you can set the LF start and stop frequency and the sweep time. You can also set the trigger for the swept-sine output, and the polarity of the TRIGGER IN and TRIGGER OUT signals.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **Swept-Sine**

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:SHAPe SWEPtsine
[:SOURce]:LFOutput:FUNCtion:SHAPe?
```

Triangle

This softkey lets you specify triangle as the waveform for the LF output signal.

This softkey is only active when you have selected the internal source to operate as a function generator.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **Triangle**

Status after Normal Preset: LF Out Waveform is set to Sine

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:SHAPe TRIangle
[:SOURce]:LFOutput:FUNCtion:SHAPe?
```

Trigger In Polarity Neg Pos

Press this softkey to toggle between a negative TTL level trigger (0 V) and a positive TTL level trigger (+5 V) for externally triggering swept-sine low frequency output.

This softkey is coupled to the **Trigger In Polarity Neg Pos** softkey for swept-sine AM, FM, and ΦM, and to the **Ext Neg** and **Ext Pos** sweep trigger selections in the Sweep/List Menu. If you set the **Trigger In Polarity Neg Pos** softkey in the LF Out Swept-Sine Menu to **Neg**, the **Trigger In Polarity Neg Pos** softkey is also set to **Neg** for swept-sine AM, FM, and ΦM. In addition, if the step or list sweep is set to externally trigger, the selection will automatically be set to **Ext Neg**. The same softkeys will toggle to **Pos** or to **Ext Pos** if you select **Pos** in the Swept-Sine LF Out Menu.

Conversely, if the **Trigger In Slope Neg Pos** softkey is toggled in the swept-sine AM, FM, or ΦM menus, it will cause the swept-sine LF Out softkey to toggle also. This is also true for the **Ext Neg** and **Ext Pos** step or list sweep trigger selections.

This softkey is only active when you have selected the internal source to operate as a function generator.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **Swept-Sine**, **LF Out Sweep Trigger**, **Ext**, **Trigger In Polarity Neg Pos**

Status after Normal Preset: Pos

SCPI Commands:

```
:TRIGger[:SEQuence]:SLOPe POSitive|NEGative
:TRIGger[:SEQuence]:SLOPe?
```

Trigger Key

This softkey is one of the choices in the LF Output Sweep Trigger menu. With **Trigger Key** selected, when you press the **Trigger** front panel key you immediately trigger a single sweep of swept-sine low frequency output.

The **Trigger** key has autorepeat capability. Hold it down and you will repeatedly trigger sweeps until you release the key.

Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **Swept-Sine**, **LF Out Sweep Trigger**, **Trigger Key**

Status after Normal Preset: LF output sweep trigger is set to Immediate

SCPI Commands:

```
[:SOURce]:LFOutput:FUNCtion:SWEep:TRIGger KEY

[:SOURce]:LFOutput:FUNCtion:SWEep:TRIGger?
```

Trigger Out Polarity Neg Pos

This softkey toggles the polarity of the TTL signal that is output at the rear panel TRIGGER OUT connector. When **Trigger Out Polarity Neg Pos** is set to **Pos**, the output signal is asserted high (+5 V) at the start of the swept-sine low frequency sweep and low (0 V) when the sweep is concluded. Setting **Trigger Out Polarity Neg Pos** to **Neg** reverses the polarity, where a high is 0 V and a low is +5 V.

This softkey is coupled to the **Trigger Out Polarity Neg Pos** softkey in the swept-sine AM, FM, and ΦM menus and the sweep/list menu. When the polarity is toggled for this softkey in any one of these menus, it affects all locations of the softkey.

This softkey is only active when you have selected the internal source to operate as a function generator.

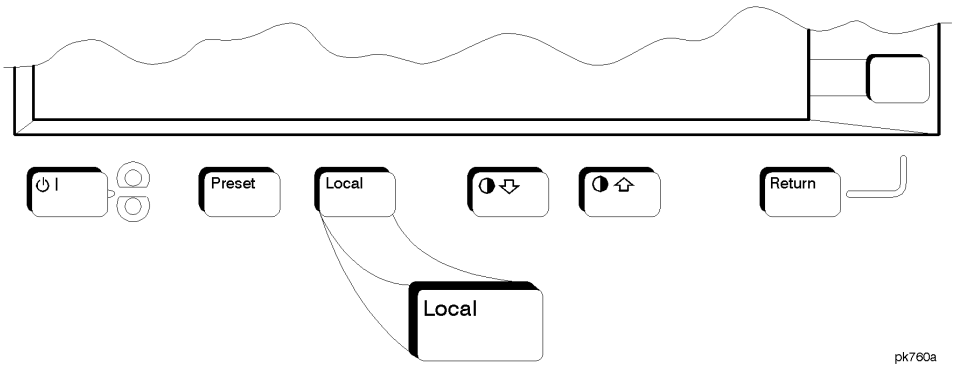
Softkey Location: Press **LF Out**, **LF Out Source**, **Function Generator**, **LF Out Waveform**, **Swept-Sine**, **Trigger Out Polarity Neg Pos**

Status after Normal Preset: Pos

SCPI Commands:

```
:TRIGger:OUTPut:POLarity POSitive|NEGative

:TRIGger:OUTPut:POLarity?
```

Local

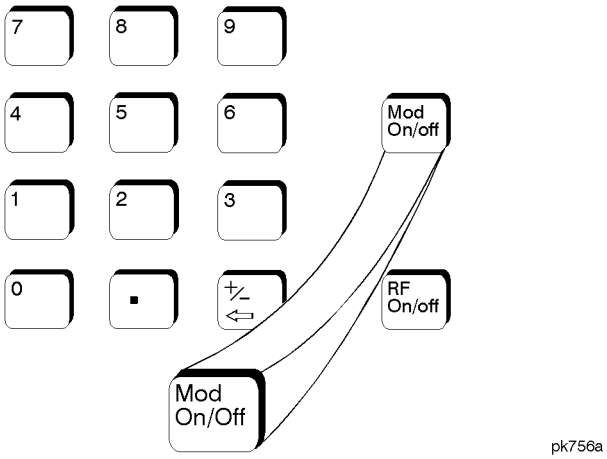


Press this key to return the signal generator to local (front panel) control from remote operation or to restore the front panel menu and status area display after RS-232 control. You can also press this key to restore the display once the screen saver has started.

This key has autorepeat capability. Hold it down and its function is continuously executed until you release it.

Status after Normal Preset: Local (unless a LOCAL LOCKOUT command has been sent).

Mod On/Off



Set this front panel hardkey to **On** to modulate the RF carrier with the modulations that you have enabled. All modulation types can be simultaneously enabled except FM with ΦM, AM with external burst source, and wideband AM with I/Q. An annunciator is always turned on in the display to indicate whether modulation is turned on or off.

Status after Normal Preset: Mod Off

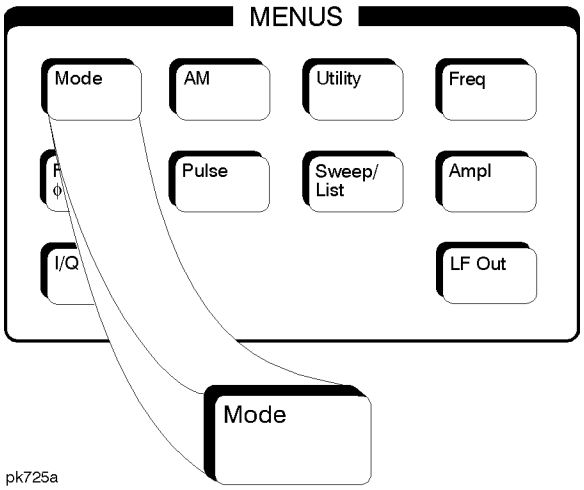
SCPI Commands:

```
:OUTPut:MODulation[:STATe] ON|OFF|1|0

:OUTPut:MODulation[:STATe]?
```

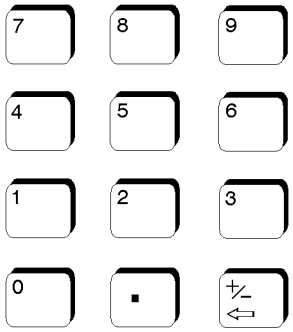
Mode

Pressing the front panel **Mode** key reveals a menu of softkeys. These softkeys let you access further menus for enabling options to the digital HP ESG-D Series Signal Generator. These options are documented in separate user's and programming guides which are part of the digital documentation set.

On the analog HP ESG Series Signal Generators, this front panel key is reserved for future use.



Numeric Keypad



The numeric keypad consists of the digit keys (0 through 9), a decimal point key, and a backspace key, +/-← The backspace key has dual functions for both backspacing and for changing the sign of a value to positive or negative. Use these keys at any time when the active function requires a value input. The backspace key function changes with the situation.

If you are modifying a previously entered value:

- If the value is negative, pressing the backspace key deletes the entire value and leaves the negative sign. Subsequent key presses change the sign between positive and negative states.
- If the value is positive, pressing the backspace key deletes the entire value and also changes the sign to a negative state. Subsequent key presses change the sign between positive and negative states.

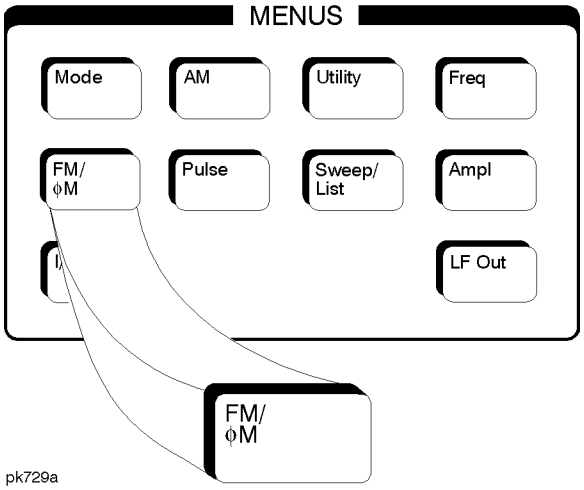
If you are entering a new value:

- If the cursor is to the right of the digits, pressing the backspace key deletes the digit immediately to the left. When no digits remain, subsequent key presses change the sign between positive and negative states.
- If the cursor is on a digit, pressing the backspace key deletes the digit immediately to the left. When a single digit remains, pressing the backspace key changes the negative sign (if present) to positive and then subsequent key presses have no effect.

These keys have autorepeat capability (except for the decimal point key). Hold a key down and its function is continuously executed until you release it.

Phase Modulation

Pressing the front panel phase modulation key (**ΦM**) reveals a menu of softkeys. These softkeys are described in this section in alphabetical order.



ΦM Dev

Use this softkey to set the phase modulation deviation for the **ΦM Path 1** and **ΦM Path 2** configurations. To change the value of the ΦM deviation, press the softkey once. The current value for ΦM deviation is displayed in the active entry area. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **pi rad**, **rad**, or **deg** terminator softkey. The range of values allowed depends on the carrier frequency and the rate selected. Refer to Table 5-2.

Table 5-2 Maximum Deviation Values for Phase Modulation

Model	Maximum Deviation	Maximum Rates (3 dB BW)	
		ΦM Path 1	ΦM Path 2
Normal	N[1] x 90 radians	100 kHz	100 kHz
High Bandwidth	N x 2π radians	1.5 MHz (typical)	1 MHz (typical)
	N x π/2 radians	6 MHz (typical)	1 MHz (typical)

1. For the value of N, refer to Table 5-3.

Table 5-3 Carrier Frequency Bands versus Value of N

Carrier Frequency	N
250 kHz to ≤ 249.999 MHz	1
> 249.999 MHz to ≤ 500 MHz	0.5
> 500 MHz to ≤ 1 GHz	1
> 1 GHz to ≤ 2 GHz	2
> 2 GHz to 4 GHz	4

For example, if you set up **ΦM Path 1** for normal phase modulation with a carrier frequency of 400 MHz, and a rate of 100 kHz, the maximum peak deviation that you can set is 0.5 (value of N) times 90 radians resulting in a maximum peak deviation of 45 radians.

Notice that the new value of ΦM deviation applies only to whichever ΦM path configuration you have currently selected. Also, **ΦM Path 2** is limited to a maximum rate of 1 MHz. Also, whenever **ΦM Path 1** is used with **ΦM Path 2**, the deviation for **ΦM Path 1** must be greater than or equal to the deviation for **ΦM Path 2.**

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **ΦM Path 1 2**

Status after Normal Preset: 0 radians

SCPI Commands:

```
[:SOURce]:PM[1]|2[:DEViation] <val><unit>

[:SOURce]:PM[1]|2[:DEViation]?
```

ΦM Dev Couple Off On

This softkey toggles the ΦM deviation coupling on and off. Turning on ΦM deviation coupling links the ΦM deviation values of **ΦM Path 1** and **ΦM Path 2**. When the values are coupled, any change you make to one ΦM deviation value is applied to both ΦM deviation values.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Dev Couple Off On**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:PM[1]|2:[DEViation]:TRACk ON|OFF|1|0

[:SOURce]:PM[1]|2:[DEViation]:TRACk?
```

ΦM Off On

This softkey toggles the phase modulation on or off for whichever ΦM configuration (**ΦM Path 1** or **ΦM Path 2**) you have selected. Notice, however that although you can turn on phase modulation with this softkey, the RF carrier is modulated by the enabled modulation only when you have also set **Mod On/Off** to **On**. Whenever phase modulation is enabled, the ΦM annunciator is turned on in the display.

There are two paths for ΦM modulation which can be simultaneously enabled as long as they use different sources (Int, Ext1, or Ext2). **ΦM Path 2** is limited to a maximum rate of 1 MHz. **ΦM Path 2** must be set to a deviation less than or equal to **ΦM Path 1**. The modulation signals from both paths are summed internally for composite modulation.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **ΦM Off On**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:PM[1]|2:STATe ON|OFF|1|0
[:SOURce]:PM[1]|2:STATe?
```

ΦM Path 1 2

Use **ΦM Path 1** and **ΦM Path 2** to define two unique phase modulation configurations. For example, select **ΦM Path 1**. (**ΦM Path 1** is the default after a normal preset. If **ΦM Path 1** is not highlighted, press the softkey once and the selection will toggle from **ΦM Path 2** to **ΦM Path 1**.) Configure the modulation characteristics (such as deviation, source, rate, and waveform) using the remaining softkeys in the ΦM menu. Then enable ΦM by setting **ΦM Off On** to **On**.

To configure a second phase modulation configuration, toggle to **ΦM Path 2**. Define the modulation characteristics for this second configuration and enable ΦM by setting **ΦM Off On** to **On**.

The RF carrier is available at the RF OUTPUT connector when you set **RF On/Off** to **On**. Set **Mod On/Off** to **On** to modulate the RF carrier with the modulations that you have enabled.

ΦM Path 1 and **ΦM Path 2** are summed internally for composite modulation. Either path can be switched to any one of the modulation sources: Int, Ext1, or Ext2. All modulation types can be simultaneously enabled, except FM with ΦM, AM with external burst source, and wideband AM with I/Q. AM, FM, and ΦM can sum simultaneous inputs from any two sources (Int, Ext1, and Ext2). Any given source (Int, Ext1, or Ext2) can only be routed to one activated modulation type.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **ΦM Path 1 2**

Status after Normal Preset: ΦM Path 1

ΦM Rate

Use this softkey to change the internal modulation frequency for the **ΦM Path 1** and **ΦM Path 2** configurations. To change the value, press the softkey once. The current value for ΦM rate is displayed in the active entry area. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Hz** or **kHz** terminator softkey. The range of values allowed is 0.1 Hz to 10 kHz. (0.1 Hz to 50 kHz is the range allowed if sinewave is selected as the internal waveform.) The minimum increment allowed is 0.1 Hz. Notice that the new value of ΦM rate applies only to whichever ΦM path configuration you have currently selected.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **ΦM Rate**

Status after Normal Preset: 400 Hz

SCPI Commands:

```
[:SOURce]:PM[1]|2:INTernal[1]:FREQuency <val><unit>

[:SOURce]:PM[1]|2:INTernal[1]:FREQuency?
```

ΦM Source

Pressing this softkey reveals a menu of choices for phase modulation sources. You can choose internally-generated phase modulation or select an externally-applied signal from either the EXT 1 INPUT or EXT 2 INPUT connectors. The internal modulation is always AC-coupled. For the externally-applied signals, you can choose between AC- and DC-coupled modulation. A 1.0 Vpk input is required for calibrated ΦM deviation settings. The `EXT 1 LO/HI` and `EXT 2 LO/HI` display annunciators will turn on if the peak input voltage differs from 1.0 Vpk by more than 3%. (The LO/HI annunciators only function for AC-coupled external inputs.)

The internal and external 1 and 2 sources have multiple uses. You can use them for amplitude, frequency, and phase modulation. For burst modulation, you can only use the external 1 source and you must use the external 2 source for pulse modulation. However, any given source can only be routed to one enabled modulation at a time. If, for example, you were using the external 1 source in a frequency modulation configuration for **FM Path 1**, and then you configured **AM Path 2** to also use the external 1 source, the signal generator would turn off **FM Path 1** and assign the external 1 source to your **AM Path 2** configuration. Notice that for these purposes the external 1 AC-coupled source is the same as the external 1 DC-coupled source and the external 2 AC-coupled source is the same as the external 2 DC-coupled source.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **ΦM Source**

SCPI Commands:

```
[:SOURce]:PM[1]|2:SOURce INT[1]|EXT1|EXT2
[:SOURce]:PM[1]|2:SOURce?
```

ΦM Start Rate

Use this softkey to change the starting internal modulation frequency for swept-sine phase modulation. To change the value, press the softkey once. The current value for the ΦM start rate is displayed in the active entry area. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Hz** or **kHz** terminator softkey. The range of values allowed is 0.1 Hz to 50 kHz. The minimum increment allowed is 0.1 Hz.

This softkey is coupled to the **ΦM Rate** softkey in the initial ΦM Menu and the **ΦM Tone 1 Rate** softkey in the ΦM Dual-Sine Menu. Any value set for **ΦM Start Rate** is reflected in the **ΦM Rate** and **ΦM Tone 1 Rate** softkeys. Conversely, if you change the value for either the **ΦM Rate** softkey or the **ΦM Tone 1 Rate** softkey, the value for **ΦM Start Rate** is changed to match.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Waveform**, **Swept-Sine**, **ΦM Start Rate**

Status after Normal Preset: 400.0 Hz

SCPI Commands:

```
[:SOURce]:PM[1]|2:INTernal[1]:FREQuency <val><unit>
[:SOURce]:PM[1]|2:INTernal[1]:FREQuency?
```

ΦM Stop Rate

Use this softkey to change the ending internal modulation frequency for swept-sine phase modulation. To change the value, press the softkey once. The current value for the ΦM stop rate is displayed in the active entry area. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Hz** or **kHz** terminator softkey. The range of values allowed is 0.1 Hz to 50 kHz. The minimum increment allowed is 0.1 Hz.

This softkey is coupled to the **ΦM Tone 2 Rate** softkey in the ΦM Dual-Sine Menu. Any value set for **ΦM Stop Rate** is reflected in the **ΦM Tone 2 Rate** softkey. Conversely, if you change the value for the **ΦM Tone 2 Rate** softkey, the value for **ΦM Stop Rate** is changed to match.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Waveform**, **Swept-Sine**, **ΦM Stop Rate**

Status after Normal Preset: 400.0 Hz

SCPI Commands:

```
[:SOURce]:PM[1]|2:INTernal[1]:FREQuency
:ALTernate <val><unit>

[:SOURce]:PM[1]|2:INTernal[1]:FREQuency:ALTernate?
```

ΦM Sweep Time

Press this softkey to set the sweep time for swept-sine phase modulation. The signal generator will vary the ΦM rate from the specified start rate to the stop rate in the time set with this softkey. Enter the desired sweep time using the up and down arrow keys, the front panel knob, or enter a value using the numeric keypad and press the **sec** or **msec** terminator softkey. The range of values allowed is 1 ms through 65.535 s. The minimum increment allowed is 1 ms.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Waveform**, **Swept-Sine**, **ΦM Sweep Time**

Status after Normal Preset: 100.0 msec

SCPI Commands:

```
[:SOURce]:PM[1]|2:INTernal[1]:SWEep:TIME <val><unit>

[:SOURce]:PM[1]|2:INTernal[1]:SWEep:TIME?
```

ΦM Sweep Trigger

Pressing this softkey reveals a menu of choices for triggering swept-sine phase modulation. You can choose triggering that occurs immediately, triggering that is supplied by the HP-IB, triggering on either the positive or negative edge of a signal supplied to the TRIGGER IN connector, or triggering by the front panel **Trigger** key.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Waveform**, **Swept-Sine**, **ΦM Sweep Trigger**

Status after Normal Preset: Immediate

SCPI Commands:

```
:TRIGger[:SEQuence]:SOURce BUS|IMMediate|EXTernal|KEY

:TRIGger[:SEQuence]:SOURce?
```

ΦM Tone 1 Rate

Press this softkey to set the internal modulation frequency for the ΦM tone 1. Enter the desired rate using the up and down arrow keys, the front panel knob, or enter a value using the numeric keypad and press the **kHz** or **Hz** terminator softkey. The range of values allowed is 0.1 Hz through 50 kHz. The minimum increment allowed is 0.1 Hz.

This softkey is coupled to the **ΦM Rate** softkey in the initial ΦM Menu and the **ΦM Start Rate** softkey in the ΦM Swept-Sine Menu. Any value set for **ΦM Tone 1 Rate** is reflected in the **ΦM Rate** and **ΦM Start Rate** softkeys. Conversely, if you change the value for either the **ΦM Rate** softkey or the **ΦM Start Rate** softkey, the value for **ΦM Tone 1 Rate** is changed to match.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Waveform**, **Dual-Sine**, **ΦM Tone 1 Rate**

Status after Normal Preset: 400.0 Hz

SCPI Commands:

```
[:SOURce]:PM[1]|2:INTernal[1]:FREQuency <val><unit>
```

```
[:SOURce]:PM[1]|2:INTernal[1]:FREQuency?
```

ΦM Tone 2 Ampl Percent Of Peak

Press this softkey to set the amplitude of the alternate frequency/rate as a percent of the peak LF analog modulation amplitude. The primary frequency/rate will make up the remaining amplitude. This softkey is for use with dual-sine modulation only.

For example, if the Tone 2 amplitude is 0%, then there would be no amplitude for Tone 2; all of the signal strength would be present in Tone 1. If **ΦM Tone 2 Ampl Percent Of Peak** is set to 50%, then Tone 2 and Tone 1 would have equal amplitudes, or half of the amplitude of both tones combined.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Waveform**, **Dual-Sine**, **ΦM Tone 2 Ampl Percent Of Peak**

Status after Normal Preset: 50.0%

SCPI Commands:

```
[:SOURce]:PM[1]|2:INTernal[1]:FREQuency:ALTernate
:AMPLitude:PERCent <val><unit>
```

```
[:SOURce]:PM[1]|2:INTernal[1]:FREQuency:ALTernate
:AMPLitude:PERCent?
```

ΦM Tone 2 Rate

Press this softkey to set the internal modulation frequency for the ΦM tone 2. Enter the desired rate using the up and down arrow keys, the front panel knob, or enter a value using the numeric keypad and press the **kHz** or **Hz** terminator softkey. The range of values allowed is 0.1 Hz through 50 kHz. The minimum increment allowed is 0.1 Hz.

This softkey is coupled to the **ΦM Stop Rate** softkey in the ΦM Swept-Sine Menu. Any value set for **ΦM Tone 2 Rate** is reflected in the **ΦM Stop Rate** softkey. Conversely, if you change the value for the **ΦM Stop Rate** softkey, the value for **ΦM Tone 2 Rate** is changed to match.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Waveform**, **Dual-Sine**, **ΦM Tone 2 Rate**

Status after Normal Preset: 400.0 Hz

SCPI Commands:

```
[:SOURce]:PM[1]|2:INTernal[1]:FREQuency
:ALTernate <val><unit>
```

```
[:SOURce]:PM[1]|2:INTernal[1]:FREQuency:ALTernate?
```

ΦM Waveform

Pressing this softkey reveals a menu of ΦM waveform choices for your **ΦM Path 1** and **ΦM Path 2** configurations. Select from sine, triangle, square, ramp, noise, dual-sine, and swept-sine waveforms. Notice that your waveform selection applies only to whichever ΦM path configuration you have currently selected.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Waveform**

Status after Normal Preset: Sine

SCPI Commands:

```
[:SOURce]:PM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Bus

This softkey is one of the choices in the ΦM Sweep Trigger menu. With **Bus** selected, you use the HP-IB to trigger single sweeps of swept-sine phase modulation.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Waveform**, **Swept-Sine**, **ΦM Sweep Trigger**, **Bus**

Status after Normal Preset: ΦM sweep trigger is set to Immediate

SCPI Commands:

```
[:SOURce]:PM[1]|2:INTernal[1]:SWEep:TRIGger BUS
```

```
[:SOURce]:PM[1]|2:INTernal[1]:SWEep:TRIGger?
```

DCFM/DCΦM Cal

Pressing this softkey initiates a DCΦM calibration. This calibration eliminates the offset in DC phase modulation so that the carrier phase remains the same with no modulation applied. External, DC-coupled ΦM must be active when this command is executed.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **DCFM/DCΦM Cal**

SCPI Commands:

```
:CALibration:DCFM
```

Dual-Sine

Pressing this softkey reveals a menu of choices for setting the dual-sine phase modulation parameters. In this menu you can set the ΦM rates for two separate tones. In addition you can set a ratio of the tone 2 ΦM deviation to the tone 1 ΦM deviation.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Waveform**, **Dual-Sine**

SCPI Commands:

```
[:SOURce]:PM[1]|2:INTernal[1]:FUNCtion:SHAPe DUALsine
```

```
[:SOURce]:PM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Ext

This softkey is one of the choices in the ΦM Sweep Trigger menu. Choosing **Ext** allows you to trigger swept-sine phase modulation using a signal applied to the TRIGGER IN rear panel connector. Set the polarity of the trigger signal using the **Trigger In Polarity Neg Pos** softkey.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Waveform**, **Swept-Sine**, **ΦM Sweep Trigger**, **Ext**

Status after Normal Preset: ΦM sweep trigger is set to Immediate

SCPI Commands:

```
[:SOURce]:PM[1]|2:INTernal[1]:SWEep:TRIGger EXTernal
```

```
[:SOURce]:PM[1]|2:INTernal[1]:SWEep:TRIGger?
```

Ext 1 AC-Coupled

This softkey lets you input an external, AC-coupled, phase modulation signal to the EXT 1 INPUT connector. The modulation signal is tested for voltage and a display annunciator will report a high or low condition if the voltage is > ±3% of 1 Vpk.

The external 1 input has multiple uses but can be used for only one modulation at a time. If, for example, you were using the external 1 input in an amplitude modulation configuration for **AM Path 1**, and then you configured **ΦM Path 2** to also use the external 1 input, the signal generator would turn off **AM Path 1** and assign the external 1 input to your **ΦM Path 2** configuration. For the purposes of this discussion, the external 1 AC-coupled input is the same as the external 1 DC-coupled source.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **ΦM Source**, **Ext 1 AC-Coupled**

SCPI Commands:

```
[:SOURce]:PM[1]|2:SOURce EXTernal1
[:SOURce]:PM[1]|2:EXTernal[1]:COUPling AC
[:SOURce]:PM[1]|2:EXTernal[1]:COUPling?
```

Ext 1 DC-Coupled

This softkey lets you input an external, DC-coupled, phase modulation signal to the EXT 1 INPUT connector.

The external 1 input has multiple uses but can be used for only one modulation at a time. If, for example, you were using the external 1 input in an amplitude modulation configuration for **AM Path 1**, and then you configured **ΦM Path 2** to also use the external 1 input, the signal generator would turn off **AM Path 1** and assign the external 1 input to your **ΦM Path 2** configuration. For the purposes of this discussion, the external 1 AC-coupled input is the same as the external 1 DC-coupled source.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **ΦM Source**, **Ext 1 DC-Coupled**

SCPI Commands:

```
[:SOURce]:PM[1]|2:SOURce EXTernal1
[:SOURce]:PM[1]|2:EXTernal[1]:COUPling DC
[:SOURce]:PM[1]|2:EXTernal[1]:COUPling?
```

Ext 2 AC-Coupled

This softkey lets you input an external, AC-coupled, phase modulation signal to the EXT 2 INPUT connector. The modulation signal is tested for voltage and a display annunciator will report a high or low condition if the voltage is > ±3% of 1 Vpk.

The external 2 input has multiple uses but can be used for only one modulation at a time. If, for example, you were using the external 2 input in an amplitude modulation configuration for **AM Path 1**, and then you configured **ΦM Path 2** to also use the external 2 input, the signal generator would turn off **AM Path 1** and assign the external 2 input to your **ΦM Path 2** configuration. For the purposes of this discussion, the external 2 AC-coupled input is the same as the external 2 DC-coupled source.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **ΦM Source**, **Ext 2 AC-Coupled**

SCPI Commands:

```
[:SOURce]:PM[1]|2:SOURce EXTernal2

[:SOURce]:PM[1]|2:EXTernal2:COUPling AC

[:SOURce]:PM[1]|2:EXTernal2:COUPling?
```

Ext 2 DC-Coupled

This softkey lets you input an external, DC-coupled, phase modulation signal to the EXT 2 INPUT connector.

The external 2 input has multiple uses but can be used for only one modulation at a time. If, for example, you were using the external 2 input in an amplitude modulation configuration for **AM Path 1**, and then you configured **ΦM Path 2** to also use the external 2 input, the signal generator would turn off **AM Path 1** and assign the external 2 input to your **ΦM Path 2** configuration. For the purposes of this discussion, the external 2 AC-coupled input is the same as the external 2 DC-coupled source.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **ΦM Source**, **Ext 2 DC-Coupled**

SCPI Commands:

```
[:SOURce]:PM[1]|2:SOURce EXTernal2

[:SOURce]:PM[1]|2:EXTernal2:COUPling DC

[:SOURce]:PM[1]|2:EXTernal2:COUPling?
```

FM/ΦM Normal High BW

This softkey toggles between the menus for FM, normal ΦM, and wideband ΦM. Normal ΦM lets you set the phase deviation as high as N x 90 radians with a 3 dB bandwidth of 100 kHz. Wideband ΦM provides increased bandwidth while restricting the maximum deviation to deviation settings up to π/2 radians (90°). The modulation bandwidth is typically 6 MHz. For deviation settings between π/2 and 2π radians

(360°), the modulation bandwidth is typically 1.5 MHz. (These increased bandwidths are only available using ΦM **Path 1**. ΦM **Path 2** is limited to 1 MHz.)

Softkey Location: Press **FM/ΦM** hardkey, press **FM/ΦM** softkey once for normal bandwidth or twice for high bandwidth

Status after Normal Preset: FM

SCPI Commands:

```
[:SOURce]:PM[1]|2:BANDwidth|BWIDth NORMal|HIGH
[:SOURce]:PM[1]|2:BANDwidth|BWIDth?
```

Immediate

This softkey is one of the choices in the ΦM Sweep Trigger menu. Choosing **Immediate** immediately triggers swept-sine phase modulation in a continuous mode. To stop the sweep, choose a different trigger such as **Ext**, or set the waveform to something other than **Swept-Sine**.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Waveform**, **Swept-Sine**, **ΦM Sweep Trigger**, **Immediate**

Status after Normal Preset: ΦM sweep trigger is set to Immediate

SCPI Commands:

```
[:SOURce]:PM[1]|2:INTernal[1]:SWEep:TRIGger IMMediate
[:SOURce]:PM[1]|2:INTernal[1]:SWEep:TRIGger?
```

Internal

This softkey lets you internally generate an AC-coupled, phase modulation signal.

The internal source has multiple uses but can be used for only one modulation at a time. If, for example, you were using the internal source in an amplitude modulation configuration for **AM Path 1**, and then you configured **ΦM Path 2** to also use the internal source, the signal generator would turn off **AM Path 1** and assign the internal source to your **ΦM Path 2** configuration.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **ΦM Source**, **Internal**

Status after Normal Preset: Internal

SCPI Commands:

```
[:SOURce]:PM[1]|2:SOURce INT[1]
[:SOURce]:PM[1]|2:SOURce?
```

Noise

This softkey lets you specify noise as the phase modulation waveform for the **ΦM Path 1** and **ΦM Path 2** configurations. Notice that the selected waveform applies only to whichever ΦM path configuration you have currently selected.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Waveform**, **Noise**

SCPI Commands:

```
[:SOURce]:PM[1]|2:INTernal[1]:FUNCtion:SHAPe NOISe
[:SOURce]:PM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Ramp

This softkey lets you specify ramp as the phase modulation waveform for the **ΦM Path 1** and **ΦM Path 2** configurations. Notice that the selected waveform applies only to whichever ΦM path configuration you have currently selected.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Waveform**, **Ramp**

SCPI Commands:

```
[:SOURce]:PM[1]|2:INTernal[1]:FUNCtion:SHAPe RAMP
[:SOURce]:PM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Sine

This softkey lets you specify sine as the phase modulation waveform for the **ΦM Path 1** and **ΦM Path 2** configurations. Notice that the selected waveform applies only to whichever ΦM path configuration you have currently selected.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Waveform**, **Sine**

SCPI Commands:

```
[:SOURce]:PM[1]|2:INTernal[1]:FUNCtion:SHAPe SINe
[:SOURce]:PM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Square

This softkey lets you to specify square as the phase modulation waveform for the **ΦM Path 1** and **ΦM Path 2** configurations. Notice that the selected waveform applies only to whichever ΦM path configuration you have currently selected.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Waveform**, **Square**

SCPI Commands:

```
[:SOURce]:PM[1]|2:INTernal[1]:FUNCtion:SHAPe SQUare
[:SOURce]:PM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Swept-Sine

Pressing this softkey reveals a menu of choices for setting the swept-sine phase modulation parameters. In this menu you can set the start and stop ΦM rate and the sweep time. You can set the signal generator to a single, externally-triggered sweep on either a negative or positive TTL level or you can choose continuous sweep, triggered immediately. In this menu you can also select either a positive or negative polarity for the TRIGGER OUT signal.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Waveform**, **Swept-Sine**

SCPI Commands:

```
[:SOURce]:PM[1]|2:INTernal[1]:FUNCtion:SHAPe SWEPtsine
[:SOURce]:PM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Triangle

This softkey lets you to specify triangle as the frequency modulation waveform for the **ΦM Path 1** and **ΦM Path 2** configurations. Notice that the selected waveform applies only to whichever ΦM path configuration you have currently selected.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Waveform**, **Triangle**

SCPI Commands:

```
[:SOURce]:PM[1]|2:INTernal[1]:FUNCtion:SHAPe TRIangle
[:SOURce]:PM[1]|2:INTernal[1]:FUNCtion:SHAPe?
```

Trigger In Polarity Neg Pos

Press this softkey to toggle between a negative TTL level trigger (0 V) and a positive TTL level trigger (+5 V) for externally triggering swept-sine phase modulation.

This softkey is coupled to the **Trigger In Polarity Neg Pos** softkey for swept-sine AM, FM, and LF Out, and to the **Ext Neg** and **Ext Pos** sweep trigger selections in the Sweep/List Menu. If you set the **Trigger In Polarity Neg Pos** softkey in the ΦM Swept-Sine Menu to **Neg**, the

Trigger In Polarity Neg Pos softkey is also set to **Neg** for swept-sine AM, FM, and LF Out. And, in addition, if the step or list sweep trigger is set to **Ext Pos**, the trigger selection will automatically be changed to **Ext Neg**. The same softkeys will toggle to **Pos** or to **Ext Pos** if you select **Pos** in the Swept-Sine ΦM Menu.

Conversely, if the **Trigger In Slope Neg Pos** softkey is toggled in the swept-sine AM, FM, or LF Out menus, it will cause the swept-sine ΦM softkey to toggle also. This is also true for the **Ext Neg** and **Ext Pos** step or list sweep trigger selections.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Waveform**, **Swept-Sine**, **ΦM Sweep Trigger**, **Ext**, **Trigger In Polarity Neg Pos**

Status after Normal Preset: Pos

SCPI Commands:

```
:TRIGger[:SEQuence]:SLOPe POSitive|NEGative

:TRIGger[:SEQuence]:SLOPe?
```

Trigger Key

This softkey is one of the choices in the ΦM Sweep Trigger menu. With **Trigger Key** selected, when you press the **Trigger** front panel key you immediately trigger a single sweep of swept-sine phase modulation.

The **Trigger** key has autorepeat capability. Hold it down and you will repeatedly trigger sweeps until you release the key.

Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Waveform**, **Swept-Sine**, **ΦM Sweep Trigger**, **Trigger Key**

Status after Normal Preset: ΦM sweep trigger is set to Immediate

SCPI Commands:

```
[:SOURce]:PM[1]|2:INTernal[1]:SWEep:TRIGger KEY

[:SOURce]:PM[1]|2:INTernal[1]:SWEep:TRIGger?
```

Trigger Out Polarity Neg Pos

This softkey toggles the polarity of the TTL signal that is output at the rear panel TRIGGER OUT connector. When **Trigger Out Polarity Neg Pos** is set to **Pos**, the output signal is asserted high (+5 V) at the start of the swept-sine phase modulation sweep and low (0 V) when the sweep is concluded. Setting **Trigger Out Polarity Neg Pos** to **Neg** reverses the polarity, where a high is 0 V and a low is +5 V.

This softkey is coupled to the **Trigger Out Polarity Neg Pos** softkey in the swept-sine AM, FM, and LF Out menus and the sweep/list menu. When the polarity is toggled for this softkey in any one of these menus, it affects all locations of the softkey.

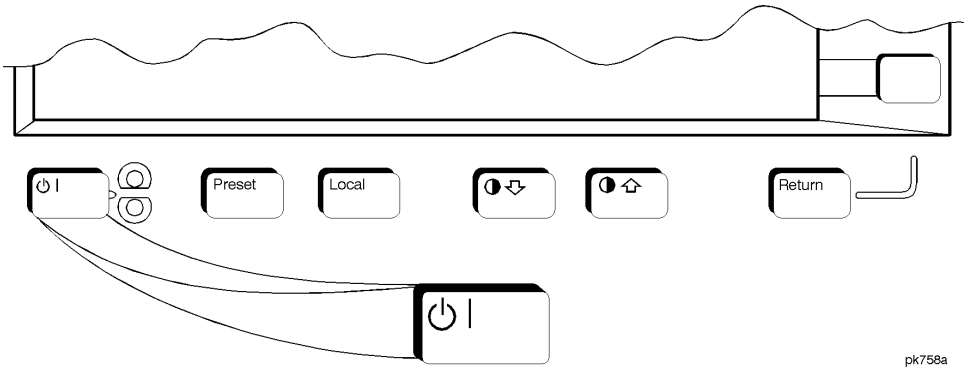
Softkey Location: Press **FM/ΦM** hardkey, toggle **FM/ΦM** softkey to **ΦM**, press **More (1 of 2)**, **ΦM Waveform**, **Swept-Sine**, **Trigger Out Polarity Neg Pos**

Status after Normal Preset: Pos

SCPI Commands:

```
:TRIGger:OUTPut:POLarity POSitive|NEGative

:TRIGger:OUTPut:POLarity?
```

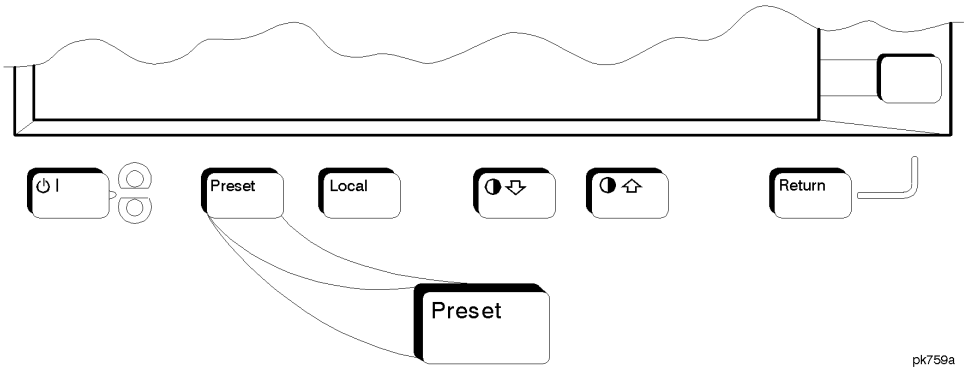
Power Switch



Pressing this front panel key toggles power to the signal generator either on (green LED on) or to standby (yellow LED on). In standby mode, the power switch is off but the instrument is still connected to the mains circuit by way of the power cord. The detachable power cord is the instrument disconnecting device. The front panel power switch, therefore, is not, and should not be used as, a line switch.

CAUTION Avoid turning off power to the signal generator unless it is quiescent (not currently changing state as a result of front panel operation or remote control).

Preset



This key sets the signal generator to a known state (either the factory-defined state or a user-defined state). The factory-defined preset conditions are shown in Table 5-4.

Use the **Preset Normal User** softkey to set your signal generator to the desired preset conditions (**Normal** = factory, **User** = a user-defined state). For details, refer to the **Preset Normal User** softkey description on page 5-156.

SCPI Commands:

```
:SYSTem:PRESet
```

Table 5-4 Factory-Defined Preset Conditions

Parameter	Condition	Parameter	Condition
Amplitude			
Amplitude	–135.00 dBm	Amplitude Increment	Persistent State
Amplitude Offset	0.00 dB	Amplitude Offset Increment	Persistent State
Amplitude Reference State	Off	Amplitude Reference	0.00 dBm
ALC	On	ALC BW	Normal
Alternate Amplitude	Off	Alternate Amplitude Delta	0.00 dB
Alternate Amplitude Trigger	Manual	Manual Trigger	Delta
Attenuator Hold	Off		

Parameter	Condition	Parameter	Condition
Amplitude Modulation			
AM Path	1	AM	Off
AM Depth	0.1%	AM Depth Increment	Persistent State
AM Rate	400 Hz	AM Rate Increment	Persistent State
AM Source	Internal	AM Waveform	Sine
AM Depth Coupling	Off		
BERT (Option UN7)			
BERT	Off	Display BER	Percent
Display Update	Cycle End	Data	PN9
Maximum Data Rate	2 Mbps	Total Bits	10000
Special Pattern Ignore	Off	Special Pattern	0's
BERT Resync	On	Resync Limits	0.4000
Pass/Fail	Off	Pass/Fail Limits	0.0100000
Pass/Fail Update	Cycle End	Clock Polarity	Pos
Data Polarity	Pos	Clock Gate	Off
Clock Gate Polarity	Pos	Impedance	TTL
BERT Trigger	Trigger Key	Cycle Count	1
Bit Delay	Off	Delayed Bits	0
CDMA (Option UND and UN5)			
CDMA	Off	Multicarrier	Off
Setup Selection	9 Ch Fwd	Chip Rate	1.228800 Mcps
Reconstruction Filter	2.500 MHz	Filter	IS-95 Mod w/EQ
Oversample Ratio (FIR Filter)	4	Waveform Length	1 Short Code
Oversample Ratio	5	ARB Reference	Internal
Trigger	Continuous		

Parameter	Condition	Parameter	Condition
Custom (Option UN8)			
Custom Modulation State	Off	Data	PN23
Filter	Root Nyquist	Filter Alpha	0.350
Optimize FIR for	ACP	Oversample Ratio (FIR Filter)	4
Filter Symbols	8	Symbol Rate	24.300 ksps
Modulation Type	π/4 DQPSK	Define User I/Q	Persistent State
Differential Encoding (User I/Q)	On	Configure Differential Encoding	Persistent State
Offset Q	Off	Define User FSK	Persistent State
Differential Encoding (User FSK)	Off	Differential Data Encode	Off
Burst Rise Time	5.860 bits	Burst Rise Delay	0.000 bits
Burst Fall Time	5.470 bits	Burst Fall Delay	0.000 bits
Sync Out	Begin Pattern	Ext Data Clock	Normal
BBG Data Clock	Internal	Phase Polarity	Normal
DECT (Option UN8)			
DECT	Off	Data Format	Pattern
Data	PN23	Sync Out	Begin Pattern
Filter	Gaussian	Filter BbT	0.500
Oversample Ratio (FIR Filter)	4	Filter Symbols	8
Symbol Rate	1.1520 Msps	Modulation Type	2-Lvl FSK
FSK Frequency Deviation	288.000 kHz	Define User I/Q	Persistent State
Differential Encoding (User I/Q)	Off	Configure Differential Encoding	Persistent State
Offset Q	Off	Define User FSK	Persistent State
Differential Encoding (User FSK)	Off	Phase Polarity	Normal
Burst Rise Time	13.797 Bits	Burst Rise Delay	–3.250 Bits
Burst Fall Time	11.529 Bits	Burst Fall Delay	–2.875 Bits
Frequency Channels	Off	Channel Number	0
Channel Band	Standard	External Data Clock	Normal
BBG Data Clock	Internal		
Display			
Brightness	Persistent State	Inverse Video	Persistent State
Screen Saver (Off/On)	Persistent State	Screen Saver Mode	Persistent State
Screen Saver Delay	Persistent State	Contrast	Persistent State

Parameter	Condition	Parameter	Condition
Dual ARB (Option UND)			
ARB State	Off	Waveform Selection	Off
ARB Sample Clock	6.1440 MHz	ARB Reference	Internal
Reconstruction Filter	2.500 MHz	Marker Polarity	Positive
Marker 2 To RF Blank	Off	Trigger	Continuous
Trigger Source	External	Retrigger Mode	On
Frequency			
Frequency	Max. Specified	Frequency Increment	Persistent State
Frequency Reference State	Off	Frequency Reference	0.00 Hz
Frequency Offset	0.00 Hz	Frequency Offset Increment	Persistent State
Frequency Multiplier	1	Phase Adjustment	0.000 Radians
Phase Adjustment Increment	Persistent State	Phase Noise Optimization	Mode 2 > 10 kHz Offset
Frequency Modulation			
FM Path	1	FM	Off
FM Deviation	1.0 kHz	FM Deviation Increment	Persistent State
FM Rate	400 Hz	FM Rate Increment	Persistent State
FM Source	Internal	FM Waveform	Sine
FM Deviation Coupling	Off		

Parameter	Condition	Parameter	Condition
GSM (Option UN8)			
GSM State	Off	Data Format	Pattern
Data	PN23	Sync Out	Begin Pattern
Filter	Gaussian	Filter BbT	0.300
Oversample Ration (FIR Filter)	4	Filter Symbols	8
Symbol Rate	270.833333 ksps	Modulation Type	MSK
MSK Phase Deviation	90 Degrees	Define User I/Q	Persistent State
Differential Encoding (User I/Q)	Off	Configure Differential Encoding	Persistent State
Offset Q	Off	Define User FSK	Persistent State
Differential Encoding (User FSK)	Off	Phase Polarity	Normal
Differential Data Encoding	On	Burst Rise Time	4.224 Bits
Burst Rise Delay	0.000 Bits	Burst Fall Time	3.440 Bits
Burst Fall Delay	0.125 Bits	Frequency Channels	Off
Channel Number	1	Channel Band	P-GSM Base
External 13 MHz	Off	External Data Clock	Normal
BBG Data Clock	Internal		
HP-IB/RS-232			
HP-IB Address	Persistent State	Remote Language	SCPI
RS-232 Baud Rate	Persistent State	RS-232 Echo	Persistent State
Transmit Pace	Persistent State	Receive Pace	Persistent State
RTS	Persistent State	RS-232 Timeout	Persistent State
I/Q Modulation			
I/Q	Off	I/Q Source	Ext I/Q
Burst Envelope	Off	Burst Source	Ext1 DC
I/Q Adjustments	Off	I/Q Gain	0.00 dB
I Offset	0.0%	Q Offset	0.0%
Quadrature Skew	0.0 Degrees	External I/Q Phase Polarity	Normal
ALC	On	I/Q Calibration Type	Persistent State
I/Q Calibration Start Frequency	Persistent State	I/Q Calibration Stop Frequency	Persistent State
Instrument Adjustments			
Step/Knob Ratio	Persistent State	Ref Osc Fine	Persistent State
Ref Osc Coarse	Persistent State		
Instrument Info/Help Mode			
Help Mode (Single/Continuous)	Persistent State	Modulation Status Information	On

Parameter	Condition	Parameter	Condition
LF Output			
LF Out State	Off	LF Out Source	Internal Modulation
LF Out Amplitude	0.000 V_p	LF Out Amplitude Increment	Persistent State
Memory Catalog			
Catalog Type	Persistent State		
NADC (Option UN8)			
NADC State	Off	Data Format	Pattern
Data	PN23	Sync Out	Begin Pattern
Filter	Root Nyquist	Filter Alpha	0.350
Optimize FIR For	EVM	Oversample Ration (FIR Filter)	4
Filter Symbols	8	Symbol Rate	24.3 ksps
Modulation Type	π/4DQPSK	Define User I/Q	Persistent State
Differential Encoding (User I/Q)	Off	Configure Differential Encoding	Persistent State
Offset Q	Off	Define User FSK	Persistent State
Differential Encoding (User FSK)	Off	Phase Polarity	Normal
Burst Rise Time	5.860 Bits	Burst Rise Delay	–1.0 Bits
Burst Fall Time	5.470 Bits	Burst Fall Delay	–1.0 Bits
Frequency Channels	Off	Channel Number	1
Channel Band	Base	External Data Clock	Normal
BBG Data Clock	Internal	I/Q Scaling	100%
Optimize FIR for	ACP		

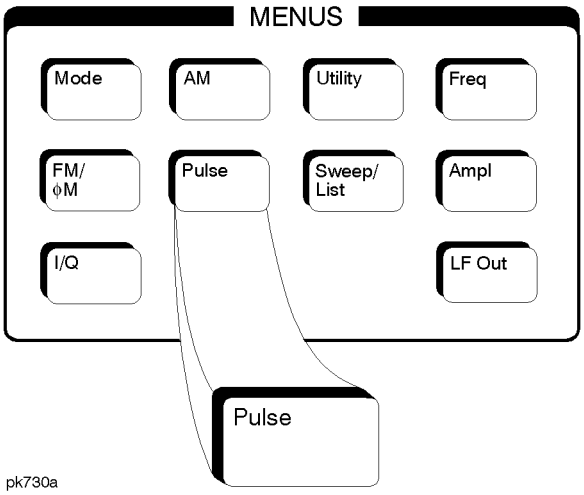
Parameter	Condition	Parameter	Condition
PDC (Option UN8)			
PDC State	Off	Data Format	Pattern
Data	PN23	Sync Out	Begin Pattern
Filter	Root Nyquist	Filter alpha	0.500
Optimize FIR For	EVM	Oversample Ratio (FIR Filter)	4
Filter Symbols	8	Symbol Rate	21.0 ksps
Modulation Type	π/4DQPSK	Define User I/q	Persistent State
Differential Encoding (User I/Q)	Off	Configure Differential Encoding	Persistent State
Offset Q	Off	Define User FSK	Persistent State
Differential Encoding (User FSK)	Off	Phase Polarity	Normal
Burst Rise Time	5.470 Bits	Burst Rise Delay	0.000 Bits
Burst Fall Time	3.830 Bits	Burst Fall Delay	–0.500 Bits
Frequency Channels	Off	Channel Number	1
Channel Band	800MHz Base	External Data Clock	Normal
BBG Data Clock	Internal	I/Q Scaling	100%
Phase Modulation			
ΦM BW	Normal	ΦM Path	1
ΦM Deviation	0.000 Radians	ΦM Dev. Increment	Persistent State
ΦM State	Off	ΦM Source	Internal
ΦM Rate	400 Hz	ΦM Rate Increment	Persistent State
ΦM Waveform	Sine	ΦM Deviation Coupling	Off

Parameter	Condition	Parameter	Condition
PHS (Option UN8)			
PHS State	Off	Data Format	Pattern
Data	PN23	Sync Out	Begin Pattern
Filter	Root Nyquist	Filter Alpha	0.500
Optimize FIR For	EVM	Oversample Ratio (FIR Filter)	4
Filter Symbols	8	Symbol Rate	192.0 ksps
Modulation Type	π/4DQPSK	Define User I/Q	Persistent State
Differential Encoding (User I/Q)	Off	Configure Differential Encoding	Persistent State
Offset Q	Off	Define User FSK	Persistent State
Differential Encoding (User FSK)	Off	Phase Polarity	Normal
Burst Rise Time	4.976 Bits	Burst Rise Delay	–1.500 Bits
Burst Fall Time	4.544 Bits	Burst Fall Delay	–1.500 Bits
Frequency Channels	Off	Channel Number	1
Channel Band	Standard	External Data Clock	Normal
BBG Data Clock	Internal	I/Q Scaling	100.0%
Power ON/Preset			
Power On (Last/Preset)	Persistent State	Preset Language	Persistent State
Preset (Normal/User)	Persistent State	PN9 Mode Preset	Persistent State
Pulse Modulation			
Pulse Modulation State	Off	Pulse Source	Internal Pulse
Pulse Period	80 µs	Pulse Period Increment	Persistent State
Pulse Width	40 µs	Pulse Width Increment	Persistent State
Rear Panel Outputs			
DATA OUT, DATA CLK OUT, SYMBOL SYNC OUT	On		
Signal Polarity Setup			
Trigger In Polarity	Positive	Symbol Sync Polarity	Positive
Burst Gate In Polarity	Positive	Pattern Trig In Polarity	Positive
Trigger Out Polarity	Positive	Data Out Polarity	Positive
Data Clock Out Polarity	Positive	Symbol Sync Out Polarity	Positive
Event 1 Polarity	Positive	Event 2 Polarity	Positive

Parameter	Condition	Parameter	Condition
Sweep List			
Sweep	Off	Sweep Type	List
Step Sweep Start Frequency	Maximum Specified	Step Sweep Stop Frequency	Maximum Specified
Step Sweep Frequency Increment	Persistent State	Sweep Repeat	Single
Step Sweep Start Amplitude	–135 dBm	Step Sweep Stop Amplitude	–135 dBm
Step Sweep Amplitude Increment	Persistent State	Step Sweep Number of Points	2
Step Sweep Dwell Time	2.0 ms	Step Sweep Dwell Time Increment	Persistent State
Sweep Trigger	Immediate	Point Trigger	Immediate
List Sweep Dwell Type	List	Sweep Direction	Up
Trigger Out Polarity	Positive		
TETRA (Option UN8)			
TETRA State	Off	Data Format	Pattern
Data	PN23	Sync Out	Begin Pattern
Filter	Root Nyquist	Filter Alpha	0.350
Optimize FIR For	EVM	Oversample Ratio (FIR Filter)	4
Filter Symbols	8	Symbol Rate	18.0 ksps
Modulation Type	π/4DQPSK	Define User I/Q	Persistent State
Differential Encoding (User I/Q)	Off	Configure Differential Encoding	Persistent State
Offset Q	On	Define User FSK	Persistent State
Differential Encoding (User FSK)	Off	Phase Polarity	Normal
Burst Rise Time	9.376 Bits	Burst Rise Delay	–1.0 Bits
Burst Fall Time	7.814 Bits	Burst Fall Delay	0.0 Bits
Frequency Channels	Off	Channel Number	1
Channel Band	Standard	External Data Clock	Normal
BBG Data Clock	Internal	I/Q Scaling	65%

Pulse

Pressing the front panel **Pulse** key reveals a menu of softkeys. These softkeys are described in this section in alphabetical order.



Ext2 DC-Coupled

This softkey lets you input an external, DC-coupled, pulse modulation signal to the EXT 2 INPUT connector.

The external 2 input has multiple uses but can be used for only one modulation at a time. If, for example you were using the external 2 input in a frequency modulation configuration for **FM Path 1**, and then you configured the pulse modulation source to also use the external 2 input, the signal generator would turn off **FM Path 1** and assign the external 2 input to your pulse configuration.

Softkey Location: Press **Pulse**, **Pulse Source**, **Ext2 DC-Coupled**

Status after Normal Preset: Pulse Source is set to Internal Square

SCPI Commands:

```
[:SOURce]:PULM:SOURce EXTernal2
[:SOURce]:PULM:SOURce?
```

Internal Pulse

This softkey lets you internally generate rectangular pulse modulation. Configure the pulse modulation using the **Pulse Period** and **Pulse Width** softkeys. For additional specifications, refer to Chapter 9, “Specifications,”

The internal source has multiple uses but can be used for only one modulation at a time. If, for example you were using the internal source in a frequency modulation configuration for **FM Path 1**, and then you configured the pulse modulation source to also use the internal source, the signal generator would turn off **FM Path 1** and assign the internal source to your pulse configuration.

Softkey Location: Press **Pulse**, **Pulse Source**, **Internal Pulse**

Status after Normal Preset: Pulse Source is set to Internal Square

SCPI Commands:

```
[:SOURce]:PULM:SOURce INT

[:SOURce]:PULM:SOURce?

[:SOURce]:PULM:INTernal[1]:FUNCtion:SHAPe PULSe

[:SOURce]:PULM:INTernal[1]:FUNCtion:SHAPe?
```

Internal Square

This softkey lets you internally generate squarewave pulse modulation. The duty cycle is set at 50% and you can set the pulse rate from 0.1 Hz to 50 kHz. For additional specifications, refer to Chapter 9, "Specifications."

The internal source has multiple uses but can be used for only one modulation at a time. If, for example you were using the internal source in a frequency modulation configuration for **FM Path 1**, and then you configured the pulse modulation source to also use the internal source, the signal generator would turn off **FM Path 1** and assign the internal source to your pulse configuration.

Softkey Location: Press **Pulse**, **Pulse Source**, **Internal Square**

Status after Normal Preset: Pulse Source is set to Internal Square

SCPI Commands:

```
[:SOURce]:PULM:SOURce INT

[:SOURce]:PULM:SOURce?

[:SOURce]:PULM:INTernal[1]:FUNCtion:SHAPe SQUare

[:SOURce]:PULM:INTernal[1]:FUNCtion:SHAPe?
```

Pulse Off On

This softkey enables the pulse modulation for whichever pulse source you have selected. Notice, however, that although you can enable the pulse modulation state with this softkey, the RF carrier is modulated by

the enabled modulation only when you have also set **Mod On/Off** to **On**. Whenever pulse modulation is enabled, the PULSE annunciator is turned on in the display.

Softkey Location: Press **Pulse**, **Pulse Off On**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:PULM:STATe ON|OFF|1|0
[:SOURce]:PULM:STATe?
```

Pulse Period

Use this softkey to change the pulse period for internal pulse modulation. To change the period, press the softkey once. The current value for pulse period is displayed in the active entry area. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **msec** or **µsec** terminator softkey. The range of values allowed is 16 µs to 30 s. If the value for pulse period is less than the value for pulse width, pulse width is changed to the same value as pulse period. Notice that pulse period applies only to internal pulse modulation; when external pulse modulation or internal square pulse modulation is selected, this softkey is disabled.

Softkey Location: Press **Pulse**, **Pulse Period**

Status after Normal Preset: 80 µs

SCPI Commands:

```
[:SOURce]:PULM:INTernal[1]:PERiod <val><unit>
[:SOURce]:PULM:INTernal[1]:PERiod?
```

Pulse Rate

Use this softkey to change the pulse rate for internal square pulse modulation. To change the rate, press the softkey once. The current value for pulse rate is displayed in the active entry area. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Hz** or **kHz** terminator softkey. The range of values allowed is 0.1 Hz to 50 kHz. Notice that the new value of pulse rate applies only to internal square pulse modulation; when external pulse modulation or internal pulse modulation is selected, this softkey is disabled.

Softkey Location: Press **Pulse**, **Pulse Rate**

Status after Normal Preset: 400 Hz

SCPI Commands:

```
[:SOURce]:PULM:INTernal[1]:FREQuency <val><unit>
[:SOURce]:PULM:INTernal[1]:FREQuency?
```

Pulse Width

Use this softkey to change the pulse width for internal pulse modulation. To change the pulse width, press the softkey once. The current value for pulse width is displayed in the active entry area. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **μsec** or **msec** terminator softkey. The range of values allowed is 8 μs to 30 s. Notice that the new value of pulse width applies only to internal pulse modulation; when external pulse modulation or internal square pulse modulation is selected, this softkey is disabled.

Softkey Location: Press **Pulse**, **Pulse Source**, **Internal Square**, **Pulse Width**

Status after Normal Preset: 40 μs

SCPI Commands:

```
[:SOURce]:PULM:INTernal[1]:PWIDth <val><unit>
[:SOURce]:PULM:INTernal[1]:PWIDth?
```

Pulse Source

Pressing this softkey reveals a menu of choices for pulse modulation sources. You can choose internally-generated pulse modulation, internally-generated square pulse modulation, or select an externally-applied, DC-coupled signal from the EXT 2 INPUT connector.

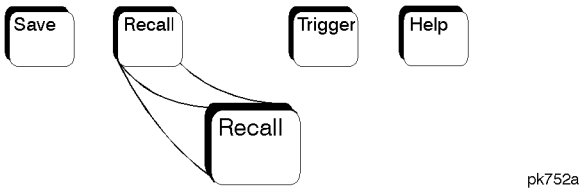
The internal and external 2 sources have multiple uses. However, you can use each source for only one modulation type at a time. If, for example, you were using the external 2 source in a frequency modulation configuration for **FM Path 1**, and then you configured the pulse modulation source to also use the external 2 source, the signal generator would turn off **FM Path 1** and assign the external 2 source to your pulse configuration.

Softkey Location: Press **Pulse**, **Pulse Source**

Status after Normal Preset: Internal Pulse

Recall

Pressing the front panel **Recall** key reveals a menu of softkeys. These softkeys are described in this section in alphabetical order.



Delete All Regs in Seq [n]

Press this softkey to delete the data saved in all of the registers of the selected sequence. Do not press this softkey until you have selected the correct sequence using the softkey. For example, if you want to delete the data in all of the registers that are saved in sequence 4, press **Select Seq**. The currently selected sequence is displayed in the active entry area. Change the number to 4 using the up and down arrow keys, the front panel knob, or enter a 4 using the numeric keypad and press the **Enter** terminator softkey. Sequence 4 is now displayed in all softkeys which specify a sequence in this menu. Now press **Delete All Regs in Seq [4]** and the data in all of the registers stored in sequence 4 will be deleted. Be certain that you want to delete this data; you cannot recover it once deleted.

NOTE This softkey has exactly the same function as the softkey with the identical name in the front panel **Save** key menu.

Softkey Location: Press **Recall**, **Delete All Regs in Seq[n]**

Delete All Sequences

Press this softkey to delete all of the data in all saved registers of all sequences. Be certain that you want to delete the data; you cannot recover it once deleted.

NOTE This softkey has exactly the same function as the softkey with the identical name in the front panel **Save** key menu.

Softkey Location: Press **Recall**, **Delete All Sequences**

Delete Seq[n] Reg[nn]

Press this softkey to delete the contents of a specified register in a specified sequence. Do not press this softkey until you have selected the correct sequence and register using the **Select Seq** and **Recall Reg** softkeys. For example, if you want to delete the contents of register 5 in

sequence 4, press **Select Seq**. The currently selected sequence is displayed in the active entry area. Change the number to 4 using the up and down arrow keys, the front panel knob, or enter a 4 using the numeric keypad and press the **Enter** terminator softkey. Sequence 4 is now displayed in all softkeys which specify a sequence in this menu. Now select register 5. (Remember, you must first have saved an instrument state to this register in sequence 4.) Press **Recall Reg**. The recall register number becomes the active function. Enter the number 5 using the numeric keypad and press the **Enter** terminator softkey. The instrument state is restored from this register and register 5 is now displayed in all softkeys which specify a register number in this menu. Now press **Delete Seq [4] Reg[05]** and register 5, stored in sequence 4, will be deleted. The instrument state that you had recalled from this register remains, however, until you change it. If you deleted this register in error, you can immediately resave it using the **Save Seq[n] Reg[n]** softkey in the **Save** menu.

NOTE This softkey has exactly the same function as the softkey with the identical name in the front panel **Save** key menu.

Softkey Location: Press **Recall**, **Delete Seq[n] Reg[nn]**

Recall Reg

Press this softkey to recall an instrument state from a saved register. Recalling a register also selects that register number for all softkeys which specify a register number in this menu. For example, if you want to select register 5, press **Recall Reg**. (Remember, you must first have saved an instrument state to this register in the current sequence identified by the **Select Seq** softkey. If there is nothing saved, you cannot recall it.) The recall register number becomes the active function. Enter the number 5 using the numeric keypad and press the **Enter** terminator softkey. The instrument state is restored from this register and register 5 is now displayed in all softkeys which specify a register in this menu. You can also use the front panel knob and the up and down arrow keys to scroll through all saved registers for the selected sequence, recalling each instrument state.

Softkey Location: Press **Recall**, **Recall Reg**

IEEE 488.2 Common Commands:

- *RCL <reg>[, <seq>]

Select Seq

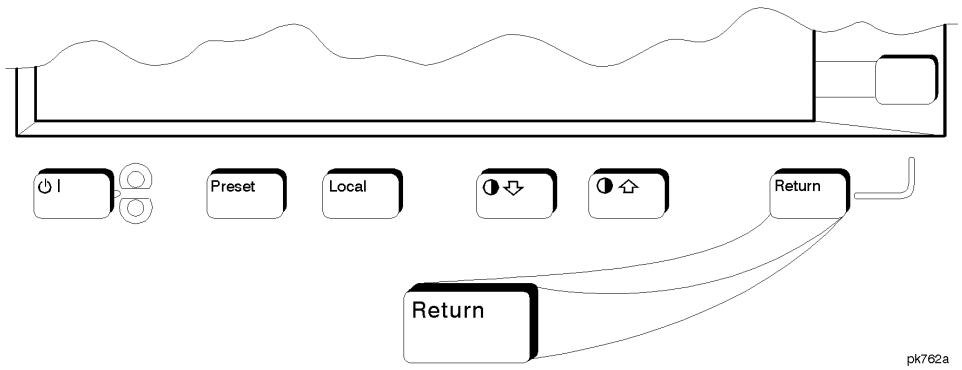
Press this softkey to choose a sequence for all softkeys which specify a sequence in this menu. For example, if you want to select sequence 4, press **Select Seq**. The currently selected sequence is displayed in the active entry area. Change the number to 4 using the up and down arrow keys, the front panel knob, or enter a 4 using the numeric keypad

and press the **Enter** terminator softkey. Sequence 4 is now displayed in all softkeys which specify a sequence in this menu. There are 100 registers available (0 through 99) in each of 10 (0 through 9) sequences. You can use these registers in any combination so long as the total number of registers used does not exceed 50.

NOTE The actual number of states that can be saved may be less if the user file system has non-instrument state files stored such as sweep/list sequences or binary files.

Softkey Location: Press **Recall**, **Select Seq**

Return



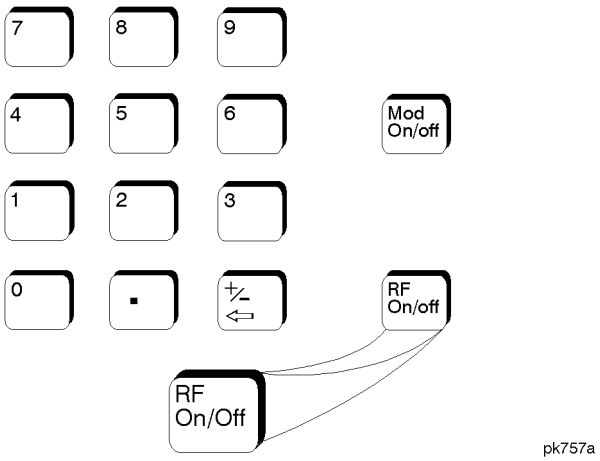
This front panel hardkey moves you from your current softkey menu to the softkey menu that precedes it. For example, press the **LF Out** front panel hardkey. The LF Out menu is displayed. Now press the **LF Out Source** softkey. (The arrow indicates that pressing this softkey will display another menu.) You should now see the LF Out Source menu. Press **Return**, and you are moved back to the LF Out menu.

When you are at the top level of the menus the **Return** key has no function.

The **Return** key has autorepeat capability. Hold it down and you are moved repeatedly back through the menus until you either release the key or you reach the top level of the menus.

While you are entering data with the numeric keypad, pressing the **Return** key cancels the data input and leaves the original value unchanged.

RF On/Off



This front panel hardkey toggles the RF signal on and off at the RF OUTPUT connector. Although you can configure and engage various modulations, no signal is available at the RF OUTPUT connector until **RF On/Off** is set to **On**. An annunciator is always turned on in the display to indicate whether RF is turned on or off.

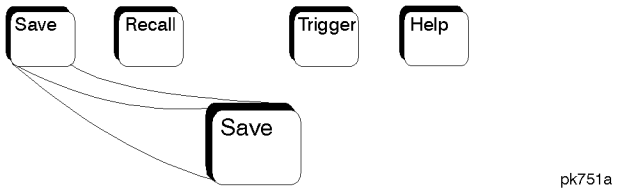
Status after Normal Preset: RF Off

SCPI Commands:

```
:OUTPut[:STATe] ON|OFF|1|0

:OUTPut[:STATe]?
```

Save

Pressing the front panel **Save** key reveals a menu of softkeys. These softkeys are described in this section in alphabetical order.



When you press the **Save** key, the text area of the display shows the registers in use and any comments associated with the registers for the last sequence accessed. The display is updated whenever you make any changes to the registers or to the comments.

Add Comment To Seq[n] Reg[nn]

Press this softkey to add a comment that is associated with a register in use. The register number is listed in the text area of the display and the comment is shown immediately following the register. You can use the comment line, for example, to identify the instrument state saved in a register.

The comment line can consist of up to 55 alpha-numeric characters and special characters. To add or change a comment, the following editing capabilities are provided:

- The **Editing Mode Insert Replace** softkey in the Editing Keys menu toggles the editing mode from inserting text to replacing text. Insertion mode causes text to be entered in the position directly to the right of the cursor. Replacement mode causes the text to be entered in the position held by the cursor (replacing any existing text in that position).
- The **Clear Text** softkey in the Editing Keys menu deletes all of the existing text in the active entry area.
- Use the left and right arrow keys to position the cursor. Use the front panel knob, up and down arrow keys, or the direct editing softkeys, to enter an alphabetic character, numeral, or special character.

When you have entered the comment text, press the **Enter** terminator softkey. If you have changed your mind, press the **Return** hardkey. Once you press **Enter**, the new comment is saved to your selected register and displayed immediately.

Softkey Location: Press **Save**, **Add Comment To Seq[n] Reg[nn]**

SCPI Commands:

```
:MEMory:STATe:COMMent <reg_num>,<seq_num>,<comment>
:MEMory:STATe:COMMent? <reg_num>,<seq_num>
```

Clear Text

Press this softkey to delete the comment text in the active entry area. If you want to change the comment text saved with a register, use this softkey to quickly delete the existing text, then use the remaining editing features to enter a new comment.

Softkey Location: Press **Save**, **Add Comment To Seq[n] Reg[nn]**, **Editing Keys**, **Clear Text**

Delete All Regs in Seq [n]

Press this softkey to delete the data saved in all of the registers of the selected sequence. Do not press this softkey until you have selected the correct sequence using the **Select Seq** softkey. For example, if you want to delete all of the registers that are saved in sequence 4, press **Select Seq**. The currently selected sequence is displayed in the active entry area. Change the number to 4 using the up and down arrow keys, the front panel knob, or enter a 4 using the numeric keypad and press the **Enter** terminator softkey. Sequence 4 is now displayed in all softkeys which specify a sequence in this menu. Now press **Delete All Regs in Seq [4]** and the data in all of the registers stored in sequence 4 will be deleted. Be certain that you want to delete the data; you cannot recover it once deleted.

NOTE This softkey has exactly the same function as the softkey with the identical name in the front panel **Recall** key menu.

Softkey Location: Press **Save**, **Delete All Regs in Seq [n]**

Delete All Sequences

Press this softkey to delete all of the data in all saved registers of all sequences. Be certain that you want to delete the data; you cannot recover it once deleted.

NOTE This softkey has exactly the same function as the softkey with the identical name in the front panel **Recall** key menu.

Softkey Location: Press **Save**, **Delete All Sequences**

Delete Seq[n] Reg[nn]

Press this softkey to delete the contents of a specified register in a specified sequence. Do not press this softkey until you have selected the correct sequence and register using the **Select Seq** and **Select Reg** softkeys. For example, if you want to delete register 5 in sequence 4, press **Select Seq**. The currently selected sequence is displayed in the active entry area. Change the number to 4 using the up and down arrow keys, the front panel knob, or enter a 4 using the numeric keypad and press the **Enter** terminator softkey. Sequence 4 is now displayed in all softkeys which specify a sequence number in this menu. Now, to select register 5, press **Select Reg**. The currently selected register is displayed in the active entry area. Change the number to 5 in the same way that you changed the sequence number. Register 5 is now displayed in all softkeys which specify a register number in this menu. Now press **Delete Seq [4] Reg[05]** and register 5, stored in sequence 4, will be deleted. Be certain that you want to delete the data; you cannot recover the data once deleted.

NOTE This softkey has exactly the same function as the softkey with the identical name in the front panel **Recall** key menu.

Softkey Location: Press **Save**, **Delete Seq[n] Reg[nn]**

Editing Keys

Pressing this softkey reveals a menu of choices for creating and editing the comment text for the selected register. In this menu you can delete the existing text in the active entry area (either the existing comment, or comment text that you have subsequently entered), and you can toggle the editing mode from inserting text to replacing text.

Softkey Location: Press **Save**, **Add Comment To Seq[n] Reg[nn]**, **Editing Keys**

Editing Mode Insert Replace

Press this softkey to toggle the editing mode from inserting text to replacing text. Insertion mode causes text to be entered in the position directly to the right of the cursor. Replacement mode causes the text to be entered in the position held by the cursor (replacing any existing text in that position).

Softkey Location: Press **Save**, **Add Comment To Seq[n] Reg[nn]**, **Editing Keys**, **Editing Mode Insert Replace**

Save Seq[n] Reg[nn]

Press this softkey to save the current instrument state in the specified register and sequence. The instrument state includes all of your setup selections except list and step sweep data and functions which are identified in this manual as persistent states. Do not press this softkey

until you have specified the correct sequence and register using the **Select Seq** and **Select Reg** softkeys. For example, if you want to save to register 5 in sequence 4, press **Select Seq**. The currently selected sequence is displayed in the active entry area. Change the number to 4 using the up and down arrow keys, the front panel knob, or enter a 4 using the numeric keypad and press the **Enter** terminator softkey. Sequence 4 is now displayed in all softkeys which specify a sequence in this menu. Now, to select register 5, press **Select Reg**. The currently selected register is displayed in the active entry area. Change the number to 5 in the same way that you changed the sequence number. Register 5 is now displayed in all softkeys which specify a register in this menu. Now press **Save Seq [4] Reg[05]** and the current instrument state will be stored in register 5 of sequence 4. There are 100 registers available (0 through 99) in each of 10 (0 through 9) sequences. You can use these registers in any combination so long as the total number of registers used does not exceed 100.

Softkey Location: Press **Save**, **Save Seq[n] Reg[nn]**

IEEE 488.2 Common Commands:

- *SAV <reg>[, <seq>]

Select Reg

Press this softkey to choose a register for all softkeys which specify a register in this menu. For example, if you want to select register 5, press **Select Reg**. The currently selected register is displayed in the active entry area. Change the number to 5 using the up and down arrow keys, the front panel knob, or enter a 5 using the numeric keypad and press the **Select Reg** terminator softkey. Register 5 is now displayed in all softkeys which specify a register in this menu.

You can also use this softkey to select a register and save the current instrument state to that register. For example, if you want to select and save to register 6, press **Select Reg**. The currently selected register is displayed in the active entry area. Change the number to 6 using the numeric keypad and press the **Save Reg** terminator softkey. Register 6 is now displayed in all softkeys which specify a register in this menu and the current instrument state has been saved to register 6.

There are 100 registers available (0 through 99) in each of 10 (0 through 9) sequences. You can use these registers in any combination so long as the total number of registers used does not exceed 100.

Softkey Location: Press **Save**, **Select Reg**

Select Seq

Press this softkey to choose a sequence for all softkeys which specify a sequence in this menu. For example, if you want to select sequence 4, press **Select Seq**. The currently selected sequence is displayed in the

active entry area. Change the number to 4 using the up and down arrow keys, the front panel knob, or enter a 4 using the numeric keypad and press the **Enter** terminator softkey. Sequence 4 is now displayed in all softkeys which specify a sequence in this menu.

There are 100 registers available (0 through 99) in each of 10 (0 through 9) sequences. You can use these registers in any combination so long as the total number of registers used does not exceed 100.

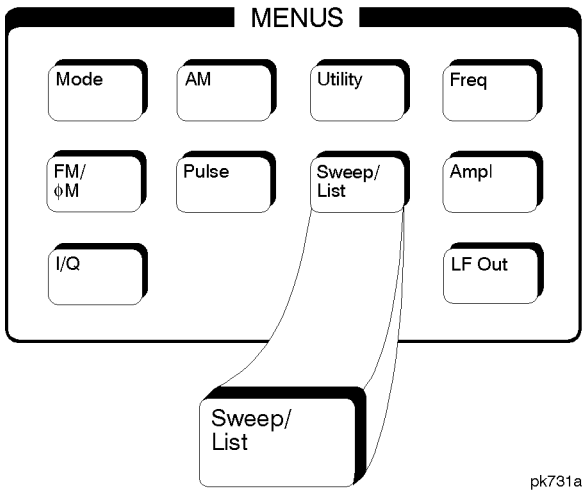
NOTE

The actual number of states that can be saved may be less if the user file system has non-instrument state files stored such as sweep/list sequences or binary files.

Softkey Location: Press **Save**, **Select Seq**

Sweep/List

Pressing the front panel **Sweep/List** key reveals a menu of softkeys. Using these softkeys you can define a series of points containing frequency, amplitude, and dwell time information for the signal generator to sweep. The softkeys are described in this section in alphabetical order.



Points

Press this softkey to define the number of points in a step sweep. To enter the number of points in the sweep, press **# Points**. The number of step sweep points becomes the active function and the current value is shown in the active entry area. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Ente**r terminator softkey. A step sweep must always have a minimum of 2 points and can be configured to have as many as 401 points.

Softkey Location: Press **Sweep/List**, **Configure Step Sweep**, **# Points**

Status after Normal Preset: 2

SCPI Commands:

```
[:SOURce]:SWEep:POINts <val>

[:SOURce]:SWEep:POINts?
```

Ampl

Press this softkey to set the signal generator to sweep amplitude data only. The frequency is set at a constant value determined by the **Frequency** front panel key. You can define a sweep containing both amplitude and frequency information and still choose to sweep amplitude only.

Softkey Location: Press **Sweep/List**, **Sweep**, **Ampl**

Status after Normal Preset: Sweep is set to Off

SCPI Commands:

```
[:SOURce]:POWer:MODE LIST
[:SOURce]:POWer:MODE?
```

Ampl Start

Press this softkey to set the amplitude of the first point in the sweep. You can set the value anywhere in the range of the signal generator's specified output power. Press **Ampl Start** and amplitude becomes the active function for the first point in the sweep. To enter the value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **dBm**, **dBuV**, **dBuVemf**, **mV**, **uV**, **mVemf**, or **uVemf** terminator softkey.

Softkey Location: Press **Sweep/List**, **Configure Step Sweep**, **Ampl Start**

Status after Normal Preset: –135 dBm

SCPI Commands:

```
[:SOURce]:POWer:STARt <val><unit>
[:SOURce]:POWer:STARt?
```

Ampl Stop

Press this softkey to set the amplitude of the last point in the sweep. You can set the value anywhere in the range of the signal generator's specified output power. Press **Ampl Stop** and amplitude becomes the active function for the last point in the sweep. To enter the value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **dBm**, **dBuV**, **dBuVemf**, **mV**, **uV**, **mVemf**, or **uVemf** terminator softkey.

Softkey Location: Press **Sweep/List**, **Configure Step Sweep**, **Ampl Stop**

Status after Normal Preset: –135 dBm

SCPI Commands:

```
[:SOURce]:POWer:STOP <val><unit>
[:SOURce]:POWer:STOP?
```

Bus

This softkey is one of the choices in both the Sweep Trigger menu and the Point Trigger menu. Press either the **Sweep Trigger** softkey or the **Point Trigger** softkey to view these menus. Choosing **Bus** in the Sweep Trigger menu allows you to trigger a list or step sweep using the HP-IB. Choosing **Bus** in the Point Trigger menu allows you to trigger a sweep point-by-point using the HP-IB via *TRG or the GET line (Group Execute Trigger).

Softkey Location: Press **Sweep/List**, **More (1 of 2)**, **Sweep Trigger**, **Bus** or press **Sweep/List**, **More (1 of 2)**, **Point Trigger**, **Bus**

Status after Normal Preset: Sweep and point trigger are set to Immediate

SCPI Commands:

```
[:SOURce]:LIST:TRIGger:SOURce BUS
[:SOURce]:LIST:TRIGger:SOURce?
```

Configure List Sweep

Pressing this softkey reveals a menu of softkeys for defining a list sweep. In this menu you can insert and delete points in a sweep. Each point can contain frequency, amplitude, and dwell time information. The list point information is stored in three binary files: FREQ_FILE, POW_FILE, and DWEL_FILE. These files will survive a preset but not a power cycle. If they are deleted, the signal generator will recreate these files as needed. In this menu you can also edit existing points in the sweep.

Softkey Location: Press **Sweep/List**, **Configure List Sweep**

SCPI Commands:

```
[:SOURce]:LIST:DWELl <val>{, <val>}
[:SOURce]:LIST:DWELl?
[:SOURce]:LIST:DWELl:POINts?
[:SOURce]:LIST:FREQuency <val>{, <val>}
[:SOURce]:LIST:FREQuency?
[:SOURce]:LIST:FREQuency:POINts?
[:SOURce]:LIST:POWer <val>{, <val>}
[:SOURce]:LIST:POWer?
[:SOURce]:LIST:POWer:POINts?
```

Configure Step Sweep

Pressing this softkey reveals a menu of softkeys for defining a step sweep. In this menu you can set the start and stop frequencies for a sweep, set the start and stop power levels, and you can set the number of points in the sweep with the dwell time at each point.

Softkey Location: Press **Sweep/List**, **Configure Step Sweep**

Delete File

Press this softkey to delete a file in the catalog listing. Use the up and down arrow keys until the file you wish to delete is highlighted. Press **Delete File** and then press the **Confirm Delete** softkey. Be certain that you want to delete the file; you cannot recover this sweep data once you press **Confirm Delete**. If you do not want to delete the file, press **Return** instead of **Confirm Delete**.

Softkey Location: Press **Sweep/List**, **Configure List Sweep**, **More (1 of 2)**, **Load/Store**, **Delete File**

Delete Item

Press this softkey to delete an item in the displayed list of sweep points. Use the arrow keys until the desired item is highlighted. Then press **Delete Item** to eliminate this item from the sweep list. Be certain that you want to delete this item; you cannot recover it once you have deleted it. If the last item in a list is deleted, it is replaced by the default value.

Softkey Location: Press **Sweep/List**, **Configure List Sweep**, **Delete Item**

Delete Row

Press this softkey to delete a selected row in the sweep list. Use the up and down arrow keys until any item is selected in the row you wish to delete. Press **Delete Row** and the entire row is deleted. Be certain that you want to delete the row; you cannot recover this sweep data once you press **Delete Row**. If the last row in a list is deleted, it is replaced by the default value.

Softkey Location: Press **Sweep/List**, **Configure List Sweep**, **Delete Row**

Dwell Type List Step

Press this softkey to toggle the dwell time for the list sweep points between the values defined in the list sweep and the value set for step sweep. Choose **List** to sweep with dwell times that you have defined in the list sweep. Choose **Step** and you will sweep each point in the list with a dwell time set by the **Step Dwell** softkey in the Configure Step

Sweep menu. When you are sweeping using the step sweep dwell time, the list sweep dwell time values are grayed out to indicate that they are not being used.

Status after Normal Preset: List

Softkey Location: Press **Sweep/List**, **Configure List Sweep**, **More (1 of 2)**, **Dwell Type List Step**

SCPI Commands:

```
[:SOURce]:LIST:DWELl:TYPE <val>{, <val>}

[:SOURce]:LIST:DWELl:TYPE LIST|STEP

[:SOURce]:LIST:DWELl:TYPE?
```

Edit Item

Press this softkey to change an item in the displayed list of sweep points. Use the arrow keys or the front panel knob until the correct item is highlighted. Press **Edit Item** and the item is displayed in the active entry area. Change the value using the up and down arrow keys, or the front panel knob and press the **Enter** terminator softkey. Or enter a new value using the numeric keypad and then press a units terminator softkey.

A short cut for editing, Auto Edit, is also available. Highlight the item you want to edit. Enter a new value *using the numeric keys*; editing immediately starts for the highlighted item. Press the **Enter** terminator softkey. The new value is stored and the next item is highlighted.

Softkey Location: Press **Sweep/List**, **Configure List Sweep**, **Edit Item**

Ext

This softkey is one of the choices in both the Sweep Trigger menu and the Point Trigger menu. Press either the **Sweep Trigger** softkey or the **Point Trigger** softkey to view this key. Choosing **Ext** allows you to trigger a sweep point-by-point on either the negative or positive edge of a signal applied to the TRIGGER IN rear panel connector. Set the polarity of the trigger signal using the **Trigger In Polarity Neg Pos** softkey.

Softkey Location: Press **Sweep/List**, **More (1 of 2)**, **Sweep Trigger**, **Ext** or press **Sweep/List**, **More (1 of 2)**, **Point Trigger**, **Ext**

Status after Normal Preset: Immediate

SCPI Commands:

```
[:SOURce]:LIST:TRIGger:SOURce EXTernal

[:SOURce]:LIST:TRIGger:SOURce?

:TRIGger[:SEQuence]:SOURce EXTernal
```

```
:TRIGger[:SEQuence]:SOURce?
:TRIGger[:SEQuence]:SLOPe?
```

Freq

Press this softkey to set the signal generator to sweep frequency data only. The amplitude is set at a constant level determined by the **Amplitude** front panel key. You can define a sweep containing both amplitude and frequency information and still choose to sweep frequency only.

Softkey Location: Press **Sweep/List**, **Sweep**, **Freq**

Status after Normal Preset: Sweep is set to Off

SCPI Commands:

```
[:SOURce]:FREQuency:MODE LIST
[:SOURce]:FREQuency:MODE?
```

Freq&Ampl

Press this softkey to set the signal generator to sweep both frequency and amplitude data. Both the frequency and the amplitude lists must have the same number of points or they must have only one point. If a list has only one point, then that point is used for each of the other list's points.

Softkey Location: Press **Sweep/List**, **Sweep**, **Freq&Ampl**

Status after Normal Preset: Sweep is set to Off

SCPI Commands:

```
[:SOURce]:POWer:MODE LIST
[:SOURce]:POWer:MODE?
[:SOURce]:FREQuency:MODE LIST
[:SOURce]:FREQuency:MODE?
```

Freq Start

Press this softkey to set the frequency of the first point in the sweep. You can set the value anywhere in the range of the signal generator's specified output frequency. Press **Freq Start** and frequency becomes the active function for the first point in the sweep. To enter the value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **GHz**, **MHz**, **kHz**, or **Hz** terminator softkey.

Softkey Location: Press **Sweep/List**, **Configure Step Sweep**, **Freq Start**

Status after Normal Preset: Maximum specified frequency

SCPI Commands:

```
[:SOURce]:FREQuency:STARt <val><unit>
[:SOURce]:FREQuency:STARt?
```

Freq Stop

Press this softkey to set the frequency of the last point in the sweep. You can set the value anywhere in the range of the signal generator's specified output frequency. Press **Freq Stop** and frequency becomes the active function for the last point in the sweep. To enter the value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **GHz**, **MHz**, **kHz**, or **Hz** terminator softkey.

Softkey Location: Press **Sweep/List**, **Configure Step Sweep**, **Freq Stop**

Status after Normal Preset: Maximum specified frequency

SCPI Commands:

```
[:SOURce]:FREQuency:STOP <val><unit>
[:SOURce]:FREQuency:STOP?
```

Goto Bottom Row

Press this softkey to move the selection bar to the bottom row of list sweep points when you are in the Goto Row menu that is accessed from the Configure List Sweep menu. If you are in the Goto Row menu that is accessed from the Load/Store menu, the selection bar moves to the bottom row of the catalog of list files.

Softkey Location: Press **Sweep/List**, **Configure List Sweep**, **Goto Row**, **Goto Bottom Row**
or press **Sweep/List**, **Configure List Sweep**, **More (1 of 2)**, **Load/Store**, **Goto Row**, **Goto Bottom Row**

Goto Middle Row

Press this softkey to move the selection bar to the middle row of list sweep points when you are in the Goto Row menu that is accessed from the Configure List Sweep menu. If you are in the Goto Row menu that is accessed from the Load/Store menu, the selection bar moves to the middle row of the catalog of list files.

Softkey Location: Press **Sweep/List**, **Configure List Sweep**, **Goto Row**, **Goto Middle Row**
or press **Sweep/List**, **Configure List Sweep**, **More (1 of 2)**, **Load/Store**, **Goto Row**, **Goto Middle Row**

Goto Row

Pressing this softkey reveals a menu of softkeys that help you move the selection bar through the rows of list sweep points when you are in the Configure List Sweep menu. If you are in the Load/Store menu, the softkeys help you move the selection bar through the catalog of list files. You can also go to a specific row by rotating the front panel knob, using the up and down arrow keys, or entering the row number with the numeric keypad. Once the desired row number is displayed, press the **Enter** terminator softkey.

Softkey Location: Press **Sweep/List**, **Configure List Sweep**, **Goto Row**
or press **Sweep/List**, **Configure List Sweep**, **More (1 of 2)**, **Load/Store**, **Goto Row**

Goto Top Row

Press this softkey to move the selection bar to the top row of list sweep points when you are in the Goto Row menu that is accessed from the Configure List Sweep menu. If you are in the Goto Row menu that is accessed from the Load/Store menu, the selection bar moves to the top row of the catalog of list files.

Softkey Location: Press **Sweep/List**, **Configure List Sweep**, **Goto Row**, **Goto Top Row**
or press **Sweep/List**, **Configure List Sweep**, **More (1 of 2)**, **Load/Store**, **Goto Row**, **Goto Top Row**

Immediate

This softkey is one of the choices in both the Sweep Trigger menu and the Point Trigger menu. Press either the **Sweep Trigger** softkey or the **Point Trigger** softkey to view these menus. Choosing **Immediate** in the Sweep Trigger menu immediately triggers the current sweep when you press the **Single Sweep** softkey. When sweep repeat is continuous and **Immediate** is chosen for the sweep trigger, then sweeps are triggered consecutively (a new sweep is triggered as soon as the current sweep ends). Choosing **Immediate** in the Point Trigger menu causes the sweep to pause for the dwell time at each point after the hardware has been set up for that point's frequency and amplitude.

Softkey Location: Press **Sweep/List**, **More (1 of 2)**, **Sweep Trigger**, **Immediate**
or press **Sweep/List**, **More (1 of 2)**, **Point Trigger**, **Immediate**

Status after Normal Preset: Sweep and point trigger are set to Immediate

SCPI Commands:

```
[:SOURce]:LIST:TRIGger:SOURce IMMediate

[:SOURce]:LIST:TRIGger:SOURce?
```

Insert Item

Press this softkey to place a copy of the selected item directly below that item in the sweep list. First use the up and down arrow keys until the item you wish to copy is selected. Press **Insert Item** and an identical copy of the selected item is placed below it.

Softkey Location: Press **Sweep/List**, **Configure List Sweep**, **Insert Item**

Insert Row

Press this softkey to place a copy of the selected row directly below that row in the sweep list. First use the up and down arrow keys until any item is selected in the row you wish to copy. Press **Insert Row** and an identical copy of the selected row is placed below it.

Softkey Location: Press **Sweep/List**, **Configure List Sweep**, **Insert Row**

Load From Selected File

Press this softkey to load the list sweep data from a file into the current sweep list. Use the arrow keys to highlight the desired sweep list file. Press **Load From Selected File** and the list sweep data from the selected file is loaded into the current list sweep. You can only have one list sweep at a time so the existing list sweep data will be lost unless it is first stored to a file. This softkey is inactive unless at least one list sweep data file has been stored to memory.

Softkey Location: Press **Sweep/List**, **Configure List Sweep**, **More (1 of 2)**, **Load/Store**, **Load From Selected File**

SCPI Commands:

```
:MEMory:LOAD:LIST "<file_name>"
```

```
:MMEMory:LOAD:LIST "<file_name>"
```

Load List From Step Sweep

Press this softkey to eliminate the existing sweep list data and replace it with the step sweep data points. You can only have one sweep list at a time so be certain that you wish to delete the existing list. You cannot recover the sweep list data once you press **Load List From Step Sweep**.

Softkey Location: Press **Sweep/List**, **Configure List Sweep**, **More (1 of 2)**, **Load List From Step Sweep**

SCPI Commands:

```
:LIST:TYPE:LIST:INITialize:FSTep
```

Load/Store

Pressing this softkey reveals a menu of choices for storing list sweep data to a file or loading list sweep data from a file into the current sweep list. In this menu you can also delete existing list sweep files.

Softkey Location: Press **Sweep/List**, **Configure List Sweep**, **More (1 of 2)**, **Load/Store**

Manual Mode Off On

This softkey toggles manual selection of the current sweep point on and off. When **Manual Mode** is **On**, the selected sweep/list point controls the frequency and amplitude according to the sweep type. The current point in the sweep is displayed in the active entry area and also below the **Manual Point** softkey. This softkey is disabled when **Sweep** is set to **Off**.

Softkey Location: Press **Sweep/List**, **More (1 of 2)**, **Manual Mode Off On**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:LIST:MODE AUTO|MANual

[:SOURce]:LIST:MODE?
```

Manual Point

Press this softkey to choose a point in the sweep list. When **Manual Mode** is **On**, the selected sweep/list point controls the frequency and amplitude according to the sweep type. The current point number is shown in the active entry area when you press **Manual Point**. The frequency of the point is shown in the frequency area of the display. The amplitude of the point is shown in the amplitude area of the display. You can choose which point to sweep using the up and down arrow keys, the front panel knob, or by entering the point number desired using the numeric keypad and pressing the **Enter** terminator softkey. This softkey is disabled when **Manual Mode Off On** is set to **Off**.

Softkey Location: Press **Sweep/List**, **More (1 of 2)**, **Manual Point**

Status after Normal Preset: 1

SCPI Commands:

```
[:SOURce]:LIST:MANual <val>

[:SOURce]:LIST:MANual?
```

Off

This softkey turns off all sweep functions. The output signal is then set according to the current frequency and amplitude settings defined by the front panel **Frequency** and **Amplitude** keys.

Softkey Location: Press **Sweep/List**, **Sweep**, **Off**

SCPI Commands:

```
[:SOURce]:FREQuency:MODE CW|FIXED

[:SOURce]:FREQuency:MODE?

[:SOURce]:POWer:MODE FIXED

[:SOURce]:POWer:MODE?
```

Page Down

Press this softkey to view the next page of list sweep points when you are in the Goto Row menu that is accessed from the Configure List Sweep menu. If you are in the Load/Store menu or the Goto Row menu that is accessed from the Load/Store menu, you will view the next page of the catalog of list files.

Softkey Location: Press **Sweep/List**, **Configure List Sweep**, **Goto Row**, **Page Down**
or press **Sweep/List**, **Configure List Sweep**, **More (1 of 2)**, **Load/Store**, **Page Down**
or press **Sweep/List**, **Configure List Sweep**, **More (1 of 2)**, **Load/Store**, **Goto Row**, **Page Down**

Page Up

Press this softkey to view the previous page of list sweep points when you are in the Goto Row menu that is accessed from the Configure List Sweep menu. If you are in the Load/Store menu or the Goto Row menu that is accessed from the Load/Store menu, you will view the previous page of the catalog of list files.

Softkey Location: Press **Sweep/List**, **Configure List Sweep**, **Goto Row**, **Page Up**
or press **Sweep/List**, **Configure List Sweep**, **More (1 of 2)**, **Load/Store**, **Page Up**
or press **Sweep/List**, **Configure List Sweep**, **More (1 of 2)**, **Load/Store**, **Goto Row**, **Page Up**

Point Trigger

Pressing this softkey reveals a menu of choices for triggering a sweep point-by-point. You can choose triggering that occurs after the dwell time for the previous point has passed, triggering that is supplied by the HP-IB, triggering on either the positive or negative edge of a signal supplied to the TRIGGER IN connector, or triggering by the front panel **Trigger** key.

Softkey Location: Press **Sweep/List**, **More (1 of 2)**, **Point Trigger**

Status after Normal Preset: Immediate

SCPI Commands:

```
[:SOURce]:LIST:TRIGger:SOURce BUS|IMMediate|EXTernal|KEY
[:SOURce]:LIST:TRIGger:SOURce?
```

Preset List

Press this softkey to eliminate the current sweep list and replace it with a new list consisting of the following: one point at the maximum specified frequency, with an amplitude of –135 dBm, and a dwell time of 2 ms. Be certain that you want to delete the current sweep list; you cannot recover the information once you press **Preset List.**

Softkey Location: Press **Sweep/List**, **Configure List Sweep**, **More (1 of 2)**, **Preset List**

SCPI Commands:

```
:LIST:TYPE:LIST:INITialize:PRESet
```

Single Sweep

Press this softkey to arm the sweep. The ARMED annunciator will turn on in the display. The signal generator will begin the sweep as soon as the sweep trigger is received. If you have set the sweep trigger to **Immediate**, a sweep is initiated as soon as you arm the sweep. The sweep sets the power and the frequency to the first point of the sweep while it is not initiated or is waiting for the sweep trigger. This softkey is disabled when **Sweep** is set to **Off.**

Softkey Location: Press **Sweep/List**, **Single Sweep**

SCPI Commands:

```
:INITiate:CONTinuous[:ALL] ON|OFF|1|0
:INITiate[:IMMediate][:ALL]
:INITiate[:IMMediate][:ALL]?
```

Step Dwell

Press this softkey to set the dwell time for each point of a step sweep. To set the dwell time, press **Step Dwell.** The current dwell time is displayed in the active entry area. Enter the desired dwell time using the up and down arrow keys, the front panel knob, or enter a value using the numeric keypad and press the **sec** or **msec** terminator softkey. The range of values allowed is 1 ms through 60 s in 1 ms increments. Dwell time is

used when the point trigger is **Immediate**. The dwell time is the amount of time the sweep is guaranteed to pause after setting the frequency and power for the current sweep/list point.

Softkey Location: Press **Sweep/List**, **Configure Step Sweep**, **Step Dwell**

SCPI Commands:

```
[:SOURce]:SWEep:DWELl <val>

[:SOURce]:SWEep:DWELl?
```

Store to File

Press this softkey to store the current list sweep data to a file in internal non-volatile memory. Press **Store To File** and you will automatically enter the editing mode to create a file name.

The file name can consist of up to 23 alpha-numeric and special characters. The following steps show you how to create the following example file name, `FREQ 1453 TO 1465 MHZ`:

NOTE The following example uses softkeys to enter the file name. You can also use a combination of the front panel knob and the arrow keys to accomplish the same function.

1. Press the softkey labeled **ABCDEFG**. A menu is revealed containing a softkey for each alphabetic character from A through G.
2. Press the softkey labeled **F**. An F is entered as the first character in your file name. Notice that the active entry area now shows `Store to: F`.
3. Enter an R in the file name by pressing the **OPQRSTU** softkey and then pressing the **R** softkey. Enter an E and a Q.
4. Next enter a space by pressing the **& # + –** softkey and then pressing .
5. Enter the value 1453 using the numeric keypad.
6. Enter another space and the letters TO.
7. Enter another space and the value 1465.
8. Enter another space and the letters MHZ.
9. Now press the **Enter** terminator softkey and the list sweep data is saved with the file name, `FREQ 1453 TO 1465 MHZ`. The characters `@LIST` are automatically appended to the file name as file type identification.

Softkey Location: Press **Sweep/List**, **Configure List Sweep**, **More (1 of 2)**, **Load/Store**, **Store To File**

SCPI Commands:

```
:MEMory:STORe:LIST "<file_name>"
:MMEMory:STORe:LIST "<file_name>"
```

Sweep

Pressing this softkey reveals a menu of choices for determining the sweep parameters. In this menu you can choose to sweep frequency only, amplitude only, or both frequency and amplitude. You can also choose to turn off all sweep functions.

Softkey Location: Press **Sweep/List**, **Sweep**

Status after Normal Preset: Off

SCPI Commands:

```
[:SOURce]:FREQuency:MODE CW|FIXed|LIST
[:SOURce]:FREQuency:MODE?
[:SOURce]:POWer:MODE FIXed|LIST
[:SOURce]:POWer:MODE?
```

Sweep Direction Down Up

This softkey changes the direction of the sweep. Choose **Up** to sweep from the first point in the list to the last point, or from the step sweep start frequency and amplitude to the stop frequency and amplitude. Choose **Down** to reverse the direction of the sweep.

Softkey Location: Press **Sweep/List**, **More (1 of 2)**, **Sweep Direction Down Up**

Status after Normal Preset: Up

SCPI Commands:

```
[:SOURce]:LIST:DIRection UP|DOWN
[:SOURce]:LIST:DIRection?
```

Sweep Repeat Single Cont

This softkey toggles the sweep repetition between single sweep or continuous sweep types. The sweep and point triggers will then trigger the sweep.

Softkey Location: Press **Sweep/List**, **Sweep Repeat Single Cont**

Status after Normal Preset: Single

SCPI Commands:

```
:INITiate:CONTinuous[:ALL] ON|OFF|1|0
:INITiate:CONTinuous[:ALL]?
```

Sweep Trigger

Pressing this softkey reveals a menu of choices for triggering a full sweep. You can choose triggering that occurs immediately once a sweep is armed, triggering that is supplied by the HP-IB, triggering on either the positive or negative edge of a signal supplied to the TRIGGER IN connector, or triggering by the front panel **Trigger** key.

Softkey Location: Press **Sweep/List**, **More (1 of 2)**, **Sweep Trigger**

Status after Normal Preset: Immediate

SCPI Commands:

```
:TRIGger[:SEQuence]:SOURce |BUS|IMMediate|EXTernal|KEY
:TRIGger[:SEQuence]:SOURce?
```

Sweep Type List Step

This softkey toggles the sweep type from list sweep to step sweep. You create a list sweep by supplying the frequency, amplitude, and dwell time for each point in the sweep. You create a step sweep by supplying the start and stop frequency and amplitude, the number of points, and a dwell time. The signal generator then calculates the points between the first and last point in a linear manner.

Softkey Location: Press **Sweep/List**, **Sweep Type List Step**

Status after Normal Preset: List

SCPI Commands:

```
[:SOURce]:LIST:TYPE LIST|STEP
[:SOURce]:LIST:TYPE?
```

Trigger Key

This softkey is one of the choices in both the Sweep Trigger menu and the Point Trigger menu. Press either the **Sweep Trigger** softkey or the **Point Trigger** softkey to view these menus. Choosing **Trigger Key** in the Sweep Trigger menu immediately triggers an armed sweep when you press the **Trigger** front panel key. Choosing **Trigger Key** in the Point Trigger menu immediately triggers the next point in a running sweep.

Softkey Location: Press **Sweep/List**, **More (1 of 2)**, **Sweep Trigger**, **Trigger Key** or press **Sweep/List**, **More (1 of 2)**, **Point Trigger**, **Trigger Key**

Status after Normal Preset: Sweep and point trigger are set to Immediate

SCPI Commands:

```
[:SOURce]:LIST:TRIGger:SOURce KEY
[:SOURce]:LIST:TRIGger:SOURce?
```

Trigger Out Polarity Neg Pos

This softkey toggles the polarity of the TTL signal that is output at the rear panel TRIGGER OUT connector. When **Trigger Out Polarity Neg Pos** is set to **Pos** the output signal is asserted high (+5 V) at the start of a dwell sequence, or at the start of waiting for the point trigger, and low (0 V) when the dwell is over, or when the point trigger is received. Setting **Trigger Out Polarity Neg Pos** to **Neg** reverses the polarity where a high is 0 V and a low is +5 V.

This softkey is coupled to the **Trigger Out Polarity Neg Pos** softkey in the swept-sine AM, FM, ΦM, and LF Out menus. When the polarity is toggled for this softkey in any one of these menus, it affects all locations of the softkey.

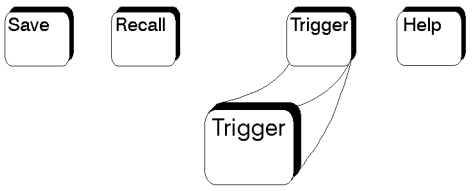
Softkey Location: Press **Sweep/List**, **More (1 of 2)**, **Trigger Out Polarity Neg Pos**

Status after Normal Preset: Pos

SCPI Commands:

```
:TRIGger:OUTPut:POLarity POSitive|NEGative

:TRIGger:OUTPut:POLarity?
```

Trigger



Press this front panel hardkey to trigger a specified event or series of events.

- The **Trigger** key can start a step or list sweep under the following conditions:
  - Sweep mode is configured and turned on.
  - In single sweep mode, the sweep is armed.
  - The **Sweep Trigger** softkey, in the Sweep/List menu, is set to **Trigger Key.**
- The **Trigger** key can cause the sweep to step point by point in a step or list sweep under the following conditions:
  - Sweep mode is configured and turned on.
  - In single sweep mode, the sweep is armed.
  - The **Point Trigger** softkey, in the Sweep/List menu, is set to **Trigger Key.**
  - The sweep must be triggered if **Sweep Trigger** is not set to **Immediate.**

  Also, under these conditions, the **Trigger** key has autorepeat capability. Hold it down and it will repeatedly trigger the consecutive points in the sweep.
- The **Trigger** key can start a single sweep of swept-sine amplitude, frequency, or phase modulation under the following conditions:
  - **Trigger Key** is selected in the AM, FM, or ΦM Sweep Trigger menu.
  - Swept-sine AM, FM, or ΦM is enabled.

  Also, under these conditions, the **Trigger** key has autorepeat capability. Hold it down and it will repeatedly trigger the sweep. This has the effect of stopping the current sweep before it finishes, when the key repeat is detected.
- The **Trigger Key** can start an LF swept-sine output under the following conditions:
  - **Function Generator** is selected as the **LF Out Source.**
  - The **LF Out Sweep Trigger** is set to **Trigger Key.**

- Swept-sine LF out is selected.

  Also, under these conditions, the **Trigger** key has autorepeat capability. Hold it down and it will repeatedly trigger the sweep. This has the effect of stopping the current sweep before it finishes, when the key repeat is detected.

- With any of the digital modulation formats configured and turned on, the **Trigger** key can initiate a burst to output a frame or a data sequence under the following conditions:

  - The digital modulation format is configured and turned on.
  - The **Pattern Trigger** or **Frame Trigger** softkey in the digital modulation menu is set to **Trigger Key.**

- With a bit error rate test configured and turned on, the **Trigger** key can initiate a bit error rate test under the following conditions:

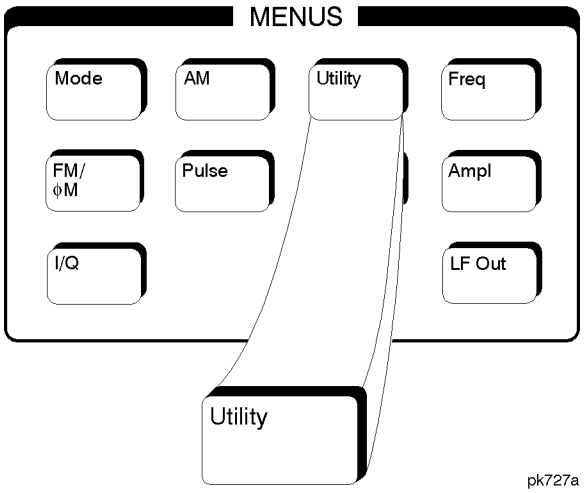
  - The bit error rate test is configured and turned on.
  - The **BERT Trigger** softkey in the bit error rate test menu is set to **Trigger Key.**

SCPI Commands:

```
:TRIGger[:SEQuence][:IMMediate]
```

Utility

Pressing the front panel **Utility** key reveals a menu of softkeys. These softkeys are described in this section in alphabetical order.



All

This softkey lets you specify that all types of files (including instrument state files, binary user data, and the current sweep list) are to be listed on the display when **Memory Catalog** is selected.

Catalog type is a persistent state; it is not changed by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Memory Catalog**, **Catalog Type**, **All**

SCPI Commands:

```
:MEMory:CATalog[:ALL]?
```

ARB (Option UND Only)

This softkey lets you specify that only dual arbitrary waveform generator files residing in the volatile ARB memory are to be listed on the display when **Memory Catalog** is selected.

Catalog type is a persistent state; it is not changed by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Memory Catalog**, **Catalog Type**, **ARB Catalog Types**, **ARB**

ARB Catalog Types (Option UND Only)

Pressing this softkey reveals a menu of choices for displaying arbitrary waveform generator (ARB) files including sequence (**Seq**) files, volatile ARB memory (**ARB**) files, nonvolatile ARB memory (**NVARB**) files , and **CDMA** files. When you have made your selection, the display is updated and your choice displayed below the **Catalog Type** softkey.

ARB catalog type is a persistent state; it is not changed by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Memory Catalog**, **Catalog Type**, **ARB Catalog Types**

Binary

This softkey lets you specify that only binary files are to be listed on the display when **Memory Catalog** is selected.

Catalog type is a persistent state; it is not changed by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Memory Catalog**, **Catalog Type**, **Binary**

SCPI Commands:

```
:MEMory:CATalog:BINary?
```

Black Pixels Screen Test

This softkey is provided for factory use in testing the display. Pressing this softkey sets all the pixels on the display to black. Pressing the **Local** front panel key returns the display to normal signal generator operation.

Softkey Location: Press **Utility**, **Display**, **Black Pixels Screen Test**

Brightness

Use this softkey to adjust the display brightness (intensity). The display is set to maximum brightness at the factory. To change the brightness, press **Utility**, **Display**, **Brightness**. The current value shown in the active entry area is a relative value for brightness. Increasing the number increases the brightness; decreasing the number decreases the brightness. You can adjust the brightness value to any number from 1 through 50. (To adjust the brightness via remote operation, set the value from 0.0 to 1.0.) Use the front panel knob, the up and down arrow keys, or enter a value using the numeric keypad and press the **Enter** terminator softkey.

Brightness is a persistent state; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Display**, **Brightness**

SCPI Commands:

```
:DISPlay:BRIGhtness <value>

:DISPlay:BRIGhtness?
```

Burst Gate In Polarity Neg Pos

This softkey in the Signal Polarity Setup menu is used to configure the polarity of the TTL signal at the BURST GATE IN connector. Pos refers to normal logic, while Neg refers to inverted logic.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Signal Polarity Setup**, **Burst Gate In Polarity Neg Pos**

Status after Normal Preset: Pos

SCPI Commands:

```
:ROUTe:HARDware:DGENerator:INPut:BPOLarity POSitive|
NEGative

:ROUTe:HARDware:DGENerator:INPut:BPOLarity?
```

Calibrate Selected Items

Press this softkey to perform a download of calibration data from the optional hardware into non-volatile memory. To confirm that you want to start the calibration, press the **Start Calibration and Store Results** softkey. The calibration takes several minutes. During the calibration, a message is displayed indicating the calibration is in progress and showing the percent complete. When the calibration is finished, the Hardware Options menu is returned.

Perform this calibration if you have just installed optional hardware in your signal generator. This calibration is not intended for repeated execution. Any further calibrations that may be required should be performed through the I/Q Calibration menu located in the **I/Q** key menus.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Hardware Options**, **Calibrate Selected Items**

Catalog Type

Pressing this softkey reveals a menu of choices for displaying files. You can choose to display all files (including instrument state files, binary user data, and the current sweep list), binary files only, list files only, instrument state files only, FIR filter files only (Option UND or Option UN8 only), ARB catalog types (Option UND only), and modulation catalog types (Option UN8 only). When you have made your selection, the display is updated and your choice displayed below the **Catalog Type** softkey.

Catalog type is a persistent state; it is not changed by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Memory Catalog**, **Catalog Type**

CDMA (Option UND Only)

This softkey lets you specify that only dual arbitrary waveform generator CDMA files are to be listed on the display when **Memory Catalog** is selected.

Catalog type is a persistent state; it is not changed by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Memory Catalog**, **Catalog Type**, **ARB Catalog Types**, **CDMA**

Clear Error Queue(s)

Press this softkey to delete any messages that are stored in the error message queues. (There are separate error queues for front panel operation and for SCPI. Pressing this softkey clears both.) You cannot recover from this action; once the messages are deleted, they are permanently gone. When the error message queue is empty, the ERR annunciator is turned off.

Softkey Location: Press **Utility**, **Error Info**, **Clear Error Queue(s)**

IEEE 488.2 Common Commands:

- *CLS

Clear Text

Press this softkey to delete the existing file name in the active entry area. When you copy from one file to another, the same file name is given to the new file unless you change it. Press **Clear Text** to delete the existing file name and then enter in a new file name using the editing keys provided.

Softkey Location: Press **Utility**, **Memory Catalog**, **Copy File**, **Editing Keys**, **Clear Text**

Copy File

Press this softkey to copy and rename a file in the displayed catalog of files. To copy a file, first select the file from the displayed list by scrolling through the list using the front panel knob or the up and down arrow keys. When the desired file is highlighted, press **Copy File**. The message `Copy to: "<file_name>"` is displayed in the active entry area where "<file_name>" is the name of the currently selected file. Your

copied file will have the same name as the original file, so you must rename it. To rename the copied file, the following editing capabilities are provided:

- The **Editing Mode Insert Replace** softkey in the Editing Keys menu toggles the editing mode from inserting text to replacing text. Insertion mode causes text to be entered in the position directly to the right of the cursor. Replacement mode causes the text to be entered in the position held by the cursor (replacing any existing text in that position).
- The **Clear Text** softkey in the Editing Keys menu deletes all of the existing text in the active entry area.
- Use the left and right arrow keys to position the cursor. Use the front panel knob, or the direct editing softkeys, to enter an alphabetic character, numeral, or special character.

When you have entered the new file name, press the **Enter** terminator softkey. If you have changed your mind, press the **Return** hardkey. Once you press **Enter**, the new file is stored and displayed immediately in the catalog list.

Softkey Location: Press **Utility**, **Memory Catalog**, **Copy File**

DATA/CLK/SYNC Rear Outputs Off On

This softkey in the Instrument Adjustments menu is used to disconnect the output signals from the rear panel DATA OUT, DATA CLK OUT, and SYMBOL SYNC OUT connectors. Normally, these output signals should be connected (softkey set to On position). However, disconnecting these outputs will decrease the spurs that are sometimes present when you are operating at high symbol rates.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **DATA/CLK/SYNC Rear Outputs Off On**

Status after Normal Preset: On

SCPI Commands:

```
:ROUTe:HARDware:DGENerator:OUTPut:DCS[:STATe] ON|OFF|1|0

:ROUTe:HARDware:DGENerator:OUTPut:DCS[:STATe]?
```

Data Polarity Neg Pos

This softkey in the Signal Polarity Setup menu is used to configure the polarity of the TTL signal at the DATA connector. Pos refers to normal logic, while Neg refers to inverted logic.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Signal Polarity Setup**, **Data Polarity Neg Pos**

Status after Normal Preset: Pos

SCPI Commands:

```
:ROUTe:HARDware:DGENerator:INPut:DPOLarity POSitive|
NEGative

:ROUTe:HARDware:DGENerator:INPut:DPOLarity?
```

Data Clock Out Polarity Neg Pos

This softkey in the Signal Polarity Setup menu is used to configure the polarity of the TTL signal at the DATA CLOCK OUT connector. Pos refers to the rising edge, while Neg refers to the falling edge.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Signal Polarity Setup**, **More (1 of 3)**, **Data Clock Out Polarity Neg Pos**

Status after Normal Preset: Pos

SCPI Commands:

```
:ROUTe:HARDware:DGENerator:OUTPut:CPOLarity POSitive|
NEGative

:ROUTe:HARDware:DGENerator:OUTPut:CPOLarity?
```

Data Clock Polarity Neg Pos

This softkey in the Signal Polarity Setup menu is used to configure the polarity of the TTL signal at the DATA CLOCK connector. Pos refers to the rising edge, while Neg refers to the falling edge.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Signal Polarity Setup**, **Data Clock Polarity Neg Pos**

Status after Normal Preset: Pos

SCPI Commands:

```
:ROUTe:HARDware:DGENerator:INPut:CPOLarity POSitive|
NEGative

:ROUTe:HARDware:DGENerator:INPut:CPOLarity?
```

Data Out Polarity Neg Pos

This softkey in the Signal Polarity Setup menu is used to configure the polarity of the TTL signal at the DATA OUT connector. Pos refers to normal logic, while Neg refers to inverted logic.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Signal Polarity Setup**, **More (1 of 3)**, **Data Out Polarity Neg Pos**

Status after Normal Preset: Pos

SCPI Commands:

```
:ROUTe:HARDware:DGENerator:OUTPut:DPOLarity POSitive|
NEGative

:ROUTe:HARDware:DGENerator:OUTPut:DPOLarity?
```

Delete All Binary Files

Press this softkey to delete all of the binary files in the displayed catalog of files. You will then confirm that you want to delete all of the binary files in memory. Press the **Confirm Delete Of Binary Files** terminator softkey and all of the files are deleted. You cannot recover the files after this step. If you have changed your mind and do not wish to delete the files, press the **Return** front panel hardkey instead.

Softkey Location: Press **Utility**, **Memory Catalog**, **Catalog Type**, **Binary**, **More (1 of 2)**, **Delete All Binary Files**

SCPI Commands:

```
:MEMory:DELete:BINary
```

Delete All Files

Press this softkey to delete all of the files in the displayed catalog of files. You will then confirm that you want to delete all of the files (binary, instrument state, and list files) in memory. Press the **Confirm Delete Of All Files** terminator softkey and all of the files are deleted. You cannot recover the files after this step. If you have changed your mind and do not wish to delete the files, press the **Return** front panel hardkey instead. This softkey does not affect the persistent state or calibration information. If power on mode is set to last, a new last state file will be created when the instrument idles.

Softkey Location: Press **Utility**, **Memory Catalog**, **Catalog Type**, **All**, **More (1 of 2)**, **Delete All Files**

SCPI Commands:

```
:MEMory:DELete:ALL
```

Delete All List Files

Press this softkey to delete all of the list files in the displayed catalog of files. You will then confirm that you want to delete all of the list files in memory. Press the **Confirm Delete Of List Files** terminator softkey and all of the list files are deleted. You cannot recover the files after this step. If you have changed your mind and do not wish to delete the file, press the **Return** front panel hardkey instead.

Softkey Location: Press **Utility**, **Memory Catalog**, **Catalog Type**, **List**, **More (1 of 2)**, **Delete All List Files**

SCPI Commands:

```
:MEMory:DELete:LIST
```

Delete All State Files

Press this softkey to delete all of the instrument state files in the displayed catalog of files. You will then confirm that you want to delete all of the instrument state files in memory. Press the **Confirm Delete Of State Files** terminator softkey and all of the files are deleted. You cannot recover the files after this step. If you have changed your mind and do not wish to delete the files, press the **Return** front panel hardkey instead.

Softkey Location: Press **Utility**, **Memory Catalog**, **Catalog Type**, **State**, **More (1 of 2)**, **Delete All State Files**

SCPI Commands:

```
:MEMory:DELete:STATe
```

Delete File

Press this softkey to delete a file in the displayed catalog of files. To delete a file, first select the file from the displayed list by scrolling through the list using the front panel knob or up and down arrow keys. When the desired file is highlighted, press **Delete File**. Then press the **Confirm Delete** terminator softkey and the file is deleted. You cannot recover the file after this step. If you have changed your mind and do not wish to delete the file, press the **Return** front panel hardkey instead.

Softkey Location: Press **Utility**, **Memory Catalog**, **Delete File**

SCPI Commands:

```
:MEMory:DELete[:NAME] "<file_name>"
```

Deselect All Items

Press this softkey to deselect all options in the list of hardware options. Selected options show an X in the column to the left of the option number. Deselected options have no X. Only those options that are selected can be enabled or calibrated.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Hardware Options**, **Deselect All Items**

Deselect Item

Press this softkey to deselect the highlighted option in the list of hardware options. Selected options show an X in the column to the left of the option number. Deselected options have no X. Only those options that are selected can be enabled or calibrated.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Hardware Options**, **Deselect Item**

Diagnostic Info

Press this softkey for a display of diagnostic information about the signal generator. The following information is included in the display:

- instrument model
- instrument options
- instrument serial number
- current firmware revision
- current firmware date
- number of hours the signal generator has been powered on
- number of hours the display has been lit
- number of power cycles
- number of attenuator cycles
- number of reverse power protection trips

Softkey Location: Press **Utility**, **Instrument Info/Help Mode**, **Diagnostic Info**

Display

Pressing this softkey reveals a menu of choices for adjusting and testing the display. In this menu you are able to set up the screen saver, change the display brightness, and perform black and white pixel screen tests.

Softkey Location: Press **Utility**, **Display**

Editing Keys

Pressing this softkey reveals a menu of choices for editing the name of a file you have just copied. When you copy a file, its name is copied also. As you cannot have two identical file names, use this menu to edit the file name of the copied file. In this menu you can delete the existing text in the active entry area (either the copied file name, or a file name that you have subsequently entered), and you can toggle the editing mode from inserting text to replacing text.

Softkey Location: Press **Utility**, **Memory Catalog**, **Copy File**, **Editing Keys**

Editing Mode Insert Replace

Press this softkey to toggle the editing mode from inserting text to replacing text. Insertion mode causes text to be entered in the position directly to the right of the cursor. Replacement mode causes the text to be entered in the position held by the cursor (replacing any existing text in that position).

Softkey Location: Press **Utility**, **Memory Catalog**, **Copy File**, **Editing Keys**, **Editing Mode Insert Replace**

Error Info

Pressing this softkey reveals a menu of choices for viewing error messages. In this menu you can view any of the error messages in the queue, and you can clear all of the error messages in the queue.

Softkey Location: Press **Utility**, **Error Info**

Event 1 Polarity Neg Pos

This softkey in the Signal Polarity Setup menu is used to configure the polarity of the TTL signal out at the EVENT 1 connector. Pos refers to normal logic, while Neg refers to inverted logic.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Signal Polarity Setup**, **More (1 of 3)**, **Event 1 Polarity Neg Pos**

Status after Normal Preset: Pos

SCPI Commands:

```
:ROUTe:HARDware:DGENerator:OUTPut:EPOL1 POSitive|NEGative

:ROUTe:HARDware:DGENerator:OUTPut:EPOL1?
```

Event 2 Polarity Neg Pos

This softkey in the Signal Polarity Setup menu is used to configure the polarity of the TTL signal out at the EVENT 2 connector. Pos refers to normal logic, while Neg refers to inverted logic.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Signal Polarity Setup**, **More (1 of 3)**, **Event 2 Polarity Neg Pos**

Status after Normal Preset: Pos

SCPI Commands:

```
:ROUTe:HARDware:DGENerator:OUTPut:EPOL2 POSitive|NEGative

:ROUTe:HARDware:DGENerator:OUTPut:EPOL2?
```

FIR (Option UND or Option UN8 Only)

This softkey lets you specify that only FIR filter files are to be listed on the display when **Memory Catalog** is selected.

Catalog type is a persistent state; it is not changed by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Memory Catalog**, **Catalog Type**, **FIR**

SCPI Commands:

```
:MEMory:CATalog:FIR?
```

FSK (Option UN8 Only)

This softkey lets you specify that only baseband generator FSK files are to be listed on the display when **Memory Catalog** is selected.

Catalog type is a persistent state; it is not changed by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Memory Catalog**, **Catalog Type**, **More (1 of 2)**, **Modulation Catalog Types**, **FSK**

Hardware Options

This softkey accesses a menu where you can configure your signal generator to enable or to disable any hardware option that you have purchased. Refer to Chapter 2, "Using Functions," for an example of using this function. This menu also provides the capability of performing a download of calibration data from the optional hardware into non-volatile memory.

CAUTION If you enable an option that does not have the required hardware installed, the menus for that option will be activated but the option *cannot* operate, despite what the menus may seem to indicate.

This menu also provides the capability of performing a download of calibration data from the optional hardware into non-volatile memory.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Hardware Options**

Help Mode Single Cont

This softkey toggles the help mode between single and continuous. In single mode, when you press the **Help** key, help text is provided for the next front panel hardkey or softkey that you press. Your next key press returns you to normal operation. In continuous mode, when you press the **Help** key, help text is provided for the next front panel hardkey or softkey that you press and that key's function is also executed. You will stay in this help mode until you press the **Help** key again.

Help mode is a persistent state; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Instrument Info/Help Mode**, **Help Mode Single Cont**

SCPI Commands:

```
:SYSTem:HELP:MODE SINGle|CONTinuous

:SYSTem:HELP:MODE?
```

HP8648A/B/C/D

This softkey is one of the choices in both the Preset Language menu and the Remote Language menu. The **HP8648A/B/C/D** softkey is a language choice for the signal generator that is compatible with the remote language commands used by the HP 8648A/B/C/D. Choosing **HP8648A/B/C/D** in the Preset Language menu allows you to select this remote language as the default after a normal preset. Choosing **HP8648A/B/C/D** in the Remote Language menu allows you to immediately change the signal generator to use this remote language.

Softkey Location: Press **Utility**, **Power On/Preset**, **Preset Language**, **HP8648A/B/C/D**
or press **Utility**, **HP-IB/RS-232**, **Remote Language**, **HP8648A/B/C/D**

SCPI Commands:

```
:SYSTem:LANGuage "HP8648"

:SYSTem:LANGuage?

:SYSTem:PRESet:LANGuage "HP8648"

:SYSTem:PRESet:LANGuage?
```

HP8656B,8657A/B

This softkey is one of the choices in both the Preset Language menu and the Remote Language menu. The **HP8656B,8657A/B** softkey is a language choice for the signal generator that is compatible with the remote language commands used by the HP 8656B and the HP 8657A/B. See the HP 8656/57 Compatibility table in the Programming Command Cross Reference section of the HP ESG and HP ESG-D Series Signal Generators Programming Guide. Choosing **HP8656B,8657A/B** in the Preset Language menu allows you to select this remote language as the default after a normal preset. Choosing **HP8656B,8657A/B** in the Remote Language menu allows you to immediately change the signal generator to use this remote language.

Softkey Location: Press **Utility**, **Power On/Preset**, **Preset Language**, **HP8656B,8657A/B**
or press **Utility**, **HP-IB/RS-232**, **Remote Language**, **HP8656B,8657A/B**

SCPI Commands:

```
:SYSTem:LANGuage "COMP"

:SYSTem:LANGuage?

:SYSTem:PRESet:LANGuage "COMP"

:SYSTem:PRESet:LANGuage?
```

HP8657D NADC

This softkey is one of the choices in both the Preset Language menu and the Remote Language menu. The **HP8657D NADC** softkey is a language choice for the signal generator that is compatible with the remote language commands used by the HP 8657D with NADC digital modulation capabilities. Choosing **HP8656D NADC** in the Preset Language menu allows you to select this remote language as the default after a normal preset. Choosing **HP8656D NADC** in the Remote Language menu allows you to immediately change the signal generator to use this remote language.

Softkey Location: Press **Utility**, **Power On/Preset**, **Preset Language**, **HP8657D NADC**
or press **Utility**, **HP-IB/RS-232**, **Remote Language**, **HP8657D NADC**

SCPI Commands:

```
:SYSTem:LANGuage "NADC"

:SYSTem:LANGuage?

:SYSTem:PRESet:LANGuage "NADC"

:SYSTem:PREset:LANGuage?
```

HP8657D PDC

This softkey is one of the choices in both the Preset Language menu and the Remote Language menu. The **HP8657D PDC** softkey is a language choice for the signal generator that is compatible with the remote language commands used by the HP 8656D with PDC digital modulation capabilities. Choosing **HP8657D PDC** in the Preset Language menu allows you to select this remote language as the default after a normal preset. Choosing **HP8657D PDC** in the Remote Language menu allows you to immediately change the signal generator to use this remote language.

Softkey Location: Press **Utility**, **Power On/Preset**, **Preset Language**, **HP8657D PDC**
or press **Utility**, **HP-IB/RS-232**, **Remote Language**, **HP8657D PDC**

SCPI Commands:

```
:SYSTem:LANGuage “PDC”

:SYSTem:LANGuage?

:SYSTem:PRESet:LANGuage “PDC”

:SYSTem:PREset:LANGuage?
```

HP8657J PHS

This softkey is one of the choices in both the Preset Language menu and the Remote Language menu. The **HP8657J PHS** softkey is a language choice for the signal generator that is compatible with the remote language commands used by the HP 8657J with PHS digital modulation capabilities. Choosing **HP8657J PHS** in the Preset Language menu allows you to select this remote language as the default after a normal preset. Choosing **HP8657J PHS** in the Remote Language menu allows you to immediately change the signal generator to use this remote language.

Softkey Location: Press **Utility**, **Power On/Preset**, **Preset Language**, **HP8657J PHS**
or press **Utility**, **HP-IB/RS-232**, **Remote Language**, **HP8657J PHS**

SCPI Commands:

```
:SYSTem:LANGuage “PHS”

:SYSTem:LANGuage?

:SYSTem:PRESet:LANGuage “PHS”

:SYSTem:PRESet:LANGuage?
```

HP-IB Address

Press this softkey to change the signal generator's HP-IB address. The HP-IB address is set to 19 at the factory. You can change the address to any number between 0 and 30. To enter a new value, press **Utility**, **HP-IB/RS-232**, **HP-IB Address** and rotate the front panel knob, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Enter** terminator softkey.

The HP-IB address setting is a persistent state; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **HP-IB/RS-232**, **HP-IB Address**

SCPI Commands:

```
:SYSTem:COMMunicate:GPIB:ADDRess <number>

:SYSTem:COMMunicate:GPIB:ADDRess?
```

HP-IB/RS-232

Pressing this softkey reveals a menu of choices for HP-IB and RS-232 configuration. In this menu, you have the following options:

- change the HP-IB address of the signal generator
- change the remote language of the signal generator
- set the baud rate for the RS-232 serial port (AUXILIARY INTERFACE connector)
- reset the RS-232 serial I/O
- turn the RS-232 echo on or off
- set the RS-232 handshake protocol
- control RS-232 RTS and CTS behavior

Softkey Location: Press **Utility**, **HP-IB/RS-232**

Instrument Adjustments

Pressing this softkey reveals a menu of front panel adjustments for the signal generator. The softkeys in this menu provide the following capabilities:

- adjust the ratio between the front panel knob and the step size for the arrow keys
- adjust the internal reference oscillator (for use by service personnel only)
- install and remove hardware and software options

Softkey Location: Press **Utility**, **Instrument Adjustments**

Instrument Info/Help Mode

Pressing this softkey reveals a menu of softkeys for the following functions:

- display diagnostic information about your signal generator
- turn on and off the display of information about the status of the modulation modes
- toggle the help mode between single and continuous

Softkey Location: Press **Utility**, **Instrument Info/Help Mode**

Inverse Video Off On

The normal display mode for the signal generator is dark text on a light background. Press this softkey to toggle inverse video on (light text on a dark background).

Inverse video is a persistent state; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Display**, **Inverse Video Off On**

SCPI Commands:

```
:DISPlay:INVerse ON|OFF|1|0>

:DISPlay:INVerse?
```

I/Q (Option UN8 Only)

This softkey lets you specify that only baseband generator I/Q files are to be listed on the display when **Memory Catalog** is selected.

Catalog type is a persistent state; it is not changed by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Memory Catalog**, **Catalog Type**, **More (1 of 2)**, **Modulation Catalog Types**, **I/Q**

List

This softkey lets you specify that only sweep list files are to be listed on the display when **Memory Catalog** is selected. The sweep list files are stored to memory using the **Store To File** softkey in the Sweep/List menu.

Catalog type is a persistent state; it is not changed by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Memory Catalog**, **Catalog Type**, **List**

SCPI Commands:

```
:MEMory:CATalog:LIST?
```

MCDMA (Option UN5 Only)

This softkey lets you specify that only multicarrier CDMA files are to be listed on the display when **Memory Catalog** is selected.

Catalog type is a persistent state; it is not changed by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Memory Catalog**, **Catalog Type**, **ARB Catalog Types**, **MCDMA**

SCPI Commands:

```
:MEMory:CATalog:MCDMa?
```

Memory Catalog

Pressing this softkey displays the catalog of user files. In addition, it reveals a menu for choosing the type of files that are displayed and functions available for file management. In this menu you can choose to display files by type (all files, instrument state files only, or binary files only), and you can copy and delete files.

Softkey Location: Press **Utility**, **Memory Catalog**

Modify License Key

Press this softkey to enter the license key for the highlighted software option. Software options are linked to specific optional hardware that must first be installed before the software option can be operational. Adding new software options requires the use of a license key that is provided by Hewlett-Packard at the time of purchase. Once the license key is entered, the software option will be enabled when you press the **Proceed with Reconfiguration** softkey. Refer to Chapter 2, "Using Functions," for an example of using this function.

CAUTION If you enable an option that does not have the required hardware installed, the menus for that option will be activated but the option *cannot* operate, despite what the menus may seem to indicate.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Software Options**, **Modify License Key**

Mod Status Info Off On

Press this softkey to toggle on and off the modulation status display. When the modulation status is set to on, information about the status of all of the modulations available is shown at any time that you have accessed one of the modulation menus. When the modulation status is set to off, the information about the status of all the modulations is never displayed.

Softkey Location: Press **Utility**, **Instrument Info/Help Mode**, **Mod Status Info Off On**

Status after Normal Preset: On

Modulation Catalog Types (Option UN8 Only)

Pressing this softkey reveals a menu of choices for displaying baseband generator modulation-type files including **I/Q** and **FSK**. When you have made your selection, the display is updated and your choice displayed below the **Catalog Type** softkey.

Modulation catalog type is a persistent state; it is not changed by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Memory Catalog**, **Catalog Type**, **More (1 of 2)**, **Modulation Catalog Types**

MTONE (Option UND Only)

This softkey lets you specify that only multitone files are to be listed on the display when **Memory Catalog** is selected.

Catalog type is a persistent state; it is not changed by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Memory Catalog**, **Catalog Type**, **ARB Catalog Types**, **MTONE**

SCPI Commands:

```
:MEMory:CATalog:MTONe?
```

Off

Press this softkey to turn the RTS line off. In this mode, the instrument will ignore the state of the CTS line (3-wire connection). This setting is not compatible with the HP 83300A Remote Interface.

RTS is a persistent state; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **HP-IB/RS-232**, **RS-232 Pace**, **RTS/CTS**, **Off**

SCPI Commands:

```
:SYSTem:COMMunicate:SERial:CONTrol:RTS OFF
```

```
:SYSTem:COMMunicate:SERial:CONTrol:RTS?
```

Page Down

Press this softkey to move down in the displayed catalog of files one page at a time.

Softkey Location: **Utility**, **Memory Catalog**, **Page Down**
or press **Utility**, **Memory Catalog**, **Goto Row**, **Page Down**

Page Up

Press this softkey to move up in the displayed catalog of files one page at a time.

Softkey Location: **Utility**, **Memory Catalog**, **Page Up**
or press **Utility**, **Memory Catalog**, **Goto Row**, **Page Up**

Pattern Trigger In Polarity Neg Pos

This softkey in the Signal Polarity Setup menu is used to configure the polarity of the TTL signal at the PATTERN TRIG IN connector that triggers an event. Pos refers to the rising edge, while Neg refers to the falling edge.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Signal Polarity Setup**, **Trigger In Polarity Neg Pos**

Status after Normal Preset: Pos

SCPI Commands:

```
:ROUTe:HARDware:DGENerator:INPut:TPOLarity POSitive|
NEGative

:ROUTe:HARDware:DGENerator:INPut:TPOLarity?
```

Power On Last Preset

This softkey toggles the power-on state of the signal generator between **Last** and **Preset**.

- If you choose **Last**, each time you cycle power to the signal generator it will turn on in the same condition as when you turned power off. The signal generator must not receive commands for a second before the power is turned off to guarantee that the most recent state is saved.
- If you choose **Preset**, each time you cycle power to the signal generator it will turn on in either the factory-defined preset condition or in a user-defined preset condition. You make the choice between factory- and user-defined preset with the **Preset Normal User** softkey.

The power-on state is a persistent state; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Power On/Preset**, **Power On Last Preset**

SCPI Commands:

```
:SYSTem:PON:TYPE PRESet|LAST

:SYSTem:PON:TYPE?
```

Power On/Preset

Pressing this softkey reveals a menu of choices for preset conditions. In this menu, you have the following options:

- Set the signal generator to power on in the same state as it was when you powered off, or to power on in the instrument preset state. (Refer to the **Power On Last Preset** softkey description, in this section.)

- Set the signal generator to preset to a factory-defined state or to a user-defined state. (Refer to the **Preset Normal User** softkey description, in this section.)
- Set up your own user-defined preset state. (Refer to the **Save User Preset** softkey description, in this section.)
- Set the signal generator to preset to the SCPI programming language or to an HP 8648 or HP 8656/57-compatible language. (Refer to the **Preset Language** softkey description, in this section.)
- Set the signal generator's reverse power protection to the factory-defined state or to an HP 8648-equivalent state. (Refer to the **Reverse Power Protection Normal HP8648** softkey description.)

Softkey Location: Press **Utility**, **Power On/Preset**

Preset Language

Pressing this softkey reveals a menu of choices for selecting the programming language that is implemented after the **Preset** key is pressed. You can choose between SCPI, which is the language chosen for the signal generator for remote implementation of all features, HP 8648-compatible, and four versions of HP 8656/57-compatible languages. The HP 8648- and 8656/67-compatible languages are provided for remote implementation of some features so that this signal generator can be compatible with systems that use those instruments. Refer to the programming guide for specifics on which commands are implemented.

The preset language is a persistent state; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Power On/Preset**, **Preset Language**

SCPI Commands:

```
:SYSTem:PRESet:LANGuage "SCPI"|"COMP"|"NADC"|"PDC"|"PHS"|
"HP8648"

:SYSTem:PRESet:LANGuage?
```

Preset Normal User

This softkey toggles the preset state between the factory-defined and the user-defined states. The instrument state conditions for the factory-defined preset state are described in the **Preset** section. You choose the instrument state conditions for the user-defined preset state. Refer to the **Save User Preset** softkey description in this section.

The preset state is a persistent state; it is not changed by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Power On/Preset**, **Preset Normal User**

SCPI Commands:

```
:SYSTem:PRESet:TYPE NORMal|USER
:SYSTem:PRESet:TYPE?
```

Proceed With Reconfiguration

Press this softkey to enable the selected hardware or software options. In the Hardware Options menu, selected options are indicated by an X in the column to the left of the option number. In the Software Options menu, selected options include any options that have a license key entered. After pressing this softkey, press the **Confirm Change** softkey to verify that you do want to reconfigure the signal generator with the options that you have selected. If you do not want to continue, press the **Return** key. Refer to Chapter 2, "Using Functions," for an example of using this function.

CAUTION If you enable an option that does not have the required hardware installed, the menus for that option will be activated but the option *cannot* operate, despite what the menus may seem to indicate.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Hardware Options**, **Proceed With Reconfiguration**
or press **Utility**, **Instrument Adjustments**, **Software Options**, **Proceed With Reconfiguration**

Recall Ref Osc Setting

This softkey is provided for adjusting the internal reference oscillator. This adjustment is for use by service personnel only. Refer to the calibration guide for more information.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Reference Oscillator Adjustment**, **Recall Ref Osc Setting**

Receive Pace None Xon

This softkey in the RS-232 Pace menu determines whether any pacing is acknowledged by the RS-232 receive channel. If Xon pacing is used, the system will send an Xoff character to suspend the transmitting of data when its buffer is nearly full. When the system is ready to receive further input, an Xon character is sent to the transmitting device. Xon pacing is not recommended if binary data will be queried from the signal generator via RS-232. Toggle **Receive Pace None Xon** to **None** to turn off Xon pacing.

Pace is a persistent state; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **HP-IB/RS-232**, **RS-232 Pace**, **Receive Pace None Xon**

SCPI Commands:

```
:SYSTem:COMMunicate:SERial:RECeive:PACE XON|NONE
:SYSTem:COMMunicate:SERial:RECeive:PACE?
```

Reference Oscillator Adjustment

Pressing this softkey reveals a menu of softkeys for adjusting the internal reference oscillator. This adjustment is for use by service personnel only.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Reference Oscillator Adjustment**

Ref Osc Coarse

This softkey is provided for adjusting the internal reference oscillator. This adjustment is for use by service personnel only. Refer to the calibration guide for more information.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Reference Oscillator Adjustment**, **Ref Osc Coarse**

Ref Osc Fine

This softkey is provided for adjusting the internal reference oscillator. This adjustment is for use by service personnel only. Refer to the calibration guide for information.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Reference Oscillator Adjustment**, **Ref Osc Fine**

Remote Language

Pressing this softkey reveals a menu of choices for immediately changing the signal generator's remote language. You can choose between SCPI, which is the language chosen for the signal generator for remote implementation of all features, HP 8648-compatible, and four versions of HP 8656/57-compatible languages. The HP 8648- and 8656/67-compatible languages are provided for remote implementation of some features so that this signal generator can be compatible with systems that use those instruments. Refer to the programming guide for specifics on which commands are implemented.

Softkey Location: Press **Utility**, **HP-IB/RS-232**, **Remote Language**

Status after Normal Preset: SCPI

SCPI Commands:

```
:SYSTem:LANGuage?
```

Rename File

Press this softkey to rename a file in the displayed catalog of files. The following text explains how to use the file name editor:

- The **Editing Mode Insert Replace** softkey in the Editing Keys menu toggles the editing mode from inserting text to replacing text. Insertion mode causes text to be entered in the position directly to the right of the cursor. Replacement mode causes the text to be entered in the position held by the cursor (replacing any existing text in that position).
- The **Clear Text** softkey in the Editing Keys menu deletes all of the existing text in the active entry area.
- Use the left and right arrow keys to position the cursor. Use the front panel knob, or the direct editing softkeys, to enter an alphabetic character, numeral, or special character.

When you have entered the new file name, press the **Enter** terminator softkey. If you have changed your mind, press the **Return** hardkey. Once you press **Enter**, the new file is stored and displayed immediately in the catalog list.

Softkey Location: Press **Utility**, **Memory Catalog**, **More (1 of 2)**, **Rename File**

SCPI Commands:

```
:MEMory:MOVE <src_file>,<dest_file>

:MMEMory:MOVE <src_file>,<dest_file>
```

Reset RS-232

Press this softkey to perform a clean-up on the RS-232 buffer which will discard any unprocessed SCPI input received over RS-232 and places the RS-232 connection in a mode which can detect the optional remote interface. All other RS-232 communication parameters (such as baud rate) are unaffected.

Softkey Location: Press **Utility**, **HP-IB/RS-232**, **Reset RS-232**

SCPI Commands:

```
:SYSTem:COMMunicate:SERial:RESet
```

Restore Default Signal Polarities

This softkey in the Signal Polarity Setup menu is used to restore the instrument's default signal polarities

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Signal Polarity Setup**, **More (1 of 3)**, **More (2 of 3)**, **Restore Default Signal Polarities**

Reverse Power Protection Normal HP8648

This softkey toggles the reverse power protection mode between the normal mode for the signal generator and the HP 8648-compatible mode.

When you have selected **Normal** and you trip the reverse power protection circuit, a caution message is displayed and the front panel is locked. Eliminate the source of the excess reverse power detected at the RF OUTPUT connector. Then press the **Reset RPP** softkey to continue normal signal generator operation.

When you have selected **HP8648** and you trip the reverse power protection circuit, a caution message is displayed and the front panel is locked. However, any command sent over HP-IB will reset the RPP circuit and return you to normal signal generator operation. This mode is provided for compatibility with systems that use the HP 8648. It is only available when you have selected HP8648A/B/C/D remote language. At all other times reverse power protection is set to **Normal**. Operate in this mode with *caution*. Repeatedly tripping the RPP can cause damage to the signal generator. It is still best to eliminate the source of the excess reverse power and then reset the reverse power protection circuit by pressing the **Reset RPP** softkey.

The RPP reset mode is a persistent state; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Power On/Preset**, **Reverse Power Protection Normal HP8648**

SCPI Commands:

```
:OUTPut:PROTection:MODE"NORMAL"|"HP8648"

:OUTPut:PROTection:MODE?

:OUTPut:PROTection:TRIPped?

:OUTPut:PROTection:CLEar
```

RS-232 Baud Rate

Press this softkey to set the baud rate in bits per second for the rear panel RS-232 connector (this connector is labeled AUXILIARY INTERFACE). To change the baud rate press the softkey. A menu is displayed of baud rates that are allowed. Press the softkey for the desired value. The baud rate is now set to the new value and the value is displayed below the **RS-232 Baud Rate** softkey.

Baud rate is a persistent state; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **HP-IB/RS-232**, **RS-232 Baud Rate**

SCPI Commands:

```
:SYSTem:COMMunicate:SERial:BAUD <number>

:SYSTem:COMMunicate:SERial:BAUD?
```

RS-232 Echo Off On

This softkey toggles the echo function on and off for the RS-232 serial port (AUXILIARY INTERFACE connector). When echo is set to on, every character sent to the signal generator is immediately sent back. No editing capability is available.

Echo is a persistent state; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **HP-IB/RS-232**, **RS-232 Echo Off On**

SCPI Commands:

```
:SYSTem:COMMunicate:SERial:ECHO ON|OFF|1|0

:SYSTem:COMMunicate:SERial:ECHO?
```

RS-232 Pace

Pressing this softkey reveals a menu of choices for setting the RS-232 handshake protocol. In this menu you can choose transmit pacing, receive pacing, and RTS/CTS control.

Softkey Location: Press **Utility**, **HP-IB/RS-232**, **RS-232 Pace**

RS-232 Timeout

Pressing this softkey allows changes to the value for the RS-232 serial port timeout. If further input is not received within the assigned timeout period while a SCPI command is being processed, then the command is aborted and the input buffer is cleared.

Softkey Location: Press **Utility**, **HP-IB/RS-232**, **RS-232 TImeout**

SCPI Commands:

```
:SYSTem:COMMunicate:SERial:TOUT <val>

:SYSTem:COMMunicate:SERial:TOUT?
```

RTS/CTS

Pressing this softkey reveals a menu of choices for controlling the RTS/CTS behavior. This feature is used with RS-232 connections, including the HP 83300A Remote Interface.

RTS is a persistent state; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **HP-IB/RS-232**, **RS-232 Pace**, **RTS/CTS**

SCPI Commands:

```
:SYSTem:COMMunicate:SERial:CONTrol:RTS?
```

RTS/CTS Pacing

Press this softkey to turn the RTS line on and instruct the signal generator to monitor the state of the CTS line (hardware handshaking). The signal generator monitors CTS and suspends transmission if this line transitions to its logically low state. Up to 16 characters may still be transmitted after the low transition. The signal generator will drop RTS if its receive buffer is nearly full. RTS will be raised again when there is sufficient room in the buffer. This setting is not compatible with an HP 83300A Remote Interface. Do not attempt to use this setting with a 3-wire connection.

RTS is a persistent state; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **HP-IB/RS-232**, **RS-232 Pace**, **RTS/CTS**, **RTS/CTS Pacing**

SCPI Commands:

```
:SYSTem:COMMunicate:SERial:CONTrol:RTS STANdard
```

```
:SYSTem:COMMunicate:SERial:CONTrol:RTS?
```

RTS On

Press this softkey to turn the RTS line on. In this mode, the instrument will ignore the state of the CTS line (3-wire connection). This setting is intended for use with an HP 83300A Remote Interface, but it will also work with a 3-wire connection. **RTS On** is the default setting for the signal generator.

RTS is a persistent state; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **HP-IB/RS-232**, **RS-232 Pace**, **RTS/CTS**, **ON**

SCPI Commands:

```
:SYSTem:COMMunicate:SERial:CONTrol:RTS ON
```

```
:SYSTem:COMMunicate:SERial:CONTrol:RTS?
```

Save User Preset

Use this softkey to establish your user-defined preset state. Set up all of the instrument state conditions that you want for your unique preset state. When you have defined the instrument state to suit your needs, press **Save User Preset**. Only one user-defined preset state is allowed, so when you save the instrument state you will save over any previously-saved state. Your instrument state will be recalled by the signal generator any time you press **Preset** as long as you have set the **Preset Normal User** softkey to **User**. For additional information about the **Preset Normal User** softkey, refer to its description in this section.

The user's state definition is a state file; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Power On/Preset**, **Save User Preset**

SCPI Commands:

```
:SYSTem:PRESet[:USER]:SAVE
```

SCPI

This softkey is one of the choices in both the Preset Language menu and the Remote Language menu. Press either the **Preset Language** softkey or the **Remote Language** softkey to view these menus. SCPI (Standard Commands for Programmable Instruments) is the language chosen for remote implementation of all supported instrument features. Choosing **SCPI** in the Preset Language menu allows you to select this remote language as the default after a normal preset. Choosing **SCPI** in the Remote Language menu allows you to immediately change the signal generator to use this remote language.

Softkey Location: Press **Utility**, **Power On/Preset**, **Preset Language**, **SCPI** or press **Utility**, **HP-IB/RS-232**, **Remote Language**, **SCPI**

SCPI Commands:

```
:SYSTem:PRESet:LANGuage "SCPI"

:SYSTem:PRESet:LANGuage?

:SYSTem:LANGuage "SCPI"

:SYSTem:LANGuage?
```

Screen Saver Delay

This softkey sets the period of time before the screen saver is activated. The screen saver delay is set to 1 hour at the factory. You can change the delay by pressing **Utility**, **Display**, **Screen Saver Delay**. The current value for delay is displayed in the active entry area. To enter a new value, rotate the front panel knob, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Enter** terminator softkey. The range of values allowed is 1 through 12 hours in 1 hour increments.

Screen saver delay is a persistent state; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Display**, **Screen Saver Delay**

SCPI Commands:

```
:SYSTem:SSAVer:DELay <val>

:SYSTem:SSAVer:DELay?
```

Screen Saver Mode

This softkey toggles between **Light Only** and **Light & Text** mode for the screen saver. When you set the screen saver to **Light Only**, only the display light is turned on and off. When you set the screen saver to **Light & Text**, the display light and the text are turned on and off.

Screen saver mode is a persistent state; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Display**, **Screen Saver Mode**

SCPI Commands:

```
:SYSTem:SSAVer:MODE LIGHt|TEXT

:SYSTem:SSAVer:MODE?
```

Screen Saver Off On

This softkey toggles the signal generator's screen saver on and off. With the screen saver on, the display is turned off after a period of time with no input from the front panel. The display turns back on when any front panel key is pressed. The screen saver is set to **Off** at the factory. You can turn it on by pressing **Utility, Display Screen Saver**. Each time you press **Screen Saver Off On** the selection toggles between **Off** and **On**.

You can adjust the screen saver mode to turn the light on and off or to turn both the light and text on and off. Refer to the **Screen Saver Mode** softkey description in this section.

The screen saver delay is set to 1 hour at the factory. You can change the delay time. Refer to the **Screen Saver Mode** softkey description in this section.

Screen saver is a persistent state; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Display**, **Screen Saver Off On**

SCPI Commands:

```
:SYSTem:SSAVer:STATe ON|OFF|1|0

:SYSTem:SSAVer:STATe?
```

Select Item

Press this softkey to select the highlighted option from the list of hardware options. Selected options show an X in the column to the left of the option number. Two operations can be performed upon the selected options. The signal generator can be configured with these options enabled (by pressing the **Proceed With Reconfiguration** softkey), or the selected options can be calibrated (by pressing the **Calibrate Selected Items** softkey). For more information, refer to the descriptions of the softkeys mentioned, or refer to Chapter 2, "Using Functions," for an example of enabling options.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Hardware Options**, **Select Item**

Seq (Option UND Only)

This softkey lets you specify that only dual arbitrary waveform generator sequence files are to be listed on the display when **Memory Catalog** is selected.

Catalog type is a persistent state; it is not changed by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Memory Catalog**, **Catalog Type**, **ARB Catalog Types**, **Seq**

SCPI Commands:

```
:MEMory:CATalog:FIR?
```

Software Options

This softkey accesses a menu where you can configure your signal generator to enable any software option that you have purchased. Software options are linked to specific optional hardware that must first be installed before the software option can be operational. Adding new software options requires the use of a license key that is provided by Hewlett-Packard at the time of purchase.

NOTE If a previously installed software option is disabled, verify that the optional hardware is installed, the hardware option is enabled, and the software option is enabled with the correct license key. Refer to your License Key Certificate for the correct license key or, if the option was installed by HP, contact your HP service office and tell them the instrument's model number, the host ID number, and the software option that should be enabled.

CAUTION Don't modify the license key for enabled software options. You will disable the option.

Refer to Chapter 2, "Using Functions," for an example of enabling software options.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Software Options**

State

This softkey lets you specify that only instrument state files are to be listed on the display when **Memory Catalog** is selected.

Catalog type is a persistent state; it is not changed by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Memory Catalog**, **Catalog Type**, **State**

SCPI Commands:

```
:MEMory:CATalog:STATe?
```

Step/Knob Ratio

This softkey sets the ratio between the increment value of the step keys and the front panel knob. For example, if you set the increment value for frequency to 1 MHz and set the step/knob ratio to 10/1, when frequency is the active function the up and down arrow keys will change the frequency in 1 MHz steps and the front panel knob will change the frequency in 1/10th of 1 MHz steps. This ratio only applies when you have a function active that has an associated increment value.

To change the step/knob ratio, press **Utility**, **Instrument Adjustments**, **Step/Knob Ratio**. The number displayed in the active entry area represents the arrow keys step size in the ratio. To enter a new value, rotate the front panel knob until the desired value is displayed, use the up and down arrow keys, or enter the value using the numeric keypad and press the **Enter** terminator softkey.

The step/knob ratio is a persistent state; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Step/Knob Ratio**

Store Ref Osc Setting

This softkey is provided for adjusting the internal reference oscillator. This adjustment is for use by service personnel only. Refer to the calibration guide for more information.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Reference Oscillator Adjustment**, **Store Ref Osc Setting**

Symbol Sync Out Polarity Neg Pos

This softkey in the Signal Polarity Setup menu is used to configure the polarity of the TTL signal at the SYMBOL SYNC OUT connector. Pos refers to normal logic, while Neg refers to inverted logic.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Signal Polarity Setup**, **More (1 of 3)**, **Symbol Sync Out Polarity Neg Pos**

Status after Normal Preset: Pos

SCPI Commands:

```
:ROUTe:HARDware:DGENerator:OUTPut:SPOLarity POSitive|
NEGative

:ROUTe:HARDware:DGENerator:OUTPut:SPOLarity?
```

Symbol Sync Polarity Neg Pos

This softkey in the Signal Polarity Setup menu is used to configure the polarity of the TTL signal at the SYMBOL SYNC connector. Pos refers to normal logic, while Neg refers to inverted logic.

Softkey Location: Press **Utility**, **Instrument Adjustments**, **Signal Polarity Setup**, **Symbol Sync Polarity Neg Pos**

Status after Normal Preset: Pos

SCPI Commands:

```
:ROUTe:HARDware:DGENerator:INPut:SPOLarity POSitive|
NEGative

:ROUTe:HARDware:DGENerator:INPut:SPOLarity?
```

Transmit Pace None Xon

This softkey in the RS-232 Pace menu determines whether any pacing is acknowledged by the RS-232 transmit channel. If Xon pacing is used, the system will suspend transmitting data upon receiving an Xoff character until an Xon character is received. The signal generator may not be responsive to other channels, or to the front panel, while transmission is suspended. Xon pacing is not recommended if binary data will be sent to the signal generator via RS-232. Toggle **Transmit Pace None Xon** to **None** to turn off Xon pacing.

Pace is a persistent state; it is not affected by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **HP-IB/RS-232**, **RS-232 Pace**, **Transmit Pace None Xon**

SCPI Commands:

```
:SYSTem:COMMunicate:SERial:TRANsmit:PACE XON|NONE

:SYSTem:COMMunicate:SERial:TRANsmit:PACE?
```

View Next Error Message

If the ERR annunciator is turned on in the display, you have at least one error message stored in the error message queue. Use this softkey to display the first error message in the queue. (The first error message is the oldest error.) There may be more than one error message in the queue; the number of error messages is displayed along with the first message. If there is more than one message, continue pressing this softkey to view the rest of the error messages. If you wish to back up and view a message you have already seen, press **View Previous Error Message**. Press any front panel key to remove the error message from the display and return to normal signal generator operation.

The error queue can contain up to 30 error messages. When the front panel error queue overflows, error messages are deleted beginning with the oldest ones first. When the SCPI error queue overflows, newer error messages are not recorded.

You can scroll through the error messages in reverse order. Refer to the **View Previous Error Message** softkey description.

Softkey Location: Press **Utility**, **Error Info**, **View Next Error Message**

SCPI Commands:

```
:SYSTem:ERRor[:NEXT]?
```

View Previous Error Message

If the ERR annunciator is turned on in the display, you have at least one error message stored in the error message queue. Use this softkey to display the newest error message first. Continue pressing this softkey to view additional error messages in order of newest to oldest. Press any front panel key to remove the error message from the display and return to normal signal generator operation.

Softkey Location: Press **Utility**, **Error Info**, **View Previous Error Message**

WCDMA (Option H97 Only)

This softkey lets you specify that only wideband CDMA files are to be listed on the display when **Memory Catalog** is selected.

Catalog type is a persistent state; it is not changed by an instrument preset or by a power cycle.

Softkey Location: Press **Utility**, **Memory Catalog**, **Catalog Type**, **ARB Catalog Types**, **WCDMA**

SCPI Commands:

```
:MEMory:CATalog:WCDMa?
```

White Pixels Screen Test

This softkey is provided for factory use in testing the display. Pressing this softkey sets all of the pixels on the display to white. Pressing the front panel Local key returns the display to normal operation.

Softkey Location: Press **Utility**, **Display**, **White Pixels Screen Test**

6 Options and Accessories

This chapter lists the options that can be ordered for your signal generator at the time of shipment, the options that can be retrofitted to your existing signal generator, and the upgrades and accessories that you can order.

Signal Generator Options

This section lists the hardware, software, and documentation options you can order with a new signal generator. Some of the options can be retrofitted into your existing signal generator. Order a retrofit by requesting either the post-sales option number or the HP part number.

Hardware and Software Options Available for New Instruments				
Desired Option	**Available on HP ESG-D Series**	**Available on HP ESG Series**	**Required Options**	**Incompatible Options**
1CM	X	X		
1CN	X	X		
1CP	X	X		
1EM	X	X		
1E5	X	X		
UN5	X		UND	
UN7	X		UN3, UN4, or UN8	
UN8	X			
UN9	X		UN8	
UNA	X		UN8	UNB
UNB	X			UNA
UND	X			

Adding Hardware and Software Options to Existing Instruments				
Desired Option	**Existing Option**	**Required Options**	**Post-Sales Option**	**HP Part Number**
UN5		UND	005	
UN7		UN3, UN4, or UN8	007	E4400-60143
UN8			008	E4400-60170
UN8	UN3 or UN4			E4400-60160
UN8 and UN9			009	E4400-60185
UN8 andUN9	UN3 or UN4			E4400-60184
UND			004	E4400-60166
UND	UN3 or UN4			E4400-60181

Option	Description
0B0	Delete Standard Manual Set - This option deletes the manual set that is normally shipped standard with each signal generator.
0B1	Extra Manual Set - This option provides a manual set in addition to the manual set which is standard with every order. The manual set contains user, programming, and calibration information. It does not include service information.
0BV	Component-Level Information Package - This option provides schematics, component locator diagrams, and parts lists for the signal generator.
0BW	Assembly-Level Service Guide - This option provides the information required to troubleshoot and repair the signal generator to the assembly level.
0BX	Assembly-Level Service Guide and Component-Level Information Package - These documents provide you with the information required to troubleshoot and repair the signal generator to the assembly level, and include schematics, component locator diagrams, and parts lists.
1CM	Rack Mount Flanges without Handles - This option adds two flanges and the necessary hardware to rack mount the signal generator in an HP System II or System II Plus cabinet.
1CN	Front Handles - This option adds two front handles with the necessary hardware to attach the handles to the front of the signal generator.
1CP	Rack Mount Flanges with Handles - This option adds two front handles, two flanges, and the necessary hardware to rack mount the signal generator in an HP System II or System II Plus cabinet.
1E5	High Stability Timebase - This option replaces the standard timebase reference assembly with a high-stability timebase reference assembly that has improved specifications over the standard assembly, including warranted specifications for aging rate.
1EM	Move All Front Panel Connectors to Rear Panel - This option moves all of the front panel connectors to the rear panel. If you order Option 1EM in combination with any option that adds front panel connectors, Option 1EM will cause all of the front panel connectors to be moved to the rear panel and, in addition, some of the connectors will be changed from BNC to SMB connectors.
AB0	Chinese for Taiwan Translation - This option provides a subset of the user's information in Chinese for Taiwan.
AB1	Korean Translation - This option provides a subset of the user's information in Korean.
AB2	Chinese Translation - This option provides a subset of the user's information in Chinese.

ABD	German Translation - This option provides a subset of the user's information in German.
ABE	Spanish Translation - This option provides a subset of the user's information in Spanish.
ABF	French Translation - This option provides a subset of the user's information in French.
ES1	This option indicates that a more recent version of firmware is resident in the signal generator than was originally shipped. The operating features in the new firmware may be different than those documented in your original manual set.
UN3	I/Q Baseband Generator with 1 Mbit Pattern RAM (Obsolete) - *This option is no longer available.* Option UN3 provided an I/Q baseband generator with DECT, GSM, NADC, PDC, PHS, and TETRA digital modulation formats. Pre-modulation filtering selections and PRBS capability with 8 Mbits of pattern RAM were also provided. Option UN3 is replaced by Option UN8.
UN4	I/Q Baseband Generator with 8 Mbit Pattern RAM (Obsolete) - *This option is no longer available.* Option UN4 provided an I/Q baseband generator with DECT, GSM, NADC, PDC, PHS, and TETRA digital modulation formats. Pre-modulation filtering selections and PRBS capability with 8 Mbits of pattern RAM were also provided. Option UN4 is replaced by Option UN8 with Option UN9 added for additional RAM.
UN5	Multi-Channel CDMA - This option provides multi-channel CDMA capability, which provides flexible, coded-channel setups for CDMA base stations or mobiles, components, or sub-system test.
UN7	Bit Error Rate Test - This option adds a bit error rate test function that evaluates PN9 or PN15 bit streams for errors. Configuration of data, clock, and clock gate inputs allow testing of demodulated TDMA or CDMA formats. A baseband generator must be part of the instrument configuration.
UN8	Real-time I/Q Baseband Generator - This option provides a custom modulation generator with 1 Mbit of pattern RAM. The custom modulation generator provides generic symbol building, variable symbol rates, and variable filter capabilities in addition to TDMA protocols.
UN9	+7 MBits RAM - This option adds an additional 7 Mbits of pattern RAM to Option UN8 for very long data pattern generation. You must purchase Option UN8 in conjunction with Option UN9.
UNA	Alternate Timeslot Power Level Control - This option provides alternate timeslot power level control for adjacent timeslots in TDMA applications.
UNB	High Power with Mechanical Attenuator - This option provides a mechanical attenuator that provides 4 to 6 dB more output power than the standard electronic attenuator.

UND	Internal Dual Arbitrary Waveform Generator - This option provides an internal dual arbitrary waveform generator that contains an on-board digital signal processor capable of playing back downloaded waveforms to generate complex, digitally modulated signals. A 1 Megasample per channel memory accepts I/Q files from different waveform generation programs, such as Omnisys and Matlab. 14 bit DACs optimize dynamic range and reduce noise.
W50	Five Year Warranty - This option provides additional warranty which extends the standard instrument warranty to a total of five years.

Signal Generator Accessories

This section describes the accessories for the signal generator that can be ordered at any time.

Accessory	Description
Transit Case	The transit case is a sturdy carrying container designed to protect your signal generator from physical damage during transportation. The interior of the container is lined with compressible foam that is form-fitting to the exterior shape of the signal generator. To order the transit case, request HP part number 9211-1296.
Remote Interface	The remote interface consists of a keypad which is connected by a 1 meter cable to the signal generator's AUXILIARY INTERFACE rear panel connector (RS-232). This keypad lets you recall instrument states. (This is the same recall function provided by the front panel keys.) The remote interface is a convenient accessory for use in production environments where multiple instrument states are used repetitively. To order the remote interface, request HP part number HP 83300A.
RS-232 Cable Kit	This kit contains the appropriate hardware (cable, adapters, and null modem) to connect the signal generator RS-232 interface to a computer controller. This hardware is required for downloading firmware from the HP SoCo Web site. To order the RS-232 cable kit, request HP part number E4400-60049.

7 Operation

This chapter contains detailed information that will help you learn how to operate your signal generator.

8 Safety and Regulatory

This chapter provides product warranty information, regulatory declarations, 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.**

CAUTION	Always use the three-prong AC power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord may cause product damage.

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.

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 3.

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.

Declaration of Conformity

Declaration of Conformity

according to ISO/IEC Guide 22 and EN45014

Manufacturer's Name:	**Hewlett-Packard Ltd.**	**Hewlett-Packard Co.**
Manufacturer's Address:	Queensferry Microwave Division South Queensferry West Lothian, EH30 9TG Scotland, United Kingdom	Microwave Instruments Division 1400 Fountaingrove Parkway Santa Rosa, CA 95403-1799 USA

Declares that the products

Product Name:	Analog RF Signal Generator Digital RF Signal Generator
Model Numbers:	HP E4400B, E4420B, E4421B, E4422B HP E4430B, E4431B, E4432B, E4433B
Product Options:	This declaration covers all options of the above products

Conforms to the following Product specifications:

Safety:	EN61010-1 (1993) / IEC 1010-1 (1990) + A1 (1992) CAN/CSA-C22.2 No. 1010.1-92 EN 60825-1 (1994) / IEC 825-1 (1993)
EMC:	CISPR11:1990/EN 55011:1991 Group 1, Class A IEC 801-2:1984/EN 50082-1:1992 4kV CD, 8kV AD IEC 801-3:1984/EN 50082-1:1992 3V/m, 27-500MHz IEC 801-4:1988/EN 50082-1:1992 0.5kV Signal Lines, 1kV Power Lines

Supplementary Information:

The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.

South Queensferry, Scotland *27 March 1998*

R.M. Evans / Quality Manager

Santa Rosa, USA *27 March 1998*

John Hiatt / Quality Engineering Manager

Compliance with German Noise Requirements

This is to declare that this instrument is in conformance with the German Regulation on Noise Declaration for Machines (Laermangabe nach der Maschinenlaermrerordnung -3.GSGV Deutschland).

Acoustic Noise Emission/Geraeuschemission	
LpA < 70 dB	LpA < 70 dB
Operator position	am Arbeitsplatz
Normal position	normaler Betrieb
per ISO 7779	nach DIN 45635 t.19

9 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 Speed[1] (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)*

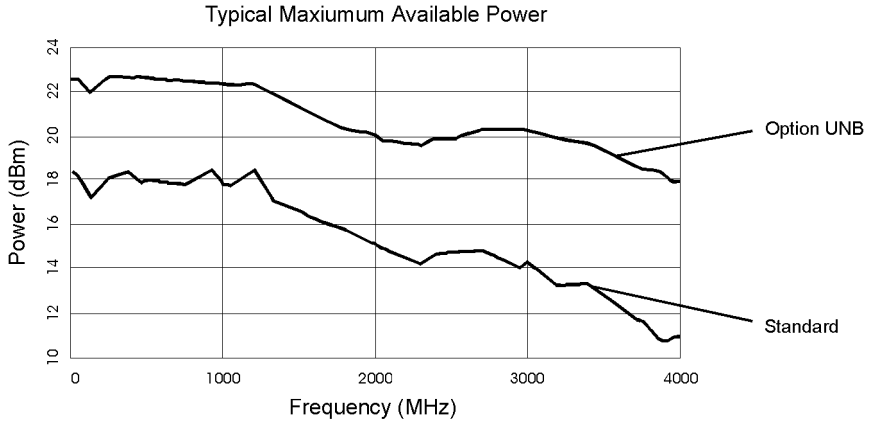
Amplitude: > 0.15 V_{rms}

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



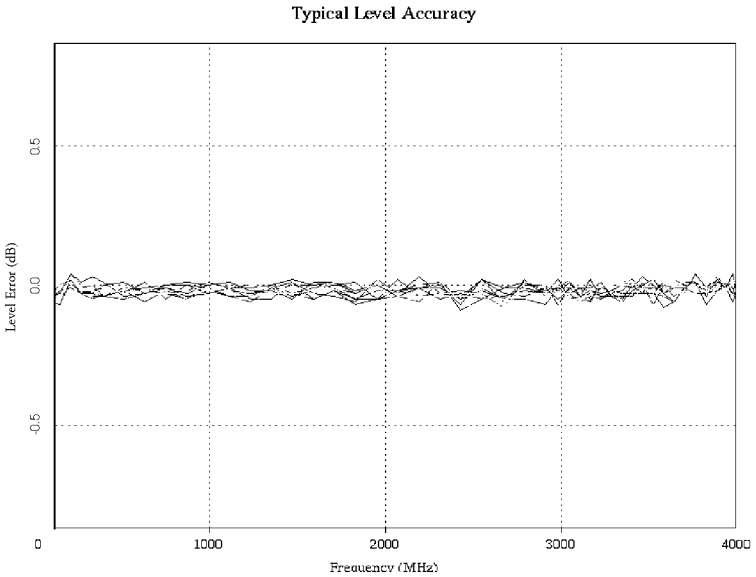
Resolution: 0.02 dB

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 Protection[1]:

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:	*< 1.4:1*	*< 1.25:1*
> 2 to 4 GHz:	*< 1.9:1*	*< 1.35:1*

Output Impedance: 50Ω

Spectral Purity

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

at 500 MHz: < *–120 dBc/Hz*

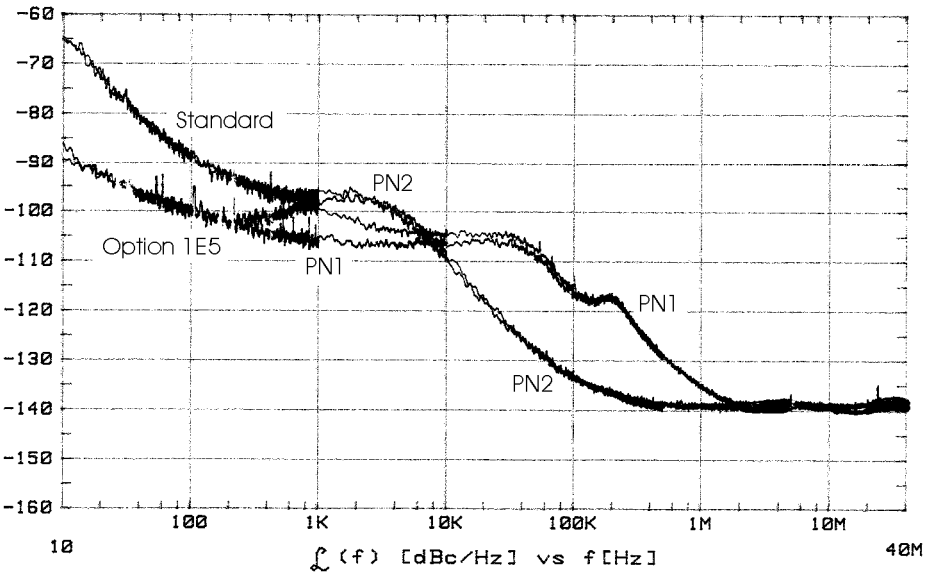
at 1 GHz: < *–116 dBc/Hz*

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 FM[1] (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 9-3 to compute specifications.

Harmonics [≤ +4 dBm (≤ +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** *(typical)*
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 ΦM. 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 Deviation[1]: N x 10 MHz

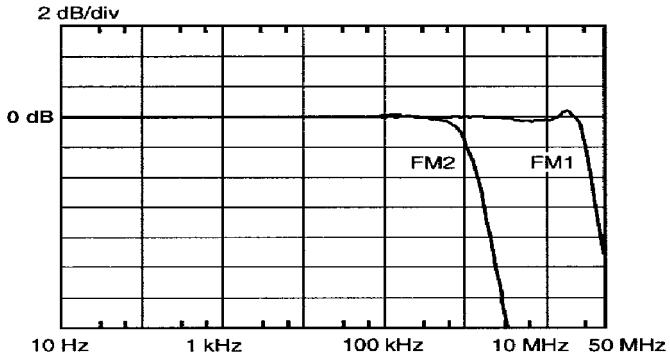
1. Refer to “Frequency Bands” on page 9-3 to compute specifications.

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** *(typical)*
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 Accuracy[1]
(1 kHz rate, deviation < N x 100 kHz): < ±(3.5% of FM deviation setting + 20 Hz)

1. Refer to "Frequency Bands" on page 9-3 to compute specifications.

Carrier Frequency Accuracy
Relative to CW in DCFM [1,2]: ±0.1% of set deviation + (N x 1 Hz)

1. Refer to the "Frequency Bands" on page 9-3 to compute specifications.
2. At the calibrated deviation and carrier frequency, within 5 °C of ambient temperature at time of calibration.

Distortion[1] (1 kHz rate, THD, Deviations = N x 100 kHz): < 1%

1. Refer to "Frequency Bands" on page 9-3 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 x 90 radians

1. Refer to "Frequency Bands" on page 9-3 to compute specifications.

Resolution: 0.1% of set deviation

Modulation Frequency Response[1]:			
Phase Modulation Mode	**Maximum Deviation**	**Rates (3 dB BW)**	
		ΦM1	**ΦM2**
Normal	N x 90 radians	dc - 100 kHz	dc - 100 kHz
High Bandwidth	N x 2π radians	*dc - 1.5 MHz, typical*	*dc - 0.9 MHz, typical*
	N x π/2 radians	*dc - 4 MHz, typical*	*dc - 1 MHz, typical*

1. Refer to "Frequency Bands" on page 9-3 to compute specifications.

Deviation Accuracy (1 kHz rate)**:** < ±(5% of deviation + 0.01 radians)

Distortion[1] (1 kHz rate, THD, Deviations < N x 90 radians**:** < 1%

1. Refer to "Frequency Bands" on page 9-3 to compute specifications.

External Inputs: Ext 1 or Ext 2

Sensitivity: 1 V_{peak} for indicated deviation

Input Impedance: *50Ω, nominal*

Paths: ΦM 1 and ΦM 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 ΦM 2 path is limited to a maximum rate of 1 MHz. The ΦM 2 path must be set to a deviation less than ΦM 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 ≤ maximum specified power)**:** 0 to 100%

Resolution: 0.1%

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

Accuracy (1 kHz rate)**:** < ±(6% 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: *50Ω, 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 µs, typical*

ALC Off: *0.4 µs, 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 µs.

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 µs to 30 s

Width: 8 µs to 30 s

Resolution: 4 µs

Internal Modulation Source

Provides FM, ΦM, 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 µs

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*
(100 Hz to 10 MHz BW, AC-coupled inputs only) *level error exceeds 3% (nominal)*

Simultaneous Modulation

All modulation types may be simultaneously enabled, except: FM with ΦM, AM with burst envelope, and wideband AM with I/Q. AM, FM and ΦM 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 Vrms nominal)[1]

1. The optimum I/Q input level is $\sqrt{I^2 + Q^2}$ = 0.5 Vrms. 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}.

π/4 DQPSK or QPSK Formats[1]: ±0.15 dB

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

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

Level Accuracy with ALC Off[1]**:** *± 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_{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)

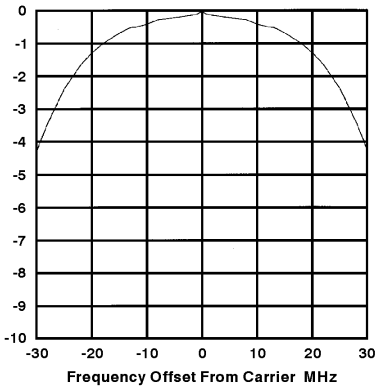
I/Q Inputs:

Input Impedance: 50Ω

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

1. The optimum I/Q input level is $\sqrt{I^2 + Q^2}$ = 0.5 Vrms. 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): ±100%

I/Q Gain Ratio: ±4 dB

I/Q Quadrature: ±10° (for $f_c \leq 3.3$ GHz)

DC Vector Accuracy[1]: [relative to full scale, power ≤ +7 dBm (≤ +10 dBm, Option UNB)]				
Frequency (GHz):	**< 0.6**	**0.6 to 2**	**2 to 3.7**	**≤ 4**
Static EVM ([2]rms):	< 0.75%	< 0.5%	< 0.75%	< 1%
Magnitude Error [2](rms):	< 0.5%	< 0.35%	< 0.5%	< 0.75%
Phase Error[2] (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, π/4DQPSK, 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 $2^{11} - 1$), PN15[1] (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 ±5% of specified data rate

1. PN15 is not continuous in bursted 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)

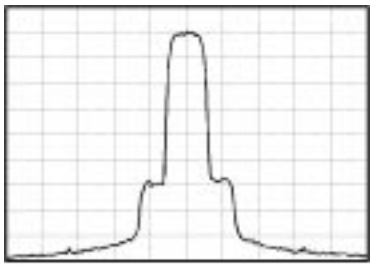
Rise/Fall Time Range: Up to 30 bits

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

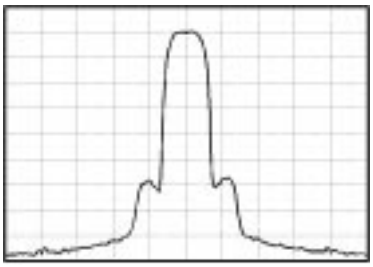
Digital Communications Standards

	NADC		PDC		PHS		TETRA		DECT	GSM (DCS, PCS)	
Error Vector Magnitude[1] (% 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 Error[1] (rms/pk)	N/A		N/A		N/A		N/A		N/A	0.6°/2.2° *0.3°/1.3°, typ*	
Deviation Accuracy[1] (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 Power [1](ACP) (Low ACP Mode, dBc, *typical*)	Cont.	Burst	Cont.	Burst	Cont.	Burst	Cont.	Burst[2]	N/A	Cont.	Burst
at Adjacent Channel[3]	*–35*	*–34*	--	--	--	--	*–69*	*–64*		*–37*	*–37*
at 1st Alternate Channel[3]	*–80*	*–78*	*–74*	*–72*	*–80*	*–78*	*–80*	*–78*		*–72*	*–71*
at 2nd Alternate Channel[3]	*–82*	*–81*	--	--	*–80*	*–79*	*–81*	*–80*		*–82*	*–80*
at 3rd Alternate Channel[3]	*–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				

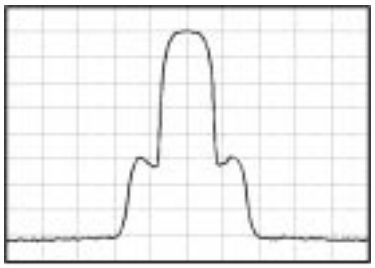
1. Specifications apply for the frequency range, symbol rates, root-raised cosine filter, filter factors (α or B_bT), and default scaling factor specified for each standard and at power levels ≤ +7 dBm (≤ +10 dBm, Option UNB); for TETRA.
2. ACP for TETRA is measured over a 25 kHz bandwidth, with an 18 kHz root-raised cosine filter applied at power levels ≤ +4 dBm (≤ +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.



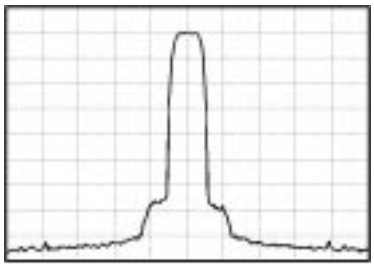
NADC Spectrum
F_c = 849 MHz
Span = 0.3 MHz
Scale = 10 dB/div
Level = +4 dBm



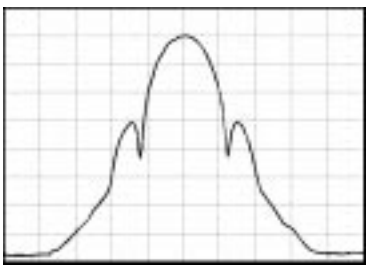
PDC Spectrum
F_c = 810 MHz
Span = 0.25 MHz
Scale = 10 dB/div
Level = +4 dBm



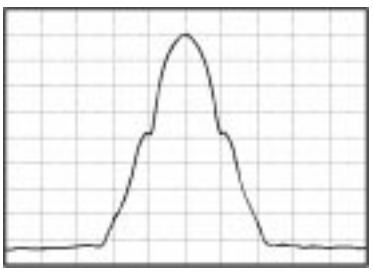
PHS Spectrum
F_c = 1907 MHz
Span = 2 MHz
Scale = 10 dB/div
Level = +4 dBm



TETRA Spectrum
F_c = 400 MHz
Span = 0.25 MHz
Scale = 10 dB/div
Level = +4 dBm



DECT Spectrum
F_c = 1800 MHz
Span = 7 MHz
Scale = 10 dB/div
Level = +4 dBm



GSM Spectrum
F_c = 920 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 50Ω[1].

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

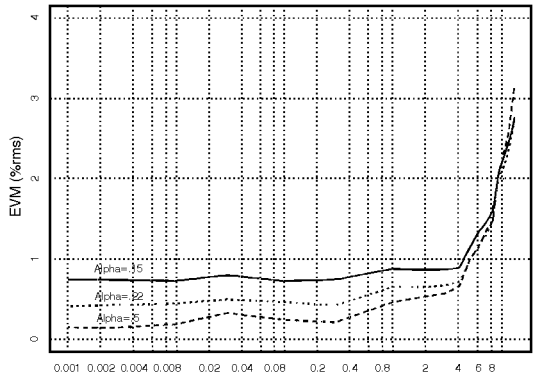
Modulation:	QPSK	π/4DQPSK	16QAM	2FSK	GMSK
Filter:	Root Nyquist			Gaussian	
Filter Factor (α or B_bT):	0.25	0.25	0.25	0.5	0.5
Modulation Index:	N/A	N/A	N/A	0.5	N/A
Symbol Rate (Msymbols/second):	4	4	4	1	1
	Error Vector Magnitude[1] (% rms)			**Shift Error**[1] (% rms)	**Global Phase Error**[1] (degrees rms)
fc=1 GHz:	1.2	1.2	1.0	0.8	0.4
fc=2 GHz:	1.3	1.3	1.2	0.9	0.4
fc=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.

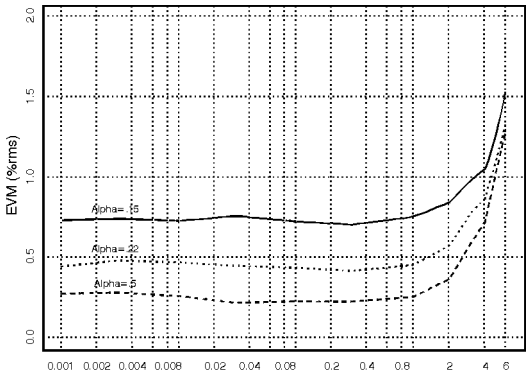
Typical Performance

Power levels ≤ +4 dBm (≤ +8 dBm, Option UNB).

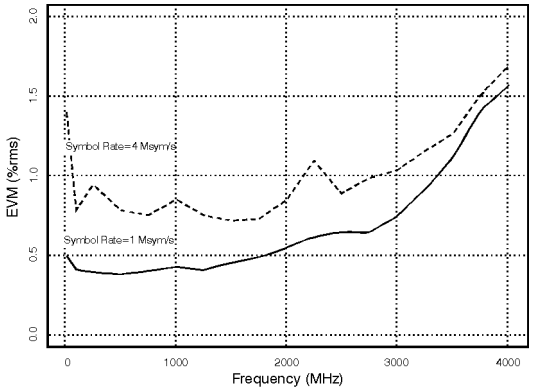
QPSK Formats.



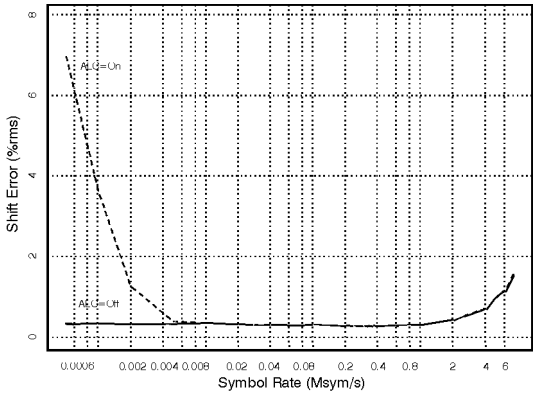
Baseband EVM performance versus symbol rate
(root Nyquist filter, modulation = QPSK)



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

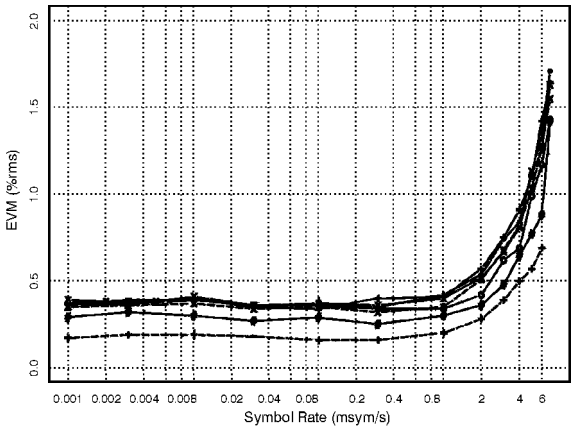


RF EVM performance versus frequency (root Nyquist filter, α = 0.25, ALC = off, modulation = π/4DQPSK)



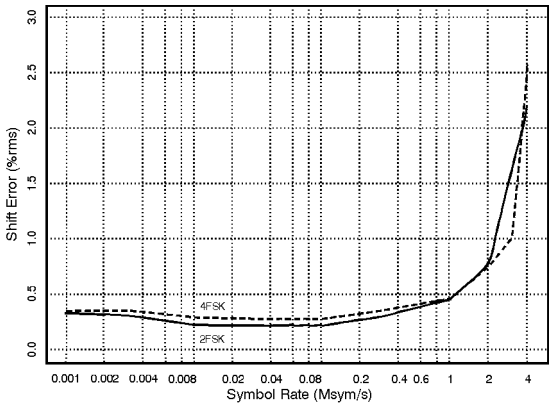
Effects of automatic level control (ALC) on EVM performance (f_c = 1 GHz, root Nyquist filter, α = 0.25, modulation = QPSK)

Non-constant Amplitude Formats.

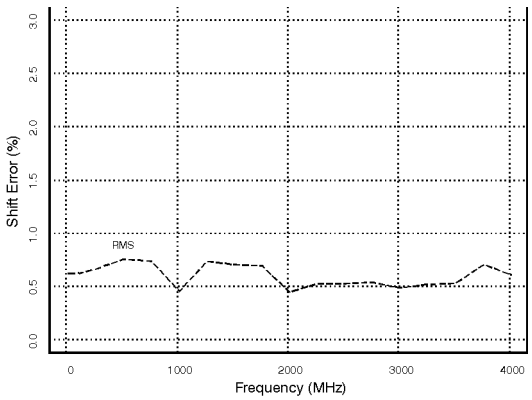


RF EVM performance versus symbol rate (f_c = 1 GHz, root Nyquist filter, α = 0.25)

FSK Formats.

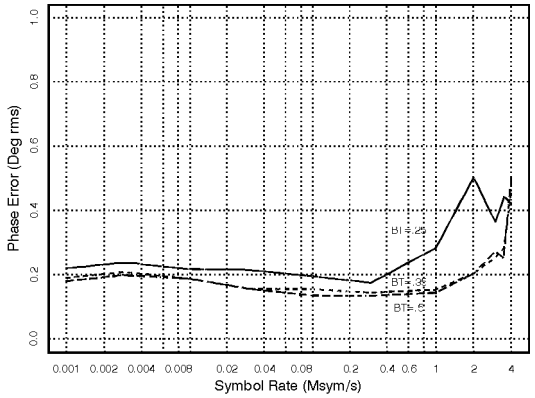


Shift error versus symbol rate
(f_c = 1 GHz, Gaussian filter, B_bT = 0.5, modulation index = 0.5)

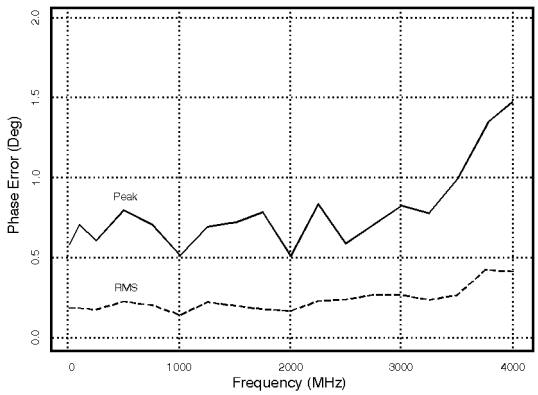


Shift error versus frequency
(Gaussian filter, B_bT = 0.5, modulation index = 0.5,
symbol rate = 1 Msymbol/second)

MSK Formats.



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



Phase error versus frequency
(Gaussian filter, B_bT = 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
π/4DQPSK	70	0.25
QAM	70	> 0.10

1. Filter factor (α or B_bT) is set to 0.5.

Alternate Timeslot Power Level Control (Option UNA Only)

Amplitude is settled within 0.5 dB in 20 µs, from +4 to –136 dBm at 23° C ±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 µs, *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:	α = 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 Emissions[1] (dBc, with high crest factor on)**:**						
	0.885 to 1.25 MHz		**1.25 to 1.98 MHz**		**1.98 to 5 MHz**[2]	
Channels/Offsets:	**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 µV (nominally 0.1 µV with a 2-turn loop) at ≤ 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

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