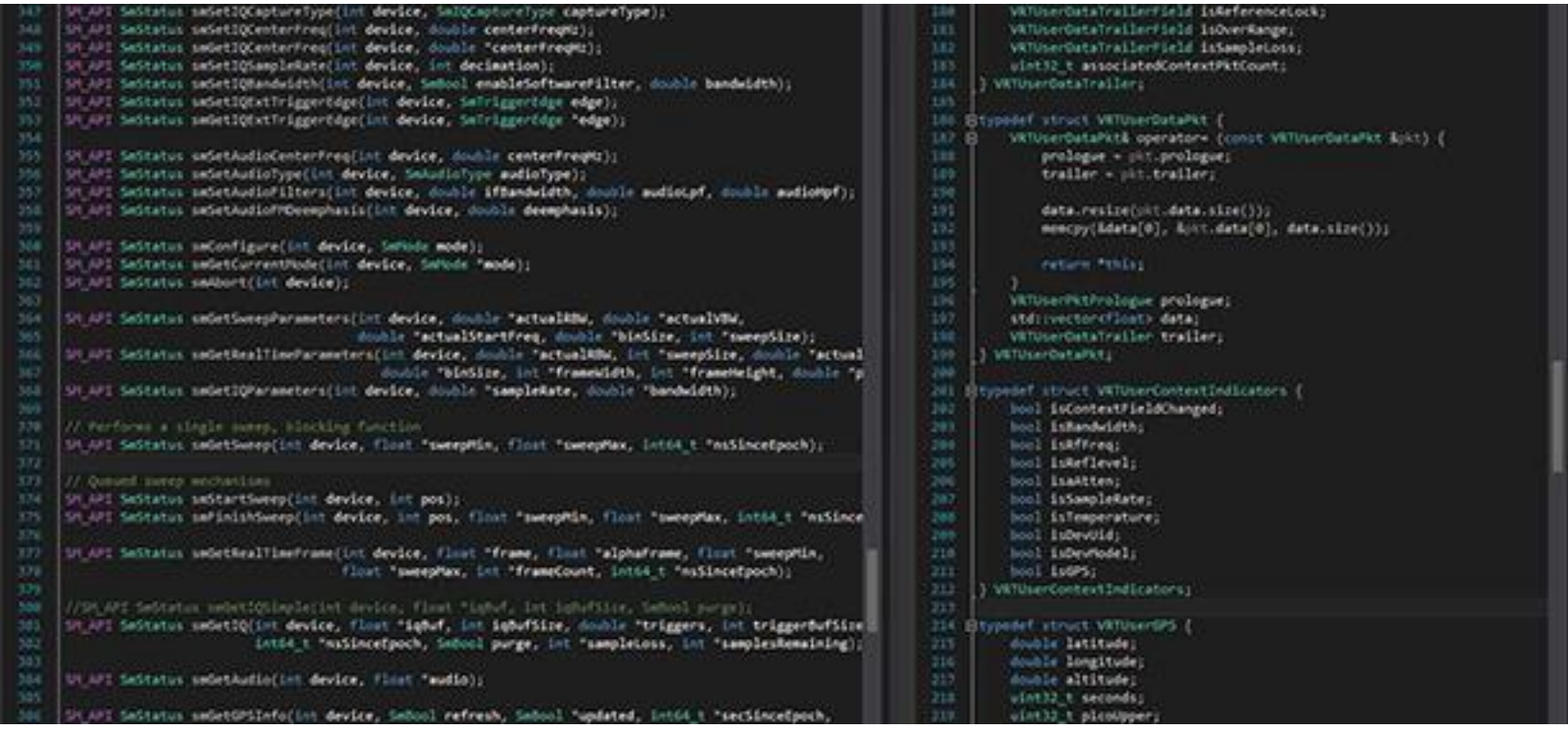
Signal Hound®



Spike™ SCPI Programming Manual

User Guide

Spike™ SCPI Programming Manual

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1 Version Notes

SCPI commands can and will change as the Spike software evolves. It is recommended that when you update Spike in an installation that is controlled via SCPI, to review the version notes and determine if any functionality needs to be updated. See the separate document title *scpi_version_notes.txt* for a full list of changes for each version of the Spike software.

2 Introduction / About SCPI

SCPI (Standard Commands for Programmable Instruments) is a standard which covers the set of commands used to program various instruments. The standard covers the syntax, form, behavior, etc. of these commands in attempt to reduce development time for the user.

For the purposes of Signal Hound and the Spike software, a user can send SCPI commands to Spike to control and make measurements using the Spike software in an automatic fashion. SCPI commands are sent to instruments over many interfaces, commonly GPIB, VXI, USB, Ethernet, etc. The Spike software accepts commands over a network socket. The Spike software will accept a single network connection in which it can receive SCPI commands and send responses.

This document will cover the basics of SCPI commands, how to get started programming the Spike software, and will cover the full SCPI command set implemented by the Spike software.

3 SCPI command basics

This section contains a quick overview of the SCPI command syntax and usage to the extent that is relevant to the Spike software. Spike does not utilize all functionality in the SCPI standard and as such said functionality will not be covered here.

3.1 Commands

A SCPI command is comprised of a series of keywords separated by colons. A command may be followed by a '?' to represent a query, a series of parameters separated by spaces, or both.

`:SENSE:FREQUENCY:CENTER 1GHz` (Example command for setting the center frequency to 1GHz)

`:sense:frequency:center?` (Example command for querying the current center frequency)

Commands are case insensitive. Each keyword in a command can have a short and long form. Both can be used interchangeably.

`:SENSe:FREQuency:CENTer` is a command with three keywords. Each keyword has a short and long form. The short form is denoted by the uppercase characters and the long form is the full keyword including the upper and lower-case characters. For example, FREQ is the short form of FREQUENCY. When constructing a command, the short and long form can be interchanged. For example, you could construct the command as such, `:SENS:FREQUENCY:CENT` where SENSE and CENTER are sent as short form and FREQUENCY as longform.

Some commands are options and are denoted as such by the '[]' characters.

`[:SENSe]:FREQuency:CENTer` is a command where the first keyword is optional. This command can be sent as `FREQ:CENT` and still be interpreted correctly.

Commands are terminated with a newline character. For example

```
:SENS:FREQ:CENT 1GHZ\n
```

Spike will begin processing the commands once a newline is reached. Additionally, a newline will reset the current keyword path.

3.2 Multiple commands

Multiple commands can be sent to the device at once using the semi colon character separating each command.

```
:SENS:FREQ:CENT 1GHz; :SENS:FREQ:SPAN 10MHz\n
```

This is an example of sending two commands at once. Additionally, when sending multiple commands, you don't need to repeat all keywords leading up to the final keyword for commands after the first.

```
:SENS:FREQ:CENT 1GHz; SPAN 10MHz\n
```

Here `SPAN` retains the `:SENS:FREQ:` keywords from the previous command. To prevent this from happening use the colon character leading the second command. For example

```
:SENS:FREQ:CENT 1GHz; :SPAN 10MHz\n
```

This is an invalid series of commands, since span is prefixed with a colon command which reset the previous keywords.

3.3 Parameters

There are several types of parameters that can be sent in commands.

Boolean	ON | OFF | 0 | 1
Keyword <bool>	Character specific strings for a given command. These keywords can also have short and long form.

Numeric
<integer>
<double>
	Numeric parameters take either the form of integer or decimal values. Examples include
	`1`
	`1.23`
	`9`
	`3.14`

Frequency <freq>	These are numeric parameters with a frequency suffix. Possible frequency suffixes include `HZ | KHZ | MHZ | GHZ` The suffixes are case insensitive. If a suffix is not present, Hz is the default unit. Examples include

	1kHz 20MHz 12GHz Any function that returns a frequency will return the frequency in Hz with no suffix present.
Amplitude <amplitude>	These are numeric parameters with an amplitude suffix. Possible amplitude suffixes include DBM | DBMV | DBUV | MV The suffixes are case insensitive. A suffix must be present unless indicated otherwise. Examples include -20DBM 60dbuv If a function returns an amplitude, it will return the amplitude in the current software units without a suffix.

3.4 Return Values

Values returned from the Spike software (as a result of sending a query command) are separated by a semi-colon if multiple query commands are sent in one string and are terminated by a newline. For example, sending

"CALC:MARK:MAX; X?; Y?\n"

results in a return string of

"1000000;-20\n"

The command sent performs a peak search and queries the X and Y positions of the marker. The return is the X and Y positions separated by a semicolon and terminated with a newline.

3.5 Special Characters

This section describes the numerous special characters that are present in the commands in this document.

Character	Description	Example
|	Vertical stroke between parameters indicates multiple choices	FLATtop | GAUSsian The choices are between FLATTOP or GAUSSIAN. Provide one or the other.
[ ]	Square brackets indicate an optional keyword	:SYSTem:ERRor[:NEXT]? Next is an optional keyword and the command could also be composed as :SYSTem:ERRor?

<>	Angle brackets around a parameter indicate a type and angle brackets should not be included in the user command.	`*RCL <int>`
		
		<int> is the type of parameter and an example of using this command would be
		
		`*RCL 1`
		
		Notice the angle brackets are not included.

4 Getting Started

See the SCPI examples found in the SDK download on any of the Signal Hound product download pages. The examples use the C programming language and a common VISA library implementation.

Instrument control is performed by connecting to the Spike software on TCP/IP port 5025. On this port, a user can send and receive raw SCPI commands. It is not necessary to use a I/O library like VISA to communicate with the Spike software but it can simplify several operations. It is possible to communicate directly over the socket with socket programming. The computer that is communicating with the Spike software does not have to be the same computer running the Spike software and does not have to be a Windows platform.

It is recommended to use a VISA library if available. Several implementations of VISA exist. Commonly used ones include Keysight's I/O libraries, and NI's VISA libraries. You can also use VISA implementations that exist in other languages/environments such as MATLAB, LabVIEW, and Python.

Connecting to the socket interface using VISA looks like this

```
viOpen(rm, "TCPIP::localhost::5025::SOCKET", VI_NULL, VI_NULL, &inst);
```

Additionally, when using a VISA library, it is necessary to set the VI_ATTR_TERMCHAR_EN attribute to true. This will terminate the read operation when the termination character is received. The termination character should be set to the newline ('\n') character if it is not set by default. The code for this is below.

```
viSetAttribute(inst, VI_ATTR_TERMCHAR_EN, VI_TRUE);

viSetAttribute(inst, VI_ATTR_TERMCHAR, '\n');
```

Only one connection to the Spike software can be active at a time. The connection can be terminated by either closing the socket connection, either through the socket library you are using, the viClose function if you are using a VISA library, or by closing your application. Spike will immediately begin waiting for another socket connection when the previous one is ended.

5 Functionality provided through SCPI

The table below details what functionality is covered under the current SCPI command set. Functionality will be added over time. If functionality you need it not available, please contact us at aj@signalhound.com to make requests.

Functionality	Implemented
Swept Analysis – Sweep Settings	Yes
Swept Analysis – Trace controls	Yes
Swept Analysis – Marker controls	Yes
Swept Analysis – Channel power, occupied bandwidth	Yes
Swept Analysis – Peak table	No
Swept Analysis – Sweep recording/playback	No
Path Loss Tables	Yes
Limit Lines	Yes
Spectrogram/Waterfall plot controls	No
Persistence display controls	No
Real-Time (Since real-time shares several controls with swept analysis, any functionality provided for swept analysis will be available for real-time measurement mode)	Partial
Zero-Span	Partial (I/Q captures only)
Harmonic Measurements	Yes
Scalar Network Analysis	Yes
Phase Noise Measurements	Yes
Digital Modulation Analysis	Yes
EMC Precompliance	No
Analog Demodulation	Yes
Interference Hunting	No
Spectrum Emission Mask	Yes
WLAN Modulation Analysis	Yes

6 Examples

All SCPI examples are provided in the API SDK download which can be downloaded on any of the device download pages on the Signal Hound website.

7 Functions

7.1 Display

Command	:DISPlay:ANNotation:TITLe <string> :DISPlay:ANNotation:TITLe? :DISPlay:ANNotation:CLEar
Description	TITLe, Set the measurement title. CLEar, Remove the title. Has the same effect as setting the title with an empty string.
Examples	SYST:DEV:ACT? SYST:DEV:COUNT? SYSTEM:DEVICE:LIST? SYSTEM:DEVICE:CONNECT? 30700189 SYSTEM:DEV:CONNECT? SYST:DEV:DISC?
Software Controls	File Menu -> Edit -> Title File Menu -> Edit -> Clear Title
Couplings	None
Preset	Default is no title
Notes	

7.2 Common Commands

The Spike software supports the following common commands.

Command	*IDN? *OPC *OPC? *RCL <int> *SAV <int> *RST
Description	*IDN?, Query the serial number and name of the device. *OPC, Waits for the current operation to complete before processing the next command. See the Mode/Measurements section for more information on the OPC command. *OPC?, Wait for the current operation to complete before processing the next command. Returns 1 when the operation completes. See the Mode/Measurements section for more information on the OPC command. *RCL, Load preset [1-9]. *SAV, Save preset [1-9]. *RST, Same as PRESet, see below.
Examples	*IDN? *OPC? *RCL 1 *SAV 1

Software Controls	Status Bar File Menu -> Presets -> Load File Menu -> Presets -> Save Preset
Couplings	None
Preset	N/A
Notes	

7.3 Format

Command	`:FORMat:TRACe[:DATA] ASCii|REAL`
	`:FORMat:TRACe[:DATA]?`
	`:FORMat:IQ[:DATA] ASCii|BINary`
	`:FORMat:IQ[:DATA]?`

Description	`TRACe:DATA`, Specify the format of the returned trace data from the `TRACe[:DATA]?` command. `IQ:DATA`, Specify the format of the returned IQ data from the `FETCH:ZS? 1` command.

Examples	`:FORM:TRAC REAL`
	`:FORMAT:TRACE:DATA ASCII`
	`:FORMAT:IQ:DATA BIN`
	`:FORM:IQ?`

Software Controls	N/A
Couplings	None
Preset	Ascii
Notes	See format description below

7.3.1 Ascii Trace Format

When the ascii format is specified, traces are returned as an ascii string of the form

`<ascii value 1>,<ascii value 2>,...,<ascii value N>`

An example of this is

`-89.324,-102.784,-27.641,…,-112.882<NL>`

7.3.2 Real Trace Format

When the real format is specified, traces are returned in a block data transfer. A block data transfer is of the form

`#NBBBBDDDDD…D<NL>`

Where

- Leading character of a block data transfer. Always present.

N – Number of decimal digits in the total byte count.

BBBB – The total byte count of the payload of the block data transfer. More specifically, the number of bytes that follow the byte count. This number must be N decimal digits long.

DDDD…D – The binary data.

An example block data transfer is below

```
#212ABCDEFGHIJKL<NL>
```

The 2 following the # denotes that the byte count is 2 decimal digits. The '12' following this is the byte count. Note it is 2 decimal digits long. Note: The '#' '2' and '12' should be read as ascii characters. 'ABC…JKL' is the data. The data in this example is 12 bytes long. The data should be read as bytes and not ascii.

Trace data is sent in little endian order, or least significant bytes first. Trace data is sent as successive 32-bit floating point values.

7.3.3 Ascii I/Q Format

See Ascii Trace Format.

7.3.4 Binary I/Q Format

See Real Trace Format. I/Q data is sent as successive 16-bit integer values.

7.4 System Functions

The following commands are used to perform system level software actions and query information about the system.

Command	:SYSTem:CLOSe
	:SYSTem:PRESet
	:SYSTem:PRESet?
	:SYSTem:PRESet[:USER]:SAVE <filename>
	:SYSTem:PRESet[:USER]:LOAD <filename>

	:SYSTem:VERsion? :SYSTem:COMMunicate:GTLocal :SYSTem:IMAGe:SAVe <filename> :SYSTem:IMAGe:SAVe:QUICk :SYSTem:PRINt
Description	CLOSe, Disconnect any active device and closes the Spike software. There is not a way to reopen the software using SCPI commands. This will also terminate the socket connection with the Spike software. PRESet, Presets the active device. This will power cycled the active device and return the software to the initial power on state. This process can take between 6-20 seconds depending on the device type. PRESet?, Presets the active device. This will close and reopen the active device. This process can take between 6-20 seconds depending on the device type. Returns 0 or 1 depending on success. (1 for success) PRESet[:USER]:SAVE, Save a preset with the given file name. The file name should have extension ".ini". PRESet[:USER]:LOAD, Load the preset given by the file name. If the preset does not exist, nothing occurs. The file name should have extension ".ini". VERsion?, Returns the Spike software version number. COMMunicate:GTLocal, Puts Spike in local mode. IMAGe:SAVe, Save and image with the specified filename. IMAGe:SAVe:QUICk, Quick save image. Same functionality as the Image quick save file menu option. PRINt, Print with the default system print settings.
Examples	SYST:CLOS SYST:PRESET? SYST:PRESET:USER:SAVE "C:/Users/Me/Documents/SignalHound/customPreset2.ini" SYST:PRESET:USER:LOAD "C:/Users/Me/Documents/SignalHound/customPreset2.ini" SYSTEM:VERSION? SYST:COMM:GTL SYST:IMAG:SAV "C:/Users/Me/Documents/SignalHound/img.png" (Usage of image save with VISA in C) viPrintf(inst, "SYST:IMAG:SAV \"C:/Users/Me/Documents/SignalHound/img.png\"\n"); SYSTEM:IMAGE:SAVE:QUICK SYSTEM:PRINT
Software Controls	Status Bar File Menu -> File -> Exit Preset File Menu -> Save User Preset File Menu -> Load User Preset File Menu -> Help -> About Spike

	Remote Mode Dialog -> Return to Local File Menu -> File -> Save As Image File Menu -> File -> Quick Save Image File Menu -> File -> Print
Couplings	None
Preset	N/A
Notes	

7.4.1 Device Management

The functions below allow you to remotely manage the active device in the Spike software. This is useful for error recovery in the event a device disconnect occurs due, or if one is managing multiple Signal Hound devices on one PC.

Connecting Signal Hound devices can take between 3-20 seconds depending on the type of device and the state of the device prior to interfacing it. If the VISA timeout is shorter than the time it takes to connect the device in the Spike software, you will need to loop on timeout until you receive the connect status return.

Command	`:SYSTem:DEVice:ACTive?`
	`:SYSTem:DEVice:COUNt?`
	`:SYSTem:DEVice:LIST?`
	`:SYSTem:DEVice:CONnect? <int>`
	`:SYSTem:DEVice:DISConnect?`

Description	`ACTive?`, Returns whether or not a device is currently connected and active in the software. Look at the `*IDN?` function to request information about the device. `COUNt?`, Returns the number of devices connected to the PC. No device may be active when this function is called. IE, you must call `DISConnect?` before calling this function. `LIST?`, Returns all serial numbers available to connect in the Spike software. The serial numbers are returned as ascii integers and are comma separated. To determine how many serial numbers are present, use the `COUNt?` function. `CONnect?`, Connect a device in the Spike software. You need to provide the serial number of the device to connect. Returns 0 or 1 depending on if the device successfully opened. `DISConnect?`, Disconnects any device actively connected in Spike. Returns 1 when finished.

Examples	`SYST:DEV:ACT?`
	`SYST:DEV:COUNT?`
	`SYSTEM:DEVICE:LIST?`
	`SYSTEM:DEVICE:CONNECT? 30700189`
	`SYSTEM:DEV:CONNECT?`
	`SYST:DEV:DISC?`

Software Controls	File Menu -> File -> Connect File Menu -> File -> Disconnect
Couplings	Only one device can be active at a time in Spike.

Preset	N/A
Notes	

7.4.2 Errors

The Spike software maintains a list of system errors available to the user. Errors are stored with a unique ID, name, and description. The types of issues represented in the error list are settings conflicts, SCPI issues such as invalid parameter types or instructions, file I/O errors, etc.

It is recommended to frequency check for errors when utilizing SCPI in the Spike software. Check the SCPI examples to see how to quickly poll Spike for any present errors.

The errors are returned in the form

```
"ID,description;error information"
```

ID is a unique integer for the error. The description is a ascii text description for the error, and error information is any additional context information for the error generated. An example error message is below.

```
"-2,Invalid Parameter;Expected frequency parameter"
```

This error indicates the SCPI parser was expecting a frequency parameter and was either unable to find it or was unable to parse it as a frequency.

Once the error queue is empty, the software will return the 'no error' error when the next system error is requested. 'No error' has an ID of 0.

Command	`:SYSTem:ERRor:COUNt?`
	`:SYSTem:ERRor[:NEXT]?`
	`:SYSTem:ERRor:CLEAr`

Description	`COUNt?`, Returns the number of errors in the error queue. `NEXT?`, Returns the next error in the queue, and removing it from the queue. `CLEAR`, Remove all errors from the queue, returns nothing.

Examples	`SYST:ERR:COUN?`
	`SYSTEM:ERROR:NEXT?`
	`SYST:ERR?`
	`SYST:ERR:CLEAR`

Software Controls	None, remote only
Couplings	None
Preset	N/A
Notes	None

7.5 Mode/Measurements

7.5.1 Instrument (Mode)

These commands control the measurement mode of the Spike software.

Command	:INSTrument[:SELect] SA|RTSA|ZS|HARMonics|SCALar|PNoise|DDEMOD|EMI|ADEMOD|IH|SEM :INSTrument[:SELect]? :INSTrument:RECALibrate
Description	SELect, Specify the active measurement mode of the Spike software. Possible values are IDLE, SA, RTSA, HARMonics, PNoise, ADEMOD RECALibrate, Perform a device recalibration.
Examples	INST SA
Software Controls	File Menu -> Analysis Mode Recal (Button)
Couplings	None
Preset	Sweep mode is selected by default.
Notes	The INST:SEL function allows you to put the Spike software into any of the available measurement modes, but not all modes at this time are programmable.

7.5.2 Initiate (Single/Continuous)

The commands are used to control when measurements are performed in the application. For automated measurements, it is common/recommended to disable CONTinuous measurement and control when the software performs the next measurement (sweep/IQ acquisition/etc) with the INIT:IMM command.

Command	:INITiate:CONTinuous ON|OFF|0|1 :INITiate:CONTinuous? :INIT[:IMMediate]
Description	CONTinuous, Enable/Disable continuous measurement operation. This state is global and will affect all measurements. When enabled, measurements are automatically triggered after the previous measurement is finished. When disabled, measurements are triggered only on the IMMediate command. IMMediate, Trigger a measurement. Has no effect if CONTinuous is enabled.
Examples	INIT:CONT OFF INIT
Software Controls	Single (button) Auto (button)
Couplings	None
Preset	CONTinuous set enabled by default.
Notes	None

7.6 Limit Lines

These commands control the limit lines which are available in sweep, real-time, and network analysis measurement modes. If no numeric suffix is provided to specify a limit line, the last used suffix is assumed. The last used suffix defaults to 1.

Command	:CALCulate:LLINe[1|2|3]:STATe ON|OFF|0|1 :CALCulate:LLINe[1|2|3]:STATe? :CALCulate:LLINe[1|2|3]:TRACe <int> :CALCulate:LLINe[1|2|3]:TRACe? :CALCulate:LLINe[1|2|3]:PAUSe[:STATe] ON|OFF|0|1 :CALCulate:LLINe[1|2|3]:PAUSe[:STATe]? :CALCulate:LLINe[1|2|3]:TYPE UPPer|LOWer :CALCulate:LLINe[1|2|3]:TYPE? :CALCulate:LLINe[1|2|3]:OFFSet:Y <double> :CALCulate:LLINe[1|2|3]:OFFSet:Y? :CALCulate:LLINe[1|2|3]:POINts? :CALCulate:LLINe[1|2|3]:DATA <freq1>, <ampl1>, … :CALCulate:LLINe[1|2|3]:DATA? :CALCulate:LLINe[1|2|3]:FAIL? :CALCulate:LLINe[1|2|3]:CLEAr :CALCulate:LLINe:ALL:CLEAr
Description	STATe, Enable or disable testing of this limit line. If there are not at least 2 points in the limit line, testing doesn't occur despite being enabled. TRACe, Specify which trace is tested against this limit line. PAUSe:STATe, When enabled, a failure of this limit will pause the sweep update. TYPE, Specify whether the limit line is tested as an upper bound or lower bound. OFFset:Y, Specify a dB offset to the limit line. POINts?, Returns the number of points in the limit line as an integer. DATA, Specify the points in the limit line, will override any existing points. Points are specified as freq/amplitude pairs where the amplitude is specified as dBm. DATA?, Returns the points in the limit line. Points are returned as freq/amplitude pairs where the frequencies are specified as Hz and the amplitudes as dBm. FAIL?, Returns 1 when the limit test has failed, 0 if passed. CLEAr, Resets the selected limit line. Removes all points stored. ALL:CLEAr, Resets all limit lines.
Examples	CALC:LLINE1:STATE ON CALC:LLINE:TRACE 2 CALC:LLINE2:PAUS:STAT OFF CALC:LLIN1:OFF:Y 20 CALC:LLINE1:POINTS? CALC:LLINE3:DATA 1e9,-10,2e9,-20 CALC:LLINE3:DATA 1GHZ,-10,2GHZ,-20 (Two points, 1 and 2 GHZ, -10dBm to -20dBm) CALC:LLINE3:DATA? CALC:LLINE1:FAIL?

	CALC:LLINE1:CLEAR
Software Controls	Manage Limit Lines -> Enabled Manage Limit Lines -> Trace Manage Limit Lines -> Pause on Break Manage Limit Lines -> Type Manage Limit Lines -> Offset Manage Limit Lines -> Modify Points Manage Limit Lines -> Number of Points
Couplings	None
Preset	Cleared.
Notes	

7.7 Path Loss Tables

These commands control the path loss tables which are available in sweep, real-time, zero-span, harmonics, digital modulation analysis, EMC precompliance, analog demod, and interference hunting measurement modes. If no numeric suffix is provided to specify a path loss table, the last used suffix is assumed. The last used suffix defaults to 1.

Command	:SENSe:CORRection:PATHloss[1-8]:STATe ON|OFF|0|1 :SENSe:CORRection:PATHloss[1-8]:STATe? :SENSe:CORRection:PATHloss[1-8]:DESCription <string> :SENSe:CORRection:PATHloss[1-8]:DESCription? :SENSe:CORRection:PATHloss[1-8]:POINts? :SENSe:CORRection:PATHloss[1-8]:DATA <freq1>, <offset1>, … :SENSe:CORRection:PATHloss[1-8]:DATA? :SENSe:CORRection:PATHloss[1-8]:CLEAr :SENSe:CORRection:PATHloss:ALL:CLEAr
Description	STATe, Enable or disable application of this path loss table. DESCription, Specify the name/description of this path loss table. POINts?, Returns the number of points in the path loss table as an integer. DATA, Specify the points in the path loss table, will override any existing points. Points are specified as freq/offset pairs where the offset is specified as dB. DATA?, Returns the points in the path loss table. Points are returned as freq/offset pairs where the frequencies are specified as Hz and the offsets as dB. CLEAr, Resets the selected path loss table. Removes all points stored. ALL:CLEAr, Resets all path loss tables.
Examples	SENSe:CORRection:PATHloss3:STATE ON SENSe:CORRection:PATHloss3:DESC Table Three SENSe:CORRection:PATHloss3:POINTS? SENSe:CORRection:PATHloss3:DATA 1e9,-10,2e9,-20 SENSe:CORRection:PATHloss3:DATA 1GHZ,-10,2GHZ,-20 (Two points, 1 and 2 GHZ, -10dBm to -20dBm) SENSe:CORRection:PATHloss3:DATA?

	SENSe:CORRection:PATHloss3:CLEAR
Software Controls	Manage Path Loss Tables -> Enabled Manage Path Loss Tables -> Name/Description Manage Path Loss Tables -> Edit Manage Path Loss Tables -> Clear Manage Path Loss Tables -> Number of Points
Couplings	None
Preset	Cleared.
Notes	

7.8 Reference

These commands control the reference oscillator settings the of the spectrum analyzer.

Command	[:SENSe]:ROSCillator:SOURce INTernal|EXTernal [:SENSe]:ROSCillator:SOURce?
Description	Specify whether the spectrum analyzer should lock to the internal reference or an external reference. This function works for all Signal Hound spectrum analyzers. This modifies the “Reference” setting in the reference control panel. For the BB60C this will choose between “Use Internal Reference” and “Use External Reference (AC)”. For the SA44/SA124 this will choose between “Not Set, User Internal Reference” and “Use External Reference”. Conflicts that normally result in user dialogs will not appear when using this SCPI command. To verify the correct value has been set and accepted, use the query command.
Examples	:SENSE:ROSCILLATOR:SOURCE INTERNAL ROSC:SOUR EXT rosc:source?
Software Controls	Settings -> Reference -> Reference
Couplings	None
Preset	On program startup, internal reference is selected.
Notes	None

7.9 Spectrum Analysis

7.9.1 Sweep Configuration

These commands control the receiver configuration in the swept analysis mode.

7.9.1.1 Frequency

These commands control the frequency range of the sweeps in swept analysis mode.

Command	[:SENSe]:FREQuency:CENTer <freq>|UP|DOWN [:SENSe]:FREQuency:CENTer? [MIN|MAX] [:SENSe]:FREQuency:STARt <freq> [:SENSe]:FREQuency:STARt? [:SENSe]:FREQuency:STOP <freq> [:SENSe]:FREQuency:STOP? [:SENSe]:FREQuency:CENTer:STEP[:INCRement] <freq> [:SENSe]:FREQuency:CENTer:STEP[:INCRement]? [:SENSe]:FREQuency:SPAN <freq>|UP|DOWN [:SENSe]:FREQuency:SPAN?
Description	CENTer, Set the measurement center frequency. This can cause the start or stop frequency to change if the device is unable to maintain the current span with the new center frequency. This can have the side effect of changing the span/start/stop frequencies. CENTer?, Query the current center frequency. Returned as Hz. By passing the MIN or MAX arguments, the user can query the upper and lower frequency limits for a sweep. STARt, Change the sweep start frequency. The lower bound for the start frequency is determined with the CENT? MIN command. STARt?, Query the current measurement start frequency in Hz. STOP, Set the sweep stop frequency. The upper bound for the stop frequency is determined with the CENT? MAX command. STOP?, Query the current measurement stop frequency in Hz. CENTer:STEP[:INCRement], Set the step amount the center frequency changes by when using the UP or DOWN parameters on the CENTer command. CENTer:STEP[:INCRement]?, Query the center frequency step size in Hz. SPAN, Set the sweep span. This will change the start/stop and potentially center frequency of the sweep in attempt to meet the span requested. SPAN?, Query the span in Hz.
Examples	SENS:FREQ:CENT 1GHz SENSE:FREQUENCY:CENTER? MAX FREQ:CENT UP FREQ:SPAN 20MHz FREQUENCY:CENTER:STEP 10KHZ
Software Controls	Sweep Settings Controls -> Frequency -> Center Sweep Settings Controls -> Frequency -> Span Sweep Settings Controls -> Frequency -> Start Sweep Settings Controls -> Frequency -> Stop Sweep Settings Controls -> Frequency -> Step
Couplings	Span is coupled with RBW and VBW. It is recommended to set RBW and VBW to auto whenever changing the span by large factors. Start/Stop is coupled with Center/Span.
Preset	Full span sweep.
Notes	Changing any frequency setting will trigger a re-sweep.

7.9.1.2 Power

These commands affect the RF front end of the device. Not all settings are available for each Signal Hound spectrum analyzer. It is recommended to leave attenuation/gain/preamp set to auto and control the RF leveling with reference level.

Command	[:SENSe]:POWer[:RF]:RLEVel <amplitude>|UP|DOWN [:SENSe]:POWer[:RF]:RLEVel? [:SENSe]:POWer[:RF]:RLEVel:UNIT? [:SENSe]:POWer[:RF]:RLEVel:OFFSet <double> [:SENSe]:POWer[:RF]:RLEVel:OFFSet? [:SENSe]:POWer[:RF]:PDIVision <double> [:SENSe]:POWer[:RF]:PDIVision? [:SENSe]:POWer[:RF]:ATTenuation <int> [:SENSe]:POWer[:RF]:ATTenuation? [:SENSe]:POWer[:RF]:ATTenuation:AUTO <bool> [:SENSe]:POWer[:RF]:ATTenuation:AUTO? [:SENSe]:POWer[:RF]:GAIN <int> [:SENSe]:POWer[:RF]:GAIN? [:SENSe]:POWer[:RF]:GAIN:AUTO <bool> [:SENSe]:POWer[:RF]:GAIN:AUTO? [:SENSe]:POWer[:RF]:PREAMP <int> [:SENSe]:POWer[:RF]:PREAMP? [:SENSe]:POWer[:RF]:PREAMP:AUTO <bool> [:SENSe]:POWer[:RF]:PREAMP:AUTO? [:SENSe]:POWer[:RF]:MW:PRESelector[:STATe] <bool> [:SENSe]:POWer[:RF]:MW:PRESelector[:STATe]? [:SENSe]:POWer[:RF]:SPURReject <bool> [:SENSe]:POWer[:RF]:SPURReject?
Description	RLEVel, Set the reference level. If UP or DOWN is specified, the reference level is increased or decreased by the div amount (when reference level is a logarithmic unit). RLEVel?, Return the current reference level as dBM. RLEVel:UNIT?, Return the current amplitude unit used to express reference level. RLEVel:OFFSet, Set the reference level offset in dB. PDIVision, specify the plot vertical division (1/10th of the plot height) as dB. Logarithmic scale only. ATTenuation, Specify the attenuation index. It is recommended to leave attenuation set to auto and set the reference level instead. GAIN, Specify the gain index. It is recommended to leave gain set to auto and set the reference level instead. PREAMP, Specify whether the preamp is on/off. Only valid for the SA devices. It is recommended to leave preamp set to auto and set the reference level instead. MW:PRESelector, SM200A only. Set the preselector state on or off. The preselector filters affected by this setting are below 650MHz. MW:SPURReject, Enable/Disable the software spur reject algorithm.
Examples	SENSE:POWER:RF:RLEVEL -20DBM POW:RLEV 90DBUV

	POW:RLEV:UNIT? POW:PDIV 6 POW:ATT:AUTO? SENS:POW:RF:GAIN:AUTO ON POW:RF:SPURR OFF
Software Controls	Sweep Settings Controls -> Amplitude -> Ref Level Measurements Controls -> Offsets -> Ref Offset Sweep Settings Controls -> Amplitude -> Div Sweep Settings Controls -> Amplitude -> Attenuation Sweep Settings Controls -> Amplitude -> Gain Sweep Settings Controls -> Amplitude -> Preamp File Menu -> Settings -> Preselector File Menu -> Settings -> Spur Reject
Couplings	If atten, gain, or preamp is set to auto, ref level overrides all their settings. All three must be set to non-auto values to override ref level. It is recommended to set them all to auto and only set the ref level.
Preset	The default value of reference level is device dependent, and the default unit is dBm. Div is set to 10 by default. Attenuation is set to auto by default. Gain is set to auto by default. Preamp is set to auto by default. Spur Reject is enabled for SA devices, and disabled for others. Preselector is disabled by default.
Notes	Changing any of these settings will trigger a re-sweep.

7.9.1.3 Bandwidth

These commands control the FFT processing for the receivers. These settings are highly coupled with the frequency range and sweep time. Additionally, there are several RBW/VBW restrictions present based on device type and span.

Command	[:SENSe]:BANDwidth[:RESolution] <freq>|UP|DOWN [:SENSe]:BANDwidth[:RESolution]? [:SENSe]:BANDwidth[:RESolution]:AUTO ON|OFF|0|1 [:SENSe]:BANDwidth[:RESolution]:AUTO? [:SENSe]:BANDwidth:VIDeo <freq>|UP|DOWN [:SENSe]:BANDwidth:VIDeo? [:SENSe]:BANDwidth:VIDeo:AUTO ON|OFF|0|1 [:SENSe]:BANDwidth:VIDeo:AUTO? [:SENSe]:BANDwidth:SHAPe FLATtop|NUTTall|GAUSsian [:SENSe]:BANDwidth:SHAPe?
Description	RESolution, Specify the RBW. If UP or DOWN is specified, the RBW is stepped in a 1/3/10 sequence. VIDeo, Specify the VBW. If UP or DOWN is specified, the VBW is stepped in a 1/3/10 sequence. SHAPe, Specify the FFT window function.
Examples	SENS:BAND:RES 10kHz BANDWIDTH:RESOLUTION 1MHz

	BAND:VID? SENSE:BAND:VIDEO:AUTO ON
Software Controls	Sweep Settings Controls -> Bandwidth -> RBW Sweep Settings Controls -> Bandwidth -> Auto RBW Sweep Settings Controls -> Bandwidth -> VBW Sweep Settings Controls -> Bandwidth -> Auto VBW
Couplings	RBW is coupled with VBW and Span. RBW will also have additional restrictions depending on the active device. If you are changing the span by more than a large factor (>2-4) then it is suggested to set RBW and VBW to auto before changing span. VBW is also coupled with sweep time. In most cases, if sweep time implies a lower VBW settings, then the lower setting is used (internally only).
Preset	RBW is set to auto by default. VBW is set to auto by default. Shape is set to Flattop by default.
Notes	Changing any bandwidth setting will trigger a re-sweep.

7.9.1.4 Sweep

The sweep commands control additional FFT settings of the receiver.

Command	[:SENSe]:SWEep:TIME <double> [:SENSe]:SWEep:TIME? [:SENSe]:SWEep:DETector:FUNCtion AVERage|MINMAX|MIN|MAX [:SENSe]:SWEep:DETector:FUNCtion? [:SENSe]:SWEep:DETector:UNITs POWer|SAMPle|VOLTage|LOG [:SENSe]:SWEep:DETector:UNITs?
Description	TIME, Specified as seconds. Controls the overall acquisition length for the sweep. If the sweep time is smaller than is needed for the current RBW/VBW settings, then sweep time is ignored. If sweep time is longer than necessary for the current RBW/VBW settings, then VBW is lowered to meet the requested sweep time. The VBW is lowered internally and won't be represented in the VBW settings. DETector:FUNCtion, Controls how the VBW processing is performed. If average, overlapping FFTs are averaged together. If MIN/MAX, overlapping FFTs are min/max held. MIN or MAX is the same processing as min/max but only returns one of the resulting arrays. DETector:UNITs, Controls the units in which the detector function is performed in.
Examples	SWE:TIME 0.1 SENS:DET:FUNC AVER SENSE:DETECTOR:FUNCTION? SWE:DET:UNIT POW
Software Controls	Sweep Settings Controls -> Acquisition -> Swp Time Sweep Settings Controls -> Acquisition -> Detector Sweep Settings Controls -> Acquisition -> Video Units
Couplings	RBW is coupled with VBW and Span. RBW will also have additional restrictions depending on the active device. If you are changing the span by more than a large factor (>2-4) then it is suggested to set RBW and VBW to auto before changing span.

Preset	Sweep time is set to 1ms (0.001) by default. Detector is set to average by default. Detector units is set to power by default.
Notes	Time is specified in seconds, 1ms minimum. Changing any of these settings will trigger a re-sweep.

7.9.2 Traces

The trace commands control the user configurable traces for sweep mode. At any point there is an active trace that is selected with the `TRACe:SELect` command. All other commands operate on the current selected trace.

It may be necessary to request the entire selected sweep from the software. To do this, use the `DATA?` command. The sweep data will be returned as comma separated ascii floating point values. For example,

```
-107.12,-88.4,-30.72,-91.94,-111.6,…
```

To determine the frequency of any given point in the sweep, use the `XSTARt?` and `XINCrement?` commands. The frequency of a given point is given by the equation,

```
Frequency of j'th point = XSTART + j * XINCREMENT
```

where j is a zero based index into the array of sweep points.

Command	`:TRACe:SELect <int>`
	`:TRACe:SELect?`
	`:TRACe:TYPE OFF|WRITe|AVERage|MAXhold|MINhold|MINMAX`
	`:TRACe:AVERage:COUNt <int>`
	`:TRACe:AVERage:COUNt?`
	`:TRACe:COPY <int>`
	`:TRACe:UPDate[:STATe] ON|OFF|0|1`
	`:TRACe:UPDate[:STATe]?`
	`:TRACe:DISPlay[:STATe] ON|OFF|0|1`
	`:TRACe:DISPlay[:STATe]?`
	`:TRACe:CLEar`
	`:TRACe:CLEar:ALL`
	`:TRACe:XSTARt?`
	`:TRACe:XINCrement?`
	`:TRACe:POINts?`
	`:TRACe[:DATA]?`

Description	`SELect`, Specify a trace index [1,6]. All future operations occur on this trace. TYPE, Specify the behavior of the trace. `AVERage:COUNt`, Specify the number of traces that are averaged together to create the final sweep.

	COPY, Copy the currently selected trace to the trace specified by the supplied parameter. The supplied parameter should be between the value [1,6] and should not equal the currently selected trace. If the destination trace type is off, the trace type is set to clear and write. Update is set to off and display is set to on for the destination trace. UPDate:STATe, Specify if the trace updates when a new sweep is acquired from the device. DISPlay:STATe, Specify if the trace is hidden. CLEar, Clear the selected trace. For example, if the current sweep is a max hold, sweep, and is cleared, the trace will be replaced with the next sweep from the device. CLEar:ALL, Clear all the traces. XSTARt?, Retrieve the frequency of the first point in the sweep as Hz. Useful for calculating the frequency of each point in the trace data returned from :TRACe:DATA? XINCrement?, Retrieve the frequency step between two points in the trace data as Hz. Useful for calculating the frequency of each point in the trace data. POINts?, Returns the number of points in the trace data. TRACe:DATA? Returns the trace data.
Examples	TRAC:SEL 2 TRAC:TYPE AVER TRACE:COPY 2 TRACE:AVERAGE:COUNT 10 TRAC:UPD ON TRAC:DISP ON
Software Controls	Measurements Controls -> Traces -> Trace Measurements Controls -> Traces -> Type Measurements Controls -> Traces -> Avg Count Measurements Controls -> Traces -> Copy To Measurements Controls -> Traces -> Update Measurements Controls -> Traces -> Hide Measurements Controls -> Traces -> Clear
Couplings	
Preset	All traces but 1 are set to OFF type. Trace 1 is set to clear and write.
Notes	Changing these settings will not trigger a re-sweep. Changing the trace display state will take effect immediately. Clearing a trace will not take effect until the next sweep. Traces are not updated until another sweep comes in from the device.

7.9.3 Markers

The marker commands control the Spike sweep markers. Select the active marker with the MARKer:SELect command. All marker commands will operate on the active marker.

Several commands operate on peaks. Peaks must meet the peak criteria which can be set with the EXCursion and THReshold commands.

Command	:CALCulate:MARKer:SELect <int> :CALCulate:MARKer:SELect? :CALCulate:MARKer:STATe ON|OFF|0|1 :CALCulate:MARKer:STATe? :CALCulate:MARKer:TRACe <int> :CALCulate:MARKer:TRACe? :CALCulate:MARKer:MODE POSition|NOISE :CALCulate:MARKer:MODE? :CALCulate:MARKer:UPDate ON|OFF|0|1 :CALCulate:MARKer:UPDate? :CALCulate:MARKer:DELTa ON|OFF|0|1 :CALCulate:MARKer:DELTa? :CALCulate:MARKer:PKTRack ON|OFF|0|1 :CALCulate:MARKer:PKTRack? :CALCulate:MARKer:X <freq> :CALCulate:MARKer:X? :CALCulate:MARKer:Y? :CALCulate:MARKer:MAXimum :CALCulate:MARKer:MAXimum:NEXT :CALCulate:MARKer:MAXimum:LEFT :CALCulate:MARKer:MAXimum:RIGHt :CALCulate:MARKer:PEAK:EXCursion <double> :CALCulate:MARKer:PEAK:EXCursion? :CALCulate:MARKer:PEAK:THReshold <amplitude> :CALCulate:MARKer:PEAK:THReshold? :CALCulate:MARKer[:SET]:CENTer :CALCulate:MARKer[:SET]:RLEVel
Description	SELect, Select the active marker. STATe, Turn the marker on/off. TRACe, Specify which trace to place the marker on. The trace must also be active to be able to retrieve marker measurements. MODE, Switch between positional and noise marker. UPDate, When update is disabled, the marker will hold its current position and will not update on future sweep updates. DELTa, When delta is enabled, the delta reference takes the current marker position and the marker measurement returns the delta frequency and amplitude between the current marker position and the delta reference. PKTRace, When enabled, the marker performs a peak search on each new trace update. X, Move the marker position to the specified frequency. X?, Retrieve the marker position frequency as Hz. Y?, Retrieve the marker position amplitude. MAXimum, Perform a peak search. MAXimum:NEXT, Move the marker to the next highest peak. Only peaks that meet the peak criteria are considered. MAXimum:LEFT, Move the marker to the next peak to the left of its current position. Only peaks that meet the peak criteria are considered.

	MAXimum:RIGHt, Move the marker to the next peak to the right of its current position (higher frequency). Only peaks that meet the peak criteria are considered. PEAK:EXCursion, Specify the peak excursion in dB. How many dB above surrounding points the point must be before being considered a peak. PEAK:THReshold, Specify the peak threshold. A point must exceed this amount before being considered as a peak. Once the threshold test is met, then the excursion test is ran. If it meets both, then a point is considered a peak. PEAK:THReshold?, Returns the current threshold as dBm. [:SET]:CENTer, Set the sweep center frequency to the current marker frequency. [:SET]:RLEVel, Set the sweep reference level to the current marker amplitude.
Examples	CALC:MARK:SEL 1 CALC:MARK:STAT ON CALCULATE:MARKER:TRACE 1 CALCULATE:MARKER:MODE POS CALCULATE:MARKER:UPDATE ON CALC:MARK:PEAK:THR -100DBM CALC:MARK:PEAK:EXC 6 CALC:MARK:MAX CALC:MARK:Y?
Software Controls	Measurements Controls -> Markers -> Marker Measurements Controls -> Markers -> Active Measurements Controls -> Markers -> Place On Measurements Controls -> Markers -> Type Measurements Controls -> Markers -> Update Measurements Controls -> Markers -> Delta Measurements Controls -> Markers -> Pk Tracking Measurements Controls -> Markers -> Set Freq Measurements Controls -> Markers -> Peak Search Measurements Controls -> Markers -> Peak Left Measurements Controls -> Markers -> Peak Right Measurements Controls -> Markers -> Pk Excurs. Measurements Controls -> Markers -> Pk Threshold Measurements Controls -> Markers -> To Center Measurements Controls -> Markers -> To Ref
Couplings	
Preset	All markers are disabled and set to Position/Normal type.
Notes	Changing the state of a marker will take effect immediately. For example, a peak search (MAXimum) command will move the marker immediately and allow you to request the updated frequency and amplitude without needing to re-sweep.

7.9.4 Trace Math

For more information on trace math, see the Spike user manual.

Command	:CALCulate:MATH[:STATe] <bool> :CALCulate:MATH[:STATe]? :CALCulate:MATH:FIRST <int> :CALCulate:MATH:FIRST?

	:CALCulate:MATH:SECond <int> :CALCulate:MATH:SECond? :CALCulate:MATH:RESult <int> :CALCulate:MATH:RESult? :CALCulate:MATH:OP PDIFF|PSUM|LOFFset|LDIFF :CALCulate:MATH:OP? :CALCulate:MATH:OFFSet <double> :CALCulate:MATH:OFFSet?
Description	STATe, Enabled or disable the trace math function. FIRST, Specify the first operand trace in the selected trace math function. Valid values are [1,6]. SECond, Specify the second operand trace in the selected trace math function. Valid values are [1,6]. RESult, Specify the result trace in the selected trace math function. Valid values are [1,6]. OP, Specify the trace math function. OFFSet, Specify the offset to use in the logarithm trace math functions.
Examples	CALC:MATH ON CALC:MATH:FIRST 1 CALC:MATH:SECOND 2 CALC:MATH:RESULT 3 CALC:MATH:OP LDIFF CALC:MATH:OFFSET -50
Software Controls	Measurements -> Trace Math -> Enabled Measurements -> Trace Math -> Op 1 Measurements -> Trace Math -> Op 2 Measurements -> Trace Math -> Result Measurements -> Trace Math -> Operation Measurements -> Trace Math -> Offset
Couplings	None
Preset	
Notes	

7.9.5 Channel Power

These commands control the channel power measurement in the Spike software. Through these commands you can configure a main channel and up to 5 adjacent channels and simultaneously measure channel and adjacent channel power.

Command	[:SENSe]:CHPower:STATe ON|OFF|0|1 [:SENSe]:CHPower:STATe? [:SENSe]:CHPower:TRACe <int> [:SENSe]:CHPower:TRACe? [:SENSe]:CHPower:WIDth <freq> [:SENSe]:CHPower:WIDth? [:SENSe]:CHPower:CHANnel:STATe <int>,ON|OFF|0|1 [:SENSe]:CHPower:CHANnel:STATe? <int>

	[:SENSe]:CHPower:CHANnel:OFFSet <int>,<freq> [:SENSe]:CHPower:CHANnel:OFFSet? <int> [:SENSe]:CHPower:CHANnel:WIDth <int>,<freq> [:SENSe]:CHPower:CHANnel:WIDth? <int> [:SENSe]:CHPower:CHPower? [:SENSe]:CHPower:CHPower:LOWer? <int> [:SENSe]:CHPower:CHPower:UPPer? <int> [:SENSe]:CHPower:ACPower:LOWer? <int> [:SENSe]:CHPower:ACPower:UPPer? <int>
Description	STATe, Enables/disables the channel power measurement. TRACe, Selects which trace the channel power measurement is performed on. WIDth, Specifies the width of the main channel power measurement as a frequency. CHANnel:STATe, Enables/disables the measurement of an adjacent channel.* CHANnel:OFFSet, Specifies the offset from center of an adjacent channel.* CHANnel:WIDth, Specifies the width of an adjacent channel.* CHPower?, Returns the channel power of the main channel. CHPower:LOWer?, Returns the lower channel power of an adjacent channel.* CHPower:UPPer?, Returns the upper channel power of an adjacent channel.* ACPower:LOWer?, Returns the lower adjacent power† of an adjacent channel.* ACPower:UPPer?, Returns the upper adjacent power† of an adjacent channel.* * Read the notes on how to specify a channel. † This is the power of the center channel minus the power of the channel specified.
Examples	SENSE:CHPOWER:STATE ON SENSE:CHPOWER:TRACE 1 SENS:CHPOWER:WID 20MHz SENS:CHPOW:CHAN:STAT 1,ON SENS:CHPOW:CHAN:OFFSET 2,1GHZ SENS:CHPOW:CHAN:WID 3,20MHZ CHP:CHP? CHP:CHP:LOW? 1 CHP:ACP:UPP? 3
Software Controls	Channel Power Controls -> Enabled Channel Power Controls -> Target Channel Power Controls -> Width Channel Power Controls -> Power Channel Power Controls -> Channels Table -> State Channel Power Controls -> Channels Table -> Offset Channel Power Controls -> Channels Table -> Bandwidth Channel Power Controls -> Channels Table -> Lower (dBc) Channel Power Controls -> Channels Table -> Lower (dBm) Channel Power Controls -> Channels Table -> Upper (dBc) Channel Power Controls -> Channels Table -> Upper (dBm)
Couplings	
Preset	Disabled by default.
Notes	Any changes to channel power will not take effect until the next sweep. It is recommended to configure the desired channel after configuring the sweep settings but before you perform a sweep.

	There are 5 adjacent channels, each with an upper and lower component. Each adjacent channel is defined by a frequency offset from the main channel, and a bandwidth. They are specified as integers from 1 through 5.

7.9.6 Occupied Bandwidth

These commands allow you to configure the occupied bandwidth measurement in the Spike software.

Command	`[:SENSe]:OBWidth:STATe ON|OFF|0|1`
	`[:SENSe]:OBWidth:STATe?`
	`[:SENSe]:OBWidth:TRACe <int>`
	`[:SENSe]:OBWidth:TRACe?`
	`[:SENSe]:OBWidth:PERCent <double>`
	`[:SENSe]:OBWidth:PERCent?`
	`[:SENSe]:OBWidth:OBWidth?`
	`[:SENSe]:OBWidth:CENTer?`
	`[:SENSe]:OBWidth:POWer?`

Description	`STATe`, Enable or disable the occupied bandwidth measurement. `TRACe`, Specify which trace the occupied bandwidth measurement is performed on. `PERCent`, The occupied bandwidth measurement must contain N% of the total energy of the sweep. Specified as a percent. `OBWidth?`, Returns the bandwidth of the occupied bandwidth measurement as Hz. `CENTer?`, Returns the center frequency of the occupied bandwidth measurement as Hz. `POWer?`, Returns the power of the occupied bandwidth measurement.

Examples	`OBW:STAT ON`
	`OBW:TRAC 1`
	`OBW:PERC 99`
	`OBW:OBW?`
	`OBW:CENT?`
	`OBW:POW?`

Software Controls	Measurements Controls -> Occupied Bandwidth -> Enabled Measurements Controls -> Occupied Bandwidth -> Target Measurements Controls -> Occupied Bandwidth -> % Power
Couplings	None
Preset	Disabled by default.
Notes	The occupied bandwidth measurement is updated only after a sweep is performed.

7.9.7 Intermodulation Distortion

These commands allow you to configure the intermodulation distortion measurement in the Spike software.

Command	`[:SENSe]:IMD:STATe ON|OFF|0|1` `[:SENSe]:IMD:STATe?`

	[:SENSe]:IMD:FREQuency? F1|F2|IM3L|IM3U [:SENSe]:IMD:TPOWer? F1|F2|IM3L|IM3U [:SENSe]:IMD:TPOWer:DIFF? IM3L|IM3U [:SENSe]:IMD:TOI? IM3L|IM3U
Description	STATe, Enable or disable the intermodulation distortion measurement. FREQuency?, Returns the frequency of the specified intermodulation product: f_1, f_2, lower third order product ($2f_1 – f_2$), or upper third order product ($2f_2 – f_1$). TPOWer?, Returns the tonal power in dBm of the specified intermodulation product. TPOWer:DIFF?, Returns the tonal power difference in dBc between the specified third order product and its corresponding first order product. TOI?, Returns the third-order intercept in dBm of the specified third order product.
Examples	IMD:STAT ON IMD:FREQ? F1 IMD:TPOW? F2 IMD:TPOW:DIFF? IM3L IMD:TOI? IM3U
Software Controls	Intermod Distortion Panel -> Enabled Intermod Distortion Panel -> Product Intermod Distortion Panel -> Frequency Intermod Distortion Panel -> Amplitude (dBm) Intermod Distortion Panel -> Amplitude (dBc) Intermod Distortion Panel -> TOI (dBm)
Couplings	None
Preset	Disabled by default.
Notes	The intermodulation distortion measurement is updated only after a sweep is performed. It is possible for the third-order intermodulation products to be outside the frequency span of the sweep. In this case, zero will be returned from any of the query functions for third-order products. In Spike, “Out of Range” is displayed in the frequency readout of the affected products.

7.10 Zero-Span

7.10.1 Configuration

These commands control the receiver configuration in zero-span mode.

7.10.1.1 Capture Settings

These commands control the configuration of the capture in zero-span mode.

Command	[:SENSe]:ZS:CAPture:RLEVel <amplitude> [:SENSe]:ZS:CAPture:RLEVel? [:SENSe]:ZS:CAPture:RLEVel:OFFSet <double> [:SENSe]:ZS:CAPture:RLEVel:OFFSet? [:SENSe]:ZS:CAPture:CENTer <freq>|UP|DOWN [:SENSe]:ZS:CAPture:CENTer? [MIN|MAX] [:SENSe]:ZS:CAPture:CENTer:STEP[:INCRement] <freq> [:SENSe]:ZS:CAPture:CENTer:STEP[:INCRement]?

	[:SENSe]:ZS:CAPture:SRATe <freq> [:SENSe]:ZS:CAPture:SRATe? [:SENSe]:ZS:CAPture:IFBWidth <freq> [:SENSe]:ZS:CAPture:IFBWidth? [:SENSe]:ZS:CAPture:IFBWidth:AUTO ON|OFF|0|1 [:SENSe]:ZS:CAPture:IFBWidth:AUTO? [:SENSe]:ZS:CAPture:SWEep:TIME <double> [:SENSe]:ZS:CAPture:SWEep:TIME?
Description	RLEVel, Set the reference level. RLEVel?, Return the current reference level as dBm. RLEVel:OFFSet, Set the reference level offset in dB. CENTer, Set the measurement center frequency. CENTer?, Query the current center frequency. Returned as Hz. By passing the MIN or MAX arguments, the user can query the upper and lower frequency limits for a capture. CENTer:STEP[:INCRement], Set the step amount the center frequency changes by when using the UP or DOWN parameters on the CENTer command. CENTer:STEP[:INCRement]?, Query the center frequency step size in Hz. SRATe, Specify the sample rate of the capture. This determines how much decimation will be applied to the full signal. IFBWidth, Specify the IF bandwidth, only active when AUTO is set to false. IFBWidth:AUTO, When enabled, the Spike software will automatically choose an appropriate IF bandwidth for the measurement. SWEep:TIME, Specified as seconds. Controls the overall acquisition length of the capture.
Examples	SENSE:ZS:CAPTURE:RLEVEL -20DBM SENS:ZS:CAP:RLEV:OFFS? SENS:ZS:CAP:CENT 1GHz SENSE:ZS:CAPTURE:CENTER? MAX ZS:CAP:CENT UP ZS:CAPTURE:SRATE 50MHZ ZS:CAP:IFBW? ZS:CAP:SWEEP:TIME .002
Software Controls	Zero-Span Settings Controls -> Capture Settings -> Ref Level Settings -> Reference Level Offset Zero-Span Settings Controls -> Capture Settings -> Center Zero-Span Settings Controls -> Capture Settings -> Step Zero-Span Settings Controls -> Capture Settings -> Sample Rate Zero-Span Settings Controls -> Capture Settings -> IF BW Zero-Span Settings Controls -> Capture Settings -> Auto IFBW Zero-Span Settings Controls -> Capture Settings -> Swp Time
Couplings	Sample rate is coupled with IFBW. It is recommended to set IFBW to auto when changing the sample rate.
Preset	Full sample rate capture at center of device range.
Notes	

7.10.1.2 Trigger Settings

Command	:TRIGger:ZS:SOURce IMMediate|IF|EXTernal|FMT :TRIGger:ZS:SOURce? :TRIGger:ZS:SLOPe POSitive|NEGative :TRIGger:ZS:SLOPe? :TRIGger:ZS:IF:LEVel <amplitude> :TRIGger:ZS:IF:LEVel? :TRIGger:ZS:POSition <double> :TRIGger:ZS:POSition?
Description	SOURce, Specify the trigger type. SLOPe, Specify rising edge (positive) or falling edge. IF:LEVel, Specify the trigger level of the IF trigger. POSition, Specify the trigger delay of the IF or ext trigger, the percentage of samples of the capture displayed before the trigger.
Examples	TRIG:ZS:SOURCE IF TRIG:ZS:SLOP POS TRIG:ZS:IF:LEV? TRIGGER:ZS:POSITION 20.0
Software Controls	Zero-Span Settings Controls -> Trigger Settings -> Trigger Type Zero-Span Settings Controls -> Trigger Settings -> Trigger Edge Zero-Span Settings Controls -> Trigger Settings -> Trigger Level Zero-Span Settings Controls -> Trigger Settings -> Trigger Position
Couplings	None
Preset	Source set to immediate. Position set to 10.00%.
Notes	

7.10.2 I/Q Data

A zero-span capture consists of a sequence of complex I/Q points. The number of points is determined by the sample rate and sweep time. Usually, *points = sample rate * sweep time*.

Each complex point has an in-phase and quadrature component, each of which is represented as a 32-bit floating point number. Data is returned as an array of values where the complex components are interleaved. For example,

$I_1, Q_1, I_2, Q_2, \ldots$

The I/Q data can be represented in ASCII or binary format. If ASCII is chosen, the data will be returned as a comma separated list of ASCII floating point values. For example,

-0.08213204145, 0.04985508695, -0.08225408942, 0.05008481443,…

In binary format, the values are scaled to 16-bit integers. The current reference level is used as scaler. To retrieve the floating point values, use the following equation:

$$float = \frac{short}{32768}\sqrt{reflevel}$$

where *reflevel* is represented in mW.

For large captures, binary format is faster and more efficient. Format is set using the `:FORMat:IQ[:DATA]` command.

7.10.3 Fetch Results

These functions are used to retrieve the measurement results. Fetch commands do not perform any measurement. The measurement must be performed with the INIT command when in single trigger mode or can be retrieved at any time in continuous measurement mode.

Command	`:FETCh:ZS? <int>`
Description	`ZS?`, Fetch I/Q data and data length. The integer parameter specifies which to retrieve. 1. I/Q data in ASCII or binary format (see "I/Q Data" section above) 2. Length of data. This is the number of complex I/Q data points (eg. *(I_1, Q_1)* is a single point).
Examples	`:FETCH:ZS? 1` `:FETCH:ZS? 2`
Software Controls	N/A
Couplings	None
Preset	
Notes	

7.11 Scalar Network Analysis

These commands control Spike in the Scalar Network Analysis measurement mode. Several commands are shared with standard spectrum analysis.

7.11.1 Frequency Configuration

Note that the commands shared with sweep measurement mode are listed here again.

Command	`[:SENSe]:FREQuency:CENTer <freq>|UP|DOWN`
	`[:SENSe]:FREQuency:CENTer? [MIN|MAX]`
	`[:SENSe]:FREQuency:STARt <freq>`
	`[:SENSe]:FREQuency:STARt?`
	`[:SENSe]:FREQuency:STOP <freq>`
	`[:SENSe]:FREQuency:STOP?`
	`[:SENSe]:FREQuency:CENTer:STEP[:INCRement] <freq>`

	[:SENSe]:FREQuency:CENTer:STEP[:INCRement]? [:SENSe]:FREQuency:SPAN <freq>|UP|DOWN [:SENSe]:FREQuency:SPAN?
Description	CENTer, Set the measurement center frequency. This can cause the start or stop frequency to change if the device is unable to maintain the current span with the new center frequency. This can have the side effect of changing the span/start/stop frequencies. CENTer?, Query the current center frequency. Returned as Hz. By passing the MIN or MAX arguments, the user can query the upper and lower frequency limits for a sweep. STARt, Change the sweep start frequency. The lower bound for the start frequency is determined with the CENT? MIN command. STARt?, Query the current measurement start frequency in Hz. STOP, Set the sweep stop frequency. The upper bound for the stop frequency is determined with the CENT? MAX command. STOP?, Query the current measurement stop frequency in Hz. CENTer:STEP[:INCRement], Set the step amount the center frequency changes by when using the UP or DOWN parameters on the CENTer command. CENTer:STEP[:INCRement]?, Query the center frequency step size in Hz. SPAN, Set the sweep span. This will change the start/stop and potentially center frequency of the sweep in attempt to meet the span requested. SPAN?, Query the span in Hz.
Examples	SENS:FREQ:CENT 1GHz SENSE:FREQUENCY:CENTER? MAX FREQ:CENT UP FREQ:SPAN 20MHz FREQUENCY:CENTER:STEP 10KHZ
Software Controls	Sweep Settings Controls -> Frequency -> Center Sweep Settings Controls -> Frequency -> Span Sweep Settings Controls -> Frequency -> Start Sweep Settings Controls -> Frequency -> Stop Sweep Settings Controls -> Frequency -> Step
Couplings	Span is coupled with RBW and VBW. It is recommended to set RBW and VBW to auto whenever changing the span by large factors. Start/Stop is coupled with Center/Span.
Preset	Full span sweep.
Notes	Changing any frequency setting will trigger a re-sweep.

7.11.2 Sweep Configuration

Command	[:SENSe]:NA:SWEep:POINts <int> [:SENSe]:NA:SWEep:POINts? [:SENSe]:NA:SWEep:TYPE PASSive|ACTive [:SENSe]:NA:SWEep:TYPE? [:SENSe]:NA:SWEep:HRANge ON|OFF|0|1 [:SENSe]:NA:SWEep:HRANge? [:SENSe]:NA:VIEW:SCALe LOG|VSWR

	[:SENSe]:NA:VIEW:SCALe? [:SENSe]:NA:VIEW:RLEVel <double> [:SENSe]:NA:VIEW:RLEVel? [:SENSe]:NA:VIEW:DIV <double> [:SENSe]:NA:VIEW:DIV? [:SENSe]:CORRection:NA:STORe:THRU [:SENSe]:CORRection:NA:STORe:THRU:HIGH [:SENSe]:CORRection:NA:STORe:THRU:ACTive?
Description	POINts, Specify a suggested sweep size. The final sweep size takes this setting into consideration as well as hardware limitations when determining the final sweep size. TYPE, Specify whether an active or passive device is being measured. This will affect the attenuation and gain used during the sweep. Failure to properly set this value may result in reduced dynamic range or IF overload. HRANge, If high range is enabled, the software will optimize the sweep for dynamic range when a 20dB pad store through is performed. Sweep speed will decrease when selected. VIEW:SCALe, Specify whether the plot is in log or VSWR units. A unique reference level and div are stored for both scale types. VIEW:RLEVel, Specify the reference level. When log scale is selected, the rlevel is specified as dBm, when VSWR is selected, rlevel is specified as SWR directly. Do not specify units. VIEW:DIV, Specify the plot vertical scale as either dB or SWR (depending on what scale is currently selected). Do not specify units. In each case, the div is 1/10th the vertical scale of the plot. NA:STORe:THRU, Perform a store through calibration. NA:STORe:THRU:HIGH, Perform a store through high range calibration. NA:STORe:THRU:ACTive?, Returns true when a calibration is active.(The store through has been performed for the current sweep settings.)
Examples	SENS:FREQ:CENT 1GHz SENSE:FREQUENCY:CENTER? MAX FREQ:CENT UP FREQ:SPAN 20MHz FREQUENCY:CENTER:STEP 10KHZ
Software Controls	Sweep Settings Controls -> Frequency -> Center Sweep Settings Controls -> Frequency -> Span Sweep Settings Controls -> Frequency -> Start Sweep Settings Controls -> Frequency -> Stop Sweep Settings Controls -> Frequency -> Step
Couplings	Span is coupled with RBW and VBW. It is recommended to set RBW and VBW to auto whenever changing the span by large factors. Start/Stop is coupled with Center/Span.
Preset	Full span sweep.
Notes	Changing any frequency setting will trigger a re-sweep.

7.11.3 Traces

See Traces

7.11.4 Markers

See Markers

7.12 Phase Noise Measurements

These commands control Spike in the Phase Noise measurement mode. Phase noise measurements are only available for certain Signal Hound devices (SA and SM series spectrum analyzers).

7.12.1 Sweep Configuration

Configure the carrier search and phase noise measurement parameters.

Command	`[:SENSe]:PNoise:CARRier:THReshold:MINimum <double>`
	`[:SENSe]:PNoise:CARRier:THReshold:MINimum?`
	`[:SENSe]:PNoise:CARRier:THReshold:VALid?`
	`[:SENSe]:PNoise:CARRier:THReshold:FREQuency?`
	`[:SENSe]:PNoise:CARRier:THReshold:AMPLitude?`
	`[:SENSe]:PNoise:VIEW:RLEVel <double>`
	`[:SENSe]:PNoise:VIEW:RLEVel?`
	`[:SENSe]:PNoise:VIEW:PDIVision <double>`
	`[:SENSe]:PNoise:VIEW:PDIVision?`
	`[:SENSe]:PNoise:FREQuency:CENTer <frequency>`
	`[:SENSe]:PNoise:FREQuency:CENTer?`
	`[:SENSe]:PNoise:FREQuency:OFFSet:STARt <frequency>`
	`[:SENSe]:PNoise:FREQuency:OFFSet:STARt?`
	`[:SENSe]:PNoise:FREQuency:OFFSet:STOP <frequency>`
	`[:SENSe]:PNoise:FREQuency:OFFSet:STOP?`
	`[:SENSe]:PNoise:AMRejection ON|OFF|0|1`
	`[:SENSe]:PNoise:AMRejection?`

Description	`CARRier:THReshold:MINimum`, Specify the minimum amplitude required in dBm (do not include units) needed for a signal to be detected as a carrier. `CARRier:THReshold:VALid?`, Returns whether a carrier was detected. `CARRier:THReshold:FREQuency?`, Returns the detected frequency of the carrier in Hz. `CARRier:THReshold:AMPLitude?`, Returns the detected amplitude of the carrier as dBm. `VIEW:RLEVel`, Specify the plot reference level as dBc/Hz. `VIEW:PDIVision`, Specify the plot division height as a floating point value. `FREQuency:CENTer`, Specify the carrier search frequency window. A search window with 200kHz span centered at the specified frequency is used for detecting a carrier. `FREQuency:OFFSet:STARt`, Specify the start frequency of the phase noise sweep as an offset from the detected carrier center frequency in Hz. Values must be

	between 10Hz and 10kHz and will be clamped to the closest value from the list [10Hz, 100Hz, 1kHz, 10kHz]. `FREQuency:OFFSet:STOP`, Specify the stop frequency of the phase noise sweep as an offset from the detected carrier center frequency in Hz. Values must be between 1kHz and 10MHz and will be clamped to the closest value from the list [1kHz, 10kHz, 100kHz, 1MHz, 10MHz] `AMRejection`, Toggle AM rejection. When enabled, the amplitude of the signal is normalized to reduce any phase noise contribution from AM.

Examples	`PN:CARR:THR:MIN -20`
	`PN:CARR:THR:VAL?`
	`PN:VIEW:RLEV -50`
	`PN:VIEW:DIV 15`
	`PN:FREQ:CENT 1GHz`
	`PN:FREQ:OFFS:STAR 100Hz`
	`PN:FREQ:OFFSET:STOP 1MHz`
	`PN:AMR ON`

Software Controls	Phase Noise -> Sweep Settings -> Ampl Thresh Phase Noise -> Sweep Settings -> Carrier Freq Phase Noise -> Sweep Settings -> Start Freq Phase Noise -> Sweep Settings -> Stop Freq Phase Noise -> Sweep Settings -> Disp Ref Phase Noise -> Sweep Settings -> Div Phase Noise -> Sweep Settings -> AM Reject
Couplings	Stop offset frequency must be 1 decade larger than the start offset.
Preset	
Notes	Carrier detection occurs before every phase noise sweep. Carrier valid, freq, and amplitude can be queried for each completed phase noise sweep. If a carrier is not detected, valid returns false, and the trace data and markers are not updated.

7.12.2 Traces

There are 3 user configurable traces for phase noise measurements. Any active user traces are updated after each phase noise sweep.

Command	`:TRACe:PNoise:SELect 1|2|3`
	`:TRACe:PNoise:SELect?`
	`:TRACe:PNoise:TYPE OFF|NORMal|AVERage|REFerence`
	`:TRACe:PNoise:TYPE?`
	`:TRACe:PNoise:AVERage:COUNt <int>`
	`:TRACe:PNoise:AVERage:COUNt?`
	`:TRACe:PNoise:TO 1|2|3`
	`:TRACe:PNoise:CLEar`

Description	`SELect`, Specify the active trace index. All future operations will occur on this trace. `TYPE`, Specify the trace type. Select `OFF` to disable the trace, `NORMal` for the standard clear/write operation, `AVERage` performs averaging over the last `AVERage:COUNt` sweeps and `REFerence` stops the trace from updating (effectively holding the current values.

	AVERage:COUNt, Specify the number of sweeps that will be averaged together when trace is set to average type. TO, Move the current trace to the selected trace. The selected trace type will be set to reference. CLEAr, Clear the current average accumulation.
Examples	TRAC:PN:SEL 1 TRAC:PN:TYPE AVER TRAC:PN:AVER:COUN 20 TRAC:PN:TO 2
Software Controls	Phase Noise -> Trace Settings -> Trace Phase Noise -> Trace Settings -> Type Phase Noise -> Trace Settings -> Avg Count Phase Noise -> Trace Settings -> Move To Phase Noise -> Trace Settings -> Clear Avg
Couplings	None
Preset	Trace 1 set to normal type. Trace 2/3 set to off.
Notes	

7.12.3 Marker

There is a single marker available for phase noise measurements. The marker can be placed on one of the 3 user configurable traces. Delta measurements can be enabled. A reference marker is placed at the current marker location when the delta measurement is enabled.

Command	:CALCulate:PNoise:MARKer[:STATe] ON|OFF|0|1 :CALCulate:PNoise:MARKer[:STATe]? :CALCulate:PNoise:MARKer:TRACe 1|2|3 :CALCulate:PNoise:MARKer:TRACe? :CALCulate:PNoise:MARKer:DELTa ON|OFF|0|1 :CALCulate:PNoise:MARKer:DELTa? :CALCulate:PNoise:MARKer:X <frequency> :CALCulate:PNoise:MARKer:X? :CALCulate:PNoise:MARKer:Y?
Description	STATe, Enable/disable the marker TRACe, Select which trace the marker is placed on. The marker is updated immediately. DELTa, Enable/disable the delta marker. A reference marker is created when the delta functionality is enabled. It is possible to update the reference marker on an already active delta marker simply by enabling delta again. X, Set the marker frequency as an offset from the carrier frequency. X?, Query the frequency of the marker as a frequency offset from the carrier. If the reference marker is active, the frequency returned is the difference between the reference marker and the current position. Y?, Query the amplitude of the marker as dBc/Hz. If the ref. marker is active, the value returned is the dB difference between the ref. marker and the current position.
Examples	CALC:PN:MARK ON CALC:PN:MARK:TRAC 1

	CALC:PN:MARK:X 10kHz CALC:PN:MARK:DELT ON CALC:PN:MARK:Y?
Software Controls	Phase Noise -> Marker Settings -> Trace Phase Noise -> Marker Settings -> Enabled Phase Noise -> Marker Settings -> Delta Marker
Couplings	None
Preset	Disabled by default.
Notes	

7.12.4 Jitter Configuration

Perform a jitter measurement on any of the 3 user traces.

Command	:CALCulate:PNoise:JITTer[:STATe] ON|OFF|0|1 :CALCulate:PNoise:JITTer[:STATe]? :CALCulate:PNoise:JITTer:TRACe 1|2|3 :CALCulate:PNoise:JITTer:TRACe? :CALCulate:PNoise:JITTer:STARt <frequency> :CALCulate:PNoise:JITTer:STARt? :CALCulate:PNoise:JITTer:STOP <frequency> :CALCulate:PNoise:JITTer:STOP? :CALCulate:PNoise:JITTer:RMS? :CALCulate:PNoise:JITTer:PHASe?
Description	STATe, Enable/disable the jitter measurement. TRACe, Specify the target trace of the jitter measurement. STARt, Specify the start frequency of the jitter measurement as an offset from the carrier frequency. STOP, Specify the stop frequency of the jitter measurement as an offset from the carrier frequency. RMS?, Query the RMS Jitter of the measurement in seconds. PHASe?, Query the Phase Jitter of the measurement in radians.
Examples	:CALC:PN:JITT ON :CALC:PN:JITT:STAR 1KHz :CALC:PN:JITT:STOP 1MHz :CALC:PN:JITT:RMS? :CALCULATE:PNOISE:JITTER:PHASE?
Software Controls	Phase Noise -> Jitter Settings -> Enabled Phase Noise -> Jitter Settings -> Trace Phase Noise -> Jitter Settings -> Meas Start Phase Noise -> Jitter Settings -> Meas Stop
Couplings	None
Preset	Disabled by default.
Notes	

7.12.5 Decade Table

These commands simply toggle the display of the decade table. To measure the points that the decade table is showing, use the marker to loop through the desired decades and read back the amplitude.

Command	:CALCulate:PNoise:DECade:TABLe[:STATe] ON|OFF|0|1 :CALCulate:PNoise:DECade:TABLe[:STATe]?
Description	STATe, Enable/disable the decade table display.
Examples	:CALC:PN:DEC:TABL ON
Software Controls	Phase Noise -> Decade Table -> Enabled
Couplings	None
Preset	Enabled by default.
Notes	

7.13 Harmonic Measurements

7.13.1 Configuration

These commands configure the harmonic measurement.

Command	[:SENSe]:HARMonics:NUMBer <int> [:SENSe]:HARMonics:NUMBer? [:SENSe]:HARMonics:TRACKing[:STATe] ON|OFF|0|1 [:SENSe]:HARMonics:TRACKing[:STATe]? [:SENSe]:HARMonics:MODE PEAK | CHPower [:SENSe]:HARMonics:MODE? [:SENSe]:HARMonics:FREQuency:FUNDamental <freq>|UP|DOWN [:SENSe]:HARMonics:FREQuency:FUNDamental? [:SENSe]:HARMonics:FREQuency:STEP[:INCRement] <freq> [:SENSe]:HARMonics:FREQuency:STEP[:INCRement]? [:SENSe]:HARMonics:FREQuency:SPAN <freq> [:SENSe]:HARMonics:FREQuency:SPAN? [:SENSe]:HARMonics:BANDwidth[:RESolution] <freq> [:SENSe]:HARMonics:BANDwidth[:RESolution]? [:SENSe]:HARMonics:BANDwidth:VIDeo <freq> [:SENSe]:HARMonics:BANDwidth:VIDEO? [:SENSe]:HARMonics:POWer[:RF]:RLEVel <double> [:SENSe]:HARMonics:POWer[:RF]:RLEVel? [:SENSe]:HARMonics:VIEW:RLEVel <double> [:SENSe]:HARMonics:VIEW:RLEVel? [:SENSe]:HARMonics:VIEW:PDIVision <double> [:SENSe]:HARMonics:VIEW:PDIVision? [:SENSe]:HARMonics:TRACe:TYPE WRITe|MAXhold [:SENSe]:HARMonics:TRACe:TYPE?
Description	NUMBer, Specify the number of harmonics to be measured and displayed on screen.

	MODE, Specify the measurement mode for a harmonics peak amplitude. When peak is selected, a peak search algorithm is performed on the measured span. When channel power is selected over the entire measured harmonic span. TRACKing:STATe, When enabled the fundamental frequency is tracked. When peak measurement mode is selected, the frequency of the peak is used, when channel power measurement mode is selected, the center of the occupied bandwidth is tracked. With tracking enabled, the harmonics are measured at multiples of the measured fundamental and the fundamental is always drawn centered on the measured frequency. FREQuency:FUNDamental, Specify the center frequency of the 1st harmonic or fundamental. FREQuency:STEP[:INCRement], Specify the step frequency. Used to step the fundamental frequency. FREQuency:SPAN, Specify the span of each measurement window at each harmonic. BANDwidth[:RESolution], Specify the RBW of the measurement at each harmonic. BANDwidth:VIDeo, Specify the VBW of the measurement at each harmonic. POWer[:RF]:RLEVel, Specify the measurement reference level as dBm. This value should be greater than the expected input power to prevent IF/ADC overload. VIEW:RLEVel, Specify the plot reference level as dBm. This affects only the plot y-axis. VIEW:PDIVision, Specify the division height of the plot in dB. The division height is 1/10th of the plot height. TRACe:TYPE, Specify the trace behavior.
Examples	:HARM:NUMB 8 :HARM:MODE PEAK :HARM:FREQ:FUND 1GHz :HARM:FREQ:STEP 1KHZ :HARM:FREQ:FUND DOWN :HARM:FREQ:SPAN 10kHz :HARM:BAND:RES 100Hz; VID 100Hz :HARM:POW:RF:RLEV 0 :HARM:VIEW:RLEV 5; PDIV 10 :HARM:TRAC:TYPE WRITE
Software Controls	Harmonic Settings Panel -> Center Freq Harmonic Settings Panel -> Step Harmonic Settings Panel -> Span Harmonic Settings Panel -> RBW Harmonic Settings Panel -> VBW Harmonic Settings Panel -> Input Level Harmonic Settings Panel -> Disp Ref Harmonic Settings Panel -> Div Harmonic Settings Panel -> Harm Count Harmonic Settings Panel -> Meas Type Harmonic Settings Panel -> Trace Type
Couplings	VBW must be less than or equal to RBW
Preset	

Notes	Span and RBW are limited.

7.13.2 Fetch Results

These commands retrieve the measurement results of the harmonic measurement. These commands do not issue a resweeps nor wait for a completed measurement. It is recommended to configure the software for single triggered measurements and using the `INIT` and `*OPC?` commands to initiate and wait for a measurement to complete before fetching measurement results.

Command	`[:SENSe]:FETCh:HARMonics:FREQuency? <int>`
	`[:SENSe]:FETCh:HARMonics:AMPLitude? <int>`
	`[:SENSe]:FETCh:HARMonics:DISTortion?`

Description	`FREQuency?`, Fetch the specified harmonics peak frequency. `AMPLitude?`, Fetch the specified harmonics amplitude in dBm. `DISTortion?`, Fetch the measured total harmonic distortion in %

Examples	`:SENS:FETC:HARM:FREQ? 1` (Fetch the fundamental harm. freq)
	`:FETC:HARM:FREQ? 10` (Fetch the 10th harm. freq)
	`:FETC:HARM:AMPL? 2`
	`:FETC:HARM:DIST?`

Software Controls	N/A
Couplings	None
Preset	
Notes	

7.14 Analog Demodulation

7.14.1 Configuration

Command	`[:SENSe]:ADEMod:FREQuency:CENTer <freq>|UP|DOWN`
	`[:SENSe]:ADEMod:FREQuency:CENTer?`
	`[:SENSe]:ADEMod:FREQuency:CENTer:STEP[:INCRement] <freq>`
	`[:SENSe]:ADEMod:FREQuency:CENTer:STEP[:INCRement]?`
	`[:SENSe]:ADEMod:POWer[:RF]:RLEVel <amplitude>`
	`[:SENSe]:ADEMod:POWer[:RF]:RLEVel?`
	`[:SENSe]:ADEMod:LPFilter <freq>`
	`[:SENSe]:ADEMod:LPFilter?`

Description	`CENTer`, Specify the measurement center frequency. `STEP`, Specify the center frequency step amount when using the `UP|DOWN` parameters. `RLEVel`, Specify the measurement reference level. This should be large than the highest expected input power. `LPFilter`, Specify the analog low pass filter cutoff frequency.
Examples	`ADEMOD:FREQ:CENT 1GHz` `ADEMOD:FREQ:CENT UP`

	ADEMOD:FREQ:CENT:STEP 1KHz ADEMOD:POW:RLEV -20DBM ADEMOD:LPF 10KHZ
Software Controls	Analog Demod Controls -> Center Freq Analog Demod Controls -> Step Analog Demod Controls -> Input Level Analog Demod Controls -> Low Pass Freq
Couplings	None
Preset	
Notes	

7.14.2 Fetch Results

Command	:FETCh:ADEMod:AM? <int> :FETCh:ADEMod:FM? <int>
Description	AM?, Fetch AM demodulation metrics. The integer parameter specifies the metric to retrieve. Possible integer values are below. Can specify a list of metrics to request as comma separated list. The metrics will be returned as a comma separated list in the order they were requested. 1. Returns carrier frequency in Hz 2. Returns carrier power in dBm 3. Returns AM modulation rate in Hz 4. Returns AM Depth (RMS) as % 5. Returns AM Depth (Peak+) as % 6. Returns AM Depth (Peak-) as % 7. Returns AM SINAD as dB 8. Returns AM THD as % FM?, Fetch FM demodulation metrics. The integer provided specifies the metric to retrieve. Possible integer values are below. Can specify a list of metrics to request as comma separated list. The metrics will be returned as a comma separated list in the order they were requested. 1. Returns carrier frequency in Hz 2. Returns carrier power in dBm 3. Returns FM modulation rate in Hz 4. Returns FM Depth (RMS) in Hz 5. Returns FM Depth (Peak+) in Hz 6. Returns FM Depth (Peak-) in Hz 7. Returns FM SINAD as dB 8. Returns FM THD as %
Examples	:FETCH:ADEMOD:AM? 1,2,3,4,5,6,7,8 :FETCH:ADEMOD:FM? 7,8
Software Controls	N/A
Couplings	None
Preset	
Notes	

7.15 Digital Demodulation

7.15.1 Configuration

7.15.1.1 Measurement

These commands modify the digital demod measurement parameters.

Command	[:SENSe]:DDEMod:FREQuency:CENTer <freq>|UP|DOWN [:SENSe]:DDEMod:FREQuency:CENTer? [:SENSe]:DDEMod:FREQuency:CENTer:STEP[:INCRement] <freq> [:SENSe]:DDEMod:FREQuency:CENTer:STEP[:INCRement]? [:SENSe]:DDEMod:POWer[:RF]:RLEVel <amplitude> [:SENSe]:DDEMod:POWer[:RF]:RLEVel? [:SENSe]:DDEMod:SRATe <freq> [:SENSe]:DDEMod:SRATe? [:SENSe]:DDEMod:MODulation BPSK|DBPSK|QPSK|DQPSK|OQPSK|PI4QPSK|8PSK|D8PSK|QAM16| QAM32|QAM64|QAM256|QAM1024|FSK2|FSK4|ASK2|CUSTom [:SENSe]:DDEMod:MODulation? [:SENSe]:DDEMod:RLENgth <int> [:SENSe]:DDEMod:RLENgth? [:SENSe]:DDEMod:FILTer NYQuist|RNYQuist|GAUSsian|RECTangle [:SENSe]:DDEMod:FILTer? [:SENSe]:DDEMod:FILTer:ABT <double> [:SENSe]:DDEMod:FILTer:ABT? [:SENSe]:DDEMod:IFBWidth:AUTO ON|OFF|0|1 [:SENSe]:DDEMod:IFBWidth:AUTO? [:SENSe]:DDEMod:IFBWidth <freq> [:SENSe]:DDEMod:IFBWidth? [:SENSe]:DDEMod:AVERage[:STATe] ON|OFF|0|1 [:SENSe]:DDEMod:AVERage[:STATe]? [:SENSe]:DDEMod:AVERage:COUNt <int> [:SENSe]:DDEMod:AVERage:COUNt?
Description	CENTer, Set the center frequency of the measurement. CENTer:STEP, Set the center frequency step amount. RLEV, Set the reference level of the measurement. This value should be higher than the expected peak power of the input signal. Setting it closer to the actual peak input will optimize for dynamic range. SRATe, Specify the sample rate of the input modulated signal. MODulation, Specify the modulation type of the input signal. RLENgth, Specify the measurement window length in symbols. FILTer, Specify the measurement and reference filter. ABT, Specify the filter alpha/beta coefficient. IFBWidth:AUTO, When enabled, the Spike software will automatically choose an appropriate IF bandwidth for the measurement, (usually 2x the sample rate) IFBWidth, Specify the IF bandwidth, only active when AUTO is set to false.

	AVERage:STATe, Enable measurement averaging. AVERage, Specify the average count.
Examples	:DDEM:FREQ:CENT 400MHZ :ddem:pow:rlev -20dbm :DDEM:SRAT 1MHz :DDEM:MOD FSK2 :ddemod:rlength 127 :ddemod:filter rnyquist :DDEM:FILT:ABT 0.22 :DDEM:IFBW:AUTO ON :DDEM:IFBW 2MHz :DDEM:AVER ON :DDEM:AVER:COUN 10
Software Controls	Modulation Analysis Control Panel -> Center Freq Modulation Analysis Control Panel -> Freq Step Modulation Analysis Control Panel -> Input Power Modulation Analysis Control Panel -> Sample Rate Modulation Analysis Control Panel -> Symbol Count Modulation Analysis Control Panel -> Modulation Modulation Analysis Control Panel -> Source Filter Modulation Analysis Control Panel -> Filter Alpha Modulation Analysis Control Panel -> Auto IF BW Modulation Analysis Control Panel -> IF BW Modulation Analysis Control Panel -> Averaging Modulation Analysis Control Panel -> Average Count
Couplings	None
Preset	IF bandwidth set to auto Averaging enabled
Notes	

7.15.1.2 Custom Modulation

Command	[:SENSe]:DDEMod:CUSTom:IQ:VALid? [:SENSe]:DDEMod:CUSTom:IQ:LENGth? [:SENSe]:DDEMod:CUSTom:IQ:DATA <float>,<float>,…,<float> [:SENSe]:DDEMod:CUSTom:IQ:DATA?
Description	VALid?, Returns 1 when the custom constellation is valid. LENGth?, Returns the number of symbols in the custom constellation. DATA, Specify the constellation symbols as IQ values. IQ values are specified as comma separated real numbers, alternating IQ values. If an odd number of real values are provided the last value is ignored. If any value is an invalid real number, the command fails and throws a system error. While not strictly necessary, it is suggested to scale the constellation so that the maximum symbol magnitude is 1. See the example below. DATA?, Returns the constellation symbols as a comma separated list of alternating IQ values.
Examples	:DDEM:CUST:IQ:VAL?

	:DDEM:CUST:IQ:LENG? Specify the constellation for QPSK IQ values are specified as alternating real/imaginary pairs *I1,Q1,I2,Q2,…,In,Qn* :DDEM:CUST:IQ:DATA 1,1,-1,1,-1,-1,1,-1 The command above specifies a constellation with the 4 points [1,1], [-1,1], [-1,-1], [1,-1] The response from DATA? is in the same format at the DATA command above. :DDEM:CUST:IQ:DATA?
Software Controls	Modulation Analysis Control Panel -> Edit Custom Mod
Couplings	None
Preset	Custom mod is empty by default.
Notes	

7.15.1.3 Trigger

Command	:TRIGger:DDEMod:SOURce IMMediate|IF|EXTernal :TRIGger:DDEMod:SOURce? :TRIGger:DDEMod:IF:LEVel <amplitude> :TRIGger:DDEMod:IF:LEVel? :TRIGger:DDEMod:DELay <int> :TRIGger:DDEMod:DELay?
Description	SOURce, Specify the trigger type. IF:LEVel, Specify the trigger level of the IF trigger. DELay, Specify the trigger delay of the IF or ext trigger, the number of symbols after the trigger to start the measurement.
Examples	:TRIG:DDEM:SOUR IF :TRIG:DDEM:IF:LEV -50DBM :TRIG:DDEM:DELAY 100
Software Controls	Modulation Analysis Control Panel -> Trigger Type Modulation Analysis Control Panel -> Trigger Level Modulation Analysis Control Panel -> Trigger Delay
Couplings	None
Preset	Source set to immediate. Delay set to 0.
Notes	

7.15.1.4 Sync Search

These commands affect the sync pattern search.

Command	[:SENSe]:DDEMod:SYNC[:STATe] ON|OFF|0|1 [:SENSe]:DDemod:SYNC[:STATe]? [:SENSe]:DDEMod:SYNC:SWORd:PATTern <hex string>

	[:SENSe]:DDEMod:SYNC:SWORd:PATTern? [:SENSe]:DDEMod:SYNC:SWORd:LENGth <int> [:SENSe]:DDEMod:SYNC:SWORd:LENGth? [:SENSe]:DDEMod:SYNC:SLENgth <int> [:SENSe]:DDEMod:SYNC:SLENgth? [:SENSe]:DDEMod:SYNC:OFFSet <int> [:SENSe]:DDEMod:SYNC:OFFSet?
Description	STATe, Enable/disable sync search. SWORd:PATTern, The pattern to trigger on for the trigger pattern. Patterns will be converted to uppercase when provided otherwise. SWORd:LENGth, The length in symbols of the pattern trigger. The pattern length is not necessarily the same length as the pattern itself. A shorter length uses only a portion of the pattern and a longer length pads the pattern with 'zeros' SLENgth, Search length for the pattern trigger. OFFSet, Offsets the measurement from the beginning of a successful sync search. Can be negative.
Examples	:DDEM:SYNC ON :DDEM:SYNC:SWOR:PATT AA11 :DDEM:SYNC:SWOR:LENG 16 :DDEM:SYNC:SLEN 1000 :DDEM:SYNC:OFFS -128
Software Controls	Modulation Analysis Control Panel -> Sync Search -> Enabled Modulation Analysis Control Panel -> Sync Search -> Pattern Modulation Analysis Control Panel -> Sync Search -> Pattern Length Modulation Analysis Control Panel -> Sync Search -> Search Length Modulation Analysis Control Panel -> Sync Search -> Offset
Couplings	None
Preset	Sync search disabled. Offset is 0.
Notes	

7.15.1.5 Compensation

These commands determine what type of compensations are performed on the measurement. When the compensations are active, they are performed before error metrics are measured.

Command	[:SENSe]:DDEMod:COMPensate:IQINVersion[:STATe] ON|OFF|0|1 [:SENSe]:DDEMod:COMPensate:IQINVersion[:STATe]? [:SENSe]:DDEMod:COMPensate:IQOFFset[:STATe] ON|OFF|0|1 [:SENSe]:DDEMod:COMPensate:IQOFFset[:STATe]? [:SENSe]:DDEMod:COMPensate:ADRoop[:STATe] ON|OFF|0|1 [:SENSe]:DDEMod:COMPensate:ADRoop[:STATe]?
Description	IQINVersion, Enabled or disable IQ swap IQOFFset, When enabled, IQ offset is removed from the signal. ADRoop, When enabled, linear amplitude errors are corrected for in the signal.
Examples	:DDEM:COMP:IQINV ON :DDEMOD:COMPENSATE:IQOFFSET:STATE 1

	:DDEM:COMP:ADR?
Software Controls	Modulation Analysis Control Panel -> I/Q Inversion Modulation Analysis Control Panel -> IQ Offset Modulation Analysis Control Panel -> Ampl Droop
Couplings	None
Preset	I/Q Offset enabled by default I/Q inversion disabled by default Ampl droop disabled by default
Notes	

7.15.1.6 Equalization

These commands affect the adaptive equalizer.

Command	[:SENSe]:DDEMod:EQUalization[:STATe] ON|OFF|0|1 [:SENSe]:DDEMod:EQUalization[:STATe]? [:SENSe]:DDEMod:EQUalization:LENGth <int> [:SENSe]:DDEMod:EQUalization:LENGth? [:SENSe]:DDEMod:EQUalization:CONVergence <double> [:SENSe]:DDEMod:EQUalization:CONVergence? [:SENSe]:DDEMod:EQUalization:HOLD[:STATe] ON|OFF|0|1 [:SENSe]:DDEMod:EQUalization:HOLD[:STATe]? [:SENSe]:DDEMod:EQUalization:RESet
Description	STATe, Enabled or disable equalization. LENGth, Length of the equalization filter in symbols. Must be odd. CONVergence, Adaptive rate. Higher number adapt faster but are more unstable. HOLD, When enabled, adaptation step is bypassed but equalization is still applied. RESet, Resets the equalization filter to the unit impulse response (pass through).
Examples	:DDEM:EQU ON :DDEM:EQU:LENG 15 :DDEM:EQU:CONV 10.0 :DDEM:EQU:HOLD ON :DDEM:EQU:RESET
Software Controls	Modulation Analysis Control Panel -> Equalization -> Enabled Modulation Analysis Control Panel -> Equalization -> Filter Len Modulation Analysis Control Panel -> Equalization -> Convergence Modulation Analysis Control Panel -> Equalization -> Hold Modulation Analysis Control Panel -> Equalization -> Reset
Couplings	None
Preset	Equalization is disabled. Filter Length is 5. Convergence is 1.0. Hold is off.
Notes	

7.15.2 Fetch Results

These functions are used to retrieve the measurement results. Fetch commands do not perform any measurement. The measurement must be performed with the INIT command when in single trigger mode or can be retrieved at any time in continuous measurement mode.

Command	`:FETCh:DDEMod? <int>`
Description	`DDEMod?`, Fetch digital demodulation metrics. The integer parameter specifies the metric to retrieve. Possible integer values are below. Can specify a list of metrics to request as comma separated list. The metrics will be returned as a comma separated list in the order they were requested. 1. RMS EVM average as % 2. RMS EVM peak as % 3. RMS mag error average as % 4. RMS mag error peak as % 5. RMS phase error average as % 6. RMS phase error peak as % 7. IQ offset average as dB 8. IQ offset peak as dB 9. Frequency error average as Hz 10. Frequency error peak as Hz 11. RF power average as dBm 12. RF power peak as dBm 13. SNR average as dB 14. SNR peak as dB 15. RMS FSK error average as % 16. RMS FSK error peak as % 17. FSK deviation avg as Hz 18. FSK deviation peak as Hz 29. Current average count 30. Demod bits as binary string
Examples	`:FETCH:DDEMOD? 1,2,3,4,5,6,7,8` `:FETCH:DDEMOD? 7,8`
Software Controls	N/A
Couplings	None
Preset	
Notes	

7.16 Spectrum Emission Mask

7.16.1 Configuration

These commands control the receiver and measurement configuration in the spectrum emission mask mode.

7.16.1.1 Frequency

These commands control the frequency range of the sweeps in spectrum emission mask mode.

Command	[:SENSe]:SEMask:FREQuency:CENTer <freq>|UP|DOWN [:SENSe]:SEMask:FREQuency:CENTer? [:SENSe]:SEMask:FREQuency:CENTer:STEP[:INCRement] <freq> [:SENSe]:SEMask:FREQuency:CENTer:STEP[:INCRement] [:SENSe]:SEMask:FREQuency:SPAN <freq> [:SENSe]:SEMask:FREQuency:SPAN?
Description	CENTer, Set the center frequency of the measurement. CENTer:STEP, Set the center frequency step amount. SPAN, Set the sweep span.
Examples	:SEMask:FREQ:CENT 1GHz :SEM:FREQUENCY:CENTER? :semask:freq:cent up :sem:freq:span 20mhz :SEMASK:FREQUENCY:CENTER:STEP 10e3
Software Controls	SEM Settings Control Panel -> Frequency -> Center Freq SEM Settings Control Panel -> Frequency -> Step SEM Settings Control Panel -> Frequency -> Span
Couplings	Span is coupled with RBW and VBW. It is recommended to set RBW and VBW to auto whenever changing the span by large factors.
Preset	None
Notes	Changing any frequency setting will trigger a re-sweep.

7.16.1.2 Bandwidth

These commands control the FFT processing for the receivers. These settings are highly coupled with the frequency range. Additionally, there are several RBW/VBW restrictions present based on device type and span.

Command	[:SENSe]:SEMask:BANDwidth[:RESolution] <freq>|UP|DOWN [:SENSe]:SEMask:BANDwidth[:RESolution]? [:SENSe]:SEMask:BANDwidth[:RESolution]:AUTO ON|OFF|0|1 [:SENSe]:SEMask:BANDwidth[:RESolution]:AUTO? [:SENSe]:SEMask:BANDwidth:VIDeo <freq>|UP|DOWN [:SENSe]:SEMask:BANDwidth:VIDeo? [:SENSe]:SEMask:BANDwidth:VIDeo:AUTO ON|OFF|0|1 [:SENSe]:SEMask:BANDwidth:VIDeo:AUTO?
Description	RESolution, Specify the RBW. If UP or DOWN is specified, the RBW is stepped in a 1/3/10 sequence. VIDeo, Specify the VBW. If UP or DOWN is specified, the VBW is stepped in a 1/3/10 sequence.
Examples	:SEMask:BAND:RES 10kHz :SENS:SEMask:BANDWIDTH:VIDEO 1e6 :SEM:BAND:VID? semask:band:vid:auto on

Software Controls	SEM Settings Control Panel -> Bandwidth -> RBW SEM Settings Control Panel -> Bandwidth -> Auto RBW SEM Settings Control Panel -> Bandwidth -> VBW SEM Settings Control Panel -> Bandwidth -> Auto VBW
Couplings	RBW is coupled with VBW and Span. RBW will also have additional restrictions depending on the active device. If you are changing the span by more than a large factor (>2-4) then it is suggested to set RBW and VBW to auto before changing span. VBW is also coupled with sweep time. In most cases, if sweep time implies a lower VBW settings, then the lower setting is used (internally only).
Preset	RBW is set to auto by default. VBW is set to auto by default.
Notes	Changing any bandwidth setting will trigger a re-sweep.

7.16.1.3 Amplitude

These commands affect the RF front end of the device.

Command	`[:SENSe]:POWer[:RF]:RLEVel <double>`
	`[:SENSe]:POWer[:RF]:RLEVel?`
	`[:SENSe]:POWer[:RF]:PDIVision <double>`
	`[:SENSe]:POWer[:RF]:PDIVision?`

Description	`RLEVel`, Set the reference level in dBm. `PDIVision`, specify the plot vertical division (1/10th of the plot height) as dB. Logarithmic scale only.
Examples	`:SEM:POWER:RF:RLEVEL -20` `:SEM:POW:PDIV 6`
Software Controls	SEM Settings Control Panel -> Amplitude -> Ref Level SEM Settings Control Panel -> Amplitude -> Div
Couplings	None
Preset	The default value of reference level is device dependent. Div is set to 10 by default.
Notes	Changing any of these settings will trigger a re-sweep.

7.16.1.4 Detector / Trace

These commands control the detector and trace settings of the receiver.

Command	`[:SENSe]:SEMask:SWEep:DETector:FUNCtion AVERage|MINMAX`
	`[:SENSe]:SEMask:SWEep:DETector:FUNCtion?`
	`[:SENSe]:SEMask:SWEep:DETector:UNITs POWer|SAMPle|VOLTage|LOG`
	`[:SENSe]:SEMask:SWEep:DETector:UNITs?`
	`:TRACe:SEMask:TYPE WRITe|MAXhold`
	`:TRACe:SEMask:TYPE?`

Description	`DETector:FUNCtion`, Controls how the VBW processing is performed. If average, overlapping FFTs are averaged together. If min/max, overlapping FFTs are min/max held.

	DETector:UNITs, Controls the units in which the detector function is performed in. TYPE, Specify the trace type. Select WRITE for the standard clear/write operation, and MAXHOLD to persist the maximum amplitudes at each frequency bin.
Examples	:SEM:SWEEP:DET:FUNC AVER :SEM:SWEEP:DETECTOR:FUNCTION? semask:sweep:det:unit pow :TRACe:SEMask:TYPE WRITE
Software Controls	SEM Settings Control Panel -> Detector / Trace -> Detector SEM Settings Control Panel -> Detector / Trace -> Video Units SEM Settings Control Panel -> Detector / Trace -> Trace Type
Couplings	The trace type determines the data that will be measured against the mask.
Preset	Detector is set to average by default. Detector units is set to power by default. Trace type is set to clear/write by default.
Notes	Changing any of these settings will trigger a re-sweep.

7.16.1.5 Measurement Reference

These commands control the configuration of the reference used in mask construction.

Command	[SENSe:]SEMask:REF:TYPE PSD|PEAK|DIRect [SENSe:]SEMask:REF:TYPE? [SENSe:]SEMask:REF:BANDwidth:MODE AUTO|MANual [SENSe:]SEMask:REF:BANDwidth:MODE? [SENSe:]SEMask:REF:BANDwidth <freq> [SENSe:]SEMask:REF:BANDwidth? [SENSe:]SEMask:REF:LEVEL <double> [SENSe:]SEMask:REF:LEVEL?
Description	REF:TYPE, Controls how the reference measurement is taken. PSD performs a channel power computation, PEAK does a peak search, and DIRECT uses the amplitude value set directly by user. REF:BANDwidth:MODE, Controls the mode of setting the width of the measurement band. AUTO chooses a value automatically, MANUAL uses a width entered by user. REF:BANDwidth, Controls the width of the measurement band in manual mode. REF:LEVEL, Controls the reference amplitude level in direct set mode.
Examples	:SEM:REF:TYPE PSD :SEM:REF:BANDWIDTH:MODE MAN :SEM:REF:BAND 100MHZ :SEMask:REF:BAND? semask:ref:level -20
Software Controls	SEM Settings Control Panel -> Measurement Reference -> Meas Type SEM Settings Control Panel -> Measurement Reference -> Width Set SEM Settings Control Panel -> Measurement Reference -> Width SEM Settings Control Panel -> Measurement Reference -> Reference
Couplings	The width mode sets whether the width is used for channel power and peak calculations. The reference measurement type determines whether the direct set level is used in measurement.
Preset	Reference measurement type is set to PEAK by default Width mode is set to AUTO by default.

Notes	Changing any of these settings will trigger a re-sweep.

7.16.2 Offset Table

These functions load data into offset tables in memory and read back offset table defining the current mask.

Command	`[SENSe:]SEMask:OFFSet:DATA <enabled1>, <startFreq1>, <stopFreq1>, <startLimit1>, <stopLimit1>, <mode1>, …` `[SENSe:]SEMask:OFFSet:DATA?`
Description	`OFFSet:DATA`, Specify the sets of offset parameters in the offset table in memory as the current mask. This will override any existing offsets. Offsets are specified as sets of six parameters: enabled: `ON|OFF|0|1` startFreq: `<freq>` startLimit: `<freq>` stopLimit: `<double>` startFreq: `<double>` mode: `RELative|ABSolute`
Examples	`:SEMASK:OFFSET:DATA 1, 13E6, 37E6, -13, -37, REL, OFF, 7MHZ, 11E6, -7, -11, ABSOLUTE`
Software Controls	Offset Table
Couplings	These offsets define the mask the trace is currently being tested against.
Preset	
Notes	

7.16.3 Measurement

These functions return measurements from spectrum emission mask mode, testing the trace against the current mask defined in the offset table.

Command	`[SENSe:]SEMask:CARRier:POWer?`
	`[SENSe:]SEMask:OFFSet:FAIL?`
	`[SENSe:]SEMask:OFFSet[1-16]:FAIL?`
	`[SENSe:]SEMask:OFFSet[1-16]:LOWer:FAIL?`
	`[SENSe:]SEMask:OFFSet[1-16]:UPper:FAIL?`
	`[SENSe:]SEMask:OFFSet[1-16]:MARgin?`
	`[SENSe:]SEMask:OFFSet[1-16]:MARgin:LOWer?`
	`[SENSe:]SEMask:OFFSet[1-16]:MARgin:UPper?`
	`[SENSe:]SEMask:OFFSet[1-16]:PEAK:LEVel:LOWer?`
	`[SENSe:]SEMask:OFFSet[1-16]:PEAK:LEVel:UPper?`
	`[SENSe:]SEMask:OFFSet[1-16]:PEAK:FREQuency:LOWer?`
	`[SENSe:]SEMask:OFFSet[1-16]:PEAK:FREQuency:UPper?`

Description	CARRier:POWer?, Retrieves the current power used as the reference for the masks. OFFSet:FAIL?, Returns 1 if mask fails, 0 if passes. OFFSet[1-16]:FAIL?, Returns 1 if specified offset fails, 0 if it passes. OFFSet[1-16]:LOWer:FAIL?, Returns 1 if lower range of specified offset fails, 0 if it passes. OFFSet[1-16]:UPper:FAIL?, Returns 1 if upper range of specified offset fails, 0 if it passes. OFFSet[1-16]:MARgin?, Retrieves worst margin (limit - peak) of specified offset. OFFSet[1-16]:MARgin:LOWer?, Retrieves margin (limit - peak) of lower range of specified offset. OFFSet[1-16]:MARgin:UPper?, Retrieves margin (limit - peak) of upper range of specified offset. OFFSet[1-16]:PEAK:LEVel:LOWer?, Retrieves peak level of lower range of specified offset. OFFSet[1-16]:PEAK:LEVel:UPper?, Retrieves peak level of upper range of specified offset. OFFSet[1-16]:PEAK:FREQuency:LOWer?, Retrieves frequency at peak of lower range of specified offset. OFFSet[1-16]:PEAK:FREQuency:UPper?, Retrieves frequency at peak of upper range of specified offset.
Examples	:SEMASK:CARR:POW? :SEM:OFFSET:FAIL? :SEM:OFFS7:MARGIN? :SEM:OFFS7:PEAK:LEVEL:LOWER? :SEM:OFFS7:PEAK:FREQ:UPPER?
Software Controls	Reference, Results
Couplings	None
Preset	
Notes	

7.16.4 Marker

The marker commands control the marker in spectrum emission mask mode.

Command	:CALCulate:SEMask:MARKer:STATe ON|OFF|0|1 :CALCulate:SEMask:MARKer:STATe? :CALCulate:SEMask:MARKer:DELTa ON|OFF|0|1 :CALCulate:SEMask:MARKer:DELTa? :CALCulate:SEMask:MARKer:X <freq> :CALCulate:SEMask:MARKer:X? :CALCulate:SEMask:MARKer:Y? :CALCulate:SEMask:MARKer:MAXimum :CALCulate:SEMask:MARKer:MINimum :CALCulate:SEMask:MARKer:NEXT :CALCulate:SEMask:MARKer:PREVious
Description	STATe, Turn the marker on/off.

	DELTa, When delta is enabled, the delta reference takes the current marker position and the marker measurement returns the delta frequency and amplitude between the current marker position and the delta reference. X, Move the marker position to the specified frequency. X?, Retrieve the marker position frequency as Hz. Y?, Retrieve the marker position amplitude. MAXimum, Perform a peak search. MINimum, Perform a minimum search. NEXT, Move marker to next graph on plot. PREVious, Move marker to previous graph on plot.
Examples	CALC:SEM:MARK:STAT ON CALC:SEM:MARK:X 1GHz CALC:SEM:MARK:DELTA ON CALC:SEM:MARK:Y? CALC:SEM:MARK:MAX CALC:SEM:MARK:NEXT
Software Controls	Plot -> Left-Click Plot Context Menu -> Disable Marker Plot Context Menu -> Place Delta Marker Plot Context Menu -> Disable Delta Marker Plot -> Marker Readout Plot Context Menu -> Peak Search Plot Context Menu -> Minimum Search Plot -> Down Arrow Plot -> Up Arrow
Couplings	
Preset	Marker is disabled.
Notes	Changing the state of a marker will take effect immediately. For example, a peak search (MAXimum) command will move the marker immediately and allow you to request the updated frequency and amplitude without needing to re-sweep.

7.17 WLAN Measurements

These commands control the receiver and measurement configuration in the WLAN measurement mode.

7.17.1 Configuration

7.17.1.1 Measurement

These commands affect the demodulation and receiver parameters of the measurement.

Command	[:SENSe]:WLAN:STANdard BG | AG | N20 | N40 | AC20 | AC40 [:SENSe]:WLAN:STANdard? [:SENSe]:WLAN:FREQuency:CENTer <freq> [:SENSe]:WLAN:FREQuency:CENTer? [:SENSe]:WLAN:FREQuency:CENTer:STEP[:INCRement] <freq> [:SENSe]:WLAN:FREQuency:CENTer:STEP[:INCRement]?

	[:SENSe]:WLAN:IFBW <freq> [:SENSe]:WLAN:IFBW? [:SENSe]:WLAN:POWer[:RF]:RLEVel <double> [:SENSe]:WLAN:POWer[:RF]:RLEVel?
Description	STANdard, Select the WLAN modulation standard. CENTer, Specify the center frequency of the WLAN measurement. CENTer:STEP[:INCRement], Specify the center frequency step size. IFBW, Specify the IF bandwidth of the measurement. This is applied as a low pass filter before the WLAN demodulation occurs. POWer[:RF]:RLEVel, Specify the reference level of the measurement in dB. This controls the sensitivity of the measurement.
Examples	:WLAN:STAN N20 :WLAN:FREQ:CENT 2.442GHz :WLAN:FREQ:CENT:STEP 20MHz :WLAN:IFBW 20MHz :WLAN:POW:RLEV -20
Software Controls	WLAN Settings Control Panel -> Standard WLAN Settings Control Panel -> Carrier Freq. WLAN Settings Control Panel -> Step Freq WLAN Settings Control Panel -> IF BW WLAN Settings Control Panel -> Ref Level
Couplings	None
Preset	
Notes	

7.17.1.2 Trigger

These commands affect the triggering and capturing parameters of the measurement.

Command	:TRIGger:WLAN:SLENgth <time> :TRIGger:WLAN:SLENgth? :TRIGger:WLAN:IF:LEVel <double> :TRIGger:WLAN:IF:LEVel?
Description	SLENgth, Specify the measurement capture length. IF:LEVel, Specify the video trigger level in dBm.
Examples	:TRIG:WLAN:SLEN 100ms :TRIG:WLAN:IF:LEV -40
Software Controls	WLAN Settings Control Panel -> Search Len WLAN Settings Control Panel -> Trigger Level
Couplings	None
Preset	
Notes	

7.17.2 Fetch Results

This command is used to retrieve the results of a WLAN measurement.

Command	`:FETCh:WLAN? <int>`
Description	`FETCh:WLAN`, Fetch WLAN demodulation metrics. The integer parameter specifies the metric to retrieve. Possible integer values are below. Can specify a list of metrics to request as comma separated list. The metrics will be returned as a comma separated list in the order they were requested. When the WLAN standard is set to 802.11 a/n/ac, the integers below correspond to the following measurement results. 1. Modulation as text 2. Modulation encoding as text 3. Guard interval as text 4. Frequency error as Hz 5. EVM as % 6. EVM as dB 7. Avg Power as dBm 8. Peak Power as dBm 9. Crest factor 10. Initial scrambler state 11. Symbol count 12. Payload bit count When the WLAN standard is set to 802.11 b, the integers below correspond to the following measurement results. 1. Modulation as text 2. Preamble as text 3. Payload bit count 4. EVM as % 5. EVM as dB 6. Freq error as Hz 7. Avg power as dBm 8. Peak power as dBm 9. Crest factor
Examples	`:FETC:WLAN 1,2,3,4,5,6` `:FETC:WLAN 1`
Software Controls	
Couplings	None
Preset	
Notes	