Notice

Hewlett-Packard to Agilent Technologies Transition

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. To reduce potential confusion, the only change to product numbers and names has been in the company name prefix: where a product name/number was HP XXXX the current name/number is now Agilent XXXX. For example, model number HP 8648 is now model number Agilent 8648.

Contacting Agilent Sales and Service Offices

The sales and service contact information in this manual may be out of date. The latest service and contact information for your location can be found on the Web at:

`http://www.agilent.com/find/assist`

If you do not have access to the Internet, contact your field engineer. In any correspondence or telephone conversation, refer to your instrument by its model number and full serial number.

Agilent Technologies

Printed in USA July 2004

Quick Reference Guide

HP ESG Series Signal Generators

Serial Number Prefixes:

HP ESG1000A, US3704 through US3723
HP ESG2000A, US3704 through US3723
HP ESG3000A, US3704 through US3723
HP ESG4000A, US3704 through US3723

HP Part No. E4400-90078
Printed in USA
Print Date: December 1997 Supersedes: June 1997

1400 Fountaingrove Parkway, Santa Rosa, CA 95403-1799, USA

Quick Reference Guide

HP ESG Series Signal Generators

Serial Number Prefixes:

HP ESG1000A, US3704 through US3723
HP ESG2000A, US3704 through US3723
HP ESG3000A, US3704 through US3723
HP ESG4000A, US3704 through US3723

HEWLETT® PACKARD

HP Part No. E4400-90078
Printed in USA
Print Date: December 1997 Supersedes: June 1997

1400 Fountaingrove Parkway, Santa Rosa, CA 95403-1799, USA

Contents

1 The Signal Generator at a Glance

2 Hardkeys and Softkeys

Contents

Contents

3 Programming Fundamentals

4 SCPI Commands

Contents

Contents

Contents

Contents

Contents

Contents

Contents

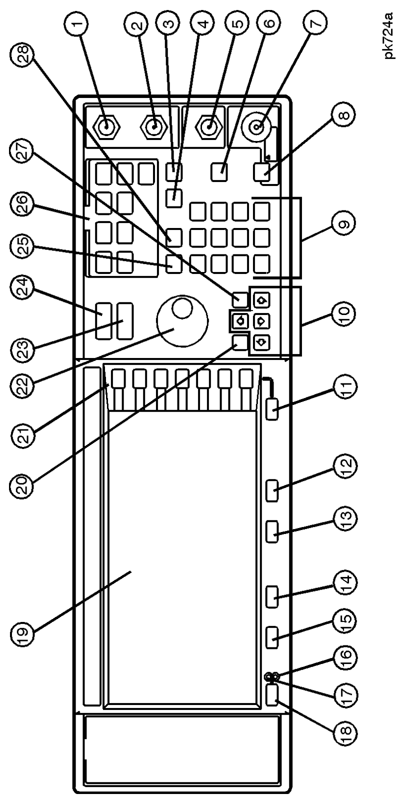
Contents

Contents

1 The Signal Generator at a Glance

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 Vpeak signal for FM, ΦM, and AM. For all these modulations, ±1 Vpk 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 Vpk. 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 Vpeak signal for FM, ΦM, AM, and pulse modulation. With FM, ΦM, or AM, ±1 Vpk 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 Vpk. 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 any other key and you will be returned to normal instrument operation.

4. Trigger Key

Press this hardkey to trigger a step or list sweep.

5. LF OUTPUT Connector

This female BNC connector is the output connector for modulation signals generated by the LF 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 which is later squared by the modulator to generate the pulse squarewave. This output is capable of driving 3.5 Vpk 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 to positive or negative. Use these keys at any time when 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, which is modified by the up and down arrow keys. You can also use these keys in a list to select items in a row.

11. Return Key

The **Return** key 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

Pressing the decrease contrast key and holding it down causes the display background to gradually darken in comparison to the text on the display.

13. Display Contrast Increase Key

Pressing the increase contrast key and holding it down causes the display background to gradually 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 mains 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

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

19. 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.

20. Hold Key

Press this 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.

21. Softkeys

Press a softkey to activate the function indicated by the label on the display directly to the left of the softkey.

22. 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 using the knob.

23. Amplitude Key

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

24. Frequency Key

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

25. Save Key

This hardkey lets you save up to 100 different instrument states in a combination of 100 memory registers and 10 register sequences.

26. 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.

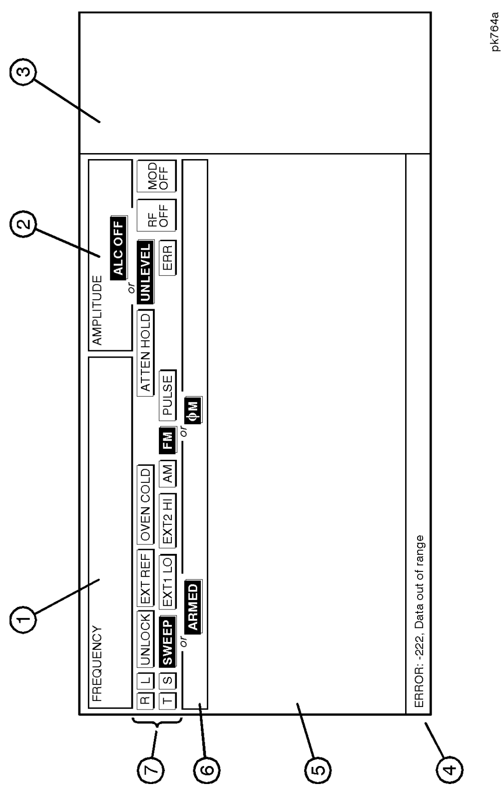
27. Incr Set Key

Press this hardkey to cancel the highlighted digit in the active function display which allows you to enter an arbitrary increment size.

28. 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.

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 Messages Area

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 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 show the status of some of the signal generator functions and indicate error conditions of the instrument. The following annunciators are available:

ΦM	This annunciator is turned on 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 is turned on when the automatic leveling control 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 is turned on when amplitude modulation is turned on.
ARMED	This annunciator is turned on when a sweep has been initiated and the signal generator is waiting for the sweep trigger event.
ATTEN HOLD	This annunciator is turned on when the attenuator hold function is turned on. When this function is on, the attenuator is frozen at its current setting.
ERR	This annunciator is turned on when an error message is placed in the error queue. This annunciator will not turn off until you clear the error queue of all error messages. 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 is turned on if the AC-coupled signal to the EXT 1 input is less than 0.97 Vpk or greater than 1.03 Vpk.

EXT2 LO/HI
This annunciator toggles between **EXT2 LO** and **EXT2 HI**. This annunciator is turned on if the AC-coupled signal to the EXT 2 input is less than 0.97 Vpk or greater than 1.03 Vpk.

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

FM
This annunciator is turned on 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.

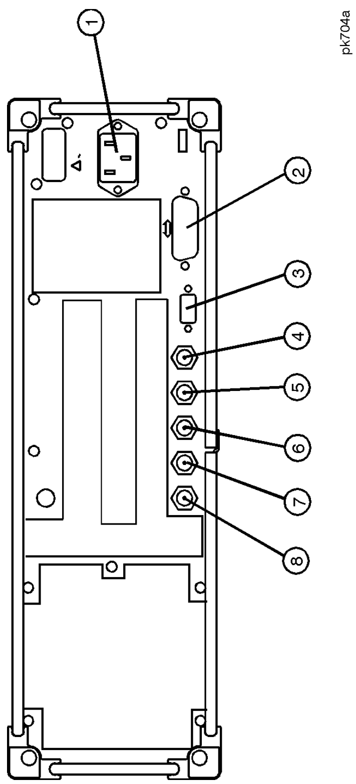
L
The **L** annunciator is turned on when the signal generator is in the listen mode and receiving information or commands over the HP-IB.

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

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

PULSE	This annunciator is turned on when pulse modulation is turned on.
R	The **R** annunciator is turned on 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 is turned on when the signal generator has generated a service request (SRQ) over the HP-IB.
SWEEP	This annunciator is turned on when the signal generator is sweeping in list or step mode.
T	The **T** annunciator is turned on when the signal generator is in the talk mode and is transmitting information over the HP-IB.
UNLEVEL	This annunciator is turned on 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. 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 is turned on 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.

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.

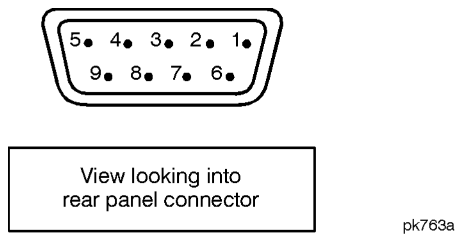
2. HP-IB Connector

The HP-IB connector allows communications with compatible devices such as power meters and external controllers.

3. AUXILIARY INTERFACE Connector

This male DB-9 connector is an RS-232 serial port which can be used for remotely controlling the signal generator. 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	



4. 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.

5. 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. The logic can be reversed.

6. TRIGGER IN Connector

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

7. 10 MHz IN Connector

This female BNC connector accepts a –3.5 to +20 dBm signal from an external timebase reference which 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.

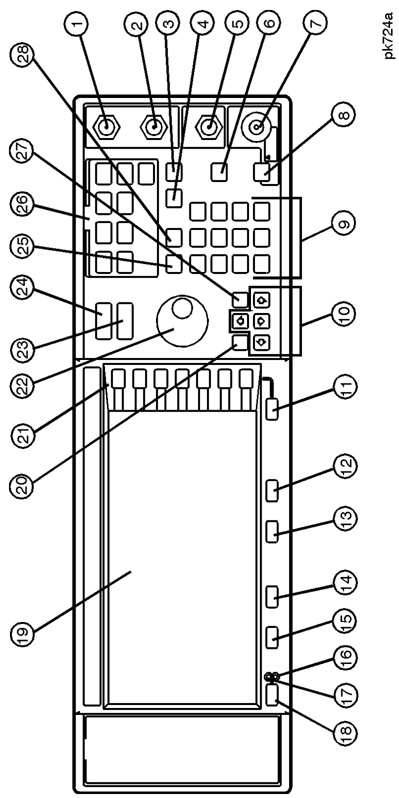
8. 10 MHz OUT Connector

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

1 The Signal Generator at a Glance

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 Vpeak signal for FM, ΦM, and AM. For all these modulations, ±1 Vpk 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 Vpk. 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 Vpeak signal for FM, ΦM, AM, and pulse modulation. With FM, ΦM, or AM, ±1 Vpk 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 Vpk. 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 any other key and you will be returned to normal instrument operation.

4. Trigger Key

Press this hardkey to trigger a step or list sweep.

5. LF OUTPUT Connector

This female BNC connector is the output connector for modulation signals generated by the LF 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 which is later squared by the modulator to generate the pulse squarewave. This output is capable of driving 3.5 Vpk 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 to positive or negative. Use these keys at any time when 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, which is modified by the up and down arrow keys. You can also use these keys in a list to select items in a row.

11. Return Key

The **Return** key 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

Pressing the decrease contrast key and holding it down causes the display background to gradually darken in comparison to the text on the display.

13. Display Contrast Increase Key

Pressing the increase contrast key and holding it down causes the display background to gradually 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 mains 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

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

19. 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.

20. Hold Key

Press this 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.

21. Softkeys

Press a softkey to activate the function indicated by the label on the display directly to the left of the softkey.

22. 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 using the knob.

23. Amplitude Key

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

24. Frequency Key

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

25. Save Key

This hardkey lets you save up to 100 different instrument states in a combination of 100 memory registers and 10 register sequences.

26. 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.

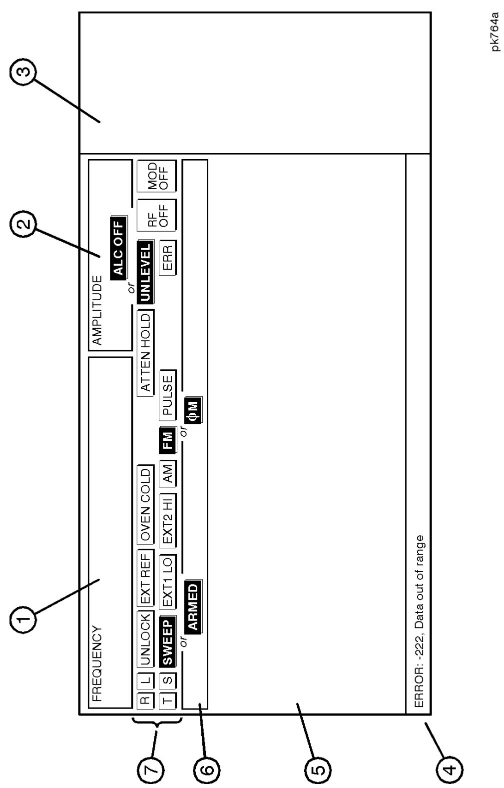
27. Incr Set Key

Press this hardkey to cancel the highlighted digit in the active function display which allows you to enter an arbitrary increment size.

28. 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.

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 Messages Area

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 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

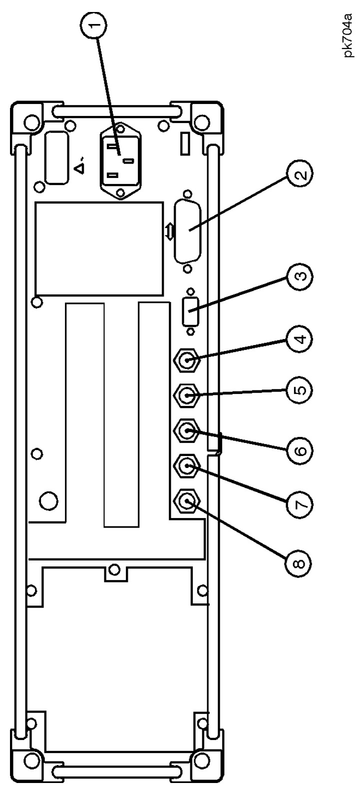
The display annunciators show the status of some of the signal generator functions and indicate error conditions of the instrument. The following annunciators are available:

ΦM	This annunciator is turned on 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 is turned on when the automatic leveling control 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 is turned on when amplitude modulation is turned on.
ARMED	This annunciator is turned on when a sweep has been initiated and the signal generator is waiting for the sweep trigger event.
ATTEN HOLD	This annunciator is turned on when the attenuator hold function is turned on. When this function is on, the attenuator is frozen at its current setting.
ERR	This annunciator is turned on when an error message is placed in the error queue. This annunciator will not turn off until you clear the error queue of all error messages. 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 is turned on if the AC-coupled signal to the EXT 1 input is less than 0.97 Vpk or greater than 1.03 Vpk.
EXT2 LO/HI	This annunciator toggles between **EXT2 LO** and **EXT2 HI**. This annunciator is turned on if the AC-coupled signal to the EXT 2 input is less than 0.97 Vpk or greater than 1.03 Vpk.
EXT REF	This annunciator is turned on when an external 1, 2, 5, or 10 MHz frequency reference is in use.
FM	This annunciator is turned on 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.
L	The **L** annunciator is turned on when the signal generator is in the listen mode and receiving information or commands over the HP-IB.
MOD OFF	This annunciator toggles between **MOD OFF** and **MOD ON** and is always visible in the display. This annunciator indicates whether the modulations which you have enabled are modulating the RF carrier.
OVEN COLD	This annunciator is turned on when the temperature of the internal ovenized reference oscillator (Option 1E5) has dropped below an acceptable level. When this annunciator is turned on, frequency accuracy will be degraded. This condition should only occur if the signal generator is disconnected from line power. The annunciator is timed and automatically turns off after a specified period of time.

PULSE	This annunciator is turned on when pulse modulation is turned on.
R	The **R** annunciator is turned on 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 is turned on when the signal generator has generated a service request (SRQ) over the HP-IB.
SWEEP	This annunciator is turned on when the signal generator is sweeping in list or step mode.
T	The **T** annunciator is turned on when the signal generator is in the talk mode and is transmitting information over the HP-IB.
UNLEVEL	This annunciator is turned on 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. 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 is turned on 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.

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.

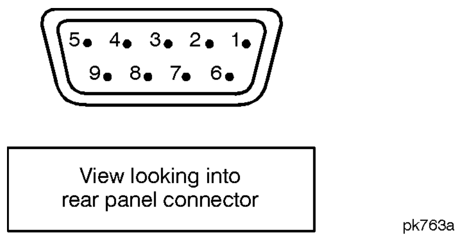
2. HP-IB Connector

The HP-IB connector allows communications with compatible devices such as power meters and external controllers.

3. AUXILIARY INTERFACE Connector

This male DB-9 connector is an RS-232 serial port which can be used for remotely controlling the signal generator. 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	



4. 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.

5. 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. The logic can be reversed.

6. TRIGGER IN Connector

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

7. 10 MHz IN Connector

This female BNC connector accepts a –3.5 to +20 dBm signal from an external timebase reference which 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.

8. 10 MHz OUT Connector

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

2 Hardkeys and Softkeys

This chapter describes each front panel hardkey and each softkey associated with the hardkey. 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. The range of values allowed is 0.1 to 100%.

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.

AM Dual-Sine Ampl Ratio

Press this softkey to set the ratio of the depth of AM tone 2 to the depth of AM tone 1 as a percent. The range of values allowed is 0 to 100%.

AM Off On

This softkey enables the amplitude modulation for whichever AM path configuration (**AM Path 1** or **AM Path 2**) you have selected.

AM Path 1 2

Use **AM Path 1** and **AM Path 2** to define two unique amplitude modulation configurations. 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**.

AM Rate

Use this softkey to change the internal modulation frequency for the **AM Path 1** and **AM Path 2** configurations. 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.)

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.

AM Start Rate

Use this softkey to change the starting internal modulation frequency for swept-sine amplitude modulation. The range of values allowed is 0.1 Hz to 50 kHz.

AM Stop Rate

Use this softkey to change the ending internal modulation frequency for swept-sine amplitude modulation. The range of values allowed is 0.1 Hz to 50 kHz.

AM Sweep Time

Press this softkey to set the sweep time for swept-sine amplitude modulation. The range of values allowed is 1 ms through 65.535 s.

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.

AM Tone 1 Rate

Press this softkey to set the internal modulation frequency for the AM tone 1. The range of values allowed is 0.1 Hz through 50 kHz.

AM Tone 2 Rate

Press this softkey to set the internal modulation frequency for the AM tone 2. The range of values allowed is 0.1 Hz through 50 kHz.

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.

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.

Dual-Sine

Pressing this softkey reveals a menu of choices for setting the dual-sine amplitude modulation parameters.

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.

Ext 1 AC-Coupled

This softkey lets you input an external, AC-coupled, amplitude modulation signal to the EXT 1 INPUT connector.

Ext 1 DC-Coupled

This softkey lets you input an external, DC-coupled, amplitude modulation signal to the EXT 1 INPUT connector.

Ext 2 AC-Coupled

This softkey lets you input an external, AC-coupled, amplitude modulation signal to the EXT 2 INPUT connector.

Ext 2 DC-Coupled

This softkey lets you input an external, DC-coupled, amplitude modulation signal to the EXT 2 INPUT connector.

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.

Internal

This softkey lets you connect an internally-generated, calibrated signal to the AM modulator.

Noise

This softkey lets you specify noise as the amplitude modulation waveform for the **AM Path 1** and **AM Path 2** configurations.

Ramp

This softkey lets you specify ramp as the amplitude modulation waveform for the **AM Path 1** and **AM Path 2** configurations.

Sine

This softkey lets you specify sine as the amplitude modulation waveform for the **AM Path 1** and **AM Path 2** configurations.

Square

This softkey lets you specify square as the amplitude modulation waveform for the **AM Path 1** and **AM Path 2** configurations.

Swept-Sine

Pressing this softkey reveals a menu of choices for setting the swept-sine amplitude modulation parameters.

Triangle

This softkey lets you specify triangle as the amplitude modulation waveform for the **AM Path 1** and **AM Path 2** configurations.

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.

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.

Trigger Out Polarity Neg Pos

This softkey toggles the polarity of the TTL signal that is output at the rear panel TRIGGER OUT connector.

Ampl

Pressing the front panel **Ampl** key reveals a menu of softkeys. These softkeys are described in this section in alphabetical order.

ALC Off On

This softkey toggles the automatic leveling control (ALC) circuit off and on.

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.

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.

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.

Atten Hold Off On

This softkey toggles the attenuator hold function on and off. Turn attenuator hold on to freeze the attenuator at it's current setting. 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. 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.

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.

The following conditions must be met in order to execute the power search routine:

- **ALC Off On** is set to **Off**
- **RF On/Off** is set to **On**

Power Search Manual Auto

This softkey toggles between the auto and manual modes of power search mode.

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. The output power range allowed depends on your instrument model.

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.

Arrow Keys

Use the up and down arrow keys to increase and decrease the value of a numeric parameter by the increment value.

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.

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.

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.

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.

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.

Dual-Sine

Pressing this softkey reveals a menu of choices for setting the dual-sine frequency modulation parameters.

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.

Ext 1 AC-Coupled

This softkey lets you input an external, AC-coupled, frequency modulation signal to the EXT 1 INPUT connector.

Ext 1 DC-Coupled

This softkey lets you input an external, DC-coupled, frequency modulation signal to the EXT 1 INPUT connector.

Ext 2 AC-Coupled

This softkey lets you input an external, AC-coupled, frequency modulation signal to the EXT 2 INPUT connector.

Ext 2 DC-Coupled

This softkey lets you input an external, DC-coupled, frequency modulation signal to the EXT 2 INPUT connector.

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.

FM Dev

Use this softkey to set the frequency modulation deviation for the **FM Path 1** and **FM Path 2** configurations. 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. (The following table lists the values for N and the resulting maximum peak deviations.)

Table 2-1.

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

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**.

FM Dual-Sine Ampl Ratio

Press this softkey to set the ratio of the deviation of FM tone 2 to the deviation of FM tone 1 as a percent. The range of values allowed is 0 to 100%.

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.

FM Path 1 2

Use **FM Path 1** and **FM Path 2** to define two unique frequency modulation configurations. 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**.

FM Rate

Use this softkey to change the internal modulation frequency for the **FM Path 1** and **FM Path 2** configurations. 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.)

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.

FM Start Rate

Use this softkey to change the starting internal modulation frequency for swept-sine frequency modulation. The range of values allowed is 0.1 Hz to 50 kHz.

FM Stop Rate

Use this softkey to change the ending internal modulation frequency for swept-sine frequency modulation. The range of values allowed is 0.1 Hz to 50 kHz.

FM Sweep Time

Press this softkey to set the sweep time for swept-sine frequency modulation. The range of values allowed is 1 ms through 65.535 s.

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.

FM Tone 1 Rate

Press this softkey to set the internal modulation frequency for the FM tone 1. The range of values allowed is 0.1 Hz through 50 kHz.

FM Tone 2 Rate

Press this softkey to set the internal modulation frequency for the FM tone 2. The range of values allowed is 0.1 Hz through 50 kHz.

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.

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.

Internal

This softkey lets you internally generate an AC-coupled, frequency modulation signal.

Noise

This softkey lets you specify noise as the frequency modulation waveform for the **FM Path 1** and **FM Path 2** configurations.

Ramp

This softkey lets you specify ramp as the frequency modulation waveform for the **FM Path 1** and **FM Path 2** configurations.

Sine

This softkey lets you specify sine as the frequency modulation waveform for the **FM Path 1** and **FM Path 2** configurations.

Square

This softkey lets you specify square as the frequency modulation waveform for the **FM Path 1** and **FM Path 2** configurations.

Swept-Sine

Pressing this softkey reveals a menu of choices for setting the swept-sine frequency modulation parameters.

Triangle

This softkey lets you specify triangle as the frequency modulation waveform for the **FM Path 1** and **FM Path 2** configurations.

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.

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.

Trigger Out Polarity Neg Pos

This softkey toggles the polarity of the TTL signal that is output at the rear panel TRIGGER OUT connector.

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.

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).

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.

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.

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.

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.

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.

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.

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.

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.

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.

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** softkey in the **Utility** section for instructions on changing the help mode from single to continuous.

Hold

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.

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.

DC

This softkey lets you specify DC as the waveform for the LF output signal.

Dual-Sine

Pressing this softkey reveals a menu of choices for setting the dual-sine low frequency output parameters.

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.

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.

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.

Internal

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.

LF Out Amplitude

Use this softkey to scale the output of the signal at the LF OUTPUT connector. The range of values allowed is 0 to 5 Vpk in increments from 1 mV to 5 V.

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. 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.)

LF Out Off On

This softkey toggles on and off the output of the selected source at the LF OUTPUT front panel connector.

LF Out Period

Use this softkey to change the pulse period for the pulsed low frequency waveform. The range of values allowed is from 16 µs to 30 s.

LF Out Source

Pressing this softkey reveals a menu of choices for LF output sources.

LF Out Start Freq

Use this softkey to change the starting frequency for swept-sine low frequency output. The range of values allowed is 0.1 Hz to 50 kHz.

LF Out Stop Freq

Use this softkey to change the ending frequency for swept-sine low frequency output. The range of values allowed is 0.1 Hz to 50 kHz.

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. The range of values allowed is 1 ms through 65.535 s.

This softkey is only active when you have selected the internal source to operate as a function generator.

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.

LF Out Tone 1 Freq

Press this softkey to set the frequency for the LF Out tone 1. The range of values allowed is 0.1 Hz through 50 kHz.

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%.

LF Out Tone 2 Freq

Press this softkey to set the frequency for the LF Out tone 2. The range of values allowed is 0.1 Hz through 50 kHz.

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.

LF Out Width

Use this softkey to change the pulse width for the pulsed low frequency waveform. The range of values allowed is from 8 µs to a maximum of the value for the pulse period.

Noise

This softkey lets you specify noise as the waveform for the LF output signal.

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.

Ramp

This softkey lets you specify ramp as the waveform for the LF output signal.

Sine

This softkey lets you specify sine as the waveform for the LF output signal.

Square

This softkey lets you specify square as the waveform for the LF output signal.

Swept-Sine

Pressing this softkey reveals a menu of choices for setting the swept-sine low frequency output.

Triangle

This softkey lets you specify triangle as the waveform for the LF output signal.

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.

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.

Trigger Out Polarity Neg Pos

This softkey toggles the polarity of the TTL signal that is output at the rear panel TRIGGER OUT connector.

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.

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. An annunciator is always turned on in the display to indicate whether modulation is turned on or off.

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. The range of values allowed depends on the carrier frequency and the rate selected. Refer to Table 2-1.

Table 2-1.Maximum Deviation Values for Phase Modulation

Mode	Maximum Deviation	Maximum Rates (3 dB BW)	
		ΦM Path 1	ΦM Path 2
Normal	N[a] 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)

a. For the value of N, refer to Table 2-2.

Table 2-2.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

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**.

ΦM Dual-Sine Ampl Ratio

Press this softkey to set the ratio of the deviation of ΦM tone 2 to the deviation of ΦM tone 1 as a percent. The range of values allowed is 0 to 100%.

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.

ΦM Path 1 2

Use **ΦM Path 1** and **ΦM Path 2** to define two unique phase modulation configurations. 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**.

ΦM Rate

Use this softkey to change the internal modulation frequency for the **ΦM Path 1** and **ΦM Path 2** configurations. 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.)

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.

ΦM Start Rate

Use this softkey to change the starting internal modulation frequency for swept-sine phase modulation. The range of values allowed is 0.1 Hz to 50 kHz.

ΦM Stop Rate

Use this softkey to change the ending internal modulation frequency for swept-sine phase modulation. The range of values allowed is 0.1 Hz to 50 kHz.

ΦM Sweep Time

Press this softkey to set the sweep time for swept-sine phase modulation. The range of values allowed is 1 ms through 65.535 s.

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.

ΦM Tone 1 Rate

Press this softkey to set the internal modulation frequency for the ΦM tone 1. The range of values allowed is 0.1 Hz through 50 kHz.

ΦM Tone 2 Rate

Press this softkey to set the internal modulation frequency for the ΦM tone 2. The range of values allowed is 0.1 Hz through 50 kHz.

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.

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.

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.

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.

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.

Ext 1 AC-Coupled

This softkey lets you input an external, AC-coupled, phase modulation signal to the EXT 1 INPUT connector.

Ext 1 DC-Coupled

This softkey lets you input an external, DC-coupled, phase modulation signal to the EXT 1 INPUT connector.

Ext 2 AC-Coupled

This softkey lets you input an external, AC-coupled, phase modulation signal to the EXT 2 INPUT connector.

Ext 2 DC-Coupled

This softkey lets you input an external, DC-coupled, phase modulation signal to the EXT 2 INPUT connector.

FM/ΦM Normal High BW

This softkey toggles between the menus for FM, normal ΦM, and wideband ΦM.)

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.

Internal

This softkey lets you internally generate an AC-coupled, phase modulation signal.

Noise

This softkey lets you specify noise as the phase modulation waveform for the **ΦM Path 1** and **ΦM Path 2** configurations.

Ramp

This softkey lets you specify ramp as the phase modulation waveform for the **ΦM Path 1** and **ΦM Path 2** configurations.

Sine

This softkey lets you specify sine as the phase modulation waveform for the **ΦM Path 1** and **ΦM Path 2** configurations.

Square

This softkey lets you to specify square as the phase modulation waveform for the **ΦM Path 1** and **ΦM Path 2** configurations.

Swept-Sine

Pressing this softkey reveals a menu of choices for setting the swept-sine phase modulation parameters.

Triangle

This softkey lets you to specify triangle as the frequency modulation waveform for the ΦM **Path 1** and ΦM **Path 2** configurations.

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.

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.

Trigger Out Polarity Neg Pos

This softkey toggles the polarity of the TTL signal that is output at the rear panel TRIGGER OUT connector.

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). To set your signal generator to default conditions, set the **Preset Normal User** softkey to **Normal**. Or you can define your own preset conditions and set your signal generator to preset to that unique state. Refer to the **Preset Normal User** softkey description which is part of the **Utility** key section.

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.

Internal Pulse

This softkey lets you internally generate rectangular pulse modulation.

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.

Pulse Off On

This softkey enables the pulse modulation for whichever pulse source you have selected.

Pulse Period

Use this softkey to change the pulse period for internal pulse modulation. The range of values allowed is 16 µs to 30 s.

Pulse Rate

Use this softkey to change the pulse rate for internal square pulse modulation. The range of values allowed is 0.1 Hz to 50 kHz.

Pulse Width

Use this softkey to change the pulse width for internal pulse modulation. The range of values allowed is 8 µs to 30 s.

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.

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 **Select Seq** softkey.

NOTE: This softkey has exactly the same function as the softkey with the identical name in the front panel **Save** key menu.

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.

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.

NOTE: This softkey has exactly the same function as the softkey with the identical name in the front panel **Save** key menu.

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.

Select Seq

Press this softkey to choose a sequence for all softkeys which specify a sequence in this menu.

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.

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.

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.

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.

NOTE: This softkey has exactly the same function as the softkey with the identical name in the front panel **Recall** key menu.

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.

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.

NOTE: This softkey has exactly the same function as the softkey with the identical name in the front panel **Recall** key menu.

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.

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).

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.

Select Reg

Press this softkey to choose a register for all softkeys which specify a register in this menu.

Select Seq

Press this softkey to choose a sequence for all softkeys which specify a sequence in this menu.

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. A step sweep must always have a minimum of 2 points and can be configured to have as many as 401 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.

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.

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.

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).

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.

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.

Delete File

Press this softkey to delete a file in the catalog listing.

Delete Item

Press this softkey to delete an item in the displayed list of sweep points.

Delete Row

Press this softkey to delete a selected row in the sweep list.

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.

Edit Item

Press this softkey to change an item in the displayed list of sweep points.

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.

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.

Freq&Ampl

Press this softkey to set the signal generator to sweep both frequency and amplitude data.

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.

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.

Goto Bottom Row

Press this softkey to move the selection bar to the bottom row of list sweep points 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.

Goto Middle Row

Press this softkey to move the selection bar to the middle row of list sweep points 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.

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 softkey helps 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.

Goto Top Row

Press this softkey to move the selection bar to the top row of list sweep points 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.

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.

Insert Item

Press this softkey to place a copy of the selected item directly below that item in the sweep list.

Insert Row

Press this softkey to place a copy of the selected row directly below that row in the sweep list.

Load From Selected File

Press this softkey to load the list sweep data from a file into the current sweep list.

Load List From Step Sweep

Press this softkey to eliminate the existing sweep list data and replace it with the step sweep data points.

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.

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.

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.

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.

Page Down

Press this softkey to view the next page of list sweep points when you are in the Configure List Sweep menu or to view the next page of the catalog listing when you are in the Load/Store List menu.

Page Up

Press this softkey to view the previous page of list sweep points when you are in the Configure List Sweep menu or to view the previous page of the catalog listing when you are in the Load/Store List menu.

Point Trigger

Pressing this softkey reveals a menu of choices for triggering a sweep point-by-point.

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.

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.

Step Dwell

Press this softkey to set the dwell time for each point of a step sweep.

Store to File

Press this softkey to store the current list sweep data to a file in internal non-volatile memory.

Sweep

Pressing this softkey reveals a menu of choices for determining the sweep parameters.

Sweep Direction Down Up

This softkey changes the direction of the sweep.

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.

Sweep Trigger

Pressing this softkey reveals a menu of choices for triggering a full sweep.

Sweep Type List Step

This softkey toggles the sweep type from list sweep to step sweep.

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 step or list sweeps.

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.

Trigger Out Polarity Neg Pos

This softkey toggles the polarity of the TTL signal that is output at the rear panel TRIGGER OUT connector.

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.

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.

Binary

This softkey lets you specify that only binary files are to be listed on the display when **Memory Catalog** is selected.

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.

Brightness

Use this softkey to adjust the display brightness (intensity).

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, or instrument state files only.

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.)

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.

Copy File

Press this softkey to copy and rename a file in the displayed catalog of files.

Delete All Binary Files

Press this softkey to delete all of the binary files in the displayed catalog of files.

Delete All Files

Press this softkey to delete all of the files in the displayed catalog of files.

Delete All List Files

Press this softkey to delete all of the list files in the displayed catalog of files.

Delete All State Files

Press this softkey to delete all of the instrument state files in the displayed catalog of files.

Delete File

Press this softkey to delete a file in the displayed catalog of files.

Diagnostic Info

Press this softkey for a display of diagnostic information about the signal generator.

Display

Pressing this softkey reveals a menu of choices for adjusting and testing the display.

Editing Keys

Pressing this softkey reveals a menu of choices for editing the name of a file you have just copied.

Editing Mode Insert Replace

Press this softkey to toggle the editing mode from inserting text to replacing text.

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.

Help Mode Single Cont

This softkey toggles the help mode between single and continuous.

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.

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.

HP-IB/RS-232

Pressing this softkey reveals a menu of choices for HP-IB and RS-232 configuration.

Instrument Adjustments

Pressing this softkey reveals a menu of front panel adjustments for the signal generator.

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

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).

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 List To File** softkey in the Sweep/List menu.

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 for file management.

Mod Status Info Off On

Press this softkey to toggle on and off the modulation status display.

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.

Page Down

Press this softkey to move down one page at a time in the displayed catalog of files.

Page Up

Press this softkey to move up one page at a time in the displayed catalog of files.

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.

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 Use 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.)

Preset Language

Pressing this softkey reveals a menu of choices for selecting the programming language that is implemented after the **Preset** key is pressed.

Preset Normal User

This softkey toggles the preset state between the factory-defined and the user-defined states.

Recall Ref Osc Setting

This softkey is provided for adjusting the internal reference oscillator. This adjustment is for use by service personnel only.

Receive Pace None Xon

This softkey in the RS-232 Pace menu determines whether any pacing is acknowledged by the RS-232 receive channel.

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.

Ref Osc Coarse

This softkey is provided for adjusting the internal reference oscillator. This adjustment is for use by service personnel only.

Ref Osc Fine

This softkey is provided for adjusting the internal reference oscillator. This adjustment is for use by service personnel only.

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.

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.

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.

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).

RS-232 Echo Off On

This softkey toggles the echo function on and off for the RS-232 serial port (AUXILIARY INTERFACE connector).

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.

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/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 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.

Save User Preset

Use this softkey to establish your user-defined preset state.

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.

Screen Saver Delay

This softkey sets the period of time before the screen saver is activated.

Screen Saver Mode

This softkey toggles between **Light Only** and **Light & Text** mode for the screen saver.

Screen Saver Off On

This softkey toggles the signal generator's screen saver on and off.

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.

State

This softkey lets you specify that only instrument state files are to be listed on the display when **Memory Catalog** is selected.

Step/Knob Ratio

This softkey sets the ratio between the increment value of the step keys and the front panel knob.

Store Ref Osc Setting

This softkey is provided for adjusting the internal reference oscillator. This adjustment is for use by service personnel only.

Transmit Pace None Xon

This softkey in the RS-232 Pace menu determines whether any pacing is acknowledged by the RS-232 transmit channel.

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.

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.

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.

2 Hardkeys and Softkeys

This chapter describes each front panel hardkey and each softkey associated with the hardkey. 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. The range of values allowed is 0.1 to 100%.

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.

AM Dual-Sine Ampl Ratio

Press this softkey to set the ratio of the depth of AM tone 2 to the depth of AM tone 1 as a percent. The range of values allowed is 0 to 100%.

AM Off On

This softkey enables the amplitude modulation for whichever AM path configuration (**AM Path 1** or **AM Path 2**) you have selected.

AM Path 1 2

Use **AM Path 1** and **AM Path 2** to define two unique amplitude modulation configurations. 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**.

AM Rate

Use this softkey to change the internal modulation frequency for the **AM Path 1** and **AM Path 2** configurations. 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.)

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.

AM Start Rate

Use this softkey to change the starting internal modulation frequency for swept-sine amplitude modulation. The range of values allowed is 0.1 Hz to 50 kHz.

AM Stop Rate

Use this softkey to change the ending internal modulation frequency for swept-sine amplitude modulation. The range of values allowed is 0.1 Hz to 50 kHz.

AM Sweep Time

Press this softkey to set the sweep time for swept-sine amplitude modulation. The range of values allowed is 1 ms through 65.535 s.

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.

AM Tone 1 Rate

Press this softkey to set the internal modulation frequency for the AM tone 1. The range of values allowed is 0.1 Hz through 50 kHz.

AM Tone 2 Rate

Press this softkey to set the internal modulation frequency for the AM tone 2. The range of values allowed is 0.1 Hz through 50 kHz.

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.

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.

Dual-Sine

Pressing this softkey reveals a menu of choices for setting the dual-sine amplitude modulation parameters.

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.

Ext 1 AC-Coupled

This softkey lets you input an external, AC-coupled, amplitude modulation signal to the EXT 1 INPUT connector.

Ext 1 DC-Coupled

This softkey lets you input an external, DC-coupled, amplitude modulation signal to the EXT 1 INPUT connector.

Ext 2 AC-Coupled

This softkey lets you input an external, AC-coupled, amplitude modulation signal to the EXT 2 INPUT connector.

Ext 2 DC-Coupled

This softkey lets you input an external, DC-coupled, amplitude modulation signal to the EXT 2 INPUT connector.

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.

Internal

This softkey lets you connect an internally-generated, calibrated signal to the AM modulator.

Noise

This softkey lets you specify noise as the amplitude modulation waveform for the **AM Path 1** and **AM Path 2** configurations.

Ramp

This softkey lets you specify ramp as the amplitude modulation waveform for the **AM Path 1** and **AM Path 2** configurations.

Sine

This softkey lets you specify sine as the amplitude modulation waveform for the **AM Path 1** and **AM Path 2** configurations.

Square

This softkey lets you specify square as the amplitude modulation waveform for the **AM Path 1** and **AM Path 2** configurations.

Swept-Sine

Pressing this softkey reveals a menu of choices for setting the swept-sine amplitude modulation parameters.

Triangle

This softkey lets you specify triangle as the amplitude modulation waveform for the **AM Path 1** and **AM Path 2** configurations.

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.

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.

Trigger Out Polarity Neg Pos

This softkey toggles the polarity of the TTL signal that is output at the rear panel TRIGGER OUT connector.

Ampl

Pressing the front panel **Ampl** key reveals a menu of softkeys. These softkeys are described in this section in alphabetical order.

ALC Off On

This softkey toggles the automatic leveling control (ALC) circuit off and on.

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.

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.

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.

Atten Hold Off On

This softkey toggles the attenuator hold function on and off. Turn attenuator hold on to freeze the attenuator at it's current setting. 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. 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.

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.

The following conditions must be met in order to execute the power search routine:

- **ALC Off On** is set to **Off**
- **RF On/Off** is set to **On**

Power Search Manual Auto

This softkey toggles between the auto and manual modes of power search mode.

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. The output power range allowed depends on your instrument model.

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.

Arrow Keys

Use the up and down arrow keys to increase and decrease the value of a numeric parameter by the increment value.

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.

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.

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.

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.

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.

Dual-Sine

Pressing this softkey reveals a menu of choices for setting the dual-sine frequency modulation parameters.

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.

Ext 1 AC-Coupled

This softkey lets you input an external, AC-coupled, frequency modulation signal to the EXT 1 INPUT connector.

Ext 1 DC-Coupled

This softkey lets you input an external, DC-coupled, frequency modulation signal to the EXT 1 INPUT connector.

Ext 2 AC-Coupled

This softkey lets you input an external, AC-coupled, frequency modulation signal to the EXT 2 INPUT connector.

Ext 2 DC-Coupled

This softkey lets you input an external, DC-coupled, frequency modulation signal to the EXT 2 INPUT connector.

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.

FM Dev

Use this softkey to set the frequency modulation deviation for the **FM Path 1** and **FM Path 2** configurations. 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. (The following table lists the values for N and the resulting maximum peak deviations.)

Table 2-1.

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

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**.

FM Dual-Sine Ampl Ratio

Press this softkey to set the ratio of the deviation of FM tone 2 to the deviation of FM tone 1 as a percent. The range of values allowed is 0 to 100%.

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.

FM Path 1 2

Use **FM Path 1** and **FM Path 2** to define two unique frequency modulation configurations. 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**.

FM Rate

Use this softkey to change the internal modulation frequency for the **FM Path 1** and **FM Path 2** configurations. 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.)

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.

FM Start Rate

Use this softkey to change the starting internal modulation frequency for swept-sine frequency modulation. The range of values allowed is 0.1 Hz to 50 kHz.

FM Stop Rate

Use this softkey to change the ending internal modulation frequency for swept-sine frequency modulation. The range of values allowed is 0.1 Hz to 50 kHz.

FM Sweep Time

Press this softkey to set the sweep time for swept-sine frequency modulation. The range of values allowed is 1 ms through 65.535 s.

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.

FM Tone 1 Rate

Press this softkey to set the internal modulation frequency for the FM tone 1. The range of values allowed is 0.1 Hz through 50 kHz.

FM Tone 2 Rate

Press this softkey to set the internal modulation frequency for the FM tone 2. The range of values allowed is 0.1 Hz through 50 kHz.

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.

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.

Internal

This softkey lets you internally generate an AC-coupled, frequency modulation signal.

Noise

This softkey lets you specify noise as the frequency modulation waveform for the **FM Path 1** and **FM Path 2** configurations.

Ramp

This softkey lets you specify ramp as the frequency modulation waveform for the **FM Path 1** and **FM Path 2** configurations.

Sine

This softkey lets you specify sine as the frequency modulation waveform for the **FM Path 1** and **FM Path 2** configurations.

Square

This softkey lets you specify square as the frequency modulation waveform for the **FM Path 1** and **FM Path 2** configurations.

Swept-Sine

Pressing this softkey reveals a menu of choices for setting the swept-sine frequency modulation parameters.

Triangle

This softkey lets you specify triangle as the frequency modulation waveform for the **FM Path 1** and **FM Path 2** configurations.

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.

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.

Trigger Out Polarity Neg Pos

This softkey toggles the polarity of the TTL signal that is output at the rear panel TRIGGER OUT connector.

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.

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).

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.

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.

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.

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.

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.

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.

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.

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.

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.

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** softkey in the **Utility** section for instructions on changing the help mode from single to continuous.

Hold

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.

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.

DC

This softkey lets you specify DC as the waveform for the LF output signal.

Dual-Sine

Pressing this softkey reveals a menu of choices for setting the dual-sine low frequency output parameters.

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.

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.

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.

Internal

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.

LF Out Amplitude

Use this softkey to scale the output of the signal at the LF OUTPUT connector. The range of values allowed is 0 to 5 Vpk in increments from 1 mV to 5 V.

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. 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.)

LF Out Off On

This softkey toggles on and off the output of the selected source at the LF OUTPUT front panel connector.

LF Out Period

Use this softkey to change the pulse period for the pulsed low frequency waveform. The range of values allowed is from 16 µs to 30 s.

LF Out Source

Pressing this softkey reveals a menu of choices for LF output sources.

LF Out Start Freq

Use this softkey to change the starting frequency for swept-sine low frequency output. The range of values allowed is 0.1 Hz to 50 kHz.

LF Out Stop Freq

Use this softkey to change the ending frequency for swept-sine low frequency output. The range of values allowed is 0.1 Hz to 50 kHz.

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. The range of values allowed is 1 ms through 65.535 s.

This softkey is only active when you have selected the internal source to operate as a function generator.

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.

LF Out Tone 1 Freq

Press this softkey to set the frequency for the LF Out tone 1. The range of values allowed is 0.1 Hz through 50 kHz.

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%.

LF Out Tone 2 Freq

Press this softkey to set the frequency for the LF Out tone 2. The range of values allowed is 0.1 Hz through 50 kHz.

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.

LF Out Width

Use this softkey to change the pulse width for the pulsed low frequency waveform. The range of values allowed is from 8 µs to a maximum of the value for the pulse period.

Noise

This softkey lets you specify noise as the waveform for the LF output signal.

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.

Ramp

This softkey lets you specify ramp as the waveform for the LF output signal.

Sine

This softkey lets you specify sine as the waveform for the LF output signal.

Square

This softkey lets you specify square as the waveform for the LF output signal.

Swept-Sine

Pressing this softkey reveals a menu of choices for setting the swept-sine low frequency output.

Triangle

This softkey lets you specify triangle as the waveform for the LF output signal.

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.

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.

Trigger Out Polarity Neg Pos

This softkey toggles the polarity of the TTL signal that is output at the rear panel TRIGGER OUT connector.

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.

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. An annunciator is always turned on in the display to indicate whether modulation is turned on or off.

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. The range of values allowed depends on the carrier frequency and the rate selected. Refer to Table 2-1.

Table 2-1.Maximum Deviation Values for Phase Modulation

Mode	Maximum Deviation	Maximum Rates (3 dB BW)	
		ΦM Path 1	ΦM Path 2
Normal	N[a] 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)

a. For the value of N, refer to Table 2-2.

Table 2-2.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

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**.

ΦM Dual-Sine Ampl Ratio

Press this softkey to set the ratio of the deviation of ΦM tone 2 to the deviation of ΦM tone 1 as a percent. The range of values allowed is 0 to 100%.

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.

ΦM Path 1 2

Use **ΦM Path 1** and **ΦM Path 2** to define two unique phase modulation configurations. 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**.

ΦM Rate

Use this softkey to change the internal modulation frequency for the **ΦM Path 1** and **ΦM Path 2** configurations. 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.)

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.

ΦM Start Rate

Use this softkey to change the starting internal modulation frequency for swept-sine phase modulation. The range of values allowed is 0.1 Hz to 50 kHz.

ΦM Stop Rate

Use this softkey to change the ending internal modulation frequency for swept-sine phase modulation. The range of values allowed is 0.1 Hz to 50 kHz.

ΦM Sweep Time

Press this softkey to set the sweep time for swept-sine phase modulation. The range of values allowed is 1 ms through 65.535 s.

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.

ΦM Tone 1 Rate

Press this softkey to set the internal modulation frequency for the ΦM tone 1. The range of values allowed is 0.1 Hz through 50 kHz.

ΦM Tone 2 Rate

Press this softkey to set the internal modulation frequency for the ΦM tone 2. The range of values allowed is 0.1 Hz through 50 kHz.

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.

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.

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.

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.

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.

Ext 1 AC-Coupled

This softkey lets you input an external, AC-coupled, phase modulation signal to the EXT 1 INPUT connector.

Ext 1 DC-Coupled

This softkey lets you input an external, DC-coupled, phase modulation signal to the EXT 1 INPUT connector.

Ext 2 AC-Coupled

This softkey lets you input an external, AC-coupled, phase modulation signal to the EXT 2 INPUT connector.

Ext 2 DC-Coupled

This softkey lets you input an external, DC-coupled, phase modulation signal to the EXT 2 INPUT connector.

FM/ΦM Normal High BW

This softkey toggles between the menus for FM, normal ΦM, and wideband ΦM.)

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.

Internal

This softkey lets you internally generate an AC-coupled, phase modulation signal.

Noise

This softkey lets you specify noise as the phase modulation waveform for the **ΦM Path 1** and **ΦM Path 2** configurations.

Ramp

This softkey lets you specify ramp as the phase modulation waveform for the **ΦM Path 1** and **ΦM Path 2** configurations.

Sine

This softkey lets you specify sine as the phase modulation waveform for the **ΦM Path 1** and **ΦM Path 2** configurations.

Square

This softkey lets you to specify square as the phase modulation waveform for the **ΦM Path 1** and **ΦM Path 2** configurations.

Swept-Sine

Pressing this softkey reveals a menu of choices for setting the swept-sine phase modulation parameters.

Triangle

This softkey lets you to specify triangle as the frequency modulation waveform for the Φ**M Path 1** and Φ**M Path 2** configurations.

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.

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.

Trigger Out Polarity Neg Pos

This softkey toggles the polarity of the TTL signal that is output at the rear panel TRIGGER OUT connector.

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). To set your signal generator to default conditions, set the **Preset Normal User** softkey to **Normal**. Or you can define your own preset conditions and set your signal generator to preset to that unique state. Refer to the **Preset Normal User** softkey description which is part of the **Utility** key section.

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.

Internal Pulse

This softkey lets you internally generate rectangular pulse modulation.

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.

Pulse Off On

This softkey enables the pulse modulation for whichever pulse source you have selected.

Pulse Period

Use this softkey to change the pulse period for internal pulse modulation. The range of values allowed is 16 µs to 30 s.

Pulse Rate

Use this softkey to change the pulse rate for internal square pulse modulation. The range of values allowed is 0.1 Hz to 50 kHz.

Pulse Width

Use this softkey to change the pulse width for internal pulse modulation. The range of values allowed is 8 µs to 30 s.

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.

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 **Select Seq** softkey.

NOTE: This softkey has exactly the same function as the softkey with the identical name in the front panel **Save** key menu.

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.

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.

NOTE:	This softkey has exactly the same function as the softkey with the identical name in the front panel **Save** key menu.

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.

Select Seq

Press this softkey to choose a sequence for all softkeys which specify a sequence in this menu.

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.

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.

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.

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.

NOTE:	This softkey has exactly the same function as the softkey with the identical name in the front panel **Recall** key menu.

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.

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.

NOTE:	This softkey has exactly the same function as the softkey with the identical name in the front panel **Recall** key menu.

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.

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).

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.

Select Reg

Press this softkey to choose a register for all softkeys which specify a register in this menu.

Select Seq

Press this softkey to choose a sequence for all softkeys which specify a sequence in this menu.

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. A step sweep must always have a minimum of 2 points and can be configured to have as many as 401 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.

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.

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.

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).

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.

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.

Delete File

Press this softkey to delete a file in the catalog listing.

Delete Item

Press this softkey to delete an item in the displayed list of sweep points.

Delete Row

Press this softkey to delete a selected row in the sweep list.

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.

Edit Item

Press this softkey to change an item in the displayed list of sweep points.

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.

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.

Freq&Ampl

Press this softkey to set the signal generator to sweep both frequency and amplitude data.

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.

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.

Goto Bottom Row

Press this softkey to move the selection bar to the bottom row of list sweep points 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.

Goto Middle Row

Press this softkey to move the selection bar to the middle row of list sweep points 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.

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 softkey helps 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.

Goto Top Row

Press this softkey to move the selection bar to the top row of list sweep points 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.

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.

Insert Item

Press this softkey to place a copy of the selected item directly below that item in the sweep list.

Insert Row

Press this softkey to place a copy of the selected row directly below that row in the sweep list.

Load From Selected File

Press this softkey to load the list sweep data from a file into the current sweep list.

Load List From Step Sweep

Press this softkey to eliminate the existing sweep list data and replace it with the step sweep data points.

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.

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.

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.

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.

Page Down

Press this softkey to view the next page of list sweep points when you are in the Configure List Sweep menu or to view the next page of the catalog listing when you are in the Load/Store List menu.

Page Up

Press this softkey to view the previous page of list sweep points when you are in the Configure List Sweep menu or to view the previous page of the catalog listing when you are in the Load/Store List menu.

Point Trigger

Pressing this softkey reveals a menu of choices for triggering a sweep point-by-point.

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.

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.

Step Dwell

Press this softkey to set the dwell time for each point of a step sweep.

Store to File

Press this softkey to store the current list sweep data to a file in internal non-volatile memory.

Sweep

Pressing this softkey reveals a menu of choices for determining the sweep parameters.

Sweep Direction Down Up

This softkey changes the direction of the sweep.

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.

Sweep Trigger

Pressing this softkey reveals a menu of choices for triggering a full sweep.

Sweep Type List Step

This softkey toggles the sweep type from list sweep to step sweep.

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 step or list sweeps.

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.

Trigger Out Polarity Neg Pos

This softkey toggles the polarity of the TTL signal that is output at the rear panel TRIGGER OUT connector.

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.

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.

Binary

This softkey lets you specify that only binary files are to be listed on the display when **Memory Catalog** is selected.

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.

Brightness

Use this softkey to adjust the display brightness (intensity).

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, or instrument state files only.

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.)

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.

Copy File

Press this softkey to copy and rename a file in the displayed catalog of files.

Delete All Binary Files

Press this softkey to delete all of the binary files in the displayed catalog of files.

Delete All Files

Press this softkey to delete all of the files in the displayed catalog of files.

Delete All List Files

Press this softkey to delete all of the list files in the displayed catalog of files.

Delete All State Files

Press this softkey to delete all of the instrument state files in the displayed catalog of files.

Delete File

Press this softkey to delete a file in the displayed catalog of files.

Diagnostic Info

Press this softkey for a display of diagnostic information about the signal generator.

Display

Pressing this softkey reveals a menu of choices for adjusting and testing the display.

Editing Keys

Pressing this softkey reveals a menu of choices for editing the name of a file you have just copied.

Editing Mode Insert Replace

Press this softkey to toggle the editing mode from inserting text to replacing text.

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.

Help Mode Single Cont

This softkey toggles the help mode between single and continuous.

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.

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.

HP-IB/RS-232

Pressing this softkey reveals a menu of choices for HP-IB and RS-232 configuration.

Instrument Adjustments

Pressing this softkey reveals a menu of front panel adjustments for the signal generator.

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

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).

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 List To File** softkey in the Sweep/List menu.

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 for file management.

Mod Status Info Off On

Press this softkey to toggle on and off the modulation status display.

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.

Page Down

Press this softkey to move down one page at a time in the displayed catalog of files.

Page Up

Press this softkey to move up one page at a time in the displayed catalog of files.

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.

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 Use 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.)

Preset Language

Pressing this softkey reveals a menu of choices for selecting the programming language that is implemented after the **Preset** key is pressed.

Preset Normal User

This softkey toggles the preset state between the factory-defined and the user-defined states.

Recall Ref Osc Setting

This softkey is provided for adjusting the internal reference oscillator. This adjustment is for use by service personnel only.

Receive Pace None Xon

This softkey in the RS-232 Pace menu determines whether any pacing is acknowledged by the RS-232 receive channel.

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.

Ref Osc Coarse

This softkey is provided for adjusting the internal reference oscillator. This adjustment is for use by service personnel only.

Ref Osc Fine

This softkey is provided for adjusting the internal reference oscillator. This adjustment is for use by service personnel only.

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.

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.

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.

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).

RS-232 Echo Off On

This softkey toggles the echo function on and off for the RS-232 serial port (AUXILIARY INTERFACE connector).

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.

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/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 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.

Save User Preset

Use this softkey to establish your user-defined preset state.

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.

Screen Saver Delay

This softkey sets the period of time before the screen saver is activated.

Screen Saver Mode

This softkey toggles between **Light Only** and **Light & Text** mode for the screen saver.

Screen Saver Off On

This softkey toggles the signal generator's screen saver on and off.

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.

State

This softkey lets you specify that only instrument state files are to be listed on the display when **Memory Catalog** is selected.

Step/Knob Ratio

This softkey sets the ratio between the increment value of the step keys and the front panel knob.

Store Ref Osc Setting

This softkey is provided for adjusting the internal reference oscillator. This adjustment is for use by service personnel only.

Transmit Pace None Xon

This softkey in the RS-232 Pace menu determines whether any pacing is acknowledged by the RS-232 transmit channel.

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.

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.

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.

3 Programming Fundamentals

This chapter explains how to program the signal generator using HP-IB command statements and SCPI language.

Getting Started with SCPI

This section describes the use of the Standard Commands for Programmable Instruments language (SCPI). This section explains how to use SCPI commands in general.

Understanding Common Terms

The following terms are used throughout the remainder of this chapter.

Controller	A controller is any computer used to communicate with a SCPI instrument. A controller can be a personal computer, a minicomputer, or a plug-in card in a card cage. Some intelligent instruments can also function as controllers.
Instrument	An instrument is any device that implements SCPI. Most instruments are electronic measurement or stimulus devices, but this is not a requirement. Similarly, most instruments use an HP-IB or RS-232 interface for communication. The same concepts apply regardless of the instrument function or the type of interface used.
Program Message	A program message is a combination of one or more properly formatted SCPI commands. Program messages always go from a controller to an instrument. Program messages tell the instrument how to make measurements and output signals.

Response Message	A response message is a collection of data in specific SCPI formats. Response messages always go from an instrument to a controller or listening instrument. Response messages tell the controller about the internal state of the instrument and about measured values.
Command	A command is an instruction in SCPI. You combine commands to form messages that control instruments. In general, a command consists of mnemonics (keywords), parameters, and punctuation.
Query	A query is a special type of command. Queries instruct the instrument to make response data available to the controller. Query mnemonics always end with a question mark.

Standard Notation

This section uses several forms of notation that have specific meaning:

Command Mnemonics	Many commands have both a long and a short form and you must use either one or the other (SCPI does not accept a combination of the two.) Consider the **`FREQuency`** command, for example. The short form is **`FREQ`** and the long form is **`FREQUENCY`**. This notation type is a shorthand to document both the long and short form of commands. SCPI is not case sensitive, so **`fREquEnCy`** is just as valid as **`FREQUENCY`**, but **`FREQ`** and **`FREQUENCY`** are the only valid forms of the **`FREQuency`** command.

Angle Brackets

Angle brackets indicate that the word or words enclosed represent something other than themselves. For example, **`<new line>`** represents the ASCII character with the decimal value 10. Similarly, **`<^END>`** means that EOI is asserted on the HP-IB interface. Words in angle brackets have much more rigidly defined meaning than words shown in ordinary text. For example, this section uses the word “message” to talk about messages generally. But the bracketed words **`<program message>`** indicate a precisely defined element of SCPI. If you need them, you can find the exact definitions of words such as **`<program message>`** in a syntax diagram.

How to Use Examples

Programming with SCPI requires knowledge of two languages. You must know the programming language of your controller (BASIC, C, Pascal) as well as the language of your instrument (SCPI). The semantic requirements of your controller’s language determine how the SCPI commands and responses are handled in your application.

Command Examples

Command examples look like this:

```
:FREQuency:CW?
```

This example tells you to put the string **`:FREQuency:CW?`** in the output statement appropriate to your application programming language. If you encounter problems, study the details of how the output statement handles message terminators such as **`<new line>`**. If you are using simple OUTPUT statements in HP BASIC, this is taken care of for you. In HP BASIC, you type:

```
OUTPUT 719”:FREQuency:CW?”
```

Command examples do not show message terminators because they are used at the end of every program message. See "Details of Commands and Responses" in this chapter for more information on message terminators.

Response Examples

Response examples look like this:

```
3.000000000000E+009
```

These are the characters you would read from an instrument after sending a query command. To actually pull them from the instrument into the controller, use the input statement appropriate to your application programming language. If you have problems, study the details of how the input statement operates. In particular, investigate how the input statement handles punctuation characters such as the comma and the semicolon and how it handles **`<new line>`** and EOI. To enter the previous response in HP BASIC you type:

```
ENTER 719;CW_frequency
```

Response examples do not show response message terminators because they are always **`<new line>`** **`<^END>`**. These terminators are typically automatically handled by the input statement. See "Details of Commands and Responses" in this chapter for more information about terminators.

Program and Response Messages

To understand how your instrument and controller communicate using SCPI, you must understand the concepts of program and response messages. Program messages are the formatted data sent from the controller to the instrument.

Conversely, response messages are the formatted data sent from the instrument to the controller. Program messages contain one or more commands, and response messages contain one or more responses.

The controller may send commands at any time, but the instrument sends responses only when specifically instructed to do so. The special type of command used to instruct the instrument to send a response message is the query. All query mnemonics end with a question mark. Queries return either measured values or internal instrument settings. Any internal setting that can be programmed with SCPI can also be queried.

Forgiving Listening and Precise Talking

SCPI uses the concept of forgiving listening and precise talking outlined in IEEE 488.2.

Forgiving listening means that instruments are very flexible in accepting various command and parameter formats. For example, the signal generator accepts either **`:POWer:ALC[:STATe] ON`** or **`:POWer:ALC[STATe] 1`** to turn on the source's RF output.

Precise talking means that the response format for a particular query is always the same. For example, if you query the power state when it is on (using **`:POWer:ALC[:STATe]?`**), the response is always 1, regardless of whether you previously sent **`:POWer:ALC[:STATe] 1`** or **`:POWer:ALC[:STATe] ON`**.

Types of Commands

Commands can be separated into two groups, common commands and subsystem commands.

Common commands are generally not measurement related. They are used to manage macros, status registers, synchronization, and data storage. Common commands are easy to recognize because they all begin with an asterisk, such as **`*IDN?`**, **`*OPC`**, and **`*RST`**. Common commands are defined by IEEE 488.2.

Subsystem commands include all measurement functions and some general purpose functions. Subsystem commands are distinguished by the colon used between keywords, as in **`:FREQuency:CW?`**. Each command subsystem is a set of commands that roughly corresponds to a functional block inside the instrument. For example, the **`:POWer`** subsystem contains commands for power generation, while the **`:STATus`** subsystem contains commands for accessing status registers.

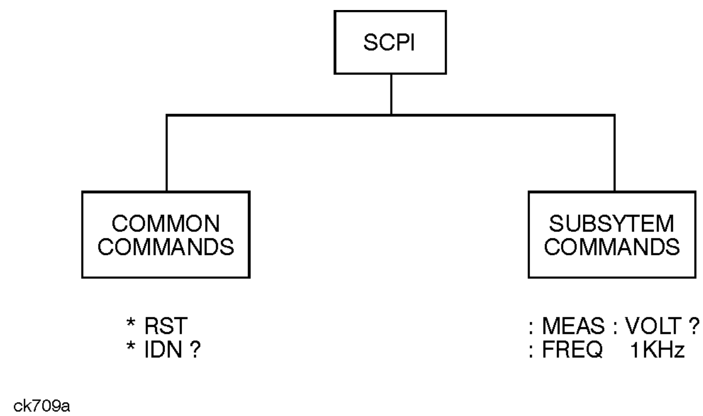


Figure 3-1. SCPI Command Types

The remaining paragraphs in this subsection discuss subsystem commands in more detail. Remember, some commands are implemented in one instrument and not in another, depending on its measurement function.

Subsystem Command Trees

Command Tree Structure

Most programming tasks involve subsystem commands. SCPI uses a hierarchical structure for subsystem commands similar to the file systems on most computers. In SCPI, this command structure is called a command tree.

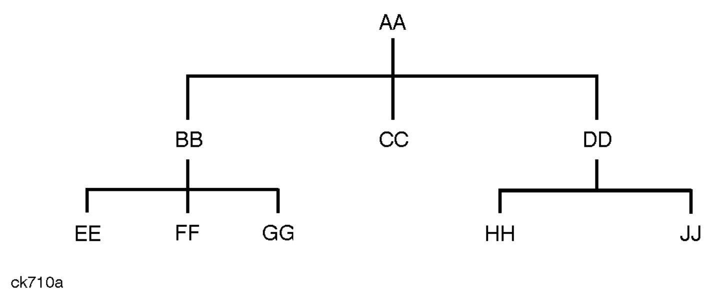


Figure 3-2. A Simplified Command Tree

In the command tree shown in Figure 3-2, the command closest to the top is the root command, or simply "the root." Notice that you must follow a particular path to reach lower level subcommands. For example, if you wish to access the GG command, you must follow the path AA to BB to GG.

Paths Through the Command Tree

To access commands in different paths in the command tree, you must understand how an instrument interprets commands. The parser, a part of the instrument firmware, decodes each message sent to the instrument. The parser breaks up the message into component commands using a set of rules to determine the command tree path used. The parser keeps track of the current path: the level in the command tree where it expects to find the next command you send. This is important because the same keyword may appear in different paths. The particular path you use determines how the keyword is interpreted. The following rules are used by the parser:

Power On and Reset	After power is cycled or after **`*RST`**, the current path is set to the root.
Message Terminators	A message terminator, such as a **`<new line>`** character, sets the current path to the root. Many programming languages have output statements that send message terminators automatically. See "Details of Commands and Responses" in this chapter for more information about message terminators.
Colon	When a colon is placed between two command mnemonics, it moves the current path down one level in the command tree. For example, the colon in **`MEAS:VOLT`** specifies that **`VOLT`** is one level below **`MEAS`**. When the colon is the first character of a command, it specifies that the next command mnemonic is a root level command. For example, the colon in **`:INIT`** specifies that **`INIT`** is a root level command.
Semicolon	A semicolon separates two commands in the same message without changing the current path.

White Space

White space characters, such as **<tab>** and **<space>**, are generally ignored. There are two important exceptions.
White space inside a keyword, such as:
:FREQ uency
is not allowed. You must use white space to separate parameters from commands. For example, the **<space>** between **LEVel** and **6.2** in the command **:POWer:LEVel 6.2** is mandatory.
White space does not affect the current path.

Commas

If a command requires more than one parameter, you must separate adjacent parameters using a comma. Commas do not affect the current path.

Common Commands

Common commands, such as ***RST**, are not part of any subsystem. An instrument interprets them in the same way, regardless of the current path setting.

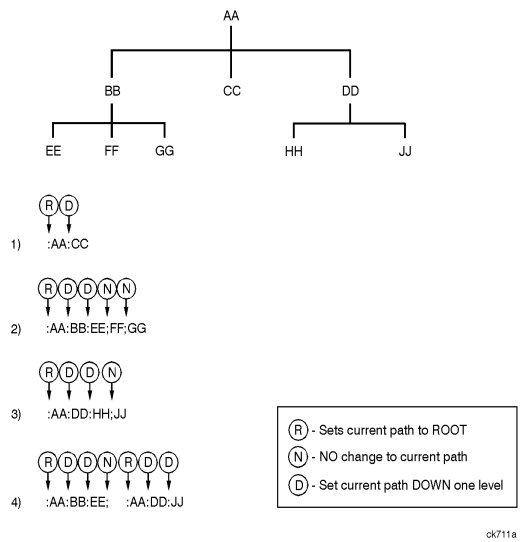


Figure 3-3. Proper Use of the Colon and Semicolon

Figure 3-3 shows examples of how to use the colon and semicolon to navigate efficiently through the command tree. Notice how proper use of the semicolon can reduce the amount of information that must be sent over the interface.

Sending this message:

```
:AA:BB:EE; FF; GG
```

is the same as sending these three messages:

```
:AA:BB:EE
:AA:BB:FF
:AA:BB:GG
```

More About Commands

Query and Event Commands

You can query any value that you can set. For example, the presence of the signal generator **`FREQuency:OFFSet`** command implies that a **`FREQuency:OFFSet?`** also exists. If you see a command ending with a question mark, it is a query-only command. Some commands are events and cannot be queried. An event has no corresponding setting if it causes something to happen inside the instrument at a particular instant.

Implied Commands

Implied commands appear in square brackets. If you send a subcommand immediately preceding an implied command, but do not send the implied command, the instrument assumes you intend to use the implied command and behaves just as if you had sent it. Notice that this means that the instrument expects you to include any parameters required by the implied command. The following example illustrates equivalent ways to program the signal generator using explicit and implied commands.

Example signal generator commands with and without an implied command:

`FREQuency[:CW] 500 MHz`	using explicit commands
`FREQuency 500 MHz`	using implied commands

Optional Parameters

Optional parameter names are enclosed in square brackets. If you do not send a value for an optional parameter, the instrument chooses a default value. The instrument's command dictionary documents the values used for optional parameters.

Program Message Examples

The following parts of the signal generator SCPI command set will be used to demonstrate how to create complete SCPI program messages:

:FREQuency

:POWER

Example 1

"FREQuency:STARt 500 MHz; STOP 1000 MHz"

The command is correct and will not cause errors. It is equivalent to sending the following:

"FREQuency:STARt 500 MHz; FREQuency:STOP 1000 MHz"

Example 2

"POWer 10 DBM; :OFFSet 5 DB"

This command results in a command error. The command makes use of the default **POWer[:LEVel][:IMMediate]** node. When using a default node, there is no change to the current path position. Since there is no command "**OFFSet**" at the root, an error results. A correct way to send this is:

"POWer 10 DBM; :POWer:OFFSet 5 DB"

Example 3

"POWer:OFFSet 5 DB; POWer 10 DBM"

This command results in a command error. The **POWer 10 DBM** portion of the command is missing a leading colon. The path level is dropped at each colon until it is in the **POWer:OFFSet** subsystem.

When the **POWer 10 DBM** command is sent, it then causes confusion because no such node occurs in the **POWer:OFFSet** subsystem. By adding a leading colon, the current path is reset to the root. The correct command is:

“POWer:OFFSet 5 DB; :POWer 10 DBM”

Example 4

“FREQ 500 MHZ; POWER 4 DBM”

In this example the keyword short form is used. The command is correct. It utilizes the default nodes of **[:CW]** and **[:LEVEL]**. Since default nodes do not affect the current path, it is not necessary to use a leading colon before **POWER**.

Reading Instrument Errors

When debugging a program, you may want to know if an instrument error has occurred. The signal generator can display error messages on their front panel displays. If your system includes an instrument that does not have this capability, you can put the following code segment in your program to read error messages and print them on the controller’s display.

```
 10 !
 20 !  The rest of your
 30 ! variable declarations
 40 !  Assign @box to 719
 50 DIM Err_msg$[75]
 60 INTEGER Err_num
 70 !
 80 ! Part of your program
 90 ! that generates errors
100 !
110 !
```

```
200 REPEAT
210 OUTPUT @Box;":SYST:ERR?"
220   ! Query instrument error
230   ENTER @Box;Err_num,Err_msg$
240   ! Read error #, message
250   PRINT Err_num,Err_msg$
260   ! Print error message
270 UNTIL Err_num = 0
280 ! Repeat until no errors
290 !
300 !   The rest of your program
310 !
```

Details of Commands and Responses

This section describes the syntax of SCPI commands and responses. It provides many examples of the data types used for command parameters and response data.

Program Message Syntax

These program messages contain commands combined with appropriate punctuation and program message terminators.

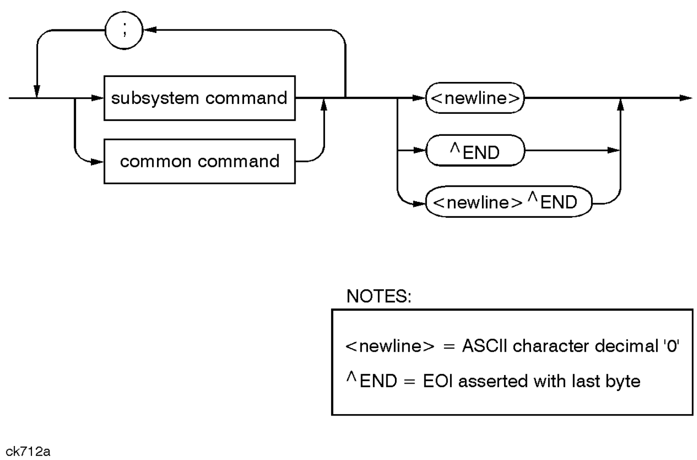
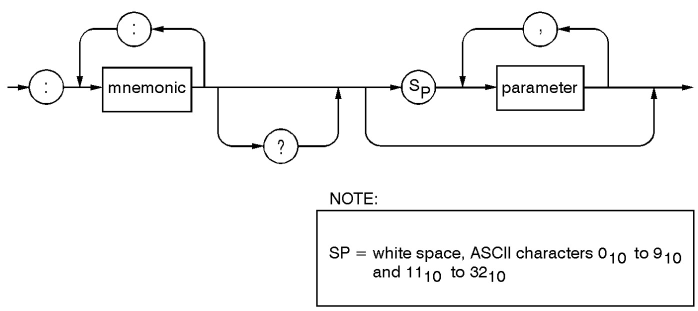


Figure 3-4. Simplified Program Message Syntax

As Figure 3-4 shows, you can send common commands and subsystem commands in the same message. If you send more than one command in the same message, you must separate them with a semicolon. You must always end a program message with one of the three program message terminators shown in Figure 3-4. Use **`<new line>`**, **`<^END>`**, or **`<new line><^END>`** as the program message terminator. The word **`<^END>`** means that EOI is asserted on the HP-IB interface at the same time the preceding data byte is sent. Most programming languages send these terminators automatically. For example, if you use the HP BASIC **`OUTPUT`** statement, **`<new line`**> is automatically sent after your last data byte. If you are using a PC, you can usually configure the system to send whatever terminator you specify.

SCPI Subsystem Command Syntax



ck713a

Figure 3-5. SCPI Simplified Subsystem Command Syntax

As Figure 3-5 shows, there must be a **`<space>`** between the last command mnemonic and the first parameter in a subsystem command. This is one of the few places in SCPI where **`<space>`** is required. Note that if you send more than one parameter with a single command, you must separate adjacent parameters with a comma. Parameter types are explained later in this subsection.

Common Command Syntax

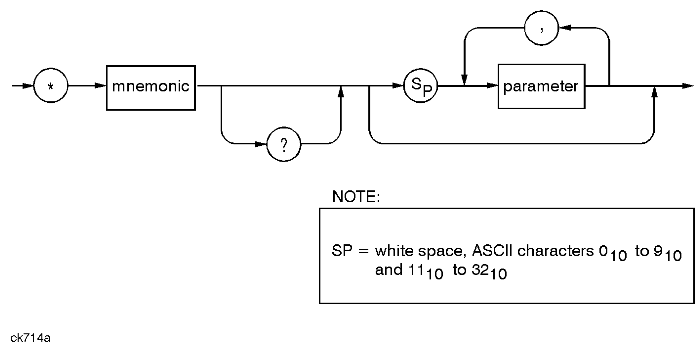


Figure 3-6. Simplified Common Command Syntax

As with subsystem commands, use a **`<space>`** to separate a command mnemonic from subsequent parameters. Separate adjacent parameters with a comma. Parameter types are explained later in this section.

Response Message Syntax

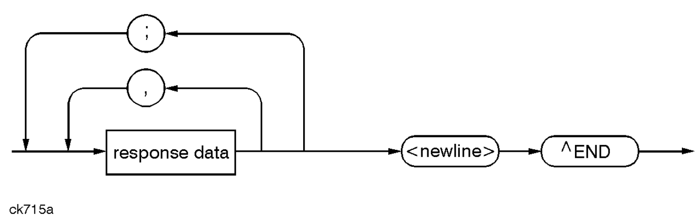


Figure 3-7. Simplified Response Message Syntax

Response messages can contain both commas and semicolons as separators. When a single query command returns multiple values, a comma separates each data item. When multiple queries are sent in the same message, the groups of data items corresponding to each query are separated by a semicolon. For example, the fictitious query **`:QUERY1?:QUERY2?`** might return a response message of:

```
<data1>,<data1>;<data2>,<data2>
```

Response data types are explained later in this subsection. Note that **`<new line><^END>`** is always sent as a response message terminator.

SCPI Data Types

SCPI defines different data formats for use in program messages and response messages. It does this to accommodate the principle of forgiving listening and precise talking. Forgiving listening means that instruments are flexible, accepting commands and parameters in various formats. Precise talking means an instrument always responds to a particular query in a predefined, rigid format. Parameter data types are designed to be flexible in the spirit of forgiving listening. Conversely, response data types are defined to meet the requirements of precise talking.

Parameter Types	Response Data Types
Numeric Extended Numeric	Real or Integer Integer
Discrete	Discrete
Boolean	Numeric Boolean
String	String
Block	Definite Length Block (all interfaces) Indefinite Length Block (not supported with RS-232)
Non-decimal Numeric	Hexadecimal Octal Binary

Each parameter type has one or more corresponding response data types. For example, a setting that you program using a numeric parameter returns either real or integer response data when queried. Whether real or integer response data is returned depends on the instrument used. However, precise talking requires that the response data type be clearly defined for a particular instrument and query.

Parameter Types

Numeric Parameters Numeric parameters are used in both subsystem commands and common commands. Numeric parameters accept all commonly used decimal representations of numbers including optional signs, decimal points, and scientific notation.

If an instrument setting programmed with a numeric parameter can only assume a finite number of values, the instrument automatically rounds the parameter. For example, if an instrument has a programmable output impedance of 50 or 75 ohms, and you specified **`76.1`** for output impedance, the value is rounded to **`75`**. If the instrument setting can only assume integer values, it automatically rounds the value to an integer. For example sending **`*ESE 10.123`** is the same as sending **`*ESE 10`**.

Examples of numeric parameters:

100	no decimal point required
100.	fractional digits optional
-1.23	leading signs allowed
4.56e<space>3	space allowed after e in exponentials
-7.89E-01	use either E or e in exponentials
+256	leading + allowed
.5	digits left of decimal point optional

Extended Numeric Parameters Most subsystems use extended numeric parameters to specify physical quantities. Extended numeric parameters accept all numeric parameter values and other special values as well. All extended numeric parameters accept **`MAXimum`** and **`MINimum`** as values. Notice that **`MINimum`** and **`MAXimum`** can be used to set or query values. The query forms are useful for determining the range of values allowed for a given parameter.

In some instruments, extended numeric parameters accept engineering unit suffixes as part of the parameter value.

Notice that extended numeric parameters are not used for common commands or **`STATus`** subsystem commands.

Examples of extended numeric parameters:

100.	any simple numeric values
-1.23	
4.56e<space>3	
-7.89E-01	
+256	
.5	
MAX	largest valid setting
MIN	valid setting nearest negative infinity
-100 mV	negative 100 millivolts

Discrete Parameters Use discrete parameters to program settings that have a finite number of values. Discrete parameters use mnemonics to represent each valid setting. They have a long and a short form, just like command mnemonics. You can use mixed upper and lower case letters for discrete parameters.

Examples of discrete parameters used with the TRIG:SOURce subsystem:

BUS	HP-IB triggering
IMMediate	immediate trigger
EXTernal	external triggering

Although discrete parameter values look like command keywords, do not confuse the two. In particular, be sure to use colons and spaces properly. Use a colon to separate command mnemonics from each other. Use a space to separate parameters from command mnemonics.

Examples of discrete parameters in commands:

```
100 OUTPUT @Source;"TRIGger:SOURce BUS"
100 OUTPUT @Source;"TRIGger:SOURce IMMediate"
100 OUTPUT @Source;"TRIGger:SOURce EXTernal"
```

Boolean Parameters Boolean parameters represent a single binary condition that is either true or false. There are only four possible representations for a Boolean parameter:

ON	Boolean true, upper/lower case allowed
OFF	Boolean false, upper/lower case allowed
1	Boolean true
0	Boolean false

Response Data Types

Real Response Data A large portion of all measurement data are formatted as real response data. Real response data are decimal numbers in either fixed decimal notation or scientific notation. Most high-level programming languages that support instrument I/O handle either decimal or scientific notation transparently.

Examples of real response data:

1.23E+0

-1.0E+2

+1.0E+2

0.5E+0

1.23

-100.0

+100.0

0.5

Integer Response Data Integer response data are decimal representations of integer values including optional signs. Most status register related queries return integer response data.

Examples of integer response data:

0	signs are optional
+100	leading + sign allowed
-100	leading sign allowed
256	never any decimal point

Discrete Response Data Discrete response data are similar to discrete parameters. The main difference is that discrete response data return only the short form of a particular mnemonic, in all upper case letters.

Examples of discrete response data:

IMM	Immediate
EXT	External

String Response Data String response data are similar to string parameters. The main difference is that string response data use only double quotes as delimiters, rather than single quotes. Embedded double quotes may be present in string response data. Embedded quotes appear as two adjacent double quotes with no characters between them.

Examples of string response data:

“This IS valid”

“SO IS THIS”” “

“I said, ““Hello!”””

Programming the Status Register System

The signal generator's instrument status system provides complete IEEE 488.2 Device Standard data structures for reporting instrument status using the register model.

The IEEE 488.2 register model of the status system is comprised of multiple registers which are arranged in a hierarchial order. The lower-priority status registers propagate their data to the higher-priority registers in the data structures by means of summary bits. The Status Byte Register is at the top of the hierarchy and contains the general status information for the instrument's events and conditions. All other individual registers are used to determine the specific events or conditions.

You can determine the state of certain instrument hardware and firmware events and conditions by programming the status register system.

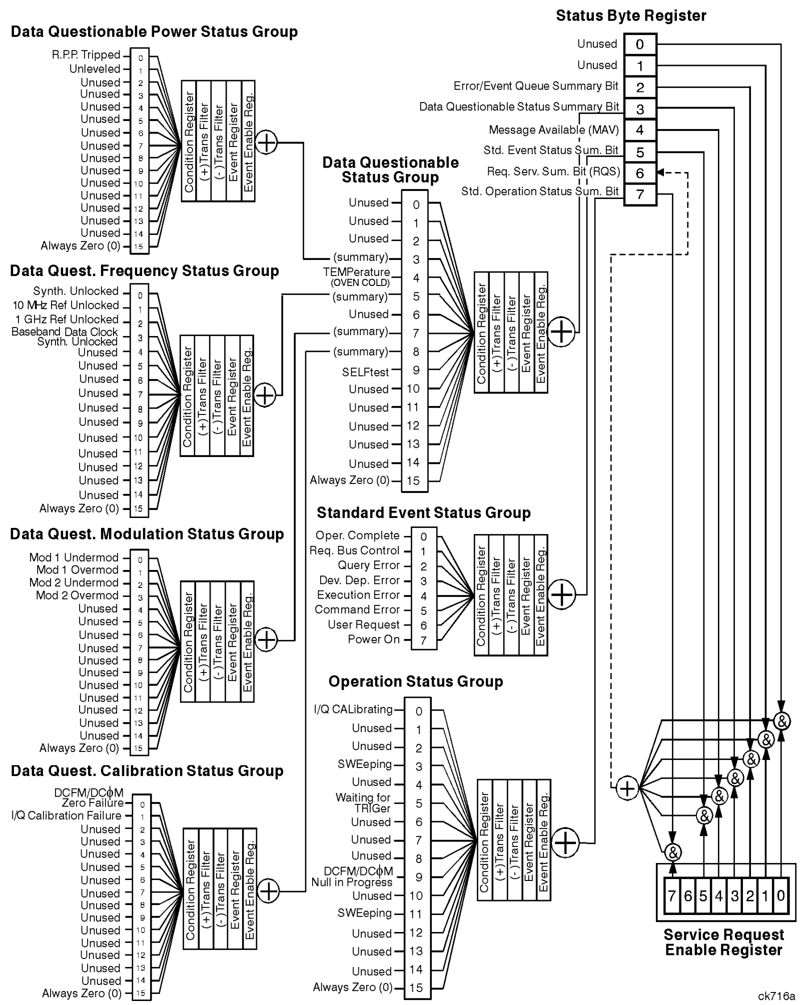


Figure 3-8. The Overall Status Byte Register System

Status Byte Group

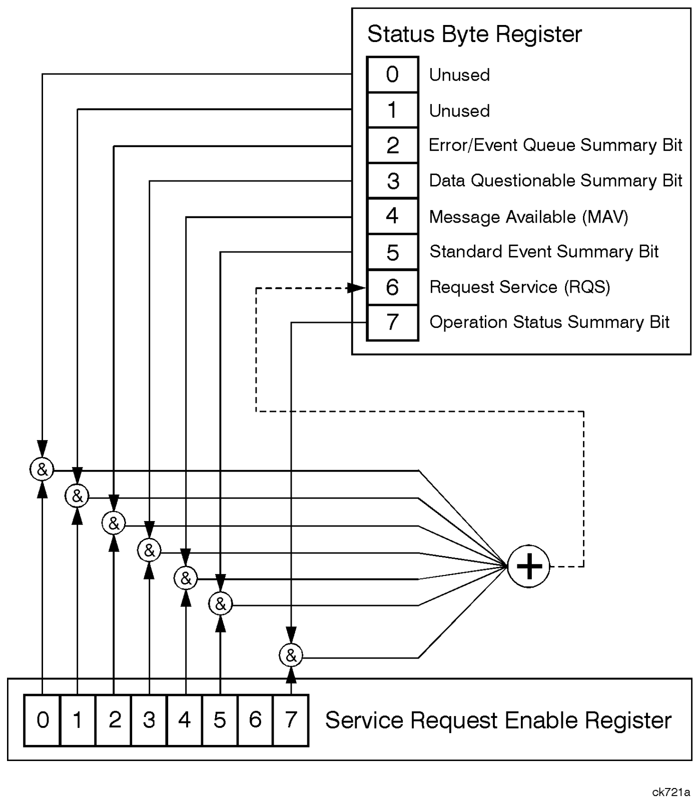
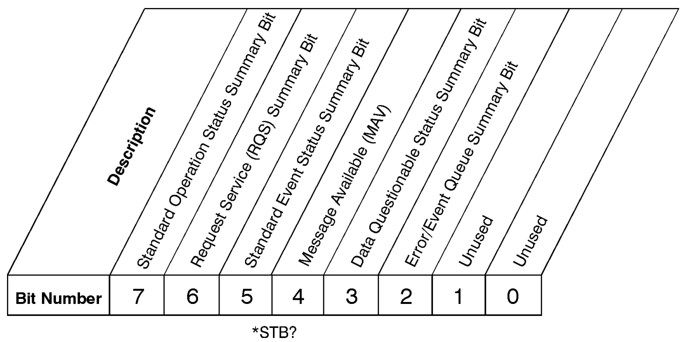


Figure 3-9. The Status Byte Group

The Status Byte Group consists of the Status Byte Register and the Service Request Enable Register. The Status Byte Register contains the following bits:



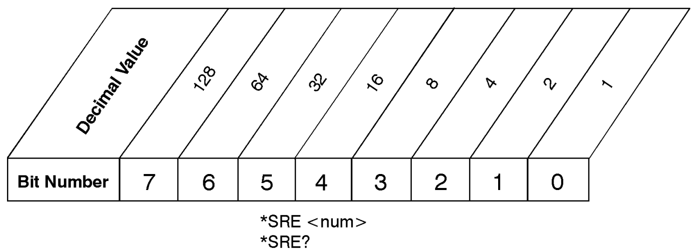
Status Byte Register

Bit	Description
0, 1	These bits are always set to 0.
2	A 1 in this bit position indicates that the SCPI error queue is not empty. The SCPI error queue contains at least one error message.
3	A 1 in this bit position indicates that the Data Questionable summary bit has been set. The Data Questionable Event Register can then be read to determine the specific condition that caused this bit to be set.
4	A 1 in this bit position indicates that the signal generator has data ready in the output queue. There are no lower status groups that provide input to this bit.

Bit	Description
5	A 1 in this bit position indicates that the Standard Event summary bit has been set. The Standard Event Status Register can then be read to determine the specific event that caused this bit to be set.
6	A 1 in this bit position indicates that the instrument has at least one reason to require service. This bit is also called the Master Summary Status bit (MSS). The individual bits in the Status Byte are individually ANDed with their corresponding service request enable register, then each individual bit value is ORed and input to this bit.
7	A 1 in this bit position indicates that the Standard Operation summary bit has been set. The Standard Operation Event Register can then be read to determine the specific condition that caused this bit to be set.

To query the Status Byte Register, send the command **`*STB?`** The response will be the *decimal* sum of the bits which are set to 1. For example, if bit number 7 and bit number 3 are set to 1, the decimal sum of the 2 bits is 128 plus 8. So the decimal value 136 is returned.

In addition to the Status Byte Register, the Status Byte Group also contains a Service Request Enable Register. This register lets you choose which bits in the Status Byte Register will trigger a service request. Send the **`*SRE <num>`** command where **`<num>`** is the sum of the decimal values of the bits you want to enable plus the decimal value of bit 6. For example, to enable bit 7 so that whenever the Standard Operation Status Register summary bit is set to 1 it will trigger a service request, send the command **`*SRE 192`** (128 + 64). You must always enable bit 6 when you enable any other bits for a service request. The command **`*SRE?`** returns the decimal value of the sum of the bits previously enabled with the **`*SRE <num>`** command.



Service Request Enable Register ck726a

Status Groups

The Standard Operation Status Group and the Data Questionable Status Group each consist of the following registers; the Standard Event Status Group is similar but does not have negative or positive transition filters.

Condition Register
A condition register continuously monitors the hardware and firmware status of the signal generator. There is no latching or buffering for a condition register; it is updated in real time.

Negative Transition Filter
A negative transition filter specifies the bits in the condition register that will set corresponding bits in the event register when the condition bit changes from 1 to 0.

Positive Transition Filter
A positive transition filter specifies the bits in the condition register that will set corresponding bits in the event register when the condition bit changes from 0 to 1.

Event Register	An event register latches transition events from the condition register as specified by the positive and negative transition filters. Bits in the event register are latched, and once set, they remain set until cleared by either querying the register contents or sending the `*CLS` command.
Event Enable Register	An enable register specifies the bits in the event register that can generate a summary bit. The signal generator logically ANDs corresponding bits in the event and enable registers and ORs all the resulting bits to produce a summary bit. Summary bits are, in turn, used by the Status Byte Register.

In general, a status group is a set of related registers whose contents are programmed in order to produce status summary bits. In each status group, corresponding bits in the condition register are filtered by the negative and positive transition filters and stored in the event register. The contents of the event register are logically ANDed with the contents of the enable register and the result is logically ORed to produce a status summary bit in the Status Byte Register.

Standard Event Status Group

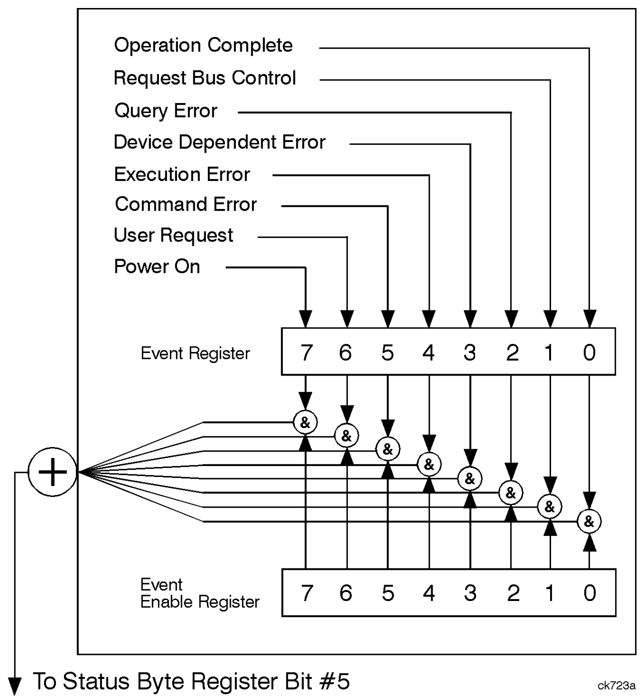
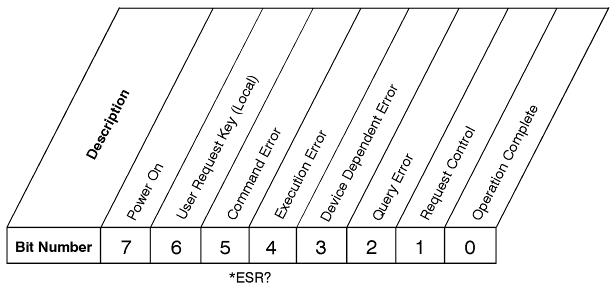


Figure 3-10. The Standard Event Status Group

The Standard Event Status Group is used to determine the specific event that set bit 5 in the Status Byte Register. The Standard Event Status Group consists of the Standard Event Status Register (an event register) and the Standard Event Status Enable Register. The Standard Event Status Register contains the following bits:

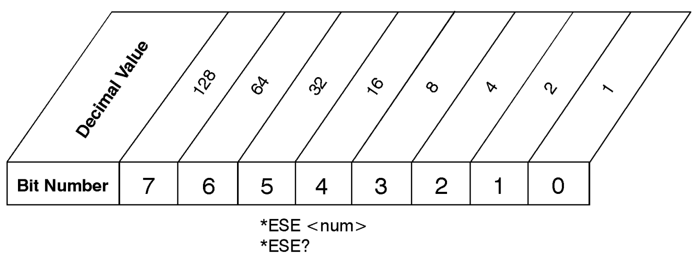


Standard Event Status Register

Bit	Description
0	A 1 in this bit position indicates that all pending signal generator operations were completed following execution of the **`*OPC`** command.
1	This bit is always set to 0. (The signal generator does not request control.)
2	A 1 in this bit position indicates that a query error has occurred. Query errors have SCPI error numbers from -499 to -400.
3	A 1 in this bit position indicates that a device dependent error has occurred. Device dependent errors have SCPI error numbers from -399 to -300 and 1 to 32767.
4	A 1 in this bit position indicates that an execution error has occurred. Execution errors have SCPI error numbers from -299 to -200.

Bit	Description
5	A 1 in this bit position indicates that a command error has occurred. Command errors have SCPI error numbers from -199 to -100.
6	A 1 in this bit position indicates that the **Local** key has been pressed. This is true even if the signal generator is in local lockout mode.
7	A 1 in this bit position indicates that the signal generator has been turned off and then on.

To query the Standard Event Status Register, send the command **`*ESR?`**. The response will be the *decimal* sum of the bits which are set to 1. For example, if bit number 7 and bit number 3 are set to 1, the decimal sum of the 2 bits is 128 plus 8. So the decimal value 136 is returned.



Standard Event Status Enable Register

ck728a

In addition to the Standard Event Status Register, the Standard Event Status Group also contains a Standard Event Status Enable Register. This register lets you choose which bits in the Standard Event Status Register will set the summary bit (bit 5 of the Status Byte Register) to 1. Send the **`*ESE <num>`** command where **`<num>`** is the sum of the decimal values of the bits you want to enable. For example, to enable bit 7 and bit 6 so that whenever either of those bits is set to 1, the Standard Event Status summary bit of the Status Byte Register will be set to 1, send the command **`*ESE 192`** (128 + 64). The command **`*ESE?`** returns the decimal value of the sum of the bits previously enabled with the **`*ESE <num>`** command.

Standard Operation Status Group

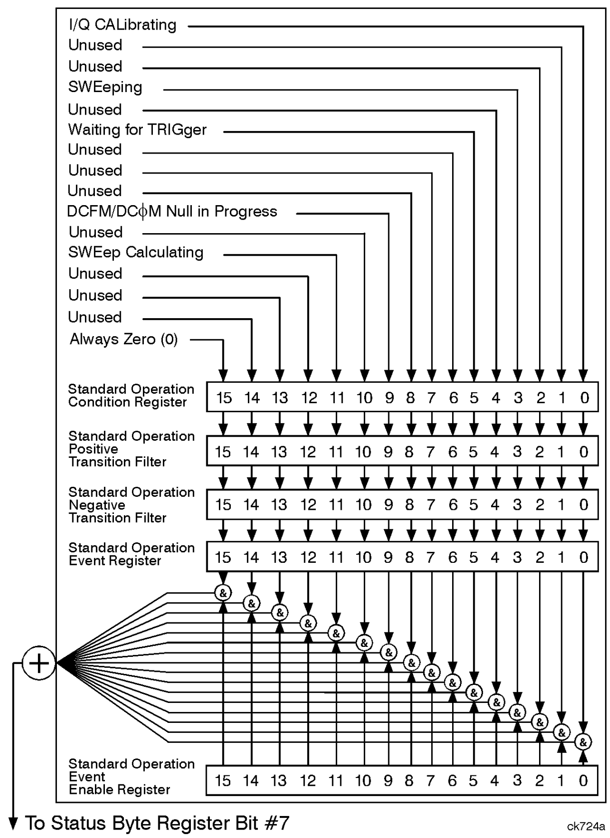
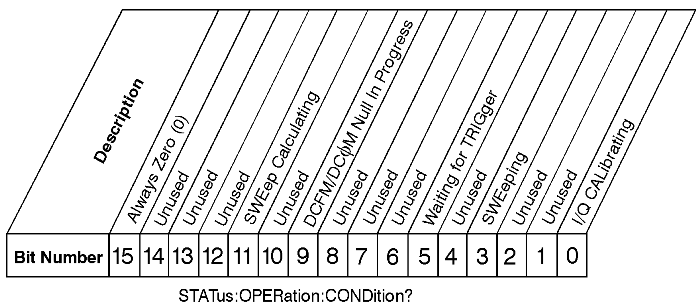


Figure 3-11. The Standard Operation Status Group

The Standard Operation Status Group is used to determine the specific event that set bit 7 in the Status Byte Register. The Standard Operation Status Group consists of the Standard Operation Condition Register, the Standard Operation Negative Transition Filter, the Standard Operation Positive Transition Filter, the Standard Operation Event Register, and the Standard Operation Event Enable Register. The Standard Operation Condition Register contains the following bits:



Standard Operation Condition Register

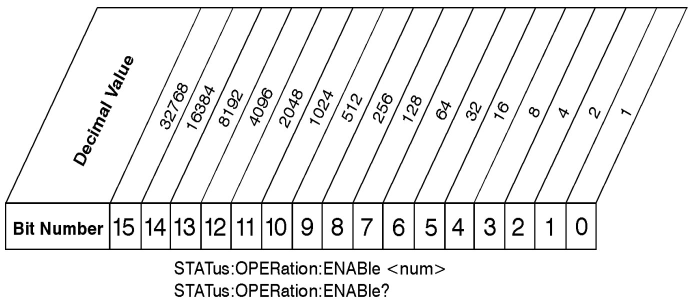
Bit	Description
0	A 1 in this bit position indicates that an I/Q calibration is being performed.
1, 2	Unused. These bits are always set to 0.
3	A 1 in this bit position indicates that a sweep is in progress.
4	Unused. This bit is always set to 0.
5	A 1 in this bit position indicates that the source is in a “wait for trigger” state of the trigger model.

Bit	Description
6,7,8	Unused. These bits are always set to 0.
9	A 1 in this bit position indicates that the signal generator is currently performing a DCFM zero calibration.
10	Unused. This bit is always set to 0.
11	A 1 in this bit position indicates that the signal generator is currently doing the necessary pre-sweep calculations.
12, 13, 14	Unused. These bits are always set to zero.

The Standard Operation Condition Register continuously monitors the hardware and firmware status of the instrument. Condition registers are read-only. To query the condition register, send the command **`STATus:OPERation:CONDition?`** The response will be the *decimal* sum of the bits which are set to 1. For example, if bit number 9 and bit number 3 are set to 1, the decimal sum of the 2 bits is 512 plus 8. So the decimal value 520 is returned.

The transition filter specifies which types of bit state changes in the condition register will set corresponding bits in the event register. The changes may be positive (from 0 to 1) or negative (from 1 to 0). Send the command **`STATus:OPERation:NTRansition <num>`** (negative) or **`STATus:OPERation:PTRansition <num>`** (positive) where **`<num>`** is the sum of the decimal values of the bits you want to enable.

The Standard Operation Event Register latches transition events from the condition register as specified by the transition filters. Event registers are destructive read-only. Reading data from an event register will clear the content of that register. To query the event register, send the command **`STATus:OPERation[:EVENt]?`**



Standard Operation Event Enable Register

ck730a

The Standard Operation Status Group also contains a Standard Operation Event Enable Register. This register lets you choose which bits in the Standard Operation Event Register will set the summary bit (bit 7 of the Status Byte Register) to 1. Send the **`STATus:OPERation:ENABle <num>`** command where **`<num>`** is the sum of the decimal values of the bits you want to enable. For example, to enable bit 9 and bit 3 so that whenever either of those bits is set to 1, the Standard Operation Status summary bit of the Status Byte Register will be set to 1, send the command **`STAT:OPER:ENAB 520`** (512 + 8). The command **`STATus:OPERation:ENABle?`** returns the decimal value of the sum of the bits previously enabled with the **`STATus:OPERation:ENABle <num>`** command.

Data Questionable Status Group

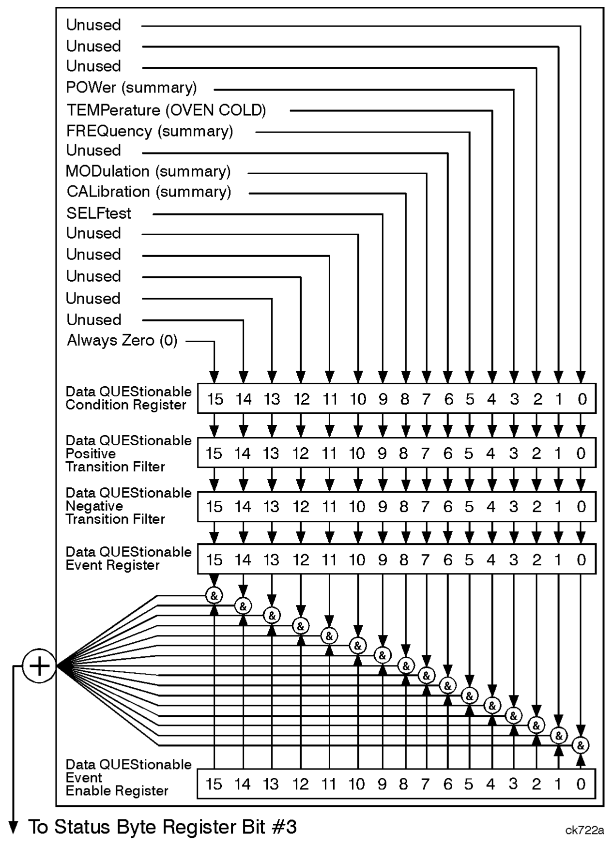
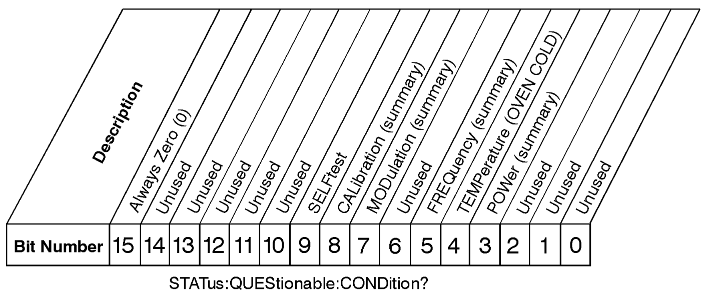


Figure 3-12. The Data Questionable Status Group

The Data Questionable Status Group is used to determine the specific event that set bit 3 in the Status Byte Register. The Data Questionable Status Group consists of the Data Questionable Condition Register, the Data Questionable Negative Transition Filter, the Data Questionable Positive Transition Filter, the Data Questionable Event Register, and the Data Questionable Event Enable Register. The Data Questionable Condition Register contains the following bits:



Data Questionable Condition Register

ck731a

Bit	Description
0, 1, 2	Unused. These bits are always set to 0.
3	This is a summary bit taken from the QUEStionable:POWer register. A 1 in this bit position indicates that one of the following may have happened: The ALC (Automatic Leveling Control) is unable to maintain a leveled RF output power (i.e., ALC is UNLEVELED), or the reverse power protection circuit has been tripped.
4	A 1 in this bit position indicates that the internal reference oscillator (reference oven) is cold. (Option 1EH only.)

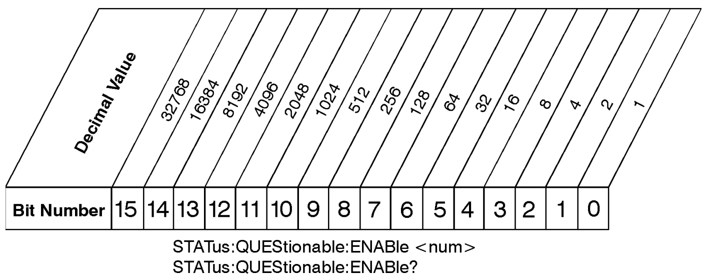
Bit	Description
5	This is a summary bit taken from the QUEStionable:FREQuency register. A 1 in this bit position indicates that one of the following may have happened: synthesizer PPL unlocked, 10 MHz reference VCO PPL unlocked, heterodyned VCO PPL unlocked, or baseband PPL unlocked. See the Data Questionable Frequency Status Group for more information.
6	Unused. This bit is always set to 0.
7	This is a summary bit taken from the QUEStionable:MODulation register. A 1 in this bit position indicates that one of the following may have happened: modulation source 1 underrange, modulation source 1 overrange, modulation source 2 underrange, or modulation source 2 overrange. See the Data Questionable Modulation Status Group for more information.
8	This is a summary bit taken from the QUEStionable:CALibration register. A 1 in this bit position indicates that one of the following may have happened: an error has occurred in the DCFM/DCΦM zero calibration or an error has occurred in the I/Q calibration. See the Data Questionable Calibration Status Group for more information.
9	A 1 in this bit position indicates that a self-test has failed during power-up. This bit can only be cleared by cycling the instrument's line power. *CLS will not clear this bit.
10, 11, 12, 13, 14	Unused. These bits are always set to 0.

Bit	Description
15	Always Zero (0).

The Data Questionable Condition Register continuously monitors the hardware and firmware status of the instrument. Condition registers are read-only. To query the condition register, send the command **`STATus:QUEStionable:CONDition?`** The response will be the *decimal* sum of the bits which are set to 1. For example, if bit number 9 and bit number 3 are set to 1, the decimal sum of the 2 bits is 512 plus 8. So the decimal value 520 is returned.

The transition filter specifies which types of bit state changes in the condition register will set corresponding bits in the event register. The changes may be positive (from 0 to 1) or negative (from 1 to 0). Send the command **`STATus:QUEStionable:NTRansition <num>`** (negative) or **`STATus:QUEStionable:PTRansition <num>`** (positive) where **`<num>`** is the sum of the decimal values of the bits you want to enable.

The Data Questionable Event Register latches transition events from the condition register as specified by the transition filters. Event registers are destructive read-only. Reading data from an event register will clear the content of that register. To query the event register, send the command **`STATus:QUEStionable[:EVENt]?`**



Data Questionable Event Enable Register

ck732a

The Data Questionable Status Group also contains a Data Questionable Event Enable Register. This register lets you choose which bits in the Data Questionable Event Register will set the summary bit (bit 3 of the Status Byte Register) to 1. Send the **`STATus:QUEStionable:ENABle <num>`** command where **`<num>`** is the sum of the decimal values of the bits you want to enable. For example, to enable bit 9 and bit 3 so that whenever either of those bits is set to 1, the Data Questionable Status summary bit of the Status Byte Register will be set to 1, send the command **`STAT:QUES:ENAB 520`** (512 + 8). The command **`STATus:QUEStionable:ENABle?`** returns the decimal value of the sum of the bits previously enabled with the **`STATus:QUEStionable:ENABle <num>`** command.

Data Questionable Power Status Group

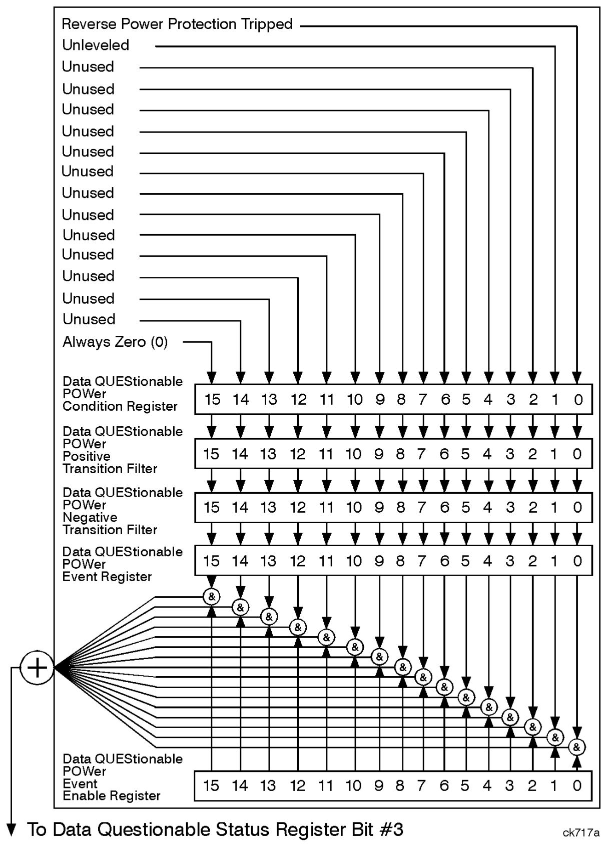
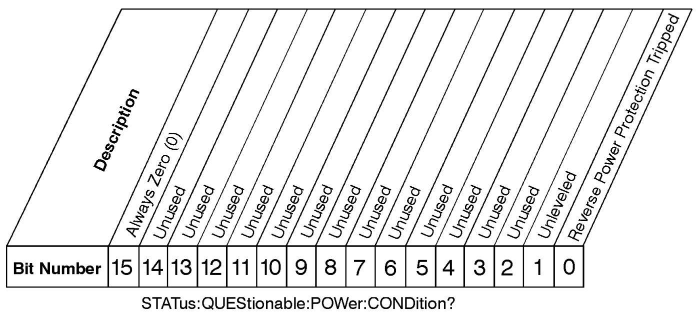


Figure 3-13. The Data Questionable Power Status Group

The Data Questionable Power Status Group is used to determine the specific event that set bit 3 in the Data Questionable Condition Register. The Data Questionable Power Status Group consists of the Data Questionable Power Condition Register, the Data Questionable Power Negative Transition Filter, the Data Questionable Power Positive Transition Filter, the Data Questionable Power Event Register, and the Data Questionable Power Event Enable Register. The Data Questionable Power Condition Register contains the following bits:



Data Questionable Power Condition Register

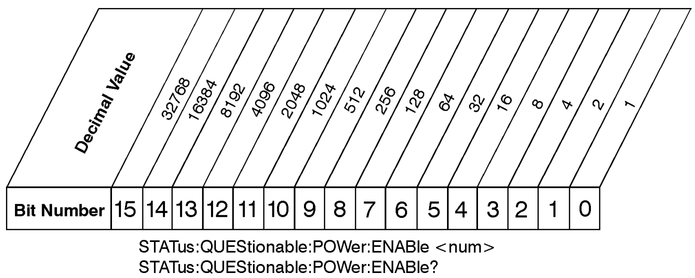
Bit	Description
0	A 1 in this bit indicates that the reverse power protection circuit has been tripped. There is no output in this state. Any conditions which may have caused reverse power should be corrected. After correcting the problem, the RPP circuit may be reset by sending the remote SCPI command statement `:OUTput:PROTection:CLEar` or by pressing the **Reset RPP** softkey on the front panel. In HP 8648 mode, any SCPI command will reset the reverse power protection circuit.

Bit	Description
1	A 1 in this bit indicates that the output leveling loop is unable to set the output power.
2-14	Unused. These bits are always set to 0.
15	Always Zero (0).

The Data Questionable Power Condition Register continuously monitors output power status of the instrument. Condition registers are read-only. To query the condition register, send the command **`STATus:QUEStionable:POWer:CONDition?`** The response will be the *decimal* sum of the bits which are set to 1.

The transition filter specifies which types of bit state changes in the condition register will set corresponding bits in the event register. The changes may be positive (from 0 to 1) or negative (from 1 to 0). Send the command **`STATus:QUEStionable:POWer:NTRansition <num>`** (negative) or **`STATus:QUEStionable:POWer:PTRansition <num>`** (positive) where **`<num>`** is the sum of the decimal values of the bits you want to enable.

The Data Questionable Power Event Register latches transition events from the condition register as specified by the transition filters. Event registers are destructive read-only. Reading data from an event register will clear the content of that register. To query the event register, send the command **`STATus:QUEStionable:POWer[:EVENt]?`**



Data Questionable Power Event Enable Register

The Data Questionable Power Status Group also contains a Data Questionable Power Event Enable Register. This register lets you choose which bits in the Data Questionable Power Event Register will set the summary bit (bit 3 of the Data Questionable Condition Register) to 1. Send the **`STATus:QUEStionable:POWer:ENABle <num>`** command where **`<num>`** is the sum of the decimal values of the bits you want to enable. For example, to enable bit 9 and bit 3 so that whenever either of those bits is set to 1, the Data Questionable Power summary bit of the Data Questionable Condition Register will be set to 1, send the command **`STAT:QUES:POW:ENAB 520`** (512 + 8). The command **`STATus:QUEStionable:POWer:ENABle?`** returns the decimal value of the sum of the bits previously enabled with the **`STATus:QUEStionable:POWer:ENABle <num>`** command.

Data Questionable Frequency Status Group

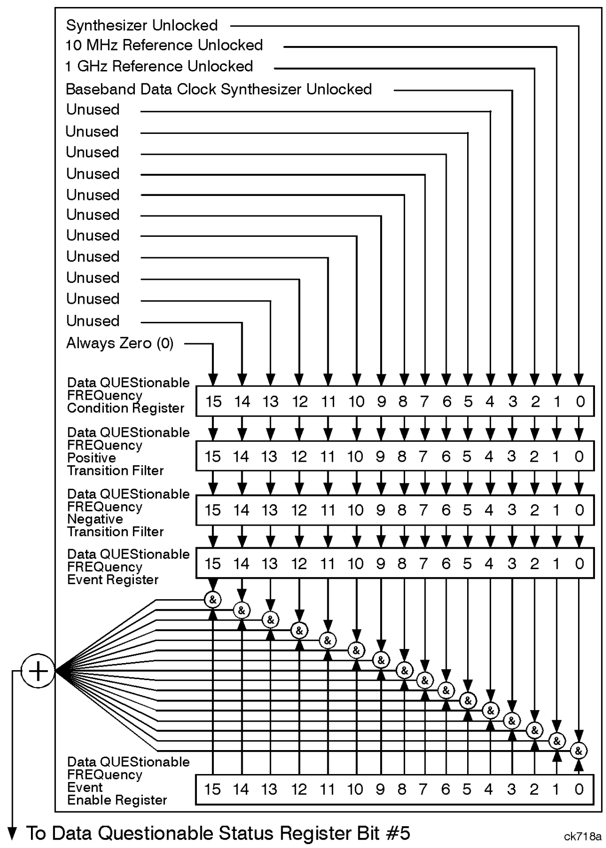
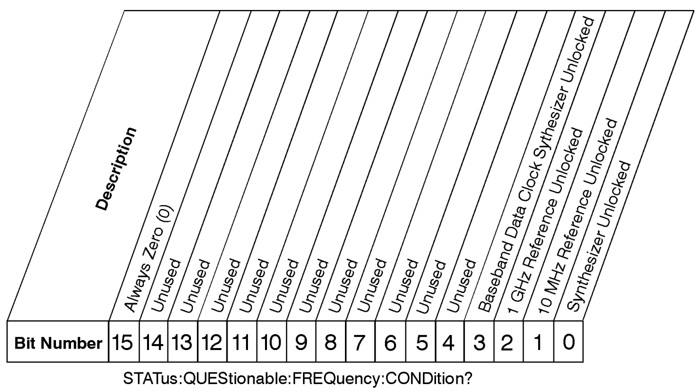


Figure 3-14. Data Questionable Frequency Status Group

The Data Questionable Frequency Status Group is used to determine the specific event that set bit 5 in the Data Questionable Condition Register. The Data Questionable Frequency Status Group consists of the Data Questionable Frequency Condition Register, the Data Questionable Frequency Negative Transition Filter, the Data Questionable Frequency Positive Transition Filter, the Data Questionable Frequency Event Register, and the Data Questionable Frequency Event Enable Register. The Data Questionable Frequency Condition Register contains the following bits:



Data Questionable Frequency Condition Register ck733a

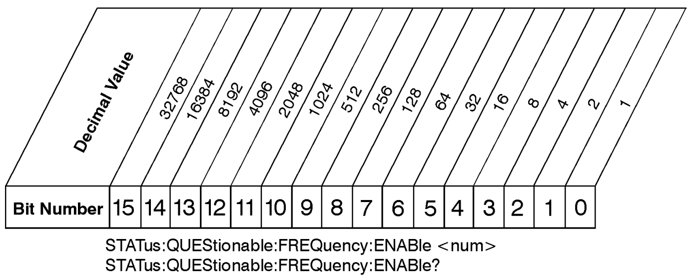
Bit	Description
0	A 1 in this bit indicates that the synthesizer is unlocked.
1	A 1 in this bit indicates that the 10 MHz reference signal is unlocked.

Bit	Description
2	A 1 in this bit indicates that the 1 GHz reference signal is unlocked.
3	A 1 in this bit indicates that the baseband data clock synthesizer is unlocked.
4-14	Unused. These bits are always set to 0.
15	Always Zero (0).

The Data Questionable Frequency Condition Register continuously monitors output frequency status of the instrument. Condition registers are read-only. To query the condition register, send the command **`STATus:QUEStionable:FREQuency:CONDition?`** The response will be the *decimal* sum of the bits which are set to 1.

The transition filter specifies which types of bit state changes in the condition register will set corresponding bits in the event register. The changes may be positive (from 0 to 1) or negative (from 1 to 0). Send the command **`STATus:QUEStionable:FREQuency:NTRansition <num>`** (negative) or **`STATus:QUEStionable:FREQuency:PTRansition <num>`** (positive) where **`<num>`** is the sum of the decimal values of the bits you want to enable.

The Data Questionable Frequency Event Register latches transition events from the condition register as specified by the transition filters. Event registers are destructive read-only. Reading data from an event register will clear the content of that register. To query the event register, send the command **`STATus:QUEStionable:FREQuency[:EVENt]?`**



Data Questionable Frequency Event Enable Register

ck734a

The Data Questionable Frequency Status Group also contains a Data Questionable Frequency Event Enable Register. This register lets you choose which bits in the Data Questionable Frequency Event Register will set the summary bit (bit 5 of the Data Questionable Condition Register) to 1. Send the **`STATus:QUEStionable:FREQuency:ENABle <num>`** command where **`<num>`** is the sum of the decimal values of the bits you want to enable. For example, to enable bit 9 and bit 3 so that whenever either of those bits is set to 1, the Data Questionable Frequency summary bit of the Data Questionable Condition Register will be set to 1, send the command **`STAT:QUES:FREQ:ENAB 520`** (512 + 8). The command **`STATus:QUEStionable:FREQ:ENABle?`** returns the decimal value of the sum of the bits previously enabled with the **`STATus:QUEStionable:FREQuency:ENABle <num>`** command.

Data Questionable Modulation Status Group

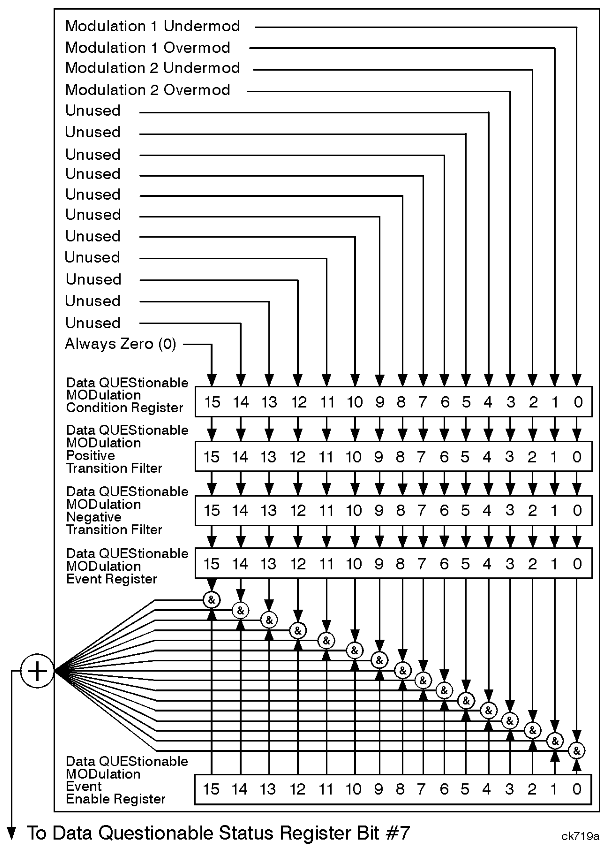
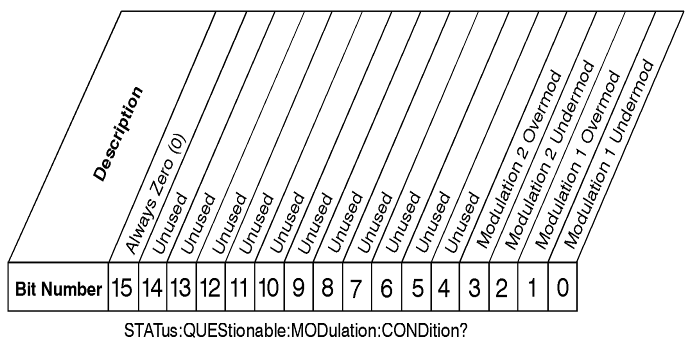


Figure 3-15. Data Questionable Modulation Status Group

The Data Questionable Modulation Status Group is used to determine the specific event that set bit 7 in the Data Questionable Condition Register. The Data Questionable Modulation Status Group consists of the Data Questionable Modulation Condition Register, the Data Questionable Modulation Negative Transition Filter, the Data Questionable Modulation Positive Transition Filter, the Data Questionable Modulation Event Register, and the Data Questionable Modulation Event Enable Register. The Data Questionable Modulation Condition Register contains the following bits:



Data Questionable Modulation Condition Register

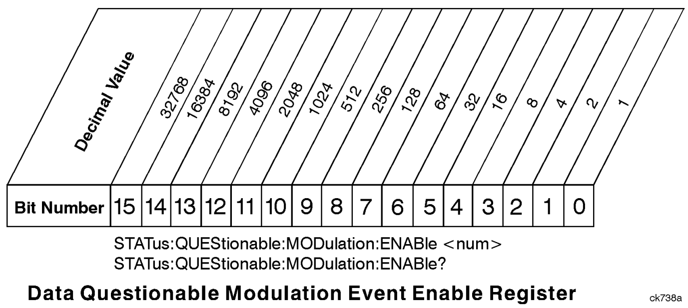
Bit	Description
0	A 1 in this bit indicates that the External 1 input, AC coupling on, is less than 0.97 volts.
1	A 1 in this bit indicates that the External 1 input, AC coupling on, is more than 1.03 volts.
2	A 1 in this bit indicates that the External 2 input, AC coupling on, is less than 0.97 volts.

Bit	Description
3	A 1 in this bit indicates that the External 2 input, AC coupling on, is more than 1.03 volts.
4-14	Unused. These bits are always set to 0.
15	Always Zero (0).

The Data Questionable Modulation Condition Register continuously monitors the modulation status of the instrument. Condition registers are read-only. To query the condition register, send the command **`STATus:QUEStionable:MODulation:CONDition?`** The response will be the *decimal* sum of the bits which are set to 1.

The transition filter specifies which types of bit state changes in the condition register will set corresponding bits in the event register. The changes may be positive (from 0 to 1) or negative (from 1 to 0). Send the command **`STATus:QUEStionable:MODulation:NTRansition <num>`** (negative) or **`STATus:QUEStionable:MODulation:PTRansition <num>`** (positive) where **`<num>`** is the sum of the decimal values of the bits you want to enable.

The Data Questionable Modulation Event Register latches transition events from the condition register as specified by the transition filters. Event registers are destructive read-only. Reading data from an event register will clear the content of that register. To query the event register, send the command **`STATus:QUEStionable:MODulation[:EVENt]?`**



Data Questionable Modulation Event Enable Register

The Data Questionable Modulation Status Group also contains a Data Questionable Modulation Event Enable Register. This register lets you choose which bits in the Data Questionable Modulation Event Register will set the summary bit (bit 7 of the Data Questionable Condition Register) to 1. Send the **`STATus:QUEStionable:MODulation:ENABle <num>`** command where **`<num>`** is the sum of the decimal values of the bits you want to enable. For example, to enable bit 9 and bit 3 so that whenever either of those bits is set to 1, the Data Questionable Modulation summary bit of the Data Questionable Condition Register will be set to 1, send the command **`STAT:QUES:MOD:ENAB 520`** (512 + 8). The command **`STATus:QUEStionable:MODulation:ENABle?`** returns the decimal value of the sum of the bits previously enabled with the **`STATus:QUEStionable:MODulation:ENABle <num>`** command.

Data Questionable Calibration Status Group

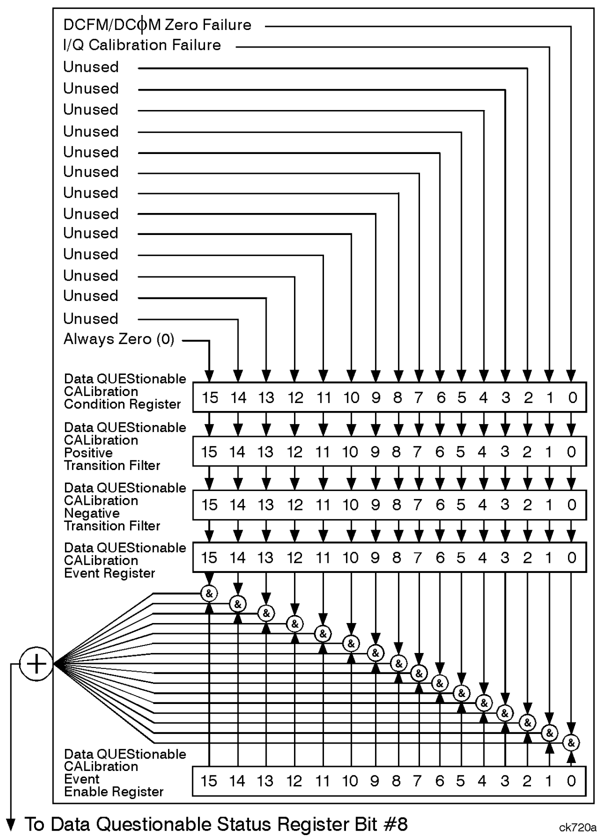
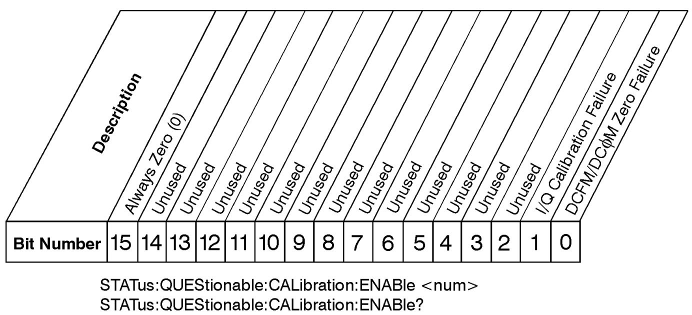


Figure 3-16. Data Questionable Calibration Status Group

The Data Questionable Calibration Status Group is used to determine the specific event that set bit 8 in the Data Questionable Condition Register. The Data Questionable Calibration Status Group consists of the Data Questionable Calibration Condition Register, the Data Questionable Calibration Negative Transition Filter, the Data Questionable Calibration Positive Transition Filter, the Data Questionable Calibration Event Register, and the Data Questionable Calibration Event Enable Register. The Data Questionable Calibration Condition Register contains the following bits:



Data Questionable Calibration Condition Register

ck740a

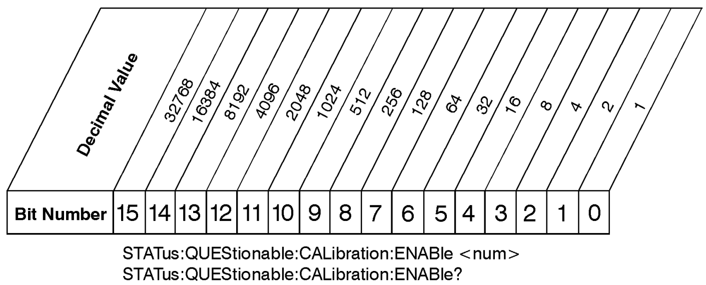
Bit	Description
0	A 1 in this bit indicates that the DCFM/DCΦM zero calibration routine has failed. This is a critical error. The output of the source has no validity until the condition of this bit is 0.
1	A 1 in this bit indicates that the I/Q calibration routine has failed. An I/Q calibration failure does not affect the validity of the source output.
2-14	Unused. These bits are always set to 0.

Bit	Description
15	Always Zero (0).

The Data Questionable Calibration Condition Register continuously monitors the calibration status of the instrument. Condition registers are read-only. To query the condition register, send the command **`STATus:QUEStionable:CALibration:CONDition?`** The response will be the *decimal* sum of the bits which are set to 1.

The transition filter specifies which types of bit state changes in the condition register will set corresponding bits in the event register. The changes may be positive (from 0 to 1) or negative (from 1 to 0). Send the command **`STATus:QUEStionable:CALibration:NTRansition <num>`** (negative) or **`STATus:QUEStionable:CALibration:PTRansition <num>`** (positive) where **`<num>`** is the sum of the decimal values of the bits you want to enable.

The Data Questionable Calibration Event Register latches transition events from the condition register as specified by the transition filters. Event registers are destructive read-only. Reading data from an event register will clear the content of that register. To query the event register, send the command **`STATus:QUEStionable:CALibration[:EVENt]?`**



Data Questionable Calibration Event Enable Register

ck741a

The Data Questionable Calibration Status Group also contains a Data Questionable Calibration Event Enable Register. This register lets you choose which bits in the Data Questionable Calibration Event Register will set the summary bit (bit 8 of the Data Questionable Condition register) to 1. Send the **`STATus:QUEStionable:CALibration:ENABle <num>`** command where **`<num>`** is the sum of the decimal values of the bits you want to enable. For example, to enable bit 9 and bit 3 so that whenever either of those bits is set to 1, the Data Questionable Calibration summary bit of the Data Questionable Condition Register will be set to 1, send the command **`STAT:QUES:CAL:ENAB 520`** (512 + 8). The command **`STATus:QUEStionable:CALIbration:ENABle?`** returns the decimal value of the sum of the bits previously enabled with the **`STATus:QUEStionable:CALibration:ENABle <num>`** command.

3 Programming Fundamentals

This chapter explains how to program the signal generator using HP-IB command statements and SCPI language.

Getting Started with SCPI

This section describes the use of the Standard Commands for Programmable Instruments language (SCPI). This section explains how to use SCPI commands in general.

Understanding Common Terms

The following terms are used throughout the remainder of this chapter.

Controller	A controller is any computer used to communicate with a SCPI instrument. A controller can be a personal computer, a minicomputer, or a plug-in card in a card cage. Some intelligent instruments can also function as controllers.
Instrument	An instrument is any device that implements SCPI. Most instruments are electronic measurement or stimulus devices, but this is not a requirement. Similarly, most instruments use an HP-IB or RS-232 interface for communication. The same concepts apply regardless of the instrument function or the type of interface used.
Program Message	A program message is a combination of one or more properly formatted SCPI commands. Program messages always go from a controller to an instrument. Program messages tell the instrument how to make measurements and output signals.

Response Message	A response message is a collection of data in specific SCPI formats. Response messages always go from an instrument to a controller or listening instrument. Response messages tell the controller about the internal state of the instrument and about measured values.
Command	A command is an instruction in SCPI. You combine commands to form messages that control instruments. In general, a command consists of mnemonics (keywords), parameters, and punctuation.
Query	A query is a special type of command. Queries instruct the instrument to make response data available to the controller. Query mnemonics always end with a question mark.

Standard Notation

This section uses several forms of notation that have specific meaning:

Command Mnemonics	Many commands have both a long and a short form and you must use either one or the other (SCPI does not accept a combination of the two.) Consider the **`FREQuency`** command, for example. The short form is **`FREQ`** and the long form is **`FREQUENCY`**. This notation type is a shorthand to document both the long and short form of commands. SCPI is not case sensitive, so **`fREquEnCy`** is just as valid as **`FREQUENCY`**, but **`FREQ`** and **`FREQUENCY`** are the only valid forms of the **`FREQuency`** command.

Angle Brackets

Angle brackets indicate that the word or words enclosed represent something other than themselves. For example, **`<new line>`** represents the ASCII character with the decimal value 10. Similarly, **`<^END>`** means that EOI is asserted on the HP-IB interface. Words in angle brackets have much more rigidly defined meaning than words shown in ordinary text. For example, this section uses the word "message" to talk about messages generally. But the bracketed words **`<program message>`** indicate a precisely defined element of SCPI. If you need them, you can find the exact definitions of words such as **`<program message>`** in a syntax diagram.

How to Use Examples

Programming with SCPI requires knowledge of two languages. You must know the programming language of your controller (BASIC, C, Pascal) as well as the language of your instrument (SCPI). The semantic requirements of your controller's language determine how the SCPI commands and responses are handled in your application.

Command Examples

Command examples look like this:

```
:FREQuency:CW?
```

This example tells you to put the string **:FREQuency:CW?** in the output statement appropriate to your application programming language. If you encounter problems, study the details of how the output statement handles message terminators such as **<new line>**. If you are using simple OUTPUT statements in HP BASIC, this is taken care of for you. In HP BASIC, you type:

```
OUTPUT 719":FREQuency:CW?"
```

Command examples do not show message terminators because they are used at the end of every program message. See "Details of Commands and Responses" in this chapter for more information on message terminators.

Response Examples

Response examples look like this:

```
3.000000000000E+009
```

These are the characters you would read from an instrument after sending a query command. To actually pull them from the instrument into the controller, use the input statement appropriate to your application programming language. If you have problems, study the details of how the input statement operates. In particular, investigate how the input statement handles punctuation characters such as the comma and the semicolon and how it handles **<new line>** and EOI. To enter the previous response in HP BASIC you type:

```
ENTER 719;CW_frequency
```

Response examples do not show response message terminators because they are always **<new line> <^END>**. These terminators are typically automatically handled by the input statement. See "Details of Commands and Responses" in this chapter for more information about terminators.

Program and Response Messages

To understand how your instrument and controller communicate using SCPI, you must understand the concepts of program and response messages. Program messages are the formatted data sent from the controller to the instrument.

Conversely, response messages are the formatted data sent from the instrument to the controller. Program messages contain one or more commands, and response messages contain one or more responses.

The controller may send commands at any time, but the instrument sends responses only when specifically instructed to do so. The special type of command used to instruct the instrument to send a response message is the query. All query mnemonics end with a question mark. Queries return either measured values or internal instrument settings. Any internal setting that can be programmed with SCPI can also be queried.

Forgiving Listening and Precise Talking

SCPI uses the concept of forgiving listening and precise talking outlined in IEEE 488.2.

Forgiving listening means that instruments are very flexible in accepting various command and parameter formats. For example, the signal generator accepts either **`:POWer:ALC[:STATe] ON`** or **`:POWer:ALC[STATe] 1`** to turn on the source's RF output.

Precise talking means that the response format for a particular query is always the same. For example, if you query the power state when it is on (using **`:POWer:ALC[:STATe]?`**), the response is always 1, regardless of whether you previously sent **`:POWer:ALC[:STATe] 1`** or **`:POWer:ALC[:STATe] ON`**.

Types of Commands

Commands can be separated into two groups, common commands and subsystem commands.

Common commands are generally not measurement related. They are used to manage macros, status registers, synchronization, and data storage. Common commands are easy to recognize because they all begin with an asterisk, such as **`*IDN?`**, **`*OPC`**, and **`*RST`**. Common commands are defined by IEEE 488.2.

Subsystem commands include all measurement functions and some general purpose functions. Subsystem commands are distinguished by the colon used between keywords, as in **`:FREQuency:CW?`**. Each command subsystem is a set of commands that roughly corresponds to a functional block inside the instrument. For example, the **`:POWer`** subsystem contains commands for power generation, while the **`:STATus`** subsystem contains commands for accessing status registers.

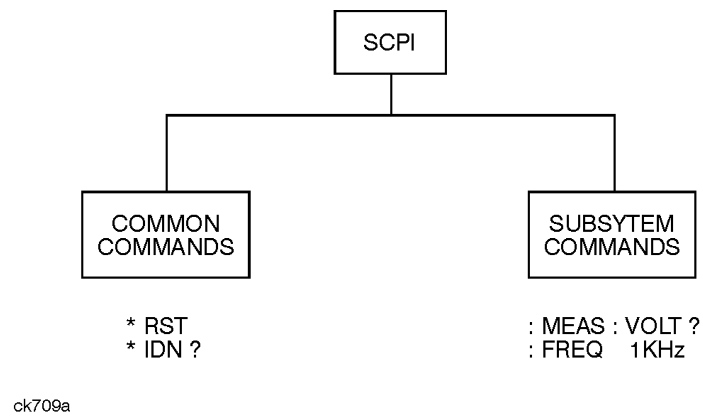


Figure 3-1. SCPI Command Types

The remaining paragraphs in this subsection discuss subsystem commands in more detail. Remember, some commands are implemented in one instrument and not in another, depending on its measurement function.

Subsystem Command Trees

Command Tree Structure

Most programming tasks involve subsystem commands. SCPI uses a hierarchical structure for subsystem commands similar to the file systems on most computers. In SCPI, this command structure is called a command tree.

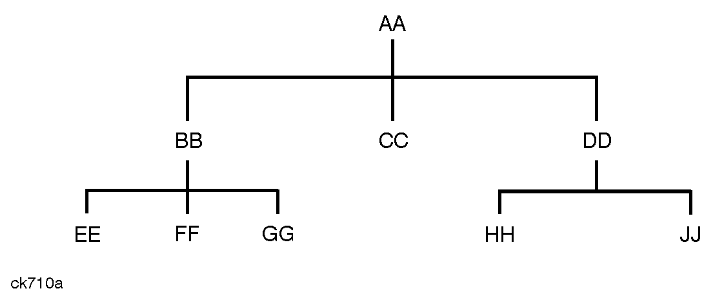


Figure 3-2. A Simplified Command Tree

In the command tree shown in Figure 3-2, the command closest to the top is the root command, or simply "the root." Notice that you must follow a particular path to reach lower level subcommands. For example, if you wish to access the GG command, you must follow the path AA to BB to GG.

Paths Through the Command Tree

To access commands in different paths in the command tree, you must understand how an instrument interprets commands. The parser, a part of the instrument firmware, decodes each message sent to the instrument. The parser breaks up the message into component commands using a set of rules to determine the command tree path used. The parser keeps track of the current path: the level in the command tree where it expects to find the next command you send. This is important because the same keyword may appear in different paths. The particular path you use determines how the keyword is interpreted. The following rules are used by the parser:

Power On and Reset	After power is cycled or after **`*RST`**, the current path is set to the root.
Message Terminators	A message terminator, such as a **`<new line>`** character, sets the current path to the root. Many programming languages have output statements that send message terminators automatically. See "Details of Commands and Responses" in this chapter for more information about message terminators.
Colon	When a colon is placed between two command mnemonics, it moves the current path down one level in the command tree. For example, the colon in **`MEAS:VOLT`** specifies that **`VOLT`** is one level below **`MEAS`**. When the colon is the first character of a command, it specifies that the next command mnemonic is a root level command. For example, the colon in **`:INIT`** specifies that **`INIT`** is a root level command.
Semicolon	A semicolon separates two commands in the same message without changing the current path.

White Space	White space characters, such as **`<tab>`** and **`<space>`**, are generally ignored. There are two important exceptions. White space inside a keyword, such as: **`:FREQ uency`** is not allowed. You must use white space to separate parameters from commands. For example, the **`<space>`** between **`LEVel`** and **`6.2`** in the command **`:POWer:LEVel 6.2`** is mandatory. White space does not affect the current path.
Commas	If a command requires more than one parameter, you must separate adjacent parameters using a comma. Commas do not affect the current path.
Common Commands	Common commands, such as **`*RST`**, are not part of any subsystem. An instrument interprets them in the same way, regardless of the current path setting.

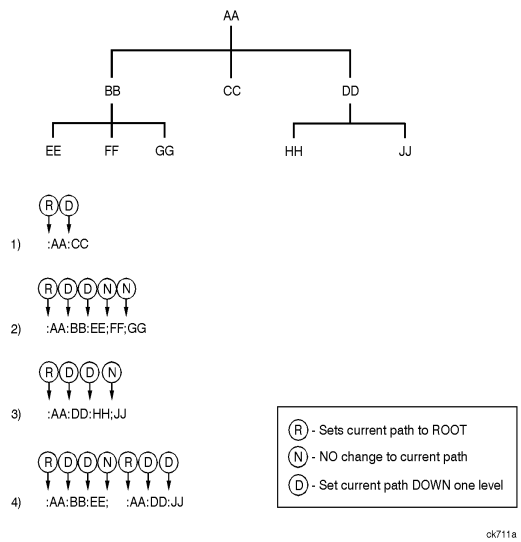


Figure 3-3. Proper Use of the Colon and Semicolon

Figure 3-3 shows examples of how to use the colon and semicolon to navigate efficiently through the command tree. Notice how proper use of the semicolon can reduce the amount of information that must be sent over the interface.

Sending this message:

```
:AA:BB:EE; FF; GG
```

is the same as sending these three messages:

```
:AA:BB:EE
:AA:BB:FF
:AA:BB:GG
```

More About Commands

Query and Event Commands

You can query any value that you can set. For example, the presence of the signal generator **`FREQuency:OFFSet`** command implies that a **`FREQuency:OFFSet?`** also exists. If you see a command ending with a question mark, it is a query-only command. Some commands are events and cannot be queried. An event has no corresponding setting if it causes something to happen inside the instrument at a particular instant.

Implied Commands

Implied commands appear in square brackets. If you send a subcommand immediately preceding an implied command, but do not send the implied command, the instrument assumes you intend to use the implied command and behaves just as if you had sent it. Notice that this means that the instrument expects you to include any parameters required by the implied command. The following example illustrates equivalent ways to program the signal generator using explicit and implied commands.

Example signal generator commands with and without an implied command:

`FREQuency[:CW] 500 MHz`	using explicit commands
`FREQuency 500 MHz`	using implied commands

Optional Parameters

Optional parameter names are enclosed in square brackets. If you do not send a value for an optional parameter, the instrument chooses a default value. The instrument's command dictionary documents the values used for optional parameters.

Program Message Examples

The following parts of the signal generator SCPI command set will be used to demonstrate how to create complete SCPI program messages:

`:FREQuency`

`:POWER`

Example 1

`“FREQuency:STARt 500 MHz; STOP 1000 MHz”`

The command is correct and will not cause errors. It is equivalent to sending the following:

`“FREQuency:STARt 500 MHz; FREQuency:STOP 1000 MHz”`

Example 2

`“POWer 10 DBM; :OFFSet 5 DB”`

This command results in a command error. The command makes use of the default **`POWer[:LEVel][:IMMediate]`** node. When using a default node, there is no change to the current path position. Since there is no command “**`OFFSet`**” at the root, an error results. A correct way to send this is:

`“POWer 10 DBM; :POWer:OFFSet 5 DB”`

Example 3

`“POWer:OFFSet 5 DB; POWer 10 DBM”`

This command results in a command error. The **`POWer 10 DBM`** portion of the command is missing a leading colon. The path level is dropped at each colon until it is in the **`POWer:OFFSet`** subsystem.

When the **POWer 10 DBM** command is sent, it then causes confusion because no such node occurs in the **POWer:OFFSet** subsystem. By adding a leading colon, the current path is reset to the root. The correct command is:

"POWer:OFFSet 5 DB; :POWer 10 DBM"

Example 4

"FREQ 500 MHZ; POWER 4 DBM"

In this example the keyword short form is used. The command is correct. It utilizes the default nodes of **[:CW]** and **[:LEVEL]**. Since default nodes do not affect the current path, it is not necessary to use a leading colon before **POWER**.

Reading Instrument Errors

When debugging a program, you may want to know if an instrument error has occurred. The signal generator can display error messages on their front panel displays. If your system includes an instrument that does not have this capability, you can put the following code segment in your program to read error messages and print them on the controller's display.

```
 10 !
 20 !  The rest of your
 30 ! variable declarations
 40 !  Assign @box to 719
 50 DIM Err_msg$[75]
 60 INTEGER Err_num
 70 !
 80 ! Part of your program
 90 ! that generates errors
100 !
110 !
```

```
200 REPEAT
210 OUTPUT @Box;":SYST:ERR?"
220   ! Query instrument error
230   ENTER @Box;Err_num,Err_msg$
240   ! Read error #, message
250   PRINT Err_num,Err_msg$
260   ! Print error message
270 UNTIL Err_num = 0
280 ! Repeat until no errors
290 !
300 !   The rest of your program
310 !
```

Details of Commands and Responses

This section describes the syntax of SCPI commands and responses. It provides many examples of the data types used for command parameters and response data.

Program Message Syntax

These program messages contain commands combined with appropriate punctuation and program message terminators.

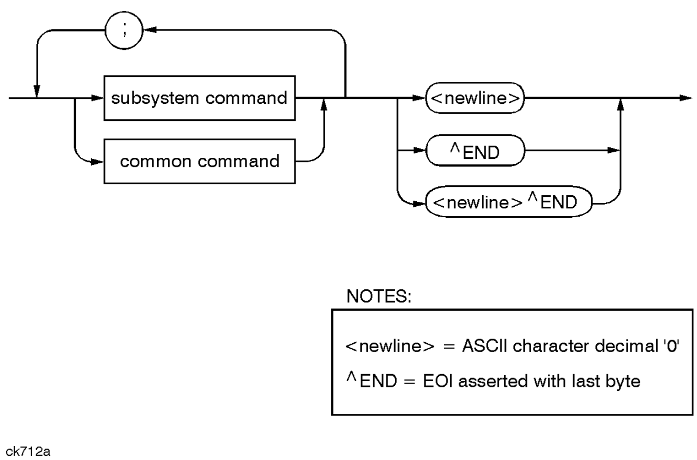


Figure 3-4. Simplified Program Message Syntax

As Figure 3-4 shows, you can send common commands and subsystem commands in the same message. If you send more than one command in the same message, you must separate them with a semicolon. You must always end a program message with one of the three program message terminators shown in Figure 3-4. Use **`<new line>`**, **`<^END>`**, or **`<new line><^END>`** as the program message terminator. The word **`<^END>`** means that EOI is asserted on the HP-IB interface at the same time the preceding data byte is sent. Most programming languages send these terminators automatically. For example, if you use the HP BASIC **`OUTPUT`** statement, **`<new line`**> is automatically sent after your last data byte. If you are using a PC, you can usually configure the system to send whatever terminator you specify.

SCPI Subsystem Command Syntax

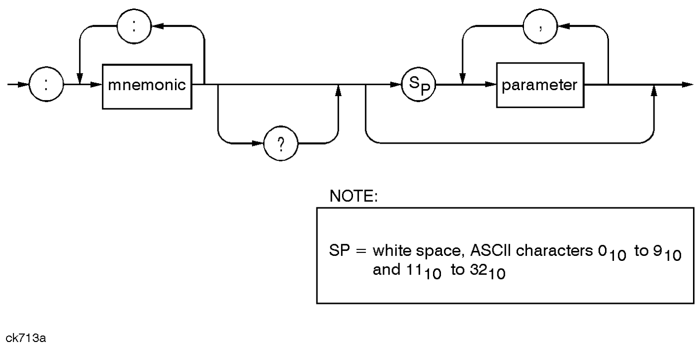
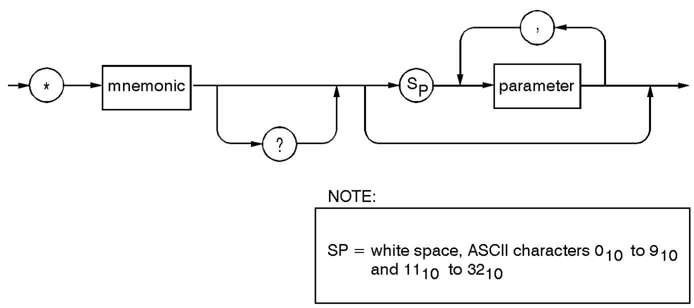


Figure 3-5. SCPI Simplified Subsystem Command Syntax

As Figure 3-5 shows, there must be a **`<space>`** between the last command mnemonic and the first parameter in a subsystem command. This is one of the few places in SCPI where **`<space>`** is required. Note that if you send more than one parameter with a single command, you must separate adjacent parameters with a comma. Parameter types are explained later in this subsection.

Common Command Syntax

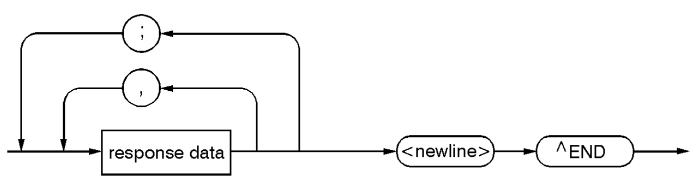


ck714a

Figure 3-6. Simplified Common Command Syntax

As with subsystem commands, use a **`<space>`** to separate a command mnemonic from subsequent parameters. Separate adjacent parameters with a comma. Parameter types are explained later in this section.

Response Message Syntax



ck715a

Figure 3-7. Simplified Response Message Syntax

Response messages can contain both commas and semicolons as separators. When a single query command returns multiple values, a comma separates each data item. When multiple queries are sent in the same message, the groups of data items corresponding to each query are separated by a semicolon. For example, the fictitious query **`:QUERY1?:QUERY2?`** might return a response message of:

```
<data1>,<data1>;<data2>,<data2>
```

Response data types are explained later in this subsection. Note that **`<new line><^END>`** is always sent as a response message terminator.

SCPI Data Types

SCPI defines different data formats for use in program messages and response messages. It does this to accommodate the principle of forgiving listening and precise talking. Forgiving listening means that instruments are flexible, accepting commands and parameters in various formats. Precise talking means an instrument always responds to a particular query in a predefined, rigid format. Parameter data types are designed to be flexible in the spirit of forgiving listening. Conversely, response data types are defined to meet the requirements of precise talking.

Parameter Types	Response Data Types
Numeric Extended Numeric	Real or Integer Integer
Discrete	Discrete
Boolean	Numeric Boolean
String	String
Block	Definite Length Block (all interfaces) Indefinite Length Block (not supported with RS-232)
Non-decimal Numeric	Hexadecimal Octal Binary

Each parameter type has one or more corresponding response data types. For example, a setting that you program using a numeric parameter returns either real or integer response data when queried. Whether real or integer response data is returned depends on the instrument used. However, precise talking requires that the response data type be clearly defined for a particular instrument and query.

Parameter Types

Numeric Parameters Numeric parameters are used in both subsystem commands and common commands. Numeric parameters accept all commonly used decimal representations of numbers including optional signs, decimal points, and scientific notation.

If an instrument setting programmed with a numeric parameter can only assume a finite number of values, the instrument automatically rounds the parameter. For example, if an instrument has a programmable output impedance of 50 or 75 ohms, and you specified **`76.1`** for output impedance, the value is rounded to **`75`**. If the instrument setting can only assume integer values, it automatically rounds the value to an integer. For example sending **`*ESE 10.123`** is the same as sending **`*ESE 10`**.

Examples of numeric parameters:

100	no decimal point required
100.	fractional digits optional
-1.23	leading signs allowed
4.56e<space>3	space allowed after e in exponentials
-7.89E-01	use either E or e in exponentials
+256	leading + allowed
.5	digits left of decimal point optional

Extended Numeric Parameters Most subsystems use extended numeric parameters to specify physical quantities. Extended numeric parameters accept all numeric parameter values and other special values as well. All extended numeric parameters accept **`MAXimum`** and **`MINimum`** as values. Notice that **`MINimum`** and **`MAXimum`** can be used to set or query values. The query forms are useful for determining the range of values allowed for a given parameter.

In some instruments, extended numeric parameters accept engineering unit suffixes as part of the parameter value.

Notice that extended numeric parameters are not used for common commands or **`STATus`** subsystem commands.

Examples of extended numeric parameters:

100.	any simple numeric values
-1.23	
4.56e<space>3	
-7.89E-01	
+256	
.5	
MAX	largest valid setting
MIN	valid setting nearest negative infinity
-100 mV	negative 100 millivolts

Discrete Parameters Use discrete parameters to program settings that have a finite number of values. Discrete parameters use mnemonics to represent each valid setting. They have a long and a short form, just like command mnemonics. You can use mixed upper and lower case letters for discrete parameters.

Examples of discrete parameters used with the TRIG:SOURce subsystem:

BUS	HP-IB triggering
IMMediate	immediate trigger
EXTernal	external triggering

Although discrete parameter values look like command keywords, do not confuse the two. In particular, be sure to use colons and spaces properly. Use a colon to separate command mnemonics from each other. Use a space to separate parameters from command mnemonics.

Examples of discrete parameters in commands:

```
100 OUTPUT @Source;"TRIGger:SOURce BUS"
100 OUTPUT @Source;"TRIGger:SOURce IMMediate"
100 OUTPUT @Source;"TRIGger:SOURce EXTernal"
```

Boolean Parameters Boolean parameters represent a single binary condition that is either true or false. There are only four possible representations for a Boolean parameter:

ON	Boolean true, upper/lower case allowed
OFF	Boolean false, upper/lower case allowed
1	Boolean true
0	Boolean false

Response Data Types

Real Response Data A large portion of all measurement data are formatted as real response data. Real response data are decimal numbers in either fixed decimal notation or scientific notation. Most high-level programming languages that support instrument I/O handle either decimal or scientific notation transparently.

Examples of real response data:

1.23E+0

-1.0E+2

+1.0E+2

0.5E+0

1.23

-100.0

+100.0

0.5

Integer Response Data Integer response data are decimal representations of integer values including optional signs. Most status register related queries return integer response data.

Examples of integer response data:

0	signs are optional
+100	leading + sign allowed
-100	leading sign allowed
256	never any decimal point

Discrete Response Data Discrete response data are similar to discrete parameters. The main difference is that discrete response data return only the short form of a particular mnemonic, in all upper case letters.

Examples of discrete response data:

IMM	Immediate
EXT	External

String Response Data String response data are similar to string parameters. The main difference is that string response data use only double quotes as delimiters, rather than single quotes. Embedded double quotes may be present in string response data. Embedded quotes appear as two adjacent double quotes with no characters between them.

Examples of string response data:

"This IS valid"

"SO IS THIS"" "

"I said, ""Hello!"""

Programming the Status Register System

The signal generator’s instrument status system provides complete IEEE 488.2 Device Standard data structures for reporting instrument status using the register model.

The IEEE 488.2 register model of the status system is comprised of multiple registers which are arranged in a hierarchial order. The lower-priority status registers propagate their data to the higher-priority registers in the data structures by means of summary bits. The Status Byte Register is at the top of the hierarchy and contains the general status information for the instrument’s events and conditions. All other individual registers are used to determine the specific events or conditions.

You can determine the state of certain instrument hardware and firmware events and conditions by programming the status register system.

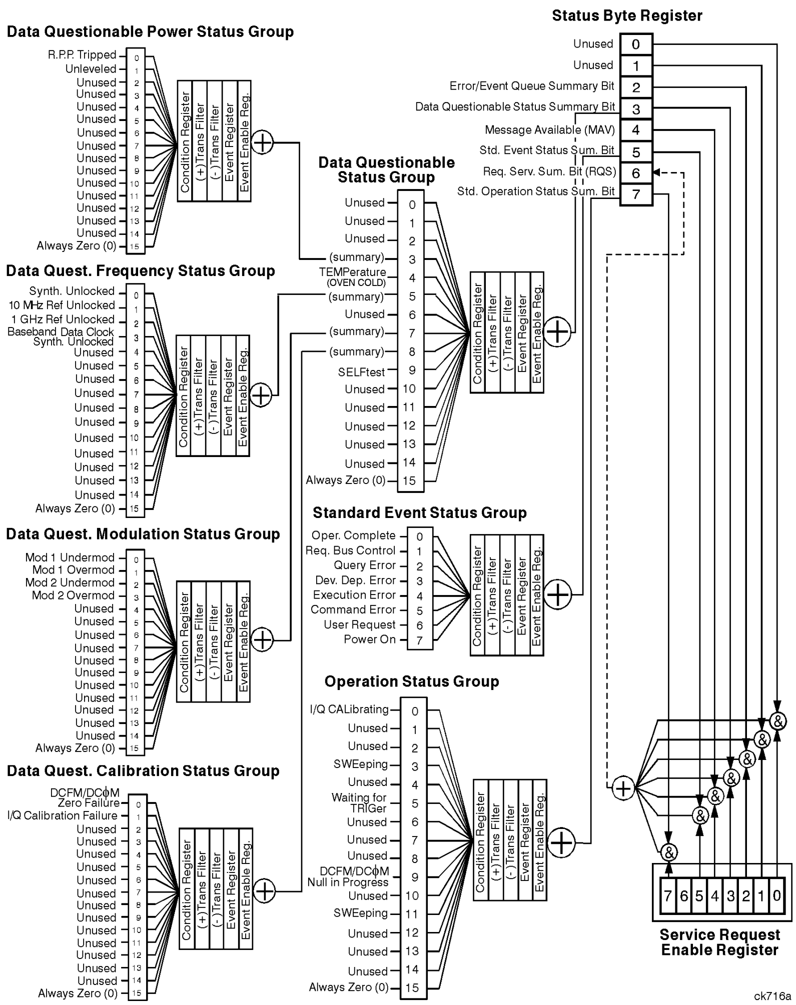


Figure 3-8. The Overall Status Byte Register System

Status Byte Group

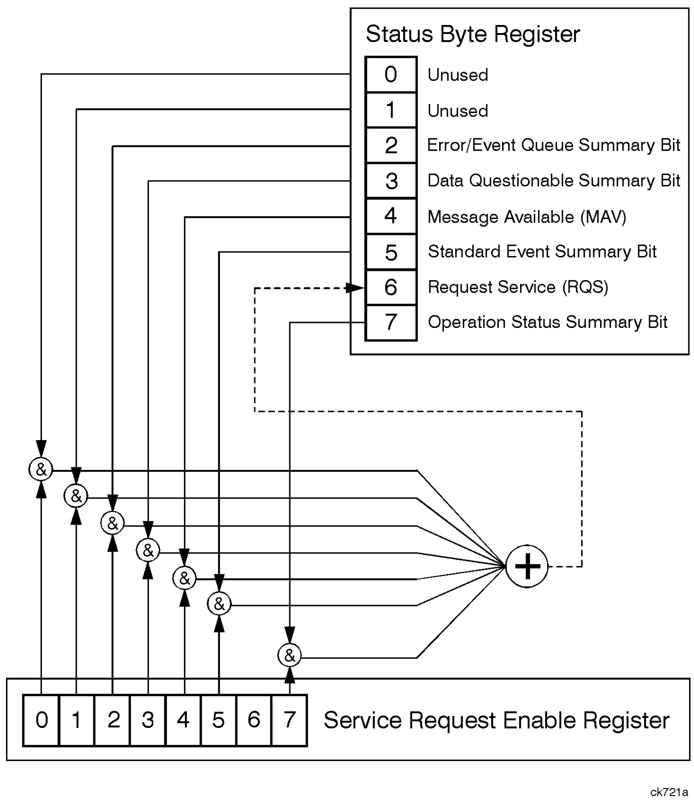
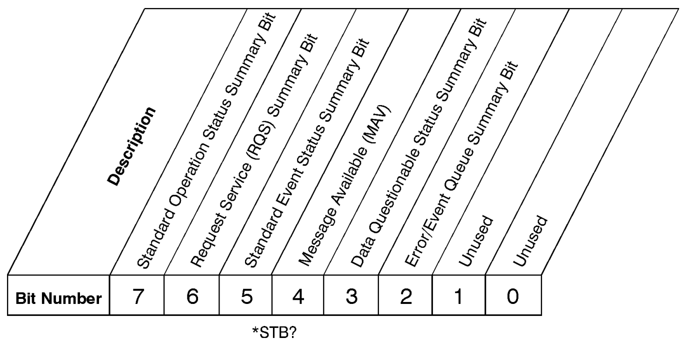


Figure 3-9. The Status Byte Group

The Status Byte Group consists of the Status Byte Register and the Service Request Enable Register. The Status Byte Register contains the following bits:



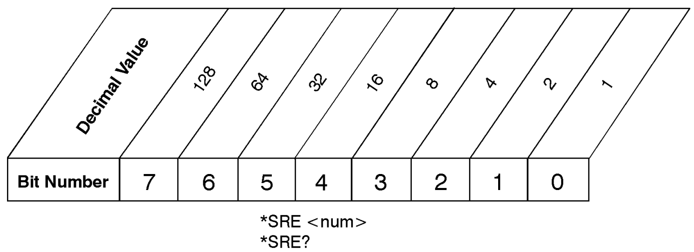
Status Byte Register

Bit	Description
0, 1	These bits are always set to 0.
2	A 1 in this bit position indicates that the SCPI error queue is not empty. The SCPI error queue contains at least one error message.
3	A 1 in this bit position indicates that the Data Questionable summary bit has been set. The Data Questionable Event Register can then be read to determine the specific condition that caused this bit to be set.
4	A 1 in this bit position indicates that the signal generator has data ready in the output queue. There are no lower status groups that provide input to this bit.

Bit	Description
5	A 1 in this bit position indicates that the Standard Event summary bit has been set. The Standard Event Status Register can then be read to determine the specific event that caused this bit to be set.
6	A 1 in this bit position indicates that the instrument has at least one reason to require service. This bit is also called the Master Summary Status bit (MSS). The individual bits in the Status Byte are individually ANDed with their corresponding service request enable register, then each individual bit value is ORed and input to this bit.
7	A 1 in this bit position indicates that the Standard Operation summary bit has been set. The Standard Operation Event Register can then be read to determine the specific condition that caused this bit to be set.

To query the Status Byte Register, send the command **`*STB?`** The response will be the *decimal* sum of the bits which are set to 1. For example, if bit number 7 and bit number 3 are set to 1, the decimal sum of the 2 bits is 128 plus 8. So the decimal value 136 is returned.

In addition to the Status Byte Register, the Status Byte Group also contains a Service Request Enable Register. This register lets you choose which bits in the Status Byte Register will trigger a service request. Send the **`*SRE <num>`** command where **`<num>`** is the sum of the decimal values of the bits you want to enable plus the decimal value of bit 6. For example, to enable bit 7 so that whenever the Standard Operation Status Register summary bit is set to 1 it will trigger a service request, send the command **`*SRE 192`** (128 + 64). You must always enable bit 6 when you enable any other bits for a service request. The command **`*SRE?`** returns the decimal value of the sum of the bits previously enabled with the **`*SRE <num>`** command.



Service Request Enable Register

ck726a

Status Groups

The Standard Operation Status Group and the Data Questionable Status Group each consist of the following registers; the Standard Event Status Group is similar but does not have negative or positive transition filters.

Condition Register — A condition register continuously monitors the hardware and firmware status of the signal generator. There is no latching or buffering for a condition register; it is updated in real time.

Negative Transition Filter — A negative transition filter specifies the bits in the condition register that will set corresponding bits in the event register when the condition bit changes from 1 to 0.

Positive Transition Filter — A positive transition filter specifies the bits in the condition register that will set corresponding bits in the event register when the condition bit changes from 0 to 1.

Event Register	An event register latches transition events from the condition register as specified by the positive and negative transition filters. Bits in the event register are latched, and once set, they remain set until cleared by either querying the register contents or sending the **`*CLS`** command.
Event Enable Register	An enable register specifies the bits in the event register that can generate a summary bit. The signal generator logically ANDs corresponding bits in the event and enable registers and ORs all the resulting bits to produce a summary bit. Summary bits are, in turn, used by the Status Byte Register.

In general, a status group is a set of related registers whose contents are programmed in order to produce status summary bits. In each status group, corresponding bits in the condition register are filtered by the negative and positive transition filters and stored in the event register. The contents of the event register are logically ANDed with the contents of the enable register and the result is logically ORed to produce a status summary bit in the Status Byte Register.

Standard Event Status Group

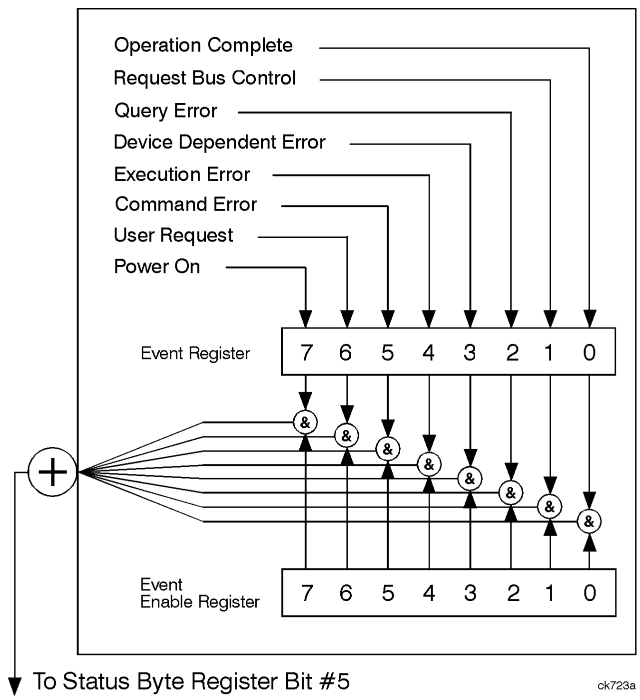
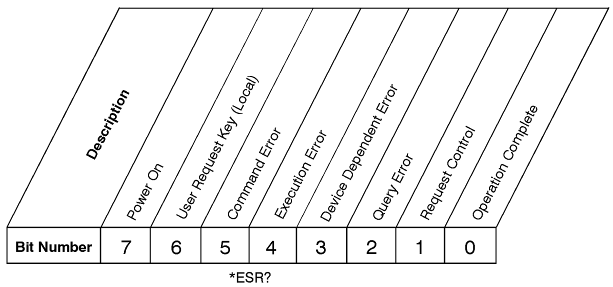


Figure 3-10. The Standard Event Status Group

The Standard Event Status Group is used to determine the specific event that set bit 5 in the Status Byte Register. The Standard Event Status Group consists of the Standard Event Status Register (an event register) and the Standard Event Status Enable Register. The Standard Event Status Register contains the following bits:



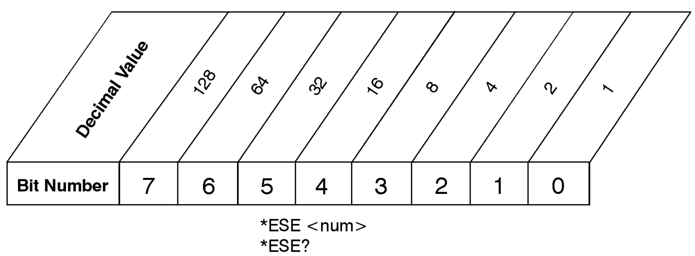
Standard Event Status Register

ck727a

Bit	Description
0	A 1 in this bit position indicates that all pending signal generator operations were completed following execution of the ***OPC** command.
1	This bit is always set to 0. (The signal generator does not request control.)
2	A 1 in this bit position indicates that a query error has occurred. Query errors have SCPI error numbers from -499 to -400.
3	A 1 in this bit position indicates that a device dependent error has occurred. Device dependent errors have SCPI error numbers from -399 to -300 and 1 to 32767.
4	A 1 in this bit position indicates that an execution error has occurred. Execution errors have SCPI error numbers from -299 to -200.

Bit	Description
5	A 1 in this bit position indicates that a command error has occurred. Command errors have SCPI error numbers from -199 to -100.
6	A 1 in this bit position indicates that the **Local** key has been pressed. This is true even if the signal generator is in local lockout mode.
7	A 1 in this bit position indicates that the signal generator has been turned off and then on.

To query the Standard Event Status Register, send the command **`*ESR?`**. The response will be the *decimal* sum of the bits which are set to 1. For example, if bit number 7 and bit number 3 are set to 1, the decimal sum of the 2 bits is 128 plus 8. So the decimal value 136 is returned.



Standard Event Status Enable Register

In addition to the Standard Event Status Register, the Standard Event Status Group also contains a Standard Event Status Enable Register. This register lets you choose which bits in the Standard Event Status Register will set the summary bit (bit 5 of the Status Byte Register) to 1. Send the **`*ESE <num>`** command where **`<num>`** is the sum of the decimal values of the bits you want to enable. For example, to enable bit 7 and bit 6 so that whenever either of those bits is set to 1, the Standard Event Status summary bit of the Status Byte Register will be set to 1, send the command **`*ESE 192`** (128 + 64). The command **`*ESE?`** returns the decimal value of the sum of the bits previously enabled with the **`*ESE <num>`** command.

Standard Operation Status Group

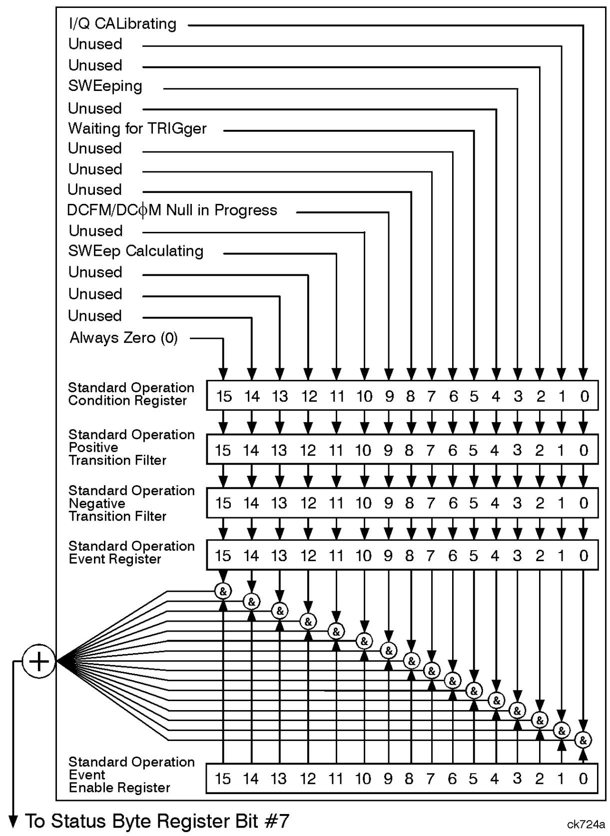
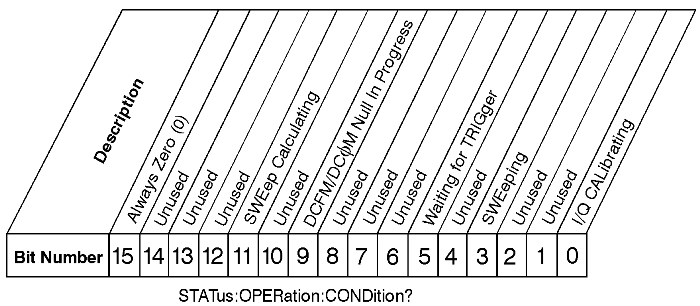


Figure 3-11. The Standard Operation Status Group

The Standard Operation Status Group is used to determine the specific event that set bit 7 in the Status Byte Register. The Standard Operation Status Group consists of the Standard Operation Condition Register, the Standard Operation Negative Transition Filter, the Standard Operation Positive Transition Filter, the Standard Operation Event Register, and the Standard Operation Event Enable Register. The Standard Operation Condition Register contains the following bits:



Standard Operation Condition Register

ck729a

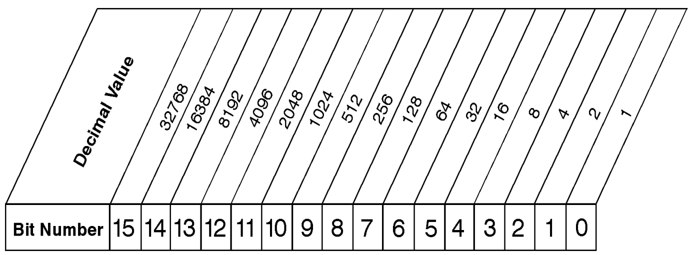
Bit	Description
0	A 1 in this bit position indicates that an I/Q calibration is being performed.
1, 2	Unused. These bits are always set to 0.
3	A 1 in this bit position indicates that a sweep is in progress.
4	Unused. This bit is always set to 0.
5	A 1 in this bit position indicates that the source is in a “wait for trigger” state of the trigger model.

Bit	Description
6,7,8	Unused. These bits are always set to 0.
9	A 1 in this bit position indicates that the signal generator is currently performing a DCFM zero calibration.
10	Unused. This bit is always set to 0.
11	A 1 in this bit position indicates that the signal generator is currently doing the necessary pre-sweep calculations.
12, 13, 14	Unused. These bits are always set to zero.

The Standard Operation Condition Register continuously monitors the hardware and firmware status of the instrument. Condition registers are read-only. To query the condition register, send the command **`STATus:OPERation:CONDition?`** The response will be the *decimal* sum of the bits which are set to 1. For example, if bit number 9 and bit number 3 are set to 1, the decimal sum of the 2 bits is 512 plus 8. So the decimal value 520 is returned.

The transition filter specifies which types of bit state changes in the condition register will set corresponding bits in the event register. The changes may be positive (from 0 to 1) or negative (from 1 to 0). Send the command **`STATus:OPERation:NTRansition <num>`** (negative) or **`STATus:OPERation:PTRansition <num>`** (positive) where **`<num>`** is the sum of the decimal values of the bits you want to enable.

The Standard Operation Event Register latches transition events from the condition register as specified by the transition filters. Event registers are destructive read-only. Reading data from an event register will clear the content of that register. To query the event register, send the command **`STATus:OPERation[:EVENt]?`**



STATus:OPERation:ENABle <num>
STATus:OPERation:ENABle?

Standard Operation Event Enable Register ck730a

The Standard Operation Status Group also contains a Standard Operation Event Enable Register. This register lets you choose which bits in the Standard Operation Event Register will set the summary bit (bit 7 of the Status Byte Register) to 1. Send the **`STATus:OPERation:ENABLe <num>`** command where **`<num>`** is the sum of the decimal values of the bits you want to enable. For example, to enable bit 9 and bit 3 so that whenever either of those bits is set to 1, the Standard Operation Status summary bit of the Status Byte Register will be set to 1, send the command **`STAT:OPER:ENAB 520`** (512 + 8). The command **`STATus:OPERation:ENABle?`** returns the decimal value of the sum of the bits previously enabled with the **`STATus:OPERation:ENABle <num>`** command.

Data Questionable Status Group

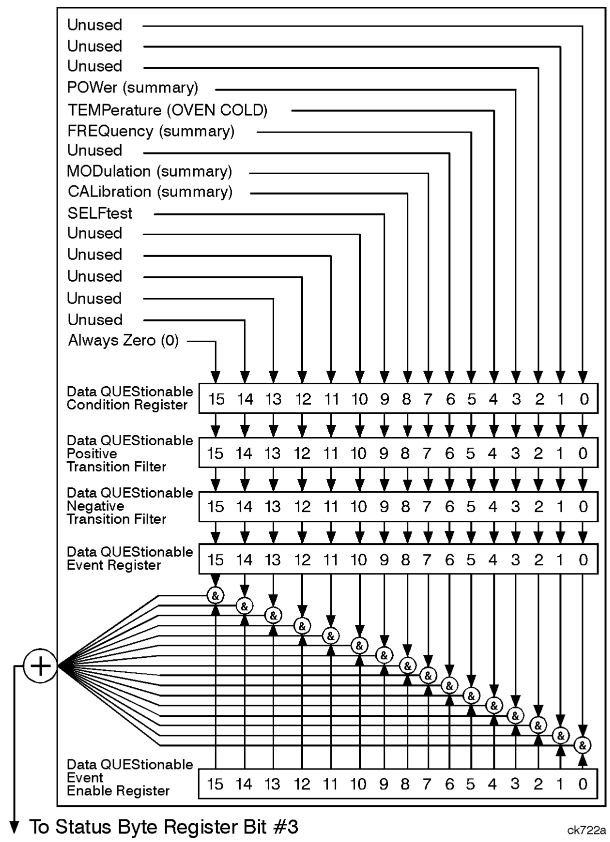
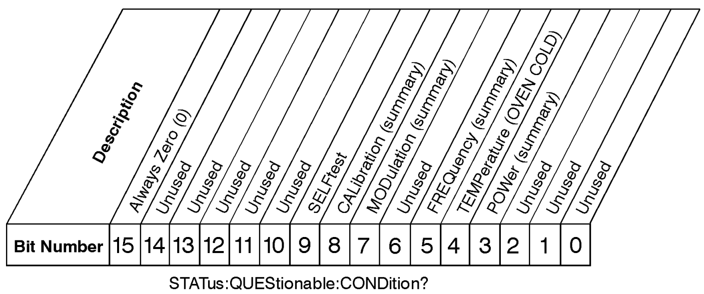


Figure 3-12. The Data Questionable Status Group

The Data Questionable Status Group is used to determine the specific event that set bit 3 in the Status Byte Register. The Data Questionable Status Group consists of the Data Questionable Condition Register, the Data Questionable Negative Transition Filter, the Data Questionable Positive Transition Filter, the Data Questionable Event Register, and the Data Questionable Event Enable Register. The Data Questionable Condition Register contains the following bits:



Data Questionable Condition Register

Bit	Description
0, 1, 2	Unused. These bits are always set to 0.
3	This is a summary bit taken from the QUEStionable:POWer register. A 1 in this bit position indicates that one of the following may have happened: The ALC (Automatic Leveling Control) is unable to maintain a leveled RF output power (i.e., ALC is UNLEVELED), or the reverse power protection circuit has been tripped.
4	A 1 in this bit position indicates that the internal reference oscillator (reference oven) is cold. (Option 1EH only.)

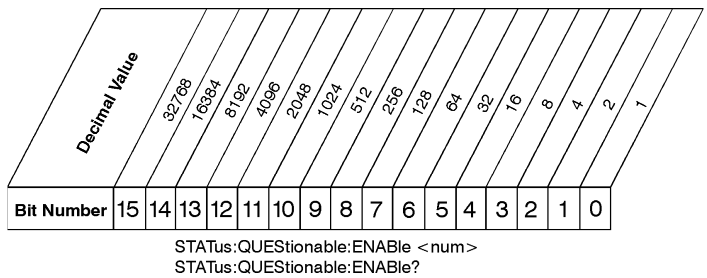
Bit	Description
5	This is a summary bit taken from the QUEStionable:FREQuency register. A 1 in this bit position indicates that one of the following may have happened: synthesizer PPL unlocked, 10 MHz reference VCO PPL unlocked, heterodyned VCO PPL unlocked, or baseband PPL unlocked. See the Data Questionable Frequency Status Group for more information.
6	Unused. This bit is always set to 0.
7	This is a summary bit taken from the QUEStionable:MODulation register. A 1 in this bit position indicates that one of the following may have happened: modulation source 1 underrange, modulation source 1 overrange, modulation source 2 underrange, or modulation source 2 overrange. See the Data Questionable Modulation Status Group for more information.
8	This is a summary bit taken from the QUEStionable:CALibration register. A 1 in this bit position indicates that one of the following may have happened: an error has occurred in the DCFM/DCΦM zero calibration or an error has occurred in the I/Q calibration. See the Data Questionable Calibration Status Group for more information.
9	A 1 in this bit position indicates that a self-test has failed during power-up. This bit can only be cleared by cycling the instrument’s line power. *CLS will not clear this bit.
10, 11, 12, 13, 14	Unused. These bits are always set to 0.

Bit	Description
15	Always Zero (0).

The Data Questionable Condition Register continuously monitors the hardware and firmware status of the instrument. Condition registers are read-only. To query the condition register, send the command **`STATus:QUEStionable:CONDition?`** The response will be the *decimal* sum of the bits which are set to 1. For example, if bit number 9 and bit number 3 are set to 1, the decimal sum of the 2 bits is 512 plus 8. So the decimal value 520 is returned.

The transition filter specifies which types of bit state changes in the condition register will set corresponding bits in the event register. The changes may be positive (from 0 to 1) or negative (from 1 to 0). Send the command **`STATus:QUEStionable:NTRansition <num>`** (negative) or **`STATus:QUEStionable:PTRansition <num>`** (positive) where **`<num>`** is the sum of the decimal values of the bits you want to enable.

The Data Questionable Event Register latches transition events from the condition register as specified by the transition filters. Event registers are destructive read-only. Reading data from an event register will clear the content of that register. To query the event register, send the command **`STATus:QUEStionable[:EVENt]?`**



Data Questionable Event Enable Register ck732a

The Data Questionable Status Group also contains a Data Questionable Event Enable Register. This register lets you choose which bits in the Data Questionable Event Register will set the summary bit (bit 3 of the Status Byte Register) to 1. Send the **`STATus:QUEStionable:ENABle <num>`** command where **`<num>`** is the sum of the decimal values of the bits you want to enable. For example, to enable bit 9 and bit 3 so that whenever either of those bits is set to 1, the Data Questionable Status summary bit of the Status Byte Register will be set to 1, send the command **`STAT:QUES:ENAB 520`** (512 + 8). The command **`STATus:QUEStionable:ENABle?`** returns the decimal value of the sum of the bits previously enabled with the **`STATus:QUEStionable:ENABle <num>`** command.

Data Questionable Power Status Group

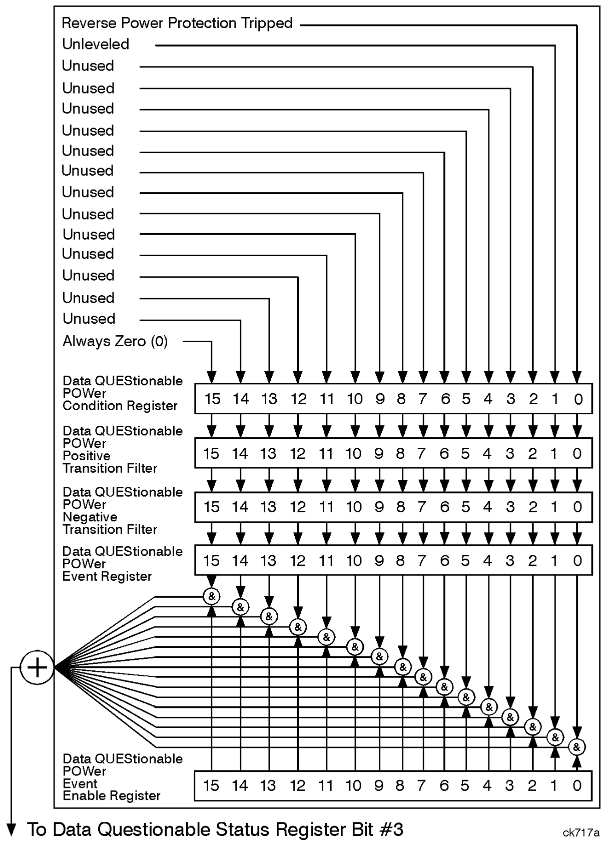
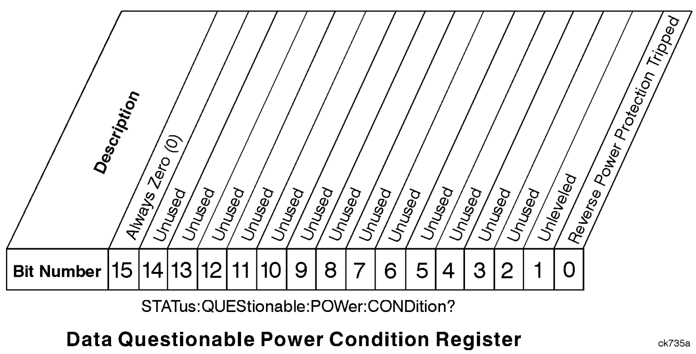


Figure 3-13. The Data Questionable Power Status Group

The Data Questionable Power Status Group is used to determine the specific event that set bit 3 in the Data Questionable Condition Register. The Data Questionable Power Status Group consists of the Data Questionable Power Condition Register, the Data Questionable Power Negative Transition Filter, the Data Questionable Power Positive Transition Filter, the Data Questionable Power Event Register, and the Data Questionable Power Event Enable Register. The Data Questionable Power Condition Register contains the following bits:



Data Questionable Power Condition Register

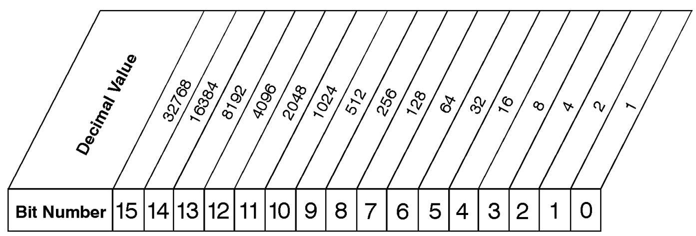
Bit	Description
0	A 1 in this bit indicates that the reverse power protection circuit has been tripped. There is no output in this state. Any conditions which may have caused reverse power should be corrected. After correcting the problem, the RPP circuit may be reset by sending the remote SCPI command statement `:OUTput:PROTection:CLEar` or by pressing the **Reset RPP** softkey on the front panel. In HP 8648 mode, any SCPI command will reset the reverse power protection circuit.

Bit	Description
1	A 1 in this bit indicates that the output leveling loop is unable to set the output power.
2-14	Unused. These bits are always set to 0.
15	Always Zero (0).

The Data Questionable Power Condition Register continuously monitors output power status of the instrument. Condition registers are read-only. To query the condition register, send the command **`STATus:QUEStionable:POWer:CONDition?`** The response will be the *decimal* sum of the bits which are set to 1.

The transition filter specifies which types of bit state changes in the condition register will set corresponding bits in the event register. The changes may be positive (from 0 to 1) or negative (from 1 to 0). Send the command **`STATus:QUEStionable:POWer:NTRansition <num>`** (negative) or **`STATus:QUEStionable:POWer:PTRansition <num>`** (positive) where **`<num>`** is the sum of the decimal values of the bits you want to enable.

The Data Questionable Power Event Register latches transition events from the condition register as specified by the transition filters. Event registers are destructive read-only. Reading data from an event register will clear the content of that register. To query the event register, send the command **`STATus:QUEStionable:POWer[:EVENt]?`**



STATus:QUEStionable:POWer:ENABle <num>
STATus:QUEStionable:POWer:ENABle?

Data Questionable Power Event Enable Register

ck736a

The Data Questionable Power Status Group also contains a Data Questionable Power Event Enable Register. This register lets you choose which bits in the Data Questionable Power Event Register will set the summary bit (bit 3 of the Data Questionable Condition Register) to 1. Send the **`STATus:QUEStionable:POWer:ENABle <num>`** command where **`<num>`** is the sum of the decimal values of the bits you want to enable. For example, to enable bit 9 and bit 3 so that whenever either of those bits is set to 1, the Data Questionable Power summary bit of the Data Questionable Condition Register will be set to 1, send the command **`STAT:QUES:POW:ENAB 520`** (512 + 8). The command **`STATus:QUEStionable:POWer:ENABle?`** returns the decimal value of the sum of the bits previously enabled with the **`STATus:QUEStionable:POWer:ENABle <num>`** command.

Data Questionable Frequency Status Group

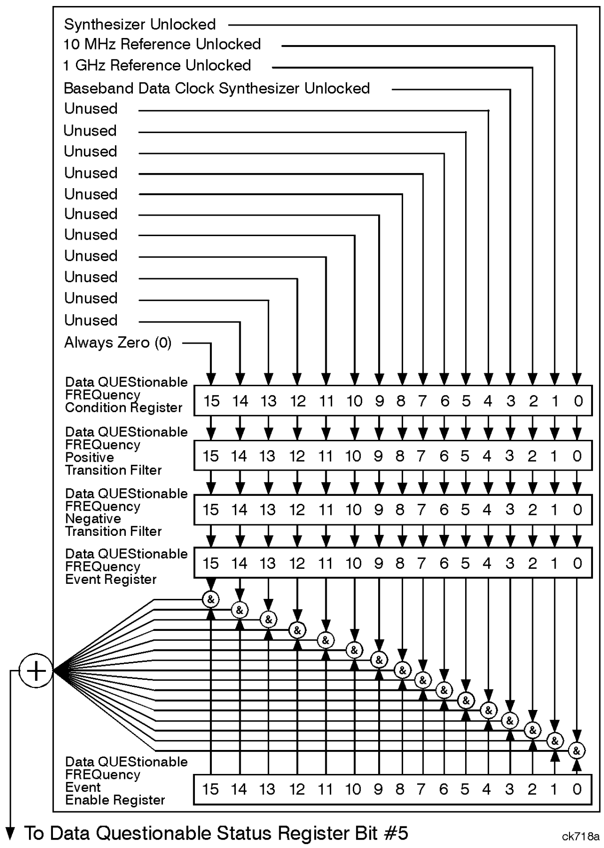
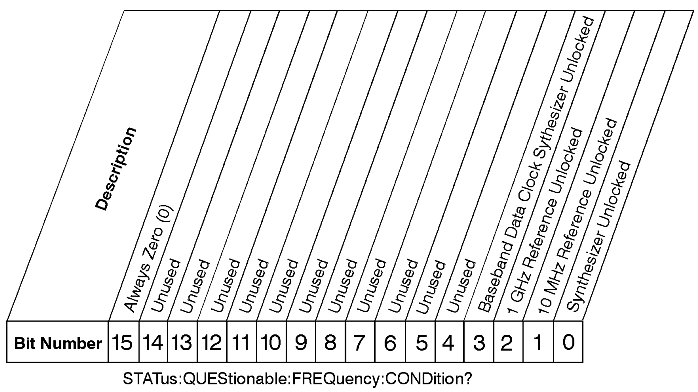


Figure 3-14. Data Questionable Frequency Status Group

The Data Questionable Frequency Status Group is used to determine the specific event that set bit 5 in the Data Questionable Condition Register. The Data Questionable Frequency Status Group consists of the Data Questionable Frequency Condition Register, the Data Questionable Frequency Negative Transition Filter, the Data Questionable Frequency Positive Transition Filter, the Data Questionable Frequency Event Register, and the Data Questionable Frequency Event Enable Register. The Data Questionable Frequency Condition Register contains the following bits:



Data Questionable Frequency Condition Register

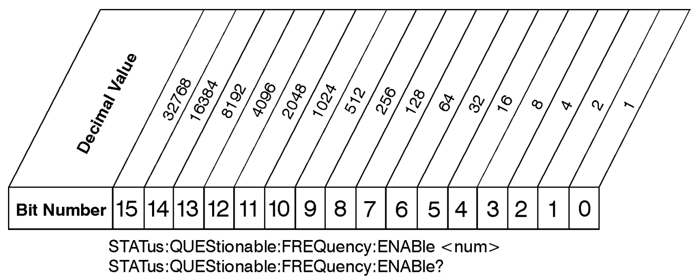
Bit	Description
0	A 1 in this bit indicates that the synthesizer is unlocked.
1	A 1 in this bit indicates that the 10 MHz reference signal is unlocked.

Bit	Description
2	A 1 in this bit indicates that the 1 GHz reference signal is unlocked.
3	A 1 in this bit indicates that the baseband data clock synthesizer is unlocked.
4-14	Unused. These bits are always set to 0.
15	Always Zero (0).

The Data Questionable Frequency Condition Register continuously monitors output frequency status of the instrument. Condition registers are read-only. To query the condition register, send the command **`STATus:QUEStionable:FREQuency:CONDition?`** The response will be the *decimal* sum of the bits which are set to 1.

The transition filter specifies which types of bit state changes in the condition register will set corresponding bits in the event register. The changes may be positive (from 0 to 1) or negative (from 1 to 0). Send the command **`STATus:QUEStionable:FREQuency:NTRansition <num>`** (negative) or **`STATus:QUEStionable:FREQuency:PTRansition <num>`** (positive) where **`<num>`** is the sum of the decimal values of the bits you want to enable.

The Data Questionable Frequency Event Register latches transition events from the condition register as specified by the transition filters. Event registers are destructive read-only. Reading data from an event register will clear the content of that register. To query the event register, send the command **`STATus:QUEStionable:FREQuency[:EVENt]?`**



Data Questionable Frequency Event Enable Register

The Data Questionable Frequency Status Group also contains a Data Questionable Frequency Event Enable Register. This register lets you choose which bits in the Data Questionable Frequency Event Register will set the summary bit (bit 5 of the Data Questionable Condition Register) to 1. Send the **`STATus:QUEStionable:FREQuency:ENABle <num>`** command where **`<num>`** is the sum of the decimal values of the bits you want to enable. For example, to enable bit 9 and bit 3 so that whenever either of those bits is set to 1, the Data Questionable Frequency summary bit of the Data Questionable Condition Register will be set to 1, send the command **`STAT:QUES:FREQ:ENAB 520`** (512 + 8). The command **`STATus:QUEStionable:FREQ:ENABle?`** returns the decimal value of the sum of the bits previously enabled with the **`STATus:QUEStionable:FREQuency:ENABle <num>`** command.

Data Questionable Modulation Status Group

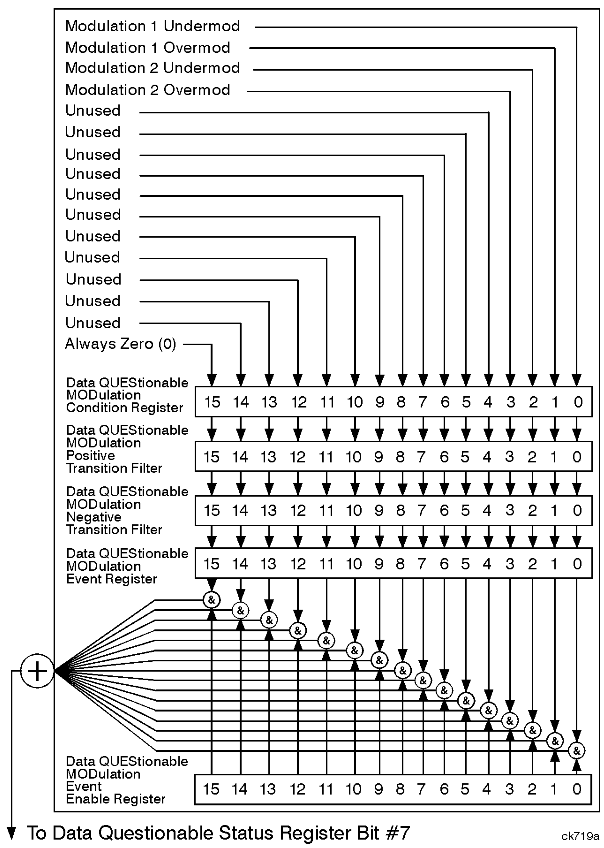
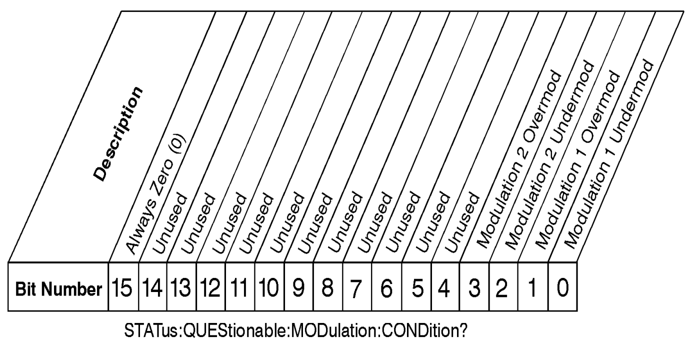


Figure 3-15. Data Questionable Modulation Status Group

The Data Questionable Modulation Status Group is used to determine the specific event that set bit 7 in the Data Questionable Condition Register. The Data Questionable Modulation Status Group consists of the Data Questionable Modulation Condition Register, the Data Questionable Modulation Negative Transition Filter, the Data Questionable Modulation Positive Transition Filter, the Data Questionable Modulation Event Register, and the Data Questionable Modulation Event Enable Register. The Data Questionable Modulation Condition Register contains the following bits:



Data Questionable Modulation Condition Register

ck737a

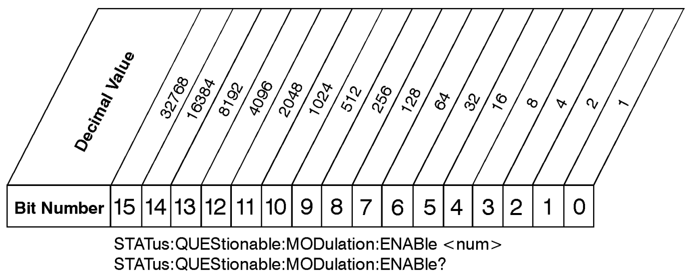
Bit	Description
0	A 1 in this bit indicates that the External 1 input, AC coupling on, is less than 0.97 volts.
1	A 1 in this bit indicates that the External 1 input, AC coupling on, is more than 1.03 volts.
2	A 1 in this bit indicates that the External 2 input, AC coupling on, is less than 0.97 volts.

Bit	Description
3	A 1 in this bit indicates that the External 2 input, AC coupling on, is more than 1.03 volts.
4-14	Unused. These bits are always set to 0.
15	Always Zero (0).

The Data Questionable Modulation Condition Register continuously monitors the modulation status of the instrument. Condition registers are read-only. To query the condition register, send the command **`STATus:QUEStionable:MODulation:CONDition?`** The response will be the *decimal* sum of the bits which are set to 1.

The transition filter specifies which types of bit state changes in the condition register will set corresponding bits in the event register. The changes may be positive (from 0 to 1) or negative (from 1 to 0). Send the command **`STATus:QUEStionable:MODulation:NTRansition <num>`** (negative) or **`STATus:QUEStionable:MODulation:PTRansition <num>`** (positive) where **`<num>`** is the sum of the decimal values of the bits you want to enable.

The Data Questionable Modulation Event Register latches transition events from the condition register as specified by the transition filters. Event registers are destructive read-only. Reading data from an event register will clear the content of that register. To query the event register, send the command **`STATus:QUEStionable:MODulation[:EVENt]?`**



Data Questionable Modulation Event Enable Register ck738a

The Data Questionable Modulation Status Group also contains a Data Questionable Modulation Event Enable Register. This register lets you choose which bits in the Data Questionable Modulation Event Register will set the summary bit (bit 7 of the Data Questionable Condition Register) to 1. Send the **`STATus:QUEStionable:MODulation:ENABle <num>`** command where **`<num>`** is the sum of the decimal values of the bits you want to enable. For example, to enable bit 9 and bit 3 so that whenever either of those bits is set to 1, the Data Questionable Modulation summary bit of the Data Questionable Condition Register will be set to 1, send the command **`STAT:QUES:MOD:ENAB 520`** (512 + 8). The command **`STATus:QUEStionable:MODulation:ENABle?`** returns the decimal value of the sum of the bits previously enabled with the **`STATus:QUEStionable:MODulation:ENABle <num>`** command.

Data Questionable Calibration Status Group

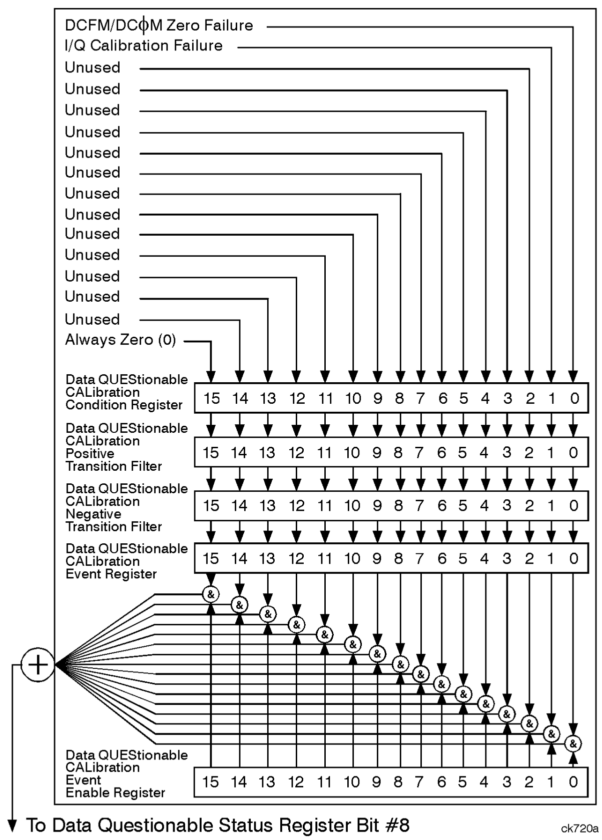
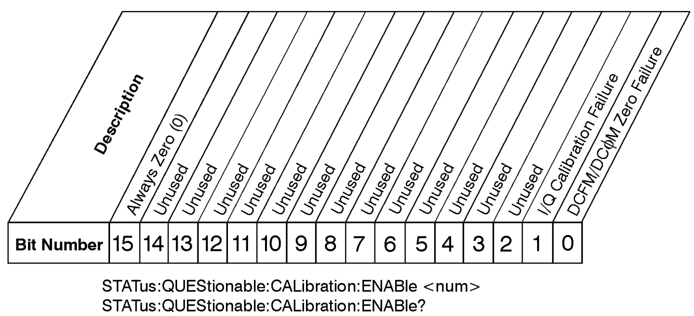


Figure 3-16. Data Questionable Calibration Status Group

The Data Questionable Calibration Status Group is used to determine the specific event that set bit 8 in the Data Questionable Condition Register. The Data Questionable Calibration Status Group consists of the Data Questionable Calibration Condition Register, the Data Questionable Calibration Negative Transition Filter, the Data Questionable Calibration Positive Transition Filter, the Data Questionable Calibration Event Register, and the Data Questionable Calibration Event Enable Register. The Data Questionable Calibration Condition Register contains the following bits:



Data Questionable Calibration Condition Register ck740a

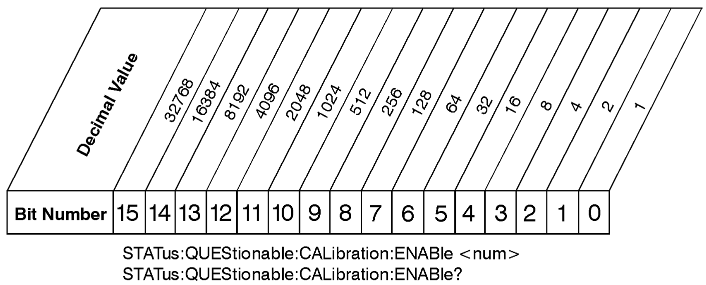
Bit	Description
0	A 1 in this bit indicates that the DCFM/DCΦM zero calibration routine has failed. This is a critical error. The output of the source has no validity until the condition of this bit is 0.
1	A 1 in this bit indicates that the I/Q calibration routine has failed. An I/Q calibration failure does not affect the validity of the source output.
2-14	Unused. These bits are always set to 0.

Bit	Description
15	Always Zero (0).

The Data Questionable Calibration Condition Register continuously monitors the calibration status of the instrument. Condition registers are read-only. To query the condition register, send the command **`STATus:QUEStionable:CALibration:CONDition?`** The response will be the *decimal* sum of the bits which are set to 1.

The transition filter specifies which types of bit state changes in the condition register will set corresponding bits in the event register. The changes may be positive (from 0 to 1) or negative (from 1 to 0). Send the command **`STATus:QUEStionable:CALibration:NTRansition <num>`** (negative) or **`STATus:QUEStionable:CALibration:PTRansition <num>`** (positive) where **`<num>`** is the sum of the decimal values of the bits you want to enable.

The Data Questionable Calibration Event Register latches transition events from the condition register as specified by the transition filters. Event registers are destructive read-only. Reading data from an event register will clear the content of that register. To query the event register, send the command **`STATus:QUEStionable:CALibration[:EVENt]?`**



Data Questionable Calibration Event Enable Register

ck741a

The Data Questionable Calibration Status Group also contains a Data Questionable Calibration Event Enable Register. This register lets you choose which bits in the Data Questionable Calibration Event Register will set the summary bit (bit 8 of the Data Questionable Condition register) to 1. Send the **`STATus:QUEStionable:CALibration:ENABle <num>`** command where **`<num>`** is the sum of the decimal values of the bits you want to enable. For example, to enable bit 9 and bit 3 so that whenever either of those bits is set to 1, the Data Questionable Calibration summary bit of the Data Questionable Condition Register will be set to 1, send the command **`STAT:QUES:CAL:ENAB 520`** (512 + 8). The command **`STATus:QUEStionable:CALIbration:ENABle?`** returns the decimal value of the sum of the bits previously enabled with the **`STATus:QUEStionable:CALibration:ENABle <num>`** command.

4 SCPI Commands

This chapter lists each of the SCPI commands alphabetically, by subsystem.

Command Syntax

Following the heading for each programming command entry is a syntax statement showing the proper syntax for the command. An example syntax statement is shown here:

`POWer[:LEVel] MAXimum|MIN`

Syntax statements read from left to right. In this example, the **`:LEVel`** portion of the statement immediately follows the **`POWer`** portion of the statement with no separating space. A separating space is legal only between the command and its argument. In this example, the portion following the **`[:LEVel]`** portion of the statement is the argument. Additional conventions used in the syntax statements are defined as follows:

- Italics are used to symbolize a program code parameter or query response.
- ::= means “is defined as.”
- | (vertical bar) indicates a choice of one element from a list. For example, <A>|<B> indicates <A> or <B> but not both.
- [ ](square brackets) indicate that the enclosed items are optional.
- Upper-case lettering indicates that the upper-case portion of the command is the minimum required for the command. For example, in the command **`FREQuency`**, **`FREQ`** is the minimum requirement.
- Lower-case lettering indicates that the lower-case portion of the command is optional; it can either be included with the upper-case portion of the command or omitted. For example, in the command **`FREQuency`**, either **`FREQ`**, or **`FREQUENCY`** is correct.
- ? after a subsystem command indicates that the command is a query.

IEEE 488.2 Common Commands

Common commands are generally not measurement related, but are used to manage macros, status registers, synchronization, and data storage. All common commands begin with an asterisk. The common commands are defined by IEEE 488.2

*CLS (Clear Status)

The *CLS command clears the status byte, the data questionable event register, the standard event status register, the standard operation status register and any other registers that are summarized in the status byte.

*ESE (Standard Event Status Enable)

`*ESE <data>`

The *ESE command sets the standard event status enable register.

`*ESE?`

*ESE? queries the status of the standard event status enable register.

*ESR? (Standard Event Status Register)

*ESR? queries the value of the standard event status register. This is a destructive read.

*IDN? (Identification)

The *IDN? query outputs an identifying string to the HP-IB. The response for the signal generator will be “HEWLETT-PACKARD, US36260150,ESG-D400A, A:01.00” where the actual model number, serial number and firmware revision will be substituted.

*OPC (Operation Complete)

The *OPC command sets bit 0 in the standard event status register when all pending operations have finished.

*OPC? (Operation Complete)

*OPC? queries bit 0 in the standard event status register. The signal generator will return an ASCII ‘1’ when all pending operations have finished.

*RCL (Recall)

`*RCL <reg>,<seq>`

The *RCL <reg>,<seq> command recalls the instrument state from the specified memory register <reg> of the specified sequence<seq>. The range of registers <reg> is 0 through 99 and the range of sequences <seq> is 0 through 9.

*RST (Reset)

The *RST command resets the instrument to a factory pre-defined condition.

*SAV (Save)

`*RCL <reg>,<seq>`

The *SAV <reg>,<seq> command saves the instrument state to the specified memory register <reg> of the specified sequence<seq>. The range of registers <reg> is 0 through 99 and the range of sequences <seq> is 0 through 9.

*SRE (Service Request Enable)

`*SRE <data>`

The *SRE command sets the value of the service request enable register.

*SRE? (Service Request Enable Query)

`*SRE <data>`

The *SRE? queries the value of the service request enable register.

*STB? (Read Status Byte)

*STB? queries the status byte. This is a non-destructive read.

*TRG (Trigger)

The *TRG command triggers the device if, and only if, Bus Triggering is the type of trigger event selected. Otherwise, *TRG is ignored.

*TST? (Self-Test)

The *TST? query returns the result of the power-up selftest:

0 - Passed (no tests failed and at least one test passed)
1 - Failed (one or more tests failed)

*WAI (Wait-to-continue)

The *WAI command causes the instrument to wait until all pending commands are completed, before executing any other commands.

Subsystem Commands

Subsystem commands include all measurement functions and some general purpose functions. Subsystem commands are distinguished by the colon used between keywords, as in **`AM:SOURce`**. Each subsystem is a set of commands that roughly corresponds to a functional block of the instrument.

The following sections list the command mnemonics and command queries for each subsystem command. The command mnemonic is always listed first with the command query listed below it. Command queries are always terminated with a "?," making them recognizable.

:AM Subsystem

The amplitude modulation subsystem is used to set the modulation controls and the parameters associated with amplitude modulated signals.

Wideband Amplitude Modulation State

```
:AM:WIDeband:STATe ON|OFF|1|0
```

```
:AM:WIDeband:STATe?
```

External Amplitude Modulation Source Coupling

```
:AM[1]|2:EXTernal[1]|2:COUPling AC|DC
```

```
:AM[1]|2:EXTernal[1]|2:COUPling?
```

Internal Amplitude Modulation Source Rate

```
:AM[1]|2:INTernal[1]:FREQuency <val><unit>
```

```
:AM[1]|2:INTernal:FREQuency?
```

Internal Amplitude Modulation Alternate Frequency

```
:AM[1]|2:INTernal:FREQuency:ALTernate <val><unit>
```

```
:AM[1]|2:INTernal:FREQuency:ALTernate?
```

Internal Amplitude Modulation Alternate Frequency Amplitude

:AM[1]|2:INTernal:FREQuency:ALTernate:AMPLitude:PERCent <val><unit>

:AM[1]|2:INTernal:FREQuency:ALTernate:AMPLitude:PERCent?

Internal Amplitude Modulation Waveform

:AM[1]|2:INTernal[1]:FUNCtion:SHAPe SINE|TRIangle|SQUare|RAMP|NOISe|DUALsine|SWEPtsine

:AM[1]|2:INTernal:FUNCtion:SHAPe?

Internal Amplitude Modulation Sweep Time

:AM[1]|2:INTernal[1]:SWEep:TIME <val><unit>

:AM[1]|2:INTernal:SWEep:TIME?

Internal Amplitude Modulation Sweep Trigger

:AM[1]|2:INTernal[1]:SWEep:TRIGger IMMediate|BUS|EXTernal|KEY

:AM[1]|2:INTernal:SWEep:TRIGger?

Amplitude Modulation Source

:AM[1]|2:SOURce INT[1]|EXT[1]|EXT2

:AM[1]|2:SOURce?

Amplitude Modulation State

:AM[1]|2:STATe ON|OFF|1|0

:AM[1]|2:STATe?

Amplitude Modulation Depth

:AM[1]|2[:DEPTh] <val><unit>

:AM[1]|2[:DEPTh]?

Amplitude Modulation Depth Coupling

:AM[1]|2[:DEPTh]:TRACk ON|OFF|1|0

:AM[1]|2[:DEPTh]:TRACk?

:CALibration Subsystem

The calibration subsystem is used to set the controls and the parameters associated with instrument calibration.

DCFM/DCΦM Calibration

`:CALibration:DCFM`

There is no query for this command.

:COMMunicate Subsystem

The communicate subsystem is used to set the controls and the parameters associated with serial system communication.

GP-IB Address

`:SYSTem:COMMunicate:GPIB:ADDRess <number>`

`:SYSTem:COMMunicate:GPIB:ADDRess?`

RS-232 Baud Rate

`:SYSTem:COMMunicate:SERial:BAUD <number>`

`:SYSTem:COMMunicate:SERial:BAUD?`

RS-232 RTS Control

`:SYSTem:COMMunicate:SERial:CONTrol:RTS ON|OFF|STANdard`

`:SYSTem:COMMunicate:SERial:CONTrol:RTS?`

RS-232 RTS Echo

`:SYSTem:COMMunicate:SERial:ECHO ON|OFF|1|0`

`:SYSTem:COMMunicate:SERial:ECHO?`

RS-232 XON Handshake Receive State

:SYSTem:COMMunicate:SERial:RECeive:PACE XON|NONE

:SYSTem:COMMunicate:SERial:RECeive:PACE?

RS-232 XON Handshake Transmit State

:SYSTem:COMMunicate:SERial:TRANsmit:PACE XON|NONE

:SYSTem:COMMunicate:SERial:TRANsmit:PACE?

RS-232 Reset

:SYSTem:COMMunicate:SERial:RESet

There is no query for this command.

:DIAGnostic Subsystem

The communicate subsystem is used to set the controls and the parameters associated with instrument operational and tracking data.

Attenuator Cycle Information

:DIAGnostic:INFOrmation:CCOunt:ATTenuator?

There is no query for this command.

Power Cycle Information

:DIAGnostic:INFOrmation:CCOunt:PON?

There is no query for this command.

Reverse Power Protection Trips Information

:DIAGnostic:INFOrmation:CCOunt:PROTection?

There is no query for this command.

Display Time-On Information

:DIAGnostic:INFOrmation:DISPlay:OTIMe?

There is no query for this command.

Option Information

`:DIAGnostic:INFOrmation:Options?`

There is no query for this command.

Instrument Time-On Information

`:DIAGnostic:INFOrmation:OTIMe?`

There is no query for this command.

Instrument Serial Number and Firmware Information

`:DIAGnostic:INFOrmation:SDATe?`

There is no query for this command.

:DISPlay Subsystem

The display subsystem is used to set the controls and the parameters associated with the signal source’s LCD display.

Configure Display Brightness

:DISPlay:BRIGhtness <val>

:DISPlay:BRIGhtness?

Configure Display Contrast

:DISPlay:CONTrast <val>

:DISPlay:CONTrast?

Configure Display Inverse Video

:DISPlay:INVerse ON|OFF|1|0

:DISPlay:INVerse?

:FM Subsystem

The frequency modulation subsystem is used to set the modulation controls and the parameters associated with frequency modulated signals.

External Frequency Modulation Source Coupling

```
:FM[1]|2:EXTernal[1]|2:COUPling AC|DC
```

```
:FM[1]|2:EXTernal[1]|2:COUPling?
```

Internal Frequency Modulation Source Rate

```
:FM[1]|2:INTernal[1]:FREQuency <val><unit>
```

```
:FM[1]|2:INTernal:FREQuency?
```

Internal Frequency Modulation Alternate Frequency

```
:FM[1]|2:INTernal[1]:FREQuency:ALTernate <val><unit>
```

```
:FM[1]|2:INTernal:FREQuency:ALTernate?
```

Internal Frequency Modulation Alternate Frequency Amplitude

```
:FM[1]|2:INTernal[1]:FREQuency:ALTernate:AMPLitude:PER
Cent <val><unit>
```

```
:FM[1]|2:INTernal:FREQuency:ALTernate:AMPLitude:PERCen
t?
```

Internal Frequency Modulation Waveform

:FM[1]|2:INTernal[1]:FUNCtion:SHAPe SINE|TRIangle|SQUare|RAMP|NOISe|DUALsine|SWEPtsine

:FM[1]|2:INTernal:FUNCtion:SHAPe?

Internal Frequency Modulation Sweep Time

:FM[1]|2:INTernal[1]:SWEep:TIME <val><unit>

:FM[1]|2:INTernal:SWEep:TIME?

Internal Frequency Modulation Sweep Trigger

:FM[1]|2:INTernal[1]:SWEep:TRIGger IMMediate|BUS|EXTernal|KEY

:FM[1]|2:INTernal:SWEep:TRIGger?

Frequency Modulation Source

:FM[1]|2:SOURce INT[1]:EXT1|EXT2

:FM[1]|2:SOURce?

Frequency Modulation State

:FM[1]|2:STATe ON|OFF|1|0

:FM[1]|2:STATe?

Frequency Modulation Deviation

:FM[1]|2[:DEViation] <val><unit>

:FM[1]|2[:DEViation]?

Frequency Modulation Deviation Coupling

`:FM[1]|2[:DEViation]:TRACk ON|OFF|1|0`

`:FM[1]|2[:DEViation]:TRACk?`

:FREQuency Subsystem

The frequency subsystem is used to set the controls and the parameters associated with carrier signal frequency.

Fixed Frequency

`:FREQuency:FIXed <val><unit>`

`:FREQuency:FIXed?`

Frequency Mode

`:FREQuency:MODE CW|FIXed|LIST`

`:FREQuency:MODE?`

Frequency Multiplier

`:FREQuency:MULTiplier <val>`

`:FREQuency:MULTiplier?`

Frequency Offset

`:FREQuency:OFFSet <val><unit>`

`:FREQuency:OFFSet?`

Frequency Reference

`:FREQuency:REFerence <val>`

`:FREQuency:REFerence?`

Frequency Reference State

`:FREQuency:REFerence:STATe ON|OFF|1|0`

`:FREQuency:REFerence:STATe?`

Start Frequency

`:FREQuency:STARt <val><unit>`

`:FREQuency:STARt?`

Stop Frequency

`:FREQuency:STOP <val><unit>`

`:FREQuency:STOP?`

Frequency Optimization

`:FREQuency:SYNThesis <val>`

`:FREQuency:SYNThesis?`

Continuous Wave Frequency

:FREQuency[:CW] <val><unit>

:FREQuency[:CW]?

:FREQuency:FIXed <val><unit>

:FREQuency:FIXed?

Set Phase Reference

:PHASe:REFerence

There is no query for this command.

Phase Adjustment

:PHASe[:ADJust] <val><unit>

:PHASe[:ADJust]?

Reference Oscillator Source Query

:ROSCillator:SOURce?

There is no query for this command.

:LFOutput Subsystem

The low frequency output subsystem is used to set the controls and the parameters associated with the low frequency output signals.

Low Frequency Output Amplitude

:LFOutput:AMPLitude <val><unit>

:LFOutput:AMPLitude?

Low Frequency Output Frequency

:LFOutput:FUNCtion:FREQuency <val><unit>

:LFOutput:FUNCtion:FREQuency?

Low Frequency Output Alternate Frequency

:LFOutput:FUNCtion:FREQuency:ALTernate <val><unit>

:LFOutput:FUNCtion:FREQuency:ALTernate?

Low Frequency Output Alternate Frequency Amplitude

:LFOutput:FUNCtion:FREQuency:ALTernate:AMPLitude:PERCent <val><unit>

:LFOutput:FUNCtion:FREQuency:ALTernate:AMPLitude:PERCent?

Configure Function Generator Pulse Period

:LFOutput:FUNCtion:PERiod <val><unit>

:LFOutput:FUNCtion:PERiod?

Configure Function Generator Pulse Width

:LFOutput:FUNCtion:PWIDth <val><unit>

:LFOutput:FUNCtion:PWIDth?

Low Frequency Output Waveform

:LFOutput:FUNCtion:SHAPe SINE|DUALsine|SWEPtsine|TRIangle|SQUare|RAMP|PULSe|NOISe|DC

:LFOutput:FUNCtion:SHAPe?

Function Generator Sweep Time

:LFOutput:FUNCtion:SWEep:TIME <val><unit>

:LFOutput:FUNCtion:SWEep:TIME?

Function Generator Sweep Trigger

:LFOutput:FUNCtion:SWEep:TRIGger IMMediate|KEY|EXTernal|BUS

:LFOutput:FUNCtion:SWEep:TRIGger?

Low Frequency Output Source

:LFOutput:SOURce INT[1]|FUNCtion

:LFOutput:SOURce?

Low Frequency Output State

:LFOutput:SOURce:STATe ON|OFF|1|0

:LFOutput:SOURce:STATe?

:LIST Subsystem

The list subsystem is used to set the controls and the parameters associated with list measurements.

List Direction

```
:LIST:DIRection UP|DOWN
```

```
:LIST:DIRection?
```

Dwell List

```
:LIST:DWELl <val>{, <val>}
```

```
:LIST:DWELl?
```

Dwell List Type

```
:LIST:DWELl:TYPE LIST|STEP
```

```
:LIST:DWELl:TYPE?
```

Dwell List Points Query

```
:LIST:DWELl:POINts?
```

There is no query for this command.

Frequency List

:LIST:FREQuency <val>{, <val>}

:LIST:FREQuency?

Frequency List Points Query

:LIST:FREQuency:POINts?

There is no query for this command.

Manual Point

:LIST:MANual <val>

:LIST:MANual?

List Mode

:LIST:MODE AUTO|MANual

:LIST:MODE?

Power List

:LIST:POWer <val>{, <val>}

:LIST:POWer?

Power List Points Query

:LIST:POWer:POINts?

There is no query for this command.

List Trigger Source

:LIST:TRIGger:SOURCe BUS|IMMediate|EXTernal|KEY

:LIST:TRIGger:SOURCe?

List Type

:LIST:TYPE LIST|STEP

:LIST:TYPE?

:MEMory and :MMemory Subsystems

The memory subsystem is used to set the controls and the parameters associated with data and memory allocation.

Binary Memory Catalog

`:MEMory:CATalog:BINary?`

There is no query for this command.

List Memory Catalog

`:MEMory:CATalog:LIST?`

There is no query for this command.

State Memory Catalog

`:MEMory:CATalog:STATe?`

There is no query for this command.

All Memory Catalog

`:MEMory:CATalog[:ALL]?`

There is no query for this command.

`:MMEMory:CATalog[:ALL]? "<file systems>"`

There is no query for this command.

Copy Files

:MEMory:COPY[:NAME]<filename>, <filename>

There is no query for this command.

:MMEMory:COPY <msus>, <msus>

There is no query for this command.

Memory Data Load

:MEMory:DATA <filename>,<datablock>

There is no query for this command.

:MMEMory:DATA <msus>, <datablock>

There is no query for this command.

Memory Filename Query

:MEMory:DATA? <filename>

There is no query for this command.

:MMEMory:DATA? <msus>

There is no query for this command.

Block Pattern RAM

`:MEMory:DATA:PRAM:BLOCK <datablock>`

There is no query for this command.

List Pattern RAM

`:MEMory:DATA:PRAM:LIST <value> [,<value>, <...>]`

There is no query for this command.

Delete All

`:MEMory:DELete:ALL`

There is no query for this command.

Delete Binary

`:MEMory:DELete:BINary`

There is no query for this command.

Delete List

`:MEMory:DELete:LIST`

There is no query for this command.

Delete State

`:MEMory:DELete:STATe`

There is no query for this command.

Delete Filename

:MEMory:DELete[:NAME]<filename>

There is no query for this command.

:MMEMory:DELete[:NAME] <msus>

There is no query for this command.

Free Memory Query

:MEMory:FREE[:ALL]?

There is no query for this command.

Load Sweep List

:MEMory:LOAD:LIST <filename>

There is no query for this command.

:MMEMory:LOAD:LIST <msus>

There is no query for this command.

State Comment

:MEMory:STATe:COMMent <reg_num>,<seq_num>,<comment>

:MEMory:STATe:COMMent? <reg_num>,<seq_num>

Store Sweep List

`:MEMory:STORe:LIST <filename>`

There is no query for this command.

`:MMEMory:STORe:LIST <msus>`

There is no query for this command.

:OUTPut Subsystem

The RF output subsystem is used to set the controls and the parameters associated with the signal generator's RF output.

RF Output Modulation State

:OUTPut:MODulation[:STATe] ON|OFF|1|0

:OUTPut:MODulation[:STATe]?

RF Output Circuit Protection Clear

:OUTPut:PROTection:CLEar

There is no query for this command.

RF Output Circuit Protection Mode

:OUTPut:PROTection:MODE NORMAL|HP8648

:OUTPut:PROTection:MODE?

RF Output Circuit Protection Query

:OUTPut:PROTection:TRIPped?

There is no query for this command.

RF Output State

`:OUTPut[:STATe] ON|OFF|1|0`

`:OUTPut[:STATe]?`

:PM Subsystem

The phase modulation subsystem is used to set the modulation controls and the parameters associated with phase modulated signals.

Configure Φ Modulation Bandwidth

```
:PM[1]|2:BANDwidth|BWID NORMal|HIGH
:PM[1]|2:BANDwidth|BWID?
```

External Φ Modulation Source Coupling

```
:PM[1]|2:EXTernal[1]|2:COUPling AC|DC
:PM[1]|2:EXTernal[1]|2:COUPling?
```

Internal Φ Modulation Source Rate

```
:PM[1]|2:INTernal[1]:FREQuency <val><unit>
:PM[1]|2:INTernal:FREQuency?
```

Internal Φ Modulation Alternate Frequency

```
:PM[1]|2:INTernal[1]:FREQuency:ALTernate <val><unit>
:PM[1]|2:INTernal:FREQuency:ALTernate?
```

Internal Φ Modulation Alternate Frequency Amplitude

```
:PM[1]|2:INTernal[1]:FREQuency:ALTernate:AMPLitude:PERCent <val><unit>
```

```
:PM[1]|2:INTernal:FREQuency:ALTernate:AMPLitude:PERCent?
```

Internal Φ Modulation Waveform

```
:PM[1]|2:INTernal[1]:FUNCtion:SHAPe
SINE|TRIangle|SQUare|RAMP|NOISe|DUALsine|SWEPtsine
```

```
:PM[1]|2:INTernal:FUNCtion:SHAPe?
```

Internal Φ Modulation Sweep Time

```
:PM[1]|2:INTernal[1]:SWEep:TIME <val><unit>
```

```
:PM[1]|2:INTernal:SWEep:TIME?
```

Internal Φ Modulation Sweep Trigger

```
:PM[1]|2:INTernal[1]:SWEep:TRIGger
IMMediate|BUS|EXTernal|KEY
```

```
:PM[1]|2:INTernal:SWEep:TRIGger?
```

Φ Modulation Source

```
:PM[1]|2:SOURce INT[1]:EXT[1]|EXT2
```

```
:PM[1]|2:SOURce?
```

Φ Modulation State

:PM[1]|2:STATe ON|OFF|1|0

:PM[1]|2:STATe?

Φ Modulation Deviation

:PM[1]|2[:DEViation] <val><unit>

:PM[1]|2[:DEViation]?

Φ Modulation Deviation Coupling

:PM[1]|2[:DEViation]:TRACk ON|OFF|1|0

:PM[1]|2[:DEViation]:TRACk?

:POWer Subsystem

The RF power subsystem is used to set the controls and the parameters associated with the signal generator's RF output amplitude.

RF Output Automatic Leveling Circuitry (ALC) Bandwidth

`:POWer:ALC:BANDwidth|BWIDth NORMal|NARRow`

`:POWer:ALC:BANDwidth|BWIDth?`

RF Output Automatic Leveling Circuitry (ALC) Search State

`:POWer:ALC:SEARch ON|OFF|1|0|ONCE`

`:POWer:ALC:SEARch?`

RF Output Automatic Leveling Circuitry (ALC) State

`:POWer:ALC:STATe ON|OFF|1|0`

`:POWer:ALC:STATe?`

Automatic RF Output Level Attenuation

`:POWer:ATTenuation:AUTO  ON|OFF|1|0`

`:POWer:ATTenuation:AUTO?`

RF Output Power Mode

`:POWer:MODE FIXed|LIST`

`:POWer:MODE?`

RF Output Reference Power

`:POWer:REFerence <val><unit>`

`:POWer:REFerence?`

RF Output Reference Power State

`:POWer:REFerence:STATe ON|OFF|1|0`

`:POWer:REFerence:STATe?`

RF Output Start Power

`:POWer:STARt <val><unit>`

`:POWer:STARt?`

RF Output Stop Power

`:POWer:STOP <val><unit>`

`:POWer:STOP?`

RF Output Level Amplitude Offset

`:POWer[:LEVel][:IMMediate]:OFFSet <val><unit>`

`:POWer[:LEVel][:IMMediate]:OFFSet?`

RF Output Level Immediate Amplitude

:POWer[:LEVel][:IMMediate][:AMPLitude] <val><unit>

:POWer[:LEVel][:IMMediate][:AMPLitude]?

:PULM Subsystem

The pulse modulation subsystem is used to set the modulation controls and the parameters associated with pulse modulated signals.

Configure Internal Pulse Waveform

:PULM:INTernal[1]:FUNCtion:SHAPe <enum>

:PULM:INTernal[1]:FUNCtion:SHAPe?

Pulse Modulation Source

:PULM:SOURce INT|EXT2

:PULM:SOURce?

Pulse Modulation State

:PULM:STATe ON|OFF|1|0

:PULM:STATe?

Internal Pulse Modulation Source Rate

:PULM:INTernal[1]:FREQuency <val><unit>

:PULM:INTernal[1]:FREQuency?

Configure Internal Pulse Modulation Pulse Period

```
:PULM:INTernal[1]:PERiod <val><unit>
```

```
:PULM:INTernal[1]:PERiod?
```

Configure Internal Pulse Modulation Pulse Width

```
:PULM:INTernal[1]:PWIDth <val><unit>
```

```
:PULM:INTernal[1]:PWIdth?
```

:STATus Subsystem

The IEEE status subsystem is used to set the controls and the parameters associated with status conditions within the signal generator.

Standard Operation Status Group Condition Register Query

`:STATus:OPERation:CONDition?`

There is no query for this command.

Standard Operation Status Group Enable

`:STATus:OPERation:ENAble <num>`

There is no query for this command.

Standard Operation Status Group Negative Transition Filter Enable

`:STATus:OPERation:NTRansition <num>`

There is no query for this command.

Standard Operation Status Group Positive Transition Filter Enable

`:STATus:OPERation:PTRansition <num>`

There is no query for this command.

Standard Operation Status Group Event Register Query

`:STATus:OPERation[:EVENt]?`

There is no query for this command.

Status Preset

`:STATus:PRESet`

There is no query for this command.

Data Questionable Status Negative Transition Filter Register Enable

`:STATus:QUEStionable:NTRansition <num>`

There is no query for this command.

Data Questionable Condition Positive Transition Filter Register Enable

`:STATus:QUEStionable:PTRansition <num>`

There is no query for this command.

Data Questionable Status Group Event Register Query

`:STATus:QUEStionable[:EVENt]?`

There is no query for this command.

Data Questionable Calibration Status Group Condition Register Query

:STATus:QUEStionable:CALibration:CONDition?

There is no query for this command.

Data Questionable Calibration Status Group Enable

:STATus:QUEStionable:CALibration:ENAble <num>

There is no query for this command.

Data Questionable Calibration Status Negative Transition Filter Register Enable

:STATus:QUEStionable:CALibration:NTRansition <num>

There is no query for this command.

Data Questionable Calibration Status Positive Transition Filter Register Enable

:STATus:QUEStionable:CALibration:PTRansition <num>

There is no query for this command.

Data Questionable Calibration Status Group Event Register Query

:STATus:QUEStionable:CALibration[:EVENt]?

There is no query for this command.

Data Questionable Condition Query

:STATus:QUEStionable:CONDition?

There is no query for this command.

Data Questionable Status Group Enable

:STATus:QUEStionable:ENABle <num>

There is no query for this command.

Data Questionable Frequency Status Group Condition Register Query

:STATus:QUEStionable:FREQuency:CONDition?

There is no query for this command.

Data Questionable Frequency Status Group Enable

:STATus:QUEStionable:FREQuency:ENAble <num>

There is no query for this command.

Data Questionable Frequency Status Negative Transition Filter Register Enable

:STATus:QUEStionable:FREQuency:NTRansition <num>

There is no query for this command.

Data Questionable Frequency Status Positive Transition Filter Register Enable

:STATus:QUEStionable:FREQuency:PTRansition <num>

There is no query for this command.

Data Questionable Frequency Status Group Event Register Query

:STATus:QUEStionable:FREQuency[:EVENt]?

There is no query for this command.

Data Questionable Modulation Status Group Condition Register Query

:STATus:QUEStionable:MODulation:CONDition?

There is no query for this command.

Data Questionable Modulation Status Group Enable

:STATus:QUEStionable:MODulation:ENAble <num>

There is no query for this command.

Data Questionable Modulation Status Negative Transition Filter Register Enable

:STATus:QUEStionable:MODulation:NTRansition <num>

There is no query for this command.

Data Questionable Modulation Status Positive Transition Filter Register Enable

`:STATus:QUEStionable:MODulation:PTRansition`

There is no query for this command.

Data Questionable Modulation Status Group Event Register Query

`:STATus:QUEStionable:MODulation[:EVENt]?`

There is no query for this command.

Data Questionable Power Status Group Condition Register Query

`:STATus:QUEStionable:POWer:CONDition?`

There is no query for this command.

Data Questionable Power Status Group Enable

`:STATus:QUEStionable:POWer:ENAble <num>`

There is no query for this command.

Data Questionable Power Status Negative Transition Filter Register Enable

`:STATus:QUEStionable:POWer:NTRansition <num>`

There is no query for this command.

Data Questionable Power Status Positive Transition Filter Register Enable

:STATus:QUEStionable:POWer:PTRansition

There is no query for this command.

Data Questionable Power Status Group Event Register Query

:STATus:QUEStionable:POWer[:EVENt]?

There is no query for this command.

:SWEep Subsystem

The sweep subsystem is used to set the controls and the parameters associated with swept measurements.

Sweep Dwell

```
:SWEep:DWELl <val>
```

```
:SWEep:DWELl?
```

Sweep Points

```
:SWEep:POINts <val>
```

```
:SWEep:POINts?
```

:SYSTem: Subsystem

The system subsystem is used to set the controls and the parameters associated with overall system communication.

Error Information Query

:SYSTem:ERRor[:NEXT]?

There is no query for this command.

Help Mode

:SYSTem:HELP:MODE SINGle|CONTinuous

:SYSTem:HELP:MODE?

Remote Language

:SYSTem:LANGuage "SCPI"|"COMP"|"NADC"|"PDC"|"PHS"|"HP8648"

:SYSTem:LANGuage?

Power On/Preset Conditions

:SYSTem:PON:TYPE PRESet|LAST

:SYSTem:PON:TYPE?

System Preset

`:SYSTem:PRESet`

There is no query for this command.

Preset Language

`:SYSTem:PRESet:LANGuage`
`"SCPI"|"COMP"|"NADC"|"PDC"|"PHS"|"HP8648"`

`:SYSTem:PRESet:LANGuage?`

PN9 Preset Configuration

`:SYSTem:PRESet:PN9 NORMal|QUICk`

`:SYSTem:PRESet:PN9?`

Preset Type

`:SYSTem:PRESet:TYPE NORMal|USER`

`:SYSTem:PRESet:TYPE?`

Screen Saver Delay

`:SYSTem:SSAVer:DELay <val>`

`:SYSTem:SSAVer:DELay?`

Screen Saver Mode

`:SYSTem:SSAVer:MODE LIGHt|TEXT`

`:SYSTem:SSAVer:MODE?`

Screen Saver State

:SYSTem:SSAVer:STATe ON|OFF|1|0

:SYSTem:SSAVer:STATe?

SCPI Version

:SYSTem:VERSion?

There is no query for this command.

:TRIGger Subsystem

The trigger subsystem is used to set the controls and the parameters associated with triggering a sweep in the signal generator.

Abort

:ABORt

There is no query for this command.

Continuous Sweep

:INITiate:CONTinuous[:ALL] ON|OFF|1|0

:INITiate:CONTinuous[:ALL]?

Single Sweep

:INITiate[:IMMediate][:ALL]

There is no query for this command.

Trigger Output Polarity

:TRIGger:OUTPut:POLarity POSitive|NEGative

:TRIGger:OUTPut:POLarity?

External Trigger On Slope

`:TRIGger[:SEQuence]:SLOPe POSitive|NEGative`

`:TRIGger[:SEQuence]:SLOPe?`

Trigger Source

`:TRIGger[:SEQuence]:SOURce BUS|IMMediate|EXTernal|KEY`

`:TRIGger[:SEQuence]:SOURce?`

Immediate Trigger

`:TRIGger[:SEQuence][:IMMediate]`

There is no query for this command.

4 SCPI Commands

This chapter lists each of the SCPI commands alphabetically, by subsystem.

Command Syntax

Following the heading for each programming command entry is a syntax statement showing the proper syntax for the command. An example syntax statement is shown here:

`POWer[:LEVel] MAXimum|MIN`

Syntax statements read from left to right. In this example, the **`:LEVel`** portion of the statement immediately follows the **`POWer`** portion of the statement with no separating space. A separating space is legal only between the command and its argument. In this example, the portion following the **`[:LEVel]`** portion of the statement is the argument. Additional conventions used in the syntax statements are defined as follows:

- Italics are used to symbolize a program code parameter or query response.
- ::= means "is defined as."
- | (vertical bar) indicates a choice of one element from a list. For example, <A>|<B> indicates <A> or <B> but not both.
- [ ](square brackets) indicate that the enclosed items are optional.
- Upper-case lettering indicates that the upper-case portion of the command is the minimum required for the command. For example, in the command **`FREQuency`**, **`FREQ`** is the minimum requirement.
- Lower-case lettering indicates that the lower-case portion of the command is optional; it can either be included with the upper-case portion of the command or omitted. For example, in the command **`FREQuency`**, either **`FREQ`**, or **`FREQUENCY`** is correct.
- ? after a subsystem command indicates that the command is a query.

IEEE 488.2 Common Commands

Common commands are generally not measurement related, but are used to manage macros, status registers, synchronization, and data storage. All common commands begin with an asterisk. The common commands are defined by IEEE 488.2

*CLS (Clear Status)

The *CLS command clears the status byte, the data questionable event register, the standard event status register, the standard operation status register and any other registers that are summarized in the status byte.

*ESE (Standard Event Status Enable)

`*ESE <data>`

The *ESE command sets the standard event status enable register.

`*ESE?`

*ESE? queries the status of the standard event status enable register.

*ESR? (Standard Event Status Register)

*ESR? queries the value of the standard event status register. This is a destructive read.

*IDN? (Identification)

The *IDN? query outputs an identifying string to the HP-IB. The response for the signal generator will be “HEWLETT-PACKARD, US36260150,ESG-D400A, A:01.00” where the actual model number, serial number and firmware revision will be substituted.

*OPC (Operation Complete)

The *OPC command sets bit 0 in the standard event status register when all pending operations have finished.

*OPC? (Operation Complete)

*OPC? queries bit 0 in the standard event status register. The signal generator will return an ASCII ‘1’ when all pending operations have finished.

*RCL (Recall)

`*RCL <reg>,<seq>`

The *RCL <reg>,<seq> command recalls the instrument state from the specified memory register <reg> of the specified sequence<seq>. The range of registers <reg> is 0 through 99 and the range of sequences <seq> is 0 through 9.

*RST (Reset)

The *RST command resets the instrument to a factory pre-defined condition.

*SAV (Save)

`*RCL <reg>,<seq>`

The *SAV <reg>,<seq> command saves the instrument state to the specified memory register <reg> of the specified sequence<seq>. The range of registers <reg> is 0 through 99 and the range of sequences <seq> is 0 through 9.

*SRE (Service Request Enable)

`*SRE <data>`

The *SRE command sets the value of the service request enable register.

*SRE? (Service Request Enable Query)

`*SRE <data>`

The *SRE? queries the value of the service request enable register.

*STB? (Read Status Byte)

*STB? queries the status byte. This is a non-destructive read.

*TRG (Trigger)

The *TRG command triggers the device if, and only if, Bus Triggering is the type of trigger event selected. Otherwise, *TRG is ignored.

*TST? (Self-Test)

The *TST? query returns the result of the power-up selftest:

0 - Passed (no tests failed and at least one test passed)
1 - Failed (one or more tests failed)

*WAI (Wait-to-continue)

The *WAI command causes the instrument to wait until all pending commands are completed, before executing any other commands.

Subsystem Commands

Subsystem commands include all measurement functions and some general purpose functions. Subsystem commands are distinguished by the colon used between keywords, as in **`AM:SOURce`**. Each subsystem is a set of commands that roughly corresponds to a functional block of the instrument.

The following sections list the command mnemonics and command queries for each subsystem command. The command mnemonic is always listed first with the command query listed below it. Command queries are always terminated with a "?," making them recognizable.

:AM Subsystem

The amplitude modulation subsystem is used to set the modulation controls and the parameters associated with amplitude modulated signals.

Wideband Amplitude Modulation State

```
:AM:WIDeband:STATe ON|OFF|1|0
```

```
:AM:WIDeband:STATe?
```

External Amplitude Modulation Source Coupling

```
:AM[1]|2:EXTernal[1]|2:COUPling AC|DC
```

```
:AM[1]|2:EXTernal[1]|2:COUPling?
```

Internal Amplitude Modulation Source Rate

```
:AM[1]|2:INTernal[1]:FREQuency <val><unit>
```

```
:AM[1]|2:INTernal:FREQuency?
```

Internal Amplitude Modulation Alternate Frequency

```
:AM[1]|2:INTernal:FREQuency:ALTernate <val><unit>
```

```
:AM[1]|2:INTernal:FREQuency:ALTernate?
```

Internal Amplitude Modulation Alternate Frequency Amplitude

:AM[1]|2:INTernal:FREQuency:ALTernate:AMPLitude:PERCent <val><unit>

:AM[1]|2:INTernal:FREQuency:ALTernate:AMPLitude:PERCent?

Internal Amplitude Modulation Waveform

:AM[1]|2:INTernal[1]:FUNCtion:SHAPe SINE|TRIangle|SQUare|RAMP|NOISe|DUALsine|SWEPtsine

:AM[1]|2:INTernal:FUNCtion:SHAPe?

Internal Amplitude Modulation Sweep Time

:AM[1]|2:INTernal[1]:SWEep:TIME <val><unit>

:AM[1]|2:INTernal:SWEep:TIME?

Internal Amplitude Modulation Sweep Trigger

:AM[1]|2:INTernal[1]:SWEep:TRIGger IMMediate|BUS|EXTernal|KEY

:AM[1]|2:INTernal:SWEep:TRIGger?

Amplitude Modulation Source

:AM[1]|2:SOURce INT[1]|EXT[1]|EXT2

:AM[1]|2:SOURce?

Amplitude Modulation State

`:AM[1]|2:STATe ON|OFF|1|0`

`:AM[1]|2:STATe?`

Amplitude Modulation Depth

`:AM[1]|2[:DEPTh] <val><unit>`

`:AM[1]|2[:DEPTh]?`

Amplitude Modulation Depth Coupling

`:AM[1]|2[:DEPTh]:TRACk ON|OFF|1|0`

`:AM[1]|2[:DEPTh]:TRACk?`

:CALibration Subsystem

The calibration subsystem is used to set the controls and the parameters associated with instrument calibration.

DCFM/DCΦM Calibration

`:CALibration:DCFM`

There is no query for this command.

:COMMunicate Subsystem

The communicate subsystem is used to set the controls and the parameters associated with serial system communication.

GP-IB Address

`:SYSTem:COMMunicate:GPIB:ADDRess <number>`

`:SYSTem:COMMunicate:GPIB:ADDRess?`

RS-232 Baud Rate

`:SYSTem:COMMunicate:SERial:BAUD <number>`

`:SYSTem:COMMunicate:SERial:BAUD?`

RS-232 RTS Control

`:SYSTem:COMMunicate:SERial:CONTrol:RTS ON|OFF|STANdard`

`:SYSTem:COMMunicate:SERial:CONTrol:RTS?`

RS-232 RTS Echo

`:SYSTem:COMMunicate:SERial:ECHO ON|OFF|1|0`

`:SYSTem:COMMunicate:SERial:ECHO?`

RS-232 XON Handshake Receive State

:SYSTem:COMMunicate:SERial:RECeive:PACE XON|NONE

:SYSTem:COMMunicate:SERial:RECeive:PACE?

RS-232 XON Handshake Transmit State

:SYSTem:COMMunicate:SERial:TRANsmit:PACE XON|NONE

:SYSTem:COMMunicate:SERial:TRANsmit:PACE?

RS-232 Reset

:SYSTem:COMMunicate:SERial:RESet

There is no query for this command.

:DIAGnostic Subsystem

The communicate subsystem is used to set the controls and the parameters associated with instrument operational and tracking data.

Attenuator Cycle Information

`:DIAGnostic:INFOrmation:CCOunt:ATTenuator?`

There is no query for this command.

Power Cycle Information

`:DIAGnostic:INFOrmation:CCOunt:PON?`

There is no query for this command.

Reverse Power Protection Trips Information

`:DIAGnostic:INFOrmation:CCOunt:PROTection?`

There is no query for this command.

Display Time-On Information

`:DIAGnostic:INFOrmation:DISPlay:OTIMe?`

There is no query for this command.

Option Information

`:DIAGnostic:INFOrmation:Options?`

There is no query for this command.

Instrument Time-On Information

`:DIAGnostic:INFOrmation:OTIMe?`

There is no query for this command.

Instrument Serial Number and Firmware Information

`:DIAGnostic:INFOrmation:SDATe?`

There is no query for this command.

:DISPlay Subsystem

The display subsystem is used to set the controls and the parameters associated with the signal source's LCD display.

Configure Display Brightness

`:DISPlay:BRIGhtness <val>`

`:DISPlay:BRIGhtness?`

Configure Display Contrast

`:DISPlay:CONTrast <val>`

`:DISPlay:CONTrast?`

Configure Display Inverse Video

`:DISPlay:INVerse ON|OFF|1|0`

`:DISPlay:INVerse?`

:FM Subsystem

The frequency modulation subsystem is used to set the modulation controls and the parameters associated with frequency modulated signals.

External Frequency Modulation Source Coupling

:FM[1]|2:EXTernal[1]|2:COUPling AC|DC

:FM[1]|2:EXTernal[1]|2:COUPling?

Internal Frequency Modulation Source Rate

:FM[1]|2:INTernal[1]:FREQuency <val><unit>

:FM[1]|2:INTernal:FREQuency?

Internal Frequency Modulation Alternate Frequency

:FM[1]|2:INTernal[1]:FREQuency:ALTernate <val><unit>

:FM[1]|2:INTernal:FREQuency:ALTernate?

Internal Frequency Modulation Alternate Frequency Amplitude

:FM[1]|2:INTernal[1]:FREQuency:ALTernate:AMPLitude:PERCent <val><unit>

:FM[1]|2:INTernal:FREQuency:ALTernate:AMPLitude:PERCent?

Internal Frequency Modulation Waveform

```
:FM[1]|2:INTernal[1]:FUNCtion:SHAPe
SINE|TRIangle|SQUare|RAMP|NOISe|DUALsine|SWEPtsine
```

```
:FM[1]|2:INTernal:FUNCtion:SHAPe?
```

Internal Frequency Modulation Sweep Time

```
:FM[1]|2:INTernal[1]:SWEep:TIME <val><unit>
```

```
:FM[1]|2:INTernal:SWEep:TIME?
```

Internal Frequency Modulation Sweep Trigger

```
:FM[1]|2:INTernal[1]:SWEep:TRIGger
IMMediate|BUS|EXTernal|KEY
```

```
:FM[1]|2:INTernal:SWEep:TRIGger?
```

Frequency Modulation Source

```
:FM[1]|2:SOURce INT[1]:EXT1|EXT2
```

```
:FM[1]|2:SOURce?
```

Frequency Modulation State

```
:FM[1]|2:STATe ON|OFF|1|0
```

```
:FM[1]|2:STATe?
```

Frequency Modulation Deviation

```
:FM[1]|2[:DEViation] <val><unit>
```

```
:FM[1]|2[:DEViation]?
```

Frequency Modulation Deviation Coupling

:FM[1]|2[:DEViation]:TRACk ON|OFF|1|0

:FM[1]|2[:DEViation]:TRACk?

:FREQuency Subsystem

The frequency subsystem is used to set the controls and the parameters associated with carrier signal frequency.

Fixed Frequency

:FREQuency:FIXed <val><unit>

:FREQuency:FIXed?

Frequency Mode

:FREQuency:MODE CW|FIXed|LIST

:FREQuency:MODE?

Frequency Multiplier

:FREQuency:MULTiplier <val>

:FREQuency:MULTiplier?

Frequency Offset

:FREQuency:OFFSet <val><unit>

:FREQuency:OFFSet?

Frequency Reference

`:FREQuency:REFerence <val>`

`:FREQuency:REFerence?`

Frequency Reference State

`:FREQuency:REFerence:STATe ON|OFF|1|0`

`:FREQuency:REFerence:STATe?`

Start Frequency

`:FREQuency:STARt <val><unit>`

`:FREQuency:STARt?`

Stop Frequency

`:FREQuency:STOP <val><unit>`

`:FREQuency:STOP?`

Frequency Optimization

`:FREQuency:SYNThesis <val>`

`:FREQuency:SYNThesis?`

Continuous Wave Frequency

:FREQuency[:CW] <val><unit>

:FREQuency[:CW]?

:FREQuency:FIXed <val><unit>

:FREQuency:FIXed?

Set Phase Reference

:PHASe:REFerence

There is no query for this command.

Phase Adjustment

:PHASe[:ADJust] <val><unit>

:PHASe[:ADJust]?

Reference Oscillator Source Query

:ROSCillator:SOURce?

There is no query for this command.

:LFOutput Subsystem

The low frequency output subsystem is used to set the controls and the parameters associated with the low frequency output signals.

Low Frequency Output Amplitude

`:LFOutput:AMPLitude <val><unit>`

`:LFOutput:AMPLitude?`

Low Frequency Output Frequency

`:LFOutput:FUNCtion:FREQuency <val><unit>`

`:LFOutput:FUNCtion:FREQuency?`

Low Frequency Output Alternate Frequency

`:LFOutput:FUNCtion:FREQuency:ALTernate <val><unit>`

`:LFOutput:FUNCtion:FREQuency:ALTernate?`

Low Frequency Output Alternate Frequency Amplitude

`:LFOutput:FUNCtion:FREQuency:ALTernate:AMPLitude:PERCent <val><unit>`

`:LFOutput:FUNCtion:FREQuency:ALTernate:AMPLitude:PERCent?`

Configure Function Generator Pulse Period

:LFOutput:FUNCtion:PERiod <val><unit>

:LFOutput:FUNCtion:PERiod?

Configure Function Generator Pulse Width

:LFOutput:FUNCtion:PWIDth <val><unit>

:LFOutput:FUNCtion:PWIDth?

Low Frequency Output Waveform

:LFOutput:FUNCtion:SHAPe SINE|DUALsine|SWEPtsine|TRIangle|SQUare|RAMP|PULSe|NOISe|DC

:LFOutput:FUNCtion:SHAPe?

Function Generator Sweep Time

:LFOutput:FUNCtion:SWEep:TIME <val><unit>

:LFOutput:FUNCtion:SWEep:TIME?

Function Generator Sweep Trigger

:LFOutput:FUNCtion:SWEep:TRIGger IMMediate|KEY|EXTernal|BUS

:LFOutput:FUNCtion:SWEep:TRIGger?

Low Frequency Output Source

:LFOutput:SOURce INT[1]|FUNCtion

:LFOutput:SOURce?

Low Frequency Output State

:LFOutput:SOURce:STATe ON|OFF|1|0

:LFOutput:SOURce:STATe?

:LIST Subsystem

The list subsystem is used to set the controls and the parameters associated with list measurements.

List Direction

`:LIST:DIRection UP|DOWN`

`:LIST:DIRection?`

Dwell List

`:LIST:DWELl <val>{, <val>}`

`:LIST:DWELl?`

Dwell List Type

`:LIST:DWELl:TYPE LIST|STEP`

`:LIST:DWELl:TYPE?`

Dwell List Points Query

`:LIST:DWELl:POINts?`

There is no query for this command.

Frequency List

:LIST:FREQuency <val>{, <val>}

:LIST:FREQuency?

Frequency List Points Query

:LIST:FREQuency:POINts?

There is no query for this command.

Manual Point

:LIST:MANual <val>

:LIST:MANual?

List Mode

:LIST:MODE AUTO|MANual

:LIST:MODE?

Power List

:LIST:POWer <val>{, <val>}

:LIST:POWer?

Power List Points Query

:LIST:POWer:POINts?

There is no query for this command.

List Trigger Source

:LIST:TRIGger:SOURCe BUS|IMMediate|EXTernal|KEY

:LIST:TRIGger:SOURCe?

List Type

:LIST:TYPE LIST|STEP

:LIST:TYPE?

:MEMory and :MMemory Subsystems

The memory subsystem is used to set the controls and the parameters associated with data and memory allocation.

Binary Memory Catalog

`:MEMory:CATalog:BINary?`

There is no query for this command.

List Memory Catalog

`:MEMory:CATalog:LIST?`

There is no query for this command.

State Memory Catalog

`:MEMory:CATalog:STATe?`

There is no query for this command.

All Memory Catalog

`:MEMory:CATalog[:ALL]?`

There is no query for this command.

`:MMEMory:CATalog[:ALL]? “<file systems>”`

There is no query for this command.

Copy Files

`:MEMory:COPY[:NAME]<filename>, <filename>`

There is no query for this command.

`:MMEMory:COPY <msus>, <msus>`

There is no query for this command.

Memory Data Load

`:MEMory:DATA <filename>,<datablock>`

There is no query for this command.

`:MMEMory:DATA <msus>, <datablock>`

There is no query for this command.

Memory Filename Query

`:MEMory:DATA? <filename>`

There is no query for this command.

`:MMEMory:DATA? <msus>`

There is no query for this command.

Block Pattern RAM

`:MEMory:DATA:PRAM:BLOCK <datablock>`

There is no query for this command.

List Pattern RAM

`:MEMory:DATA:PRAM:LIST <value> [,<value>, <...>]`

There is no query for this command.

Delete All

`:MEMory:DELete:ALL`

There is no query for this command.

Delete Binary

`:MEMory:DELete:BINary`

There is no query for this command.

Delete List

`:MEMory:DELete:LIST`

There is no query for this command.

Delete State

`:MEMory:DELete:STATe`

There is no query for this command.

Delete Filename

:MEMory:DELete[:NAME]<filename>

There is no query for this command.

:MMEMory:DELete[:NAME] <msus>

There is no query for this command.

Free Memory Query

:MEMory:FREE[:ALL]?

There is no query for this command.

Load Sweep List

:MEMory:LOAD:LIST <filename>

There is no query for this command.

:MMEMory:LOAD:LIST <msus>

There is no query for this command.

State Comment

:MEMory:STATe:COMMent <reg_num>,<seq_num>,<comment>

:MEMory:STATe:COMMent? <reg_num>,<seq_num>

Store Sweep List

`:MEMory:STORe:LIST <filename>`

There is no query for this command.

`:MMEMory:STORe:LIST <msus>`

There is no query for this command.

:OUTPut Subsystem

The RF output subsystem is used to set the controls and the parameters associated with the signal generator's RF output.

RF Output Modulation State

:OUTPut:MODulation[:STATe] ON|OFF|1|0

:OUTPut:MODulation[:STATe]?

RF Output Circuit Protection Clear

:OUTPut:PROTection:CLEar

There is no query for this command.

RF Output Circuit Protection Mode

:OUTPut:PROTection:MODE NORMAL|HP8648

:OUTPut:PROTection:MODE?

RF Output Circuit Protection Query

:OUTPut:PROTection:TRIPped?

There is no query for this command.

RF Output State

:OUTPut[:STATe] ON|OFF|1|0

:OUTPut[:STATe]?

:PM Subsystem

The phase modulation subsystem is used to set the modulation controls and the parameters associated with phase modulated signals.

Configure Φ Modulation Bandwidth

```
:PM[1]|2:BANDwidth|BWID NORMal|HIGH
:PM[1]|2:BANDwidth|BWID?
```

External Φ Modulation Source Coupling

```
:PM[1]|2:EXTernal[1]|2:COUPling AC|DC
:PM[1]|2:EXTernal[1]|2:COUPling?
```

Internal Φ Modulation Source Rate

```
:PM[1]|2:INTernal[1]:FREQuency <val><unit>
:PM[1]|2:INTernal:FREQuency?
```

Internal Φ Modulation Alternate Frequency

```
:PM[1]|2:INTernal[1]:FREQuency:ALTernate <val><unit>
:PM[1]|2:INTernal:FREQuency:ALTernate?
```

Internal Φ Modulation Alternate Frequency Amplitude

```
:PM[1]|2:INTernal[1]:FREQuency:ALTernate:AMPLitude:PER
Cent <val><unit>
```

```
:PM[1]|2:INTernal:FREQuency:ALTernate:AMPLitude:P
ERCent?
```

Internal Φ Modulation Waveform

```
:PM[1]|2:INTernal[1]:FUNCtion:SHAPe
SINE|TRIangle|SQUare|RAMP|NOISe|DUALsine|SWEPtsine
```

```
:PM[1]|2:INTernal:FUNCtion:SHAPe?
```

Internal Φ Modulation Sweep Time

```
:PM[1]|2:INTernal[1]:SWEep:TIME <val><unit>
```

```
:PM[1]|2:INTernal:SWEep:TIME?
```

Internal Φ Modulation Sweep Trigger

```
:PM[1]|2:INTernal[1]:SWEep:TRIGger
IMMediate|BUS|EXTernal|KEY
```

```
:PM[1]|2:INTernal:SWEep:TRIGger?
```

Φ Modulation Source

```
:PM[1]|2:SOURce INT[1]:EXT[1]|EXT2
```

```
:PM[1]|2:SOURce?
```

Φ Modulation State

```
:PM[1]|2:STATe ON|OFF|1|0
```

```
:PM[1]|2:STATe?
```

Φ Modulation Deviation

```
:PM[1]|2[:DEViation] <val><unit>
```

```
:PM[1]|2[:DEViation]?
```

Φ Modulation Deviation Coupling

```
:PM[1]|2[:DEViation]:TRACk ON|OFF|1|0
```

```
:PM[1]|2[:DEViation]:TRACk?
```

:POWer Subsystem

The RF power subsystem is used to set the controls and the parameters associated with the signal generator’s RF output amplitude.

RF Output Automatic Leveling Circuitry (ALC) Bandwidth

`:POWer:ALC:BANDwidth|BWIDth NORMal|NARRow`

`:POWer:ALC:BANDwidth|BWIDth?`

RF Output Automatic Leveling Circuitry (ALC) Search State

`:POWer:ALC:SEARch ON|OFF|1|0|ONCE`

`:POWer:ALC:SEARch?`

RF Output Automatic Leveling Circuitry (ALC) State

`:POWer:ALC:STATe ON|OFF|1|0`

`:POWer:ALC:STATe?`

Automatic RF Output Level Attenuation

`:POWer:ATTenuation:AUTO  ON|OFF|1|0`

`:POWer:ATTenuation:AUTO?`

RF Output Power Mode

`:POWer:MODE FIXed|LIST`

`:POWer:MODE?`

RF Output Reference Power

`:POWer:REFerence <val><unit>`

`:POWer:REFerence?`

RF Output Reference Power State

`:POWer:REFerence:STATe ON|OFF|1|0`

`:POWer:REFerence:STATe?`

RF Output Start Power

`:POWer:STARt <val><unit>`

`:POWer:STARt?`

RF Output Stop Power

`:POWer:STOP <val><unit>`

`:POWer:STOP?`

RF Output Level Amplitude Offset

`:POWer[:LEVel][:IMMediate]:OFFSet <val><unit>`

`:POWer[:LEVel][:IMMediate]:OFFSet?`

RF Output Level Immediate Amplitude

`:POWer[:LEVel][:IMMediate][:AMPLitude] <val><unit>`

`:POWer[:LEVel][:IMMediate][:AMPLitude]?`

:PULM Subsystem

The pulse modulation subsystem is used to set the modulation controls and the parameters associated with pulse modulated signals.

Configure Internal Pulse Waveform

:PULM:INTernal[1]:FUNCtion:SHAPe <enum>

:PULM:INTernal[1]:FUNCtion:SHAPe?

Pulse Modulation Source

:PULM:SOURce INT|EXT2

:PULM:SOURce?

Pulse Modulation State

:PULM:STATe ON|OFF|1|0

:PULM:STATe?

Internal Pulse Modulation Source Rate

:PULM:INTernal[1]:FREQuency <val><unit>

:PULM:INTernal[1]:FREQuency?

Configure Internal Pulse Modulation Pulse Period

`:PULM:INTernal[1]:PERiod <val><unit>`

`:PULM:INTernal[1]:PERiod?`

Configure Internal Pulse Modulation Pulse Width

`:PULM:INTernal[1]:PWIDth <val><unit>`

`:PULM:INTernal[1]:PWIdth?`

:STATus Subsystem

The IEEE status subsystem is used to set the controls and the parameters associated with status conditions within the signal generator.

Standard Operation Status Group Condition Register Query

`:STATus:OPERation:CONDition?`

There is no query for this command.

Standard Operation Status Group Enable

`:STATus:OPERation:ENAble <num>`

There is no query for this command.

Standard Operation Status Group Negative Transition Filter Enable

`:STATus:OPERation:NTRansition <num>`

There is no query for this command.

Standard Operation Status Group Positive Transition Filter Enable

`:STATus:OPERation:PTRansition <num>`

There is no query for this command.

Standard Operation Status Group Event Register Query

`:STATus:OPERation[:EVENt]?`

There is no query for this command.

Status Preset

`:STATus:PRESet`

There is no query for this command.

Data Questionable Status Negative Transition Filter Register Enable

`:STATus:QUEStionable:NTRansition <num>`

There is no query for this command.

Data Questionable Condition Positive Transition Filter Register Enable

`:STATus:QUEStionable:PTRansition <num>`

There is no query for this command.

Data Questionable Status Group Event Register Query

`:STATus:QUEStionable[:EVENt]?`

There is no query for this command.

Data Questionable Calibration Status Group Condition Register Query

:STATus:QUEStionable:CALibration:CONDition?

There is no query for this command.

Data Questionable Calibration Status Group Enable

:STATus:QUEStionable:CALibration:ENAble <num>

There is no query for this command.

Data Questionable Calibration Status Negative Transition Filter Register Enable

:STATus:QUEStionable:CALibration:NTRansition <num>

There is no query for this command.

Data Questionable Calibration Status Positive Transition Filter Register Enable

:STATus:QUEStionable:CALibration:PTRansition <num>

There is no query for this command.

Data Questionable Calibration Status Group Event Register Query

:STATus:QUEStionable:CALibration[:EVENt]?

There is no query for this command.

Data Questionable Condition Query

:STATus:QUEStionable:CONDition?

There is no query for this command.

Data Questionable Status Group Enable

:STATus:QUEStionable:ENABle <num>

There is no query for this command.

Data Questionable Frequency Status Group Condition Register Query

:STATus:QUEStionable:FREQuency:CONDition?

There is no query for this command.

Data Questionable Frequency Status Group Enable

:STATus:QUEStionable:FREQuency:ENAble <num>

There is no query for this command.

Data Questionable Frequency Status Negative Transition Filter Register Enable

:STATus:QUEStionable:FREQuency:NTRansition <num>

There is no query for this command.

Data Questionable Frequency Status Positive Transition Filter Register Enable

`:STATus:QUEStionable:FREQuency:PTRansition <num>`

There is no query for this command.

Data Questionable Frequency Status Group Event Register Query

`:STATus:QUEStionable:FREQuency[:EVENt]?`

There is no query for this command.

Data Questionable Modulation Status Group Condition Register Query

`:STATus:QUEStionable:MODulation:CONDition?`

There is no query for this command.

Data Questionable Modulation Status Group Enable

`:STATus:QUEStionable:MODulation:ENAble <num>`

There is no query for this command.

Data Questionable Modulation Status Negative Transition Filter Register Enable

`:STATus:QUEStionable:MODulation:NTRansition <num>`

There is no query for this command.

Data Questionable Modulation Status Positive Transition Filter Register Enable

:STATus:QUEStionable:MODulation:PTRansition

There is no query for this command.

Data Questionable Modulation Status Group Event Register Query

:STATus:QUEStionable:MODulation[:EVENt]?

There is no query for this command.

Data Questionable Power Status Group Condition Register Query

:STATus:QUEStionable:POWer:CONDition?

There is no query for this command.

Data Questionable Power Status Group Enable

:STATus:QUEStionable:POWer:ENAble <num>

There is no query for this command.

Data Questionable Power Status Negative Transition Filter Register Enable

:STATus:QUEStionable:POWer:NTRansition <num>

There is no query for this command.

Data Questionable Power Status Positive Transition Filter Register Enable

:STATus:QUEStionable:POWer:PTRansition

There is no query for this command.

Data Questionable Power Status Group Event Register Query

:STATus:QUEStionable:POWer[:EVENt]?

There is no query for this command.

:SWEep Subsystem

The sweep subsystem is used to set the controls and the parameters associated with swept measurements.

Sweep Dwell

`:SWEep:DWELl <val>`

`:SWEep:DWELl?`

Sweep Points

`:SWEep:POINts <val>`

`:SWEep:POINts?`

:SYSTem: Subsystem

The system subsystem is used to set the controls and the parameters associated with overall system communication.

Error Information Query

`:SYSTem:ERRor[:NEXT]?`

There is no query for this command.

Help Mode

`:SYSTem:HELP:MODE SINGle|CONTinuous`

`:SYSTem:HELP:MODE?`

Remote Language

`:SYSTem:LANGuage "SCPI"|"COMP"|"NADC"|"PDC"|"PHS"|"HP8648"`

`:SYSTem:LANGuage?`

Power On/Preset Conditions

`:SYSTem:PON:TYPE PRESet|LAST`

`:SYSTem:PON:TYPE?`

System Preset

`:SYSTem:PRESet`

There is no query for this command.

Preset Language

`:SYSTem:PRESet:LANGuage "SCPI"|"COMP"|"NADC"|"PDC"|"PHS"|"HP8648"`

`:SYSTem:PRESet:LANGuage?`

PN9 Preset Configuration

`:SYSTem:PRESet:PN9 NORMal|QUICk`

`:SYSTem:PRESet:PN9?`

Preset Type

`:SYSTem:PRESet:TYPE NORMal|USER`

`:SYSTem:PRESet:TYPE?`

Screen Saver Delay

`:SYSTem:SSAVer:DELay <val>`

`:SYSTem:SSAVer:DELay?`

Screen Saver Mode

`:SYSTem:SSAVer:MODE LIGHt|TEXT`

`:SYSTem:SSAVer:MODE?`

Screen Saver State

:SYSTem:SSAVer:STATe ON|OFF|1|0

:SYSTem:SSAVer:STATe?

SCPI Version

:SYSTem:VERSion?

There is no query for this command.

:TRIGger Subsystem

The trigger subsystem is used to set the controls and the parameters associated with triggering a sweep in the signal generator.

Abort

:ABORt

There is no query for this command.

Continuous Sweep

:INITiate:CONTinuous[:ALL] ON|OFF|1|0

:INITiate:CONTinuous[:ALL]?

Single Sweep

:INITiate[:IMMediate][:ALL]

There is no query for this command.

Trigger Output Polarity

:TRIGger:OUTPut:POLarity POSitive|NEGative

:TRIGger:OUTPut:POLarity?

External Trigger On Slope

:TRIGger[:SEQuence]:SLOPe POSitive|NEGative

:TRIGger[:SEQuence]:SLOPe?

Trigger Source

:TRIGger[:SEQuence]:SOURce BUS|IMMediate|EXTernal|KEY

:TRIGger[:SEQuence]:SOURce?

Immediate Trigger

:TRIGger[:SEQuence][:IMMediate]

There is no query for this command.

5 Error Messages

This chapter explains the error messages that might be shown on the front panel display or transmitted over the interface bus.

Error Messages

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

The Front Panel Error Queue

This queue is designed in a circular (rotating) fashion. It can hold up to 30 error messages. If the queue is full, and additional error messages arrive, the oldest errors are lost. The previously read messages are not cleared from the queue; they remain in the queue until they are overwritten by a new error message.

The front panel error queue information can be accessed by pressing **Utility**, **Error Info**. From the Error Info menu, you may choose from **View Previous Error Message**, **View Next Error Message**, or **Clear Error Queue(s)**. You can also use the RPG and the arrow keys to review the messages/

If there are any unviewed messages in the front panel error queue, the **ERR** annunciator will be activated on the signal generator's display. you can optionally rotate the RPG or use the arrow keys to view the error messages. To empty the queue, press **Utility**, **Error Info, Clear Error Queue(s).**

There are some special error types called permanent errors. These include **`unlock`**, **`ovencold`**, **`hi/lo`**, etc. Permanent errors remain in the error queues until the error condition is cleared. Pressing **Utility**, **Error Info, Clear Error Queue(s)** will empty the front panel error queue, but the permanent errors will be re-reported if the error condition(s) still exist.

The SCPI Remote Interface Error Queue

This queue is constructed in a linear first-in/first-out fashion. It can hold up to 30 error messages. As errors and events are detected, they are placed in the queue. Unlike the front panel error queue, errors in this queue are not overwritten by the latest incoming error messages. If the queue overflows, the last error in the queue is replaced with the error:

`-350,Queue overflow`

When the queue overflows, the least recent errors remain in the queue, and the most recent error is discarded. Reading an error from the head of the queue removes that error from the queue, and opens a position in the tail of the queue for a new error, if one is subsequently detected.

When all the errors have been read from the queue, further error queries will return:

`0,No error`

The SCPI query **`SYSTem:ERRor?`** is used to view messages in the SCPI error queue. The error queue will be cleared when any of the following occur (IEEE 488.2, section 11.4.3.4):

- Upon power up
- Upon receipt of a **`*CLS`** command
- Upon reading the last item from the queue

In the SCPI error queue, the permanent errors are re-reported after the message **`0, No error`** is read using the **`SYSTem:ERRor?`** query and after the **`*CLS`** command is executed.

Querying the Error Queue

The queue query message is a request for the next entry from the instrument's error queue. This queue contains an integer that can range from −32768 to 32767. Negative error numbers are reserved by the SCPI standard and are defined in this section. Positive error numbers are instrument-dependent. An error value of zero indicates that no error or event has occurred.

The signal generator responds to the **SYSTem:ERRor?** (or **STATus:QUEue?**) query using the following form:

<error number>, <error description>

The <error number> is a unique error descriptor. Certain standard error numbers are described in this section. The <error description> is a short description of the error, (optionally) followed by additional information regarding the error. Short descriptions of the standard error numbers are described in this section. The information that follows the error message may contain corrective actions that should be followed to correct the error condition.

The <device-dependent info> section of the response may contain information which will allow you to determine the exact error and context. For example:

```
-131, Invalid suffix;FREQuency:CENT 2.0E+5 dBmV
```

The maximum string length of <error description> plus <device-dependent info> is 255 characters. The <error description> will be sent exactly as indicated in this document, including case.

If there has been no error, that is, if the queue is empty, the signal generator will respond with:

```
0, No error
```

If there has been more than one error, the instrument will respond with the first one in its queue. Subsequent responses to **SYSTem:ERRor?** will continue with the queue until it is empty.

Error Numbers

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 listed here. The first error described in each class (for example, –100, –200, –300, –400) is a “generic” error. In selecting the proper error number to report, more specific error codes are preferred.

No Error

This message indicates that the error queue contains no errors.

Error Number	Error Description [description/explanation/examples]
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`**.

SCPI Standard Error Messages

Error Message Description

The list of error messages in this chapter describes all of the SCPI error messages associated with signal generator operation. A sample error message description is provided below to help you understand how information will be presented in this section.

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

Indicates that the user has entered a deviation, depth or internal source frequency that is beyond the specified limits.

The following list explains each element of the sample error message listing shown above.

- SCPI Error Number - The standard SCPI error number (–222 in this example). Standard SCPI error numbers are always negative, with the exception of **`0, No error`**.
- SCPI Error Message - The SCPI error message is **`Data out of range;`** in this example.
- Detailed Description - The information that appears after the semicolon (**`;`**) provides more detail as to the exact nature of the error. In this example, **`value clipped to lower limit`** tells you that you have entered a value outside the allowable range and the signal generator has changed the value so that it falls within the allowable limits. If no detailed description exists, it will be omitted from the error message.
- Explanation/Action Required - The text that appears below each error message listing contains an explanation of the error message and, in some cases, corrective actions that should be followed in order to correct the error

condition. Though this information is not shown on the signal generator's display, it can be found in the following section.

Command Error

An error number in the range [–199 to –100] indicates that an IEEE 488.2 syntax error has been detected by the instrument's parser. The occurrence of any error in this class will cause the command error bit (bit 5) in the event status register (IEEE 488.2, section 11.5.1) to be set. If this bit is set, one of the following events has occurred:

- An IEEE 488.2 syntax error has been detected by the parser. That is, a control-to-device message was received which 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.
- An unrecognized header was received. Unrecognized headers include incorrect device-specific headers and incorrect or unimplemented IEEE 488.2 common commands.

Events that generate command errors will not generate execution errors, device-specific errors, or query errors; see the error definitions in this chapter.

Command Error Message Descriptions

This section lists the signal generator's command error messages and their associated descriptions.

Error Number	Error Description [description/explanation/examples]
-100	**`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.

-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.

-102 **`Syntax error`**

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

-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.

-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.

-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.

-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.

-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.

-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.

-111 **`Header separator error`**

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

-112 **`Program mnemonic too long`**

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

-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.

-114 **`Header suffix out of range`**

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

-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.

-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.	
-123	**`Exponent too large`**	
	The magnitude of an exponent was greater than 32000 (see IEEE 488.2, 7.7.2.4.1).	
-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).	
-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.	
-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.	
-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.	
-134	**`Suffix too long`**	
	The suffix contained more than twelve characters (see IEEE 488.2, 7.7.3.4).	

-138 `Suffix not allowed`

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

-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.

-141 `Invalid character data`

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

-144 `Character data too long`

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

-148 `Character data not allowed`

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

-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.

-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.

-158	**`String data not allowed`**
	A string data element was encountered, but not allowed by the device at this point in the parsing.
-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.
-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.
-168	**`Block data not allowed`**
	A legal block data element was encountered, but not allowed by the device at this point in the parsing.
-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.
-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.
-178	**`Expression data not allowed`**
	A legal expression data was encountered, but was not allowed by the device at this point in parsing.

-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.

-181 **`Invalid outside macro definition`**

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

-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).

-184 **`Macro parameter error`**

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

Execution Error

An error number in the range [–299 to –200] indicates that an error has been detected by the instrument’s execution control block. The occurrence of any error in this class will cause the execution error bit (bit 4) in the event status register (IEEE 488.2, section 11.5.1) to be set. If this bit is set, one of the following events has occurred:

- 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.
- A valid program message could not be properly executed due to some device condition.

Execution errors will be reported by the device after rounding and expression evaluation operations have been completed. Rounding a numeric data element, for example, will not be reported as an execution error. Events that generate execution errors will not generate command errors, device-specific errors, or query errors; see the error definitions in this chapter.

Execution Error Message Descriptions

This section lists the signal generator’s execution error messages and their associated descriptions.

Error Number	Error Description [description/explanation/examples]
-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.

-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.

-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.

-210 **`Trigger error`**

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

-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.

-212 **`Arm ignored`**

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

-213 **`Init ignored`**

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

-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.

-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.

-220 **`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 errors described for errors –221 through –229.

-221 **`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).

-222 **`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).

-223 **`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.

-224 **`Illegal parameter value`**

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

-225 **`Out of memory`**

The device has insufficient memory to perform the requested operation.

-226 **`Lists not same length`**

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

-230 **`Data corrupt or stale`**

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

-231 **`Data questionable`**

Indicates that the measurement accuracy is questionable.

-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.

-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.

-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.

-241 **`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.

-250 **`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.

-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.

-253 **`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.

-254 **`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.

-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.

-256 **`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.

-257 **`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.

-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.

-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.

-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.

-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.

-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).

-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).

-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.
-274	**`Macro parameter error`**
	Indicates that the macro definition improperly used a macro parameter placeholder (see IEEE 488.2, 10.7.3).
-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).
-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).
-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).
-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.

-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.

-281 **`Cannot create program`**

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

-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.

-283 **`Illegal variable name`**

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

-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.

-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.

-286 **`Program runtime error`**

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

-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.

-291 **`Out of memory`**

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

-292 **`Referenced name does not exist`**

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

-293 **`Referenced name already exists`**

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

-294 **`Incompatible type`**

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

Device-specific Error

An error number in the range [–399 to –300] or [1 to 32767] indicates that the instrument has detected an error which is not a command error, a query error, or an execution error; 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. The occurrence of any error in this class will cause the device-specific error bit (bit 3) in the event status register (IEEE 488.2, section 11.5.1) to be set.

NOTE: For positive error number descriptions see the section titled “ESG Series Signal Generator Instrument-Specific Error Messages.”

The meaning of positive error codes is device-dependent and may be enumerated or bit mapped. The <error_message> string for positive error codes is not defined by SCPI. The occurrence of any error in this class will cause the device-specific error bit (bit 3) in the event status register (IEEE 488.2, section 11.5.1) to be set. Events that generate device-specific errors will not generate command errors, or query errors; see the other error definitions in this section.

Device-Specific Error Message Descriptions

This section lists the signal generator’s device-specific error messages and their associated descriptions.

Error Number	Error Description [description/explanation/examples]
-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.

-310	**`System error`**
	Indicates that an error, termed “system error” by the device, has occurred.
-311	**`Memory error`**
	Indicates that an error was detected in the device’s memory.
-312	**`PUD memory lost`**
	Indicates that the protected user data saved by the **`*PUD`** command has been lost.
-313	**`Calibration memory lost`**
	Indicates that non-volatile calibration data has been lost.
-314	**`Save/recall memory loss`**
	Indicates that the non-volatile data saved by the **`*SAV?`** command has been lost.
-315	**`Configuration memory lost`**
	Indicates that non-volatile configuration data saved by the device has been lost. The meaning of this error is device-dependent.
-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.
-321	**`Out of memory`**
	Indicates that an internal operation needed more memory than was available.

-330	**`Self-test failed`**
	Indicates that the device has detected a failure during its self-test procedure.
-340	**`Calibration failed`**
	Indicates that the device has detected a failure during its calibration procedure.
-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.
-360	**`Communication error`**
	This is the generic communication error for devices that cannot detect the more specific errors described for errors −361 through −363.
-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).
-362	**`Framing error in program message`**
	Indicates that a stop bit was not detected when data was received (for example, a baud rate mismatch).

Query Error

An error number in the range [–499 to –400] indicates that the output queue control of the instrument has detected a problem with the message exchange protocol described in IEEE 4888.2, chapter 6. The occurrence of any error in this class will cause the query error bit (bit 2) to be set 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. If a query error occurs one of the following is true:

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

Events that generate query errors will not generate command errors, execution errors, or device-specific errors; see the other error definitions in this section.

Query Error Message Descriptions

This section lists the signal generator's query error messages and their associated descriptions.

Error Number	Error Description [description/explanation/examples]
-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.

-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.

-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.

-430 **`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.

-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).

ESG Series Specific Error Messages

Some instrument-specific error messages incorporate the negative or “generic” SCPI error number with the addition of device-dependent/instrument-specific (ESG series-specific) information following the semicolon in the error message.

A positive error number indicates that the instrument has detected an error within the HP-IB system, within the instrument’s firmware or hardware, during the transfer of block data, or during calibration.

Error Number	Error Description [description/explanation/examples]
-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.

-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.

-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.

-221 **`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;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;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;Pattern repeat is changed to continuous because data source is external.`

Indicates that, while in non-bursted data generation, Pattern Repeat was in Single mode and data source was selected to be External. For non-bursted data generation using an external data source, Pattern Repeat must be in Continuous mode. To continue data transmission, Pattern repeat has been changed to Continuous mode.

-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; 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; 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 the circumstances to the factory.

`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.

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

Indicates that a SCPI list has been entered that is longer than the maximum allowed length, which is also the maximum number of step points; too many points were given for a frequency, amplitude, or dwell time list. This error can also be caused by attempting to copy items in the list editor when the list is already at its maximum length.

-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 problem to the factory.

-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 problem to the factory.

-241 **`Hardware missing; <card_name>`**

Indicates that a test communication to a hardware card failed. The instrument is most likely not functional. Contact the nearest HP 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.

-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. Contact the nearest HP Sales and Service office.

-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.

-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.

-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.

-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 `@`. Supported values are **`@STATE`** and **`@LIST`**.

`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. The valid user choices are **`:`**, **`DEFAULT:`**, **`STATE:`**, and **`LIST:`**.

`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.

-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 the circumstances to the nearest HP Sales and Service office.

-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 factory.

-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.

-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.

-321 **`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). Please report the circumstances to the factory. 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). Please report the circumstances to the factory. 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). Please report the circumstances to the factory. 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 the circumstances to the factory.

`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;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 the circumstances to the nearest HP Sales and Service office.

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

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.

-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. Contact the nearest HP 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. Contact the nearest HP 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. Contact the nearest HP 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. Contact the nearest HP 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. Contact the nearest HP 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. Contact the nearest HP Sales and Service office.

-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.

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 the problem to the factory.

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;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.

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.

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.
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. Contact the nearest HP Sales and Service office.
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.

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.

605 **`DSP FW download failed.`**

Indicates that the instrument's firmware was unable to successfully initialize the internal DSP. Report the circumstances to the nearest HP Sales and Service office.

606 **`DSP times out.`**

Indicates that the DSP failed to respond within the appropriate amount of time. Report the circumstances to the nearest HP Sales and Service office.

607 **`DSP returns error.`**

Indicates that the DSP is in an indeterminate state. Report the circumstances to the nearest HP Sales and Service office.

608 **`DSP in use by other process.`**

Indicates that the DSP is in an indeterminate state. Report the circumstances to the nearest HP 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.

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. If the error persists, contact the factory.

`Configuration error; Installed option boards do not match configuration information.`

This indicates that the option boards have not been properly installed in the instrument. Verify that the correct option boards have been installed in the correct slots. Reinstall the correct option. If the error persists, contact the factory.

`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. If the error persists, contact the factory.

`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. If the error persists, contact the factory.

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.

5 Error Messages

This chapter explains the error messages that might be shown on the front panel display or transmitted over the interface bus.

Error Messages

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

The Front Panel Error Queue

This queue is designed in a circular (rotating) fashion. It can hold up to 30 error messages. If the queue is full, and additional error messages arrive, the oldest errors are lost. The previously read messages are not cleared from the queue; they remain in the queue until they are overwritten by a new error message.

The front panel error queue information can be accessed by pressing **Utility**, **Error Info**. From the Error Info menu, you may choose from **View Previous Error Message**, **View Next Error Message**, or **Clear Error Queue(s)**. You can also use the RPG and the arrow keys to review the messages/

If there are any unviewed messages in the front panel error queue, the **ERR** annunciator will be activated on the signal generator’s display. you can optionally rotate the RPG or use the arrow keys to view the error messages. To empty the queue, press **Utility**, **Error Info, Clear Error Queue(s).**

There are some special error types called permanent errors. These include **`unlock`**, **`ovencold`**, **`hi/lo`**, etc. Permanent errors remain in the error queues until the error condition is cleared. Pressing **Utility**, **Error Info, Clear Error Queue(s)** will empty the front panel error queue, but the permanent errors will be re-reported if the error condition(s) still exist.

The SCPI Remote Interface Error Queue

This queue is constructed in a linear first-in/first-out fashion. It can hold up to 30 error messages. As errors and events are detected, they are placed in the queue. Unlike the front panel error queue, errors in this queue are not overwritten by the latest incoming error messages. If the queue overflows, the last error in the queue is replaced with the error:

`-350,Queue overflow`

When the queue overflows, the least recent errors remain in the queue, and the most recent error is discarded. Reading an error from the head of the queue removes that error from the queue, and opens a position in the tail of the queue for a new error, if one is subsequently detected.

When all the errors have been read from the queue, further error queries will return:

`0,No error`

The SCPI query **`SYSTem:ERRor?`** is used to view messages in the SCPI error queue. The error queue will be cleared when any of the following occur (IEEE 488.2, section 11.4.3.4):

- Upon power up
- Upon receipt of a **`*CLS`** command
- Upon reading the last item from the queue

In the SCPI error queue, the permanent errors are re-reported after the message **`0, No error`** is read using the **`SYSTem:ERRor?`** query and after the **`*CLS`** command is executed.

Querying the Error Queue

The queue query message is a request for the next entry from the instrument’s error queue. This queue contains an integer that can range from −32768 to 32767. Negative error numbers are reserved by the SCPI standard and are defined in this section. Positive error numbers are instrument-dependent. An error value of zero indicates that no error or event has occurred.

The signal generator responds to the **`SYSTem:ERRor?`** (or **`STATus:QUEue?`**) query using the following form:

<error number>, <error description>

The <error number> is a unique error descriptor. Certain standard error numbers are described in this section. The <error description> is a short description of the error, (optionally) followed by additional information regarding the error. Short descriptions of the standard error numbers are described in this section. The information that follows the error message may contain corrective actions that should be followed to correct the error condition.

The <device-dependent info> section of the response may contain information which will allow you to determine the exact error and context. For example:

```
-131, Invalid suffix;FREQuency:CENT 2.0E+5 dBmV
```

The maximum string length of <error description> plus <device-dependent info> is 255 characters. The <error description> will be sent exactly as indicated in this document, including case.

If there has been no error, that is, if the queue is empty, the signal generator will respond with:

```
0, No error
```

If there has been more than one error, the instrument will respond with the first one in its queue. Subsequent responses to **`SYSTem:ERRor?`** will continue with the queue until it is empty.

Error Numbers

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 listed here. The first error described in each class (for example, –100, –200, –300, –400) is a “generic” error. In selecting the proper error number to report, more specific error codes are preferred.

No Error

This message indicates that the error queue contains no errors.

Error Number	Error Description [description/explanation/examples]
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`**.

SCPI Standard Error Messages

Error Message Description

The list of error messages in this chapter describes all of the SCPI error messages associated with signal generator operation. A sample error message description is provided below to help you understand how information will be presented in this section.

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

Indicates that the user has entered a deviation, depth or internal source frequency that is beyond the specified limits.

The following list explains each element of the sample error message listing shown above.

- SCPI Error Number - The standard SCPI error number (–222 in this example). Standard SCPI error numbers are always negative, with the exception of **`0, No error`**.
- SCPI Error Message - The SCPI error message is **`Data out of range;`** in this example.
- Detailed Description - The information that appears after the semicolon (**`;`**) provides more detail as to the exact nature of the error. In this example, **`value clipped to lower limit`** tells you that you have entered a value outside the allowable range and the signal generator has changed the value so that it falls within the allowable limits. If no detailed description exists, it will be omitted from the error message.
- Explanation/Action Required - The text that appears below each error message listing contains an explanation of the error message and, in some cases, corrective actions that should be followed in order to correct the error

condition. Though this information is not shown on the signal generator's display, it can be found in the following section.

Command Error

An error number in the range [–199 to –100] indicates that an IEEE 488.2 syntax error has been detected by the instrument’s parser. The occurrence of any error in this class will cause the command error bit (bit 5) in the event status register (IEEE 488.2, section 11.5.1) to be set. If this bit is set, one of the following events has occurred:

- An IEEE 488.2 syntax error has been detected by the parser. That is, a control-to-device message was received which 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.
- An unrecognized header was received. Unrecognized headers include incorrect device-specific headers and incorrect or unimplemented IEEE 488.2 common commands.

Events that generate command errors will not generate execution errors, device-specific errors, or query errors; see the error definitions in this chapter.

Command Error Message Descriptions

This section lists the signal generator’s command error messages and their associated descriptions.

Error Number	Error Description [description/explanation/examples]
-100	`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.

-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.

-102 **`Syntax error`**

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

-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.

-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.

-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.

-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.

-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.
-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.
-111	**`Header separator error`**
	A character which is not a legal header separator was encountered while parsing the header.
-112	**`Program mnemonic too long`**
	The header contains more than twelve characters (see IEEE 488.2, 7.6.1.4.1).
-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.
-114	**`Header suffix out of range`**
	The value of a header suffix attached to a program mnemonic makes the header invalid.
-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.

-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.

-123 `Exponent too large`

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

-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).

-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.

-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.

-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.

-134 `Suffix too long`

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

-138	**`Suffix not allowed`**
	A suffix was encountered after a numeric element which does not allow suffixes.
-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.
-141	**`Invalid character data`**
	Either the character data element contains an invalid character or the particular element received is not valid for the header.
-144	**`Character data too long`**
	The character data element contains more that twelve characters (see IEEE 488.2, 7.7.1.4).
-148	**`Character data not allowed`**
	A legal character data element was encountered where prohibited by the device.
-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.
-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.

-158	**`String data not allowed`**	
	A string data element was encountered, but not allowed by the device at this point in the parsing.	
-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.	
-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.	
-168	**`Block data not allowed`**	
	A legal block data element was encountered, but not allowed by the device at this point in the parsing.	
-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.	
-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.	
-178	**`Expression data not allowed`**	
	A legal expression data was encountered, but was not allowed by the device at this point in parsing.	

-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.

-181 **Invalid outside macro definition**

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

-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).

-184 **Macro parameter error**

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

Execution Error

An error number in the range [–299 to –200] indicates that an error has been detected by the instrument’s execution control block. The occurrence of any error in this class will cause the execution error bit (bit 4) in the event status register (IEEE 488.2, section 11.5.1) to be set. If this bit is set, one of the following events has occurred:

- 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.
- A valid program message could not be properly executed due to some device condition.

Execution errors will be reported by the device after rounding and expression evaluation operations have been completed. Rounding a numeric data element, for example, will not be reported as an execution error. Events that generate execution errors will not generate command errors, device-specific errors, or query errors; see the error definitions in this chapter.

Execution Error Message Descriptions

This section lists the signal generator’s execution error messages and their associated descriptions.

Error Number	Error Description [description/explanation/examples]
-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.

-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.

-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.

-210 `Trigger error`

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

-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.

-212 `Arm ignored`

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

-213 `Init ignored`

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

-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.

-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.

-220 **`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 errors described for errors –221 through –229.

-221 **`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).

-222 **`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).

-223 **`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.

-224 **`Illegal parameter value`**

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

-225 **`Out of memory`**

The device has insufficient memory to perform the requested operation.

-226 **`Lists not same length`**

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

-230 **`Data corrupt or stale`**

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

-231 **`Data questionable`**

Indicates that the measurement accuracy is questionable.

-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.

-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.

-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.

-241 **`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.

-250 **`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.

-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.

-253 `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.

-254 `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.

-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.

-256 `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.

-257 `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.

-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.

-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.

-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.

-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.

-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).

-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).

-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.

-274 **`Macro parameter error`**

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

-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).

-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).

-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).

-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.

-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.

-281 **`Cannot create program`**

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

-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.

-283 **`Illegal variable name`**

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

-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.

-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.

-286	**`Program runtime error`**
	Indicates that a runtime error was detected in a downloaded program.
-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.
-291	**`Out of memory`**
	A downloaded program required more memory than was available in the instrument.
-292	**`Referenced name does not exist`**
	A downloadecd program attempted to access an undefined element (a variable, constant, filename, etc.).
-293	**`Referenced name already exists`**
	A downloaded program attempted to define an element (a variable, constant, filename, etc.) that had already been defined.
-294	**`Incompatible type`**
	Indicates that the type or structure of a memory item is inadequate.

Device-specific Error

An error number in the range [–399 to –300] or [1 to 32767] indicates that the instrument has detected an error which is not a command error, a query error, or an execution error; 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. The occurrence of any error in this class will cause the device-specific error bit (bit 3) in the event status register (IEEE 488.2, section 11.5.1) to be set.

NOTE: For positive error number descriptions see the section titled “ESG Series Signal Generator Instrument-Specific Error Messages.”

The meaning of positive error codes is device-dependent and may be enumerated or bit mapped. The <error_message> string for positive error codes is not defined by SCPI. The occurrence of any error in this class will cause the device-specific error bit (bit 3) in the event status register (IEEE 488.2, section 11.5.1) to be set. Events that generate device-specific errors will not generate command errors, or query errors; see the other error definitions in this section.

Device-Specific Error Message Descriptions

This section lists the signal generator’s device-specific error messages and their associated descriptions.

Error Number	Error Description [description/explanation/examples]
-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.

-310	**`System error`** Indicates that an error, termed "system error" by the device, has occurred.
-311	**`Memory error`** Indicates that an error was detected in the device's memory.
-312	**`PUD memory lost`** Indicates that the protected user data saved by the **`*PUD`** command has been lost.
-313	**`Calibration memory lost`** Indicates that non-volatile calibration data has been lost.
-314	**`Save/recall memory loss`** Indicates that the non-volatile data saved by the **`*SAV?`** command has been lost.
-315	**`Configuration memory lost`** Indicates that non-volatile configuration data saved by the device has been lost. The meaning of this error is device-dependent.
-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.
-321	**`Out of memory`** Indicates that an internal operation needed more memory than was available.

-330	**`Self-test failed`**
	Indicates that the device has detected a failure during its self-test procedure.
-340	**`Calibration failed`**
	Indicates that the device has detected a failure during its calibration procedure.
-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.
-360	**`Communication error`**
	This is the generic communication error for devices that cannot detect the more specific errors described for errors −361 through −363.
-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).
-362	**`Framing error in program message`**
	Indicates that a stop bit was not detected when data was received (for example, a baud rate mismatch).

Query Error

An error number in the range [–499 to –400] indicates that the output queue control of the instrument has detected a problem with the message exchange protocol described in IEEE 4888.2, chapter 6. The occurrence of any error in this class will cause the query error bit (bit 2) to be set 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. If a query error occurs one of the following is true:

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

Events that generate query errors will not generate command errors, execution errors, or device-specific errors; see the other error definitions in this section.

Query Error Message Descriptions

This section lists the signal generator’s query error messages and their associated descriptions.

Error Number	Error Description [description/explanation/examples]
-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.

-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.

-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.

-430 **`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.

-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).

ESG Series Specific Error Messages

Some instrument-specific error messages incorporate the negative or “generic” SCPI error number with the addition of device-dependent/instrument-specific (ESG series-specific) information following the semicolon in the error message.

A positive error number indicates that the instrument has detected an error within the HP-IB system, within the instrument’s firmware or hardware, during the transfer of block data, or during calibration.

Error Number	Error Description [description/explanation/examples]
-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.

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

-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.

-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.

-221 **`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;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;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;Pattern repeat is changed to continuous because data source is external.`

Indicates that, while in non-bursted data generation, Pattern Repeat was in Single mode and data source was selected to be External. For non-bursted data generation using an external data source, Pattern Repeat must be in Continuous mode. To continue data transmission, Pattern repeat has been changed to Continuous mode.

-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; 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; 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 the circumstances to the factory.

`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.

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

Indicates that a SCPI list has been entered that is longer than the maximum allowed length, which is also the maximum number of step points; too many points were given for a frequency, amplitude, or dwell time list. This error can also be caused by attempting to copy items in the list editor when the list is already at its maximum length.

-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 problem to the factory.

-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 problem to the factory.

-241 **`Hardware missing; <card_name>`**

Indicates that a test communication to a hardware card failed. The instrument is most likely not functional. Contact the nearest HP 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.

-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. Contact the nearest HP Sales and Service office.

-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.

-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.

-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.

-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 `@`. Supported values are **`@STATE`** and **`@LIST`**.

`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. The valid user choices are **`:`**, **`DEFAULT:`**, **`STATE:`**, and **`LIST:`**.

`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.

-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 the circumstances to the nearest HP Sales and Service office.

-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 factory.

-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.

-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.

-321 **`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). Please report the circumstances to the factory. 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). Please report the circumstances to the factory. 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). Please report the circumstances to the factory. 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 the circumstances to the factory.

`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;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 the circumstances to the nearest HP Sales and Service office.

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

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.

-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. Contact the nearest HP 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. Contact the nearest HP 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. Contact the nearest HP 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. Contact the nearest HP 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. Contact the nearest HP 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. Contact the nearest HP Sales and Service office.

-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.

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 the problem to the factory.

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;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.

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.

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.
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. Contact the nearest HP Sales and Service office.
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.

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.

605 **`DSP FW download failed.`**

Indicates that the instrument's firmware was unable to successfully initialize the internal DSP. Report the circumstances to the nearest HP Sales and Service office.

606 **`DSP times out.`**

Indicates that the DSP failed to respond within the appropriate amount of time. Report the circumstances to the nearest HP Sales and Service office.

607 **`DSP returns error.`**

Indicates that the DSP is in an indeterminate state. Report the circumstances to the nearest HP Sales and Service office.

608 **`DSP in use by other process.`**

Indicates that the DSP is in an indeterminate state. Report the circumstances to the nearest HP 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.

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. If the error persists, contact the factory.

`Configuration error; Installed option boards do not match configuration information.`

This indicates that the option boards have not been properly installed in the instrument. Verify that the correct option boards have been installed in the correct slots. Reinstall the correct option. If the error persists, contact the factory.

`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. If the error persists, contact the factory.

`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. If the error persists, contact the factory.

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.

Index

Index

Index

Index

Index

Index

Index

Index

Index

Index

Index

Index