

User Guide

Remote Spectrum Monitor

MS2710xA

9 kHz to 6 GHz



Introduction

This documentation provides a description of the Anritsu Remote Spectrum Monitor MS2710xA software. It describes the graphical user interface, provides a how-to chapter to set up measurements, discusses SCPI programming, and covers a lists of SCPI programming commands.

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Appendix B—SCPI Command Listing

Chapter 1 — Graphical User Interface

1-1 Overview

Each model of remote spectrum monitors contains an embedded web server. Using a browser (Google Chrome and Firefox are supported), users can access the graphical user interface (GUI) and send control commands to the remote spectrum monitor. Tabs and Setup Panels can change location in the web browser depending on the size of the browser.

The following figure illustrates some of the key information areas of the Remote Spectrum Monitor GUI. The graphical user interface primary components are:

- Web Address
- Instrument Settings Summary
- Measurement Display
- Spectrogram
- Setup Panels

The secondary components on the GUI include:

- Instrument Model Number
- GPS position of the Remote Spectrum Monitor
- Date and Time
- Start/Stop/Center Frequency
- Markers
- Limit Lines

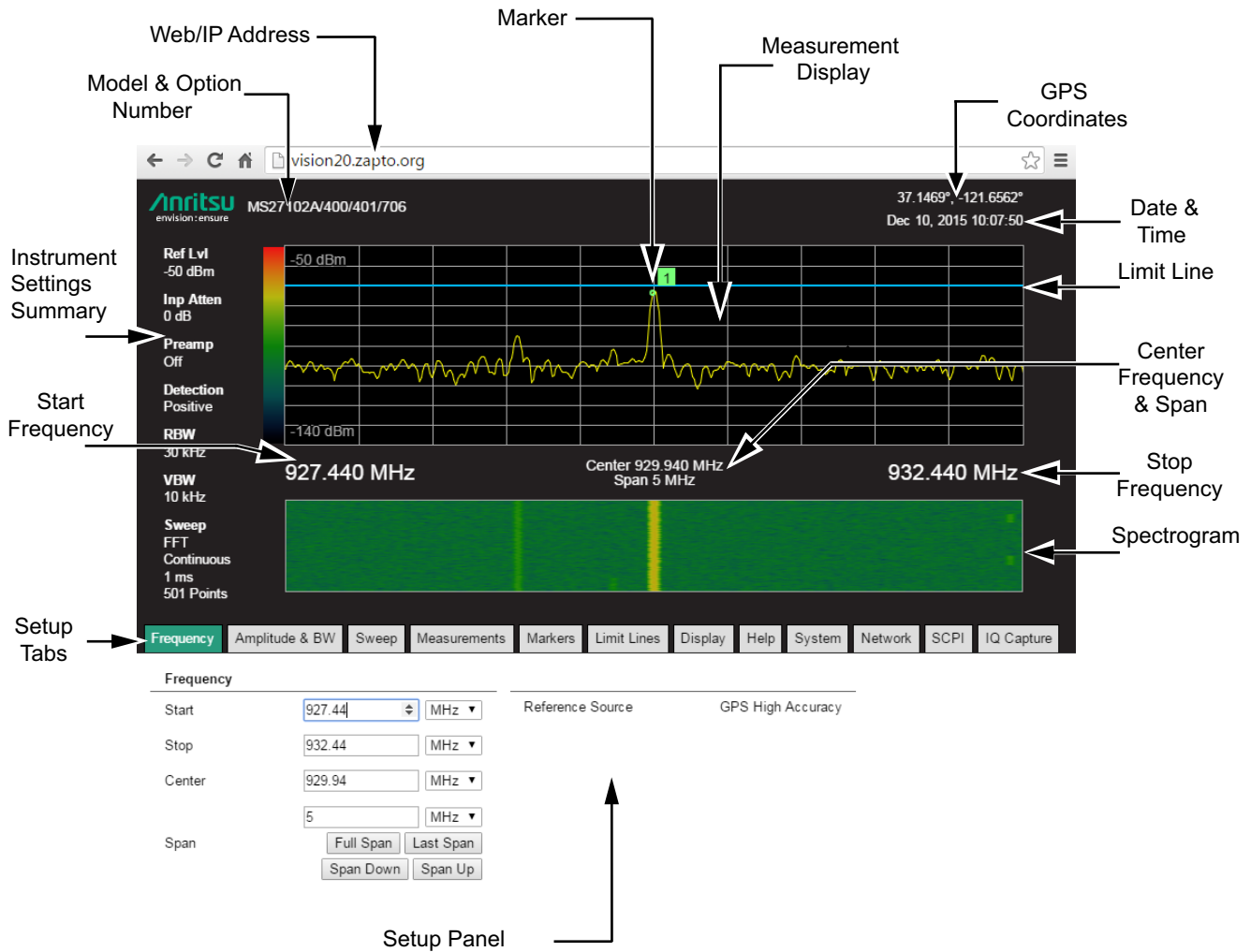


Figure 1-1. Remote Spectrum Monitor GUI Overview

Web Address

This is the IP address of the Remote Spectrum Monitor. The IP address of the instrument can be entered into the Web Browser's address window and the Remote Spectrum Monitor web server will display.

Instrument Settings Summary

The Settings Summary lists the current settings for the reference level, input attenuation, RBW, VBW, sweep mode and type, and display points of the instrument.

Measurement Display

The measurement display (sweep window) provides measurement trace data. Markers and limit lines are also displayed here. Above the top left corner of the display is the Remote Spectrum Monitor's model number. Next to the Model Number is a listing of options (if any) for the instrument. Above the top right corner of the display is the GPS location of the Remote Spectrum Monitor and the current date and time. At the bottom left and right corners of the display are the start and stop frequencies. At the center are the center frequency and span. Adjacent to the left edge of the display is a color bar that indicates the power level of the trace and is reflected in the spectrogram. An image of the measurement display can either be saved or copied by right clicking on the display and selecting the desired function from the pop-up menu.

Spectrogram

Spectrogram is a representation of the frequency spectrum as it varies with time. Color is used to represent power levels. This feature is useful for identifying intermittent interference and for observing changes in frequency over time.

1-2 Setup Panels

This row of tabs open up the panels for setting up measurement parameters, display, system and network configurations. The green tab denotes the open panel. Click on green tab or double-click on a gray tab to remove the setup panels from view and increase the display area. Click on any tab to return the setup panels into view.

Frequency

Use the Frequency Panel to set up the start, stop, and center frequency of the trace displayed.

You can also set the Span by entering a value or by setting the span using the preset buttons:

- Full Span
- Last Span
- Span Down
- Span Up

Amplitude & Bandwidth

Set both the amplitude and bandwidth parameters for measurement.

Sweep

Select the Sweep tab to set Trace parameters and Sweep parameters.

Measurements

Select this tab to do additional post-processing calculations on the spectrum data.

Markers

Set up markers on the trace displayed. Useful in marking specific frequencies or amplitudes. Eight markers are available for trace analysis.

Limit Lines

Create and edit limit lines using buttons, input boxes and a table. An audible alarm can also be set.

Display

There are two types of display controls, display resolution and color management. There is also a check box to turn on/off the Spectrogram.

File

Opens the panel to file management functions - Save, Recall, Copy and Delete.

Help

Access the Remote Spectrum Monitor Help or SCPI Programming Commands and Errors.

System

Select this tab to perform firmware updates, presets, and other functions that affect the whole system. This panel also contains system information like firmware version, and Remote Spectrum Monitor GPS status. Here the GPS supply voltage can be set to 3.3 V or 5 V.

When a System Preset is initiated the system is restored to factory default settings. See [Table 1-1 Primary Factory Settings](#).

Table 1-1. Primary Factory Settings

Parameter	Value
Start Frequency	0 Hz
Stop Frequency	6 GHz
Center	3 GHz
Span	6 GHz
RBW	3 MHz
VBW	1 MHz
SPAN/RBW	100
RBW/VBW	3
VBW type	Linear
Reference Level	+10 dBm
Reference Level Offset	0 dB
Y-Axis Scale	10 dB/div
Attenuation	30 dB
Preamp	Off
Detection	Positive
Antenna Number	1
Trace Operation	Normal
Sweep Type	Continuous
Sweep Mode	No FFT
Display Point Count	501
Font Size	10 pt
Show Spectrogram	Yes
GPS Supply Voltage	3.3V

Network

Select this tab to configure and view the instrument's Ethernet and dynamic DNS settings.

SCPI

The SCPI tab opens a console where users can directly type in SCPI commands and view the response of SCPI queries, or execute a sequence of commands contained in a text file. The console also reflects any SCPI commands that were sent as a result of interacting with a control on a different tab. For more information refer to [Chapter 3, "Programming with SCPI"](#).

IQ Capture

The IQ Capture measurement captures raw data, magnitude/phase or real/imaginary, components of a waveform. See [Figure 1-2, "IQ Capture Measurement Sample"](#). Select this tab to configure the parameters for IQ Capture and to view captured data in the Data Display.

Note Information in the Instrument Setting Summary updates only after a capture has been completed.

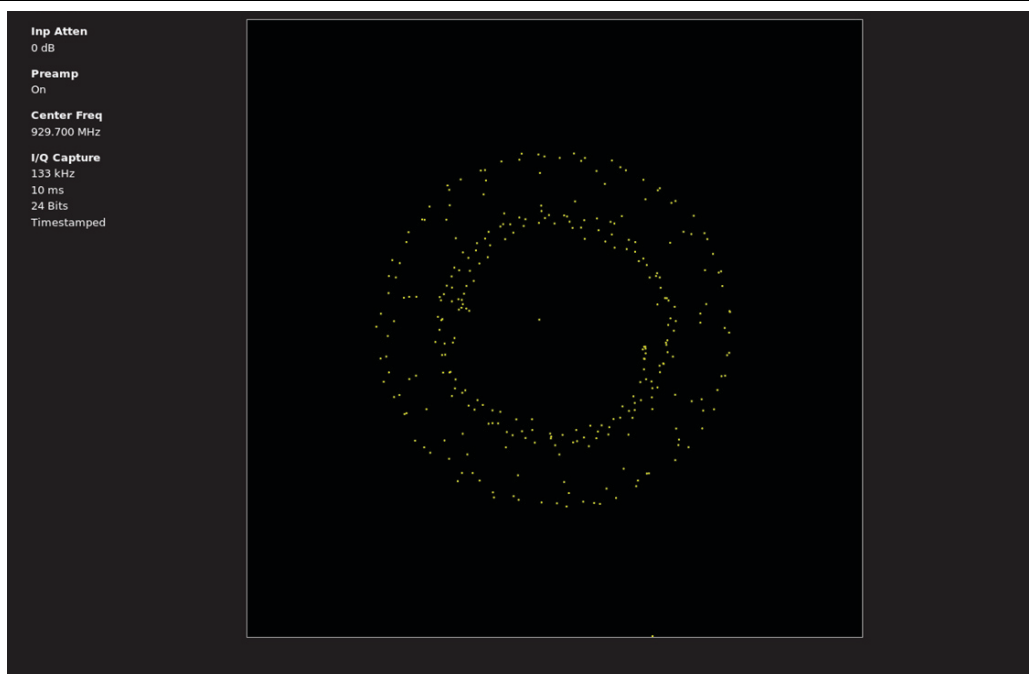


Figure 1-2. IQ Capture Measurement Sample

Chapter 2 — How To

2-1 Set the Measurement Frequency

The frequency settings are displayed on the left and right bottom edges of the measurement display.

Using Start and Stop Frequencies

1. Select the **Frequency** tab.
2. Enter the start frequency in the **Start** entry box.
3. Click the **Units** list associated with the start frequency entry box.
4. Select the desired Unit - Hz, kHz, MHz, or GHz. Typing the first letter of the units after typing the number will display the corresponding unit in the Units list box. For example, typing 700M automatically enters 700 MHz.
5. Enter the start frequency in the **Stop** entry box.
6. Click the **Units** list associated with the stop frequency entry box.
7. Select the desired Unit - Hz, kHz, MHz, or GHz.

Entering Center Frequency

1. Select the **Frequency** tab.
2. Enter the center frequency in the **Center** entry box.
3. Click the **Units** list associated with the start frequency entry box.
4. Select the desired Unit - Hz, kHz, MHz, or GHz.

Entering Span

1. Select the **Frequency** tab.
2. Enter the center frequency in the **Span** entry box.
3. Click the **Units** list associated with the start frequency entry box.
4. Select the desired Unit - Hz, kHz, MHz, or GHz.
5. There are also buttons for Full Span, Last Span, Span Down, and Span Up.
 - **Full Span:** Sets the span to cover the entire tunable spectrum of the instrument.
 - **Last Span:** Returns the span to the most recent span value immediately before a change was made.
 - **Span Down:** Span Down 1-2-5. This is a convenient way to narrow the frequency span. The first time this button is pressed, the span value decreases to the nearest even value that starts with 1, 2, or 5. For example, if the span is 1.8 MHz, then pressing this button for the first time changes the span to 1.0 MHz, and the next press takes the value to 500 kHz, then 200 kHz, and so on.
 - **Span Up:** Span Up 1-2-5. This is a convenient way to quickly arrive at a wider span value. The first time the button is pressed, the span value increases to the nearest even value that starts with 1, 2, or 5. For example, if the span is 1.8 MHz, then pressing this button for the first time changes the span to 2.0 MHz, and the next press takes the value to 5.0 MHz, and so on.

2-2 Set the Measurement Bandwidth and Amplitude

Set the Frequency Bandwidth

1. Click the **RBW** list box. Select the desired RBW or check the box next to Auto to have the RBW set automatically.
2. Click the **VBW** list box. Select the desired VBW or check the box next to Auto to have the VBW set automatically.
3. Enter the desired Span/RBW ratio in the **Span/RBW Ratio** entry box.
4. Enter the desired RBW/VBW ratio in the **RBW/VBW Ratio** entry box.
5. Enter the desired VBW type in the **VBW Type** entry box.

Set the Amplitude

1. Select the **Amplitude & BW** tab.
2. Enter a Reference Level value in the **Reference Level** entry box. Or, you can press the up/down arrow buttons to incrementally raise or lower the current value in the box.
3. Enter a Reference Level Offset (db Ext Gain) value in the **Reference Level Offset (db Ext Gain)** entry box. Or, you can press the up/down arrow buttons to incrementally increase or decrease the current value in the box.
4. Enter a Y-Axis scale value in the **Set the Y-Axis Scale (dB/div)** entry box.
5. From the **Units** drop-down list, select **dBm** or **dBuV**.

Set the Input

1. Set the Attenuation by clicking on the list and selecting the desired attenuation value. Or, check the box next to **Auto** to have Attenuation set automatically.
2. If the use of the Preamp is desired, click the **Preamp** check box. If attenuation is set to Auto, then the Preamp can only be enabled for Reference Levels -40 dBm or lower.
3. Set the input detection by clicking the **Detection** list and selecting the desired state of detection - Positive, Negative or RMS.
4. Set the **Antenna Number** to the number of antenna ports on your instrument.

2-3 Set Sweep Parameters

Trace

In trace average, the number of traces to average is specified in the Average Count box. The resulting trace then shows a moving average over X number of sweeps. For instance if the average count is set to “10”, then trace average shows a moving average over 10 sweeps. The average is continuously updated as new sweep data is acquired.

Operation

- **Normal:** Displays data for the current trace sweep.
- **Min Hold:** Shows the cumulative minimum value of each display point over many trace sweeps.
- **Max Hold:** Shows the cumulative maximum value of each display point over many trace sweeps.
- **Average:** Shows an exponential average of a number of traces, determined by the number entered in Average Count.
- **Rolling Max:** Rolling max displays the max over a set number of sweeps. The number of sweeps is also specified in the average count box.
- **Rolling Min:** Rolling min displays the max over a set number of sweeps. The number of sweeps is also specified in the average count box.

Average Count

Sets the number of traces for use in calculating the average display value. The number used for averaging ranges from 1 to 65535.

Single/Continuous Sweep

In single sweep mode, after the sweep, the instrument waits in Hold mode until the **Initiate** button is pressed. Change the Sweep Type by selecting the radio button for Single or Continuous.

Sweep Modes

Two sweep modes are available on the instrument - FFT or No FFT (default). Press the radio button for the desired Sweep Mode. Review the table below to help determine which mode to use for the current measurement.

Table 2-1. Sweep Modes Table

	FFT	No FFT
Sweep Speed	Fastest	Slowest
Capturing Short Burst	Better	Good
Amplitude Accuracy	Good	Specified
Spurious	Good	Best
FFT Artifacts	Small	None
Frequency Accuracy	Excellent	Excellent

2-4 Configure Measurements

When initially run, the active measurement is spectrum. Occupied Bandwidth or Channel Power Measurement are other measurements that can be selected for testing. For an overview of SCPI programming and example programs refer to [Chapter 3, “Programming with SCPI”](#). For the list of SCPI commands and their description select the Help tab in the Remote Spectrum Monitor GUI.

Occupied Bandwidth

Occupied Bandwidth (OBW) is a common measurement performed on radio transmitters. This measurement calculates the bandwidth containing the total integrated power occupied in a given signal bandwidth. There are two different methods of calculation depending upon the technique used to modulate the carrier.

- % Integrated Power Method: The occupied frequency bandwidth is calculated as the bandwidth containing the specified percentage of the transmitted power.
- >dB Method: The occupied frequency bandwidth is defined as the bandwidth between the upper and lower frequency points at which the signal level is a desired number of dB below the peak carrier level.

SCPI Commands

Configure : Configures the default occupied bandwidth measurement. Disables any other active one-button measurements, including channel power, ACPR, AM/FM demodulation and C/I. Sets the method to %. Sets the % of power to 99%. Sets the instrument to single sweep mode (:INITiate:CONTinuous: OFF). Measurement settings can be modified by using the [:SENSe]:OBWidth commands before initiating a sweep. Note that this measurement is not valid in zero span.

Fetch: Returns the most recent occupied bandwidth measurement results: occupied bandwidth, percent of power and dB down. One of either percent of power or dB down is measured and the other is set. That is determined by the value set using [:SENSe]:OBWidth:METhod. If the instrument is sweeping, it will not return until the sweep is complete. If the instrument is not sweeping and the current data is not valid it will return error -230. This could occur if there was a *RST immediately before the :FETCh? or if a measurement parameter was changed without an :INITiate. If the measurement is not enabled with :SENSe:OBWidth:STATe then, the instrument will indicate error -400 and return the string "nan,nan,nan".

Method: Select either Percent (% Integrated Power Method) or X dB (dB Method).

Percent: If Percent is selected, enter the desired value.

Channel Power Measurement

SCPI Commands

- Configure:** Configures the default channel power measurement. Disables any other active one-button measurements, including ACPR, occupied bandwidth, AM/FM demodulation and C/I. Sets the integration bandwidth equal to the span. Sets the detection method to RMS. Sets the instrument to single sweep mode (:INITiate:CONTinuous OFF). Measurement settings can be modified by using the [:SENSe]:CHPower commands before initiating a sweep. Note that this measurement is not valid in zero span.
- Fetch:** Returns the most recent channel power measurement result. It returns only the channel power, not the channel power density. Use FETCh:CHPower? to get both channel power and channel power density. If the instrument is sweeping, it will not return until the sweep is complete. If the instrument is not sweeping and the current data is not valid it will return error -230. This could occur if there was a *RST immediately before the :FETCh? or if a measurement parameter was changed without an :INITiate. If the measurement is not enabled with [:SENSe]:CHPower:STATE then, the instrument will indicate error -400 and return the string "nan,nan"
- Measure:** Sets the active measurement to channel power, sets the default measurement parameters, triggers a new measurement and returns channel power as the result. To measure both channel power and channel power density use MEASure:CHPower? It is a combination of the commands :CONFigure:CHPower; :READ:CHPower? For a description of the default channel power measurement parameters see :CONFigure:CHPower. To make a channel power measurement with settings other than the default values, send ::CONFigure:CHPower Commands to set desired settings :READ:CHPower?.
- Read:** Triggers a new channel power measurement and returns the channel power result:channel power and channel power density. It is a combination of the commands :ABORT; :INITiate; :FETCh:CHPower? It aborts any current triggering sequence and sets the trigger state to idle. It then initiates a new active measurement (i.e. begins the collection of new data). The channel power measurement must be the active measurement (specified by the command :CONFigure:CHPower). Data returned is :channel power. If the measurement is not active, the instrument will indicate error -400 and return the string "nan"; If :INITiate command fails it returns a string "nan".

Integration Bandwidth

Set the integration bandwidth appropriate for the particular application. Select the desired unit from the drop-down list.

2-5 Set Up Markers

1. Select the **Markers** tab to display the Markers Setup Panel.
2. Click the check box of the desired Marker.
3. Click on the **frequency** entry box. A horizontal line is
4. Setting the frequency:
 - Type the desired frequency and units into the box.
 - Move the horizontal line cursor onto the trace at the desired point and click the left mouse button. The frequency value of that point is entered into the marker table. In the display, a red marker is created with it labeled 1, 2, 3, 4, 5, 6, 7, or 8.

In either type of entry, the amplitude of the trace of the entered frequency will be automatically entered into the Amplitude box. If a frequency entry box is selected, the associated marker will be red. Markers with unselected frequency boxes are colored green. Hide and deselect the marker/s by clicking on the desired check box.

2-6 Set Up Limit Lines

The Limit Line setup panel allows you to create upper limit lines. An unlimited number of limit lines can be created. Limit lines are automatically entered into a table. The active editable limit line is green with larger end circles. The active line can be re-positioned on the measurement display. Place the cursor on the measurement display. Move the cursor and the limit line will move accordingly.

The limit lines shown in the display represent a 'limit being edited' and are not active on the instrument until set with the Apply button. The Apply button must be pressed before any changes made to the limit configuration or state take effect.

Limit Configuration

- **Enable Limit Checking:** Click the check box to enable the limit checking feature. A red note will display when a signal amplitude crosses the limit line. If the feature “Play a sound when a limit fails” is checked, a beep will also occur.
- **Relative Frequencies:** Click to set the values of the start and stop frequencies relative to the center frequency.
- **Relative Amplitudes:** Click this check box to set the limit line amplitude relative to the top amplitude line value in the display.

Audible Limit Alarm

- **Play a sound when a limit fails:** When checked, a beep will occur when the limit line is violated.
- **Limit Sound Volume:** Move the control bar to adjust the volume.

Limit Segments

- **Add Limit Row:** Press to automatically places a line in the center of the measurement display. The length of the line is 50% of the start and stop frequencies.
- **Delete Limit Row:** Highlight a limit line in the limit line table. The line will turn green. Press this button to remove it from the measurement display and limit line table.
- **Copy:** Replicates the active line. A the copied line green line will be drawn over the original line. The original line will be colored blue. To get a quick view the new line, change its amplitude. Then drag it to the desired position.
- **Draw:** Turns the cursor into a pencil. Draws only one segment.
- **Split:** Halves the highlighted row/line into two segments.
- **Apply:** Applies all edited limit segments, synchronizing them to the instrument and saving the limits to a file on the instrument that can be restored at a later time with the “Restore Last” button. Any changes made to the limit segments in this editor must be applied before they will take effect on the instrument.
- **Restore Last:** Loads the last applied limit state into the instrument and synchronizes the limits to the measurement display and limit segment table. This function implicitly applies the restored limit, so it is not necessary to apply the restored limit for it to take effect.

Edit the frequency or amplitude value of the limit line by clicking the limit line in the limit line table. Then change its values in the **Line Segments** section of this setup panel. After a value has been entered, press on the “check” button to use the value or press the “x” button to cancel the entry.

2-7 Configure the Display

Set The Display Resolution

To change the trace point count in the measurement display window and spectrogram, enter a value in the box labeled **Display Point Count**. Changing this value will have an inverse effect on sweep speed. An increase in the number of measurement points reduces the sweep speed while a decrease in points results in a faster sweep. Change the font size of the text in the measurement display, settings summary, tabs and setting panels by clicking on the pull-down list and selecting the desired font size. Click the check box for **Show Spectrogram** if you want the spectrum bar on the y-axis and spectrogram displayed.

Set the Display Correction

Adjust Brightness, Contrast, and Saturation by moving the their respective sliders. Press the **Reset Corrections** button to return the values to default.

2-8 Manage Measurement Files

Press the File tab to manage the setup, measurement, limit line files using the Save, Copy, Recall, and Delete functions. For the Save, Recall, and Copy Functions there are selectable file types. File types vary with instrument modes. These file types are -

- **Setup:** Setup files contain basic instrument information, measurement mode setup details, measurement marker data, and limit data.
- **Measurement:** Measurement files contain all of the information in the setup files and the measurement data.
- **Limit Lines:** The Limit Lines file contains limit line data details.
- **All:** Displays all file types.

Note

If there are two USB memory sticks attached to the instrument, they will be listed as USB0 and USB1 on the drop-down list.

Save

1. Press the drop-down arrow for **File Type** to display the list of file types - Setup, Measurement, and Limit Lines.
2. Select the desired file type.
3. Press the drop-down arrow for **File Location** to select the destination location to save the file - PC/Server, Internal, or USB0.
4. Select the destination location. If PC/Server is selected, the Save File entry window will be grayed and inactive. The file will be placed in the Download folder of the PC when saved.
5. Press **Save**. The file is saved to the destination folder.

Copy

1. Press the drop-down arrow for **From** to select the source location of the file - PC/Server, Internal, or USB0.
2. Select the desired source location.
3. Press the drop-down arrow for **To** to select the destination location of the file - PC/Server, Internal, or USB0.
4. Select the destination folder. If PC/Server is selected, the Save File entry window will be grayed and inactive. The file will be placed in the Download folder of the PC when copied.
5. Press the **Choose** button for Source.
6. In the Source File dialog, navigate to the file and press **Choose**.
7. Press the **Choose** button for Destination.
8. In the Destination File dialog, navigate to the folder and press **Choose**.
9. Press **Copy**. The selected file is copied from the designated source folder to the designated destination folder.

Note	You cannot copy a file from PC/Server to PC/Server. The Source, Destination entry windows and the Copy button will be grayed become inactive.
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Recall

1. Press the drop-down arrow for **File Type** to display the of file types - All, Setup, Measurement, Limit Lines.
2. Select the desired file type.
3. Press the drop-down arrow for **File Location** to select the source location for the file - PC/Server, Internal, or USB0.
4. Select the source location.
5. Press **Choose** for Recall File.
6. In the Recall File dialog, navigate to the desired file and press **Choose**.
7. Press **Recall**. The selected file is recalled.

Delete

1. Press the drop-down arrow for **File Location** to select the source location for the file - Internal or USB0.
2. Select the source location.
3. Press **Choose** for Delete File
4. Navigate to the desired file or folder in the Delete File Or Directory dialog and press **Choose**.
5. Press **Delete**. The file or folder will be deleted from source location.

2-9 Access the Help Panel

Select the **Help** tab to view links to this Help file and SCPI Programming documents.

2-10 Configure the System

To return the instrument to its original default settings, press the **System Preset** button.

Power down and then power up the instrument using the **Reboot** button. (Network connectivity could be lost during this function. If the unit is configured for DHCP, then its IP address could also change after the reboot.)

Set the supply voltage for the GPS antenna in use by clicking on the **GPS Supply Voltage** list and selecting the desired voltage.

Press the **Check for Updates** button to check for recent releases of firmware. A simple check will be done by the software server to see what version of software is on the instrument. If the current firmware is up to date, you will be notified that it is. If not, a dialog will display and state that new firmware is available. Press the **Install Update** button to install the new firmware. The Advanced check box opens a firmware list - the current release, new firmware if available, and previously released versions of firmware. Select the desired firmware version and press the **Update to Selected** button.

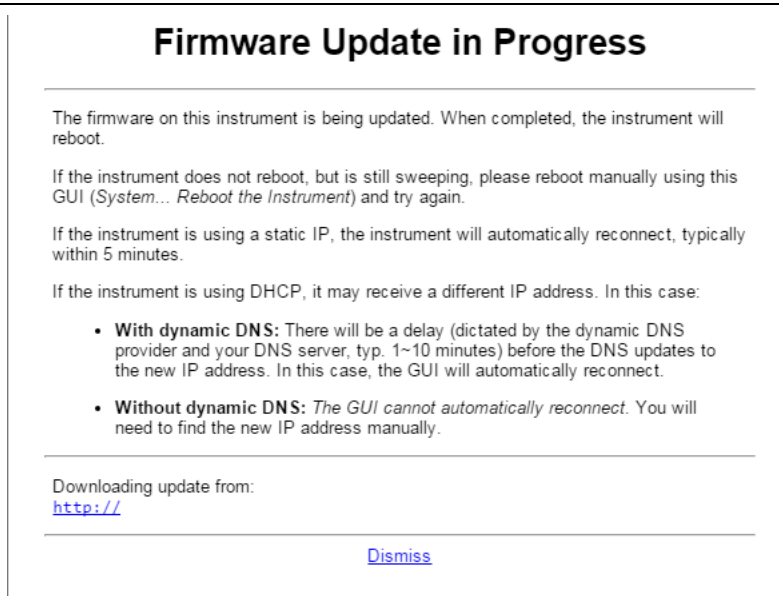


Figure 2-1. Firmware Update in Progress Dialog

2-11 Configure the Network

Ethernet

The Ethernet default is set to Static IP. The default Static IP is 10.0.0.2. To change static IP addresses, click on the **IP Address Allocation** list box in the Network tab and select Static. Three entry boxes will be listed - Static IP, Static Subnet and Static Gateway. Fill them with their respective information and then press the **Apply Ethernet Configuration** button.

To change to DHCP, click on the **IP Address Allocation** list box and select DHCP. Then press the **Apply Ethernet Configuration** button. This setting will automatically obtain an IP address from the DNS server. Refer to the Quick Start Guide to find the assigned DHCP IP address on your network.

Dynamic DNS

The information regarding Host, Username, and Password, should be obtained from the person setting up the network for remote spectrum monitoring. When the information is obtained and entered, press the **Apply Dynamic DNS Settings** button. Currently, only the www.no-ip.com Dynamic DNS service provider is supported.

2-12 Execute SPCPI Commands

Opening the SCPI panel, a list of recent executed SCPI commands are displayed. Individual or script commands can be executed within this panel.

Execute a SCPI Command

1. Type a SCPI command in the **Enter SCPI Command** entry window.
2. Press **Send**. The SCPI command is executed and listed in the executed command list above.

Execute a SCPI Script

1. Press the **Choose Files** button in line with Execute SCPI script.
2. Navigate to and select the desired SCPI script from Open dialog window.
3. Press **Open** and the script is immediately executed.

2-13 IQ Capture

Configure the following capture parameters and execute a capture.

Configure IQ Capture

IQ Bit

This sets the grid resolution for the display. Select the desired value from the pull-down list. The higher the number, the more positions the sample data (dots) can be in.

IQ Bandwidth

IQ Bandwidth is the rate of data to be collected for the duration of the IQ length. Select the desired value from the pull-down list.

IQ Length

This is the duration of the waveform capture. The GUI and data window can only display 1000 samples or data points. To view the additional data samples, click on the Download full IQ data in CSV format link to save the file. The maximum allowable capture period is 10 seconds.

IQ Capture

Start Capture

Press this button to execute a capture.

Note

Confirm that the SCPI port is not in use. The SCPI port is used during IQ Capture because of the large amount of data being collected. A red notice will appear if the data capture is interrupted. "Resource unavailable. Is somebody using the SCPI Port?"

Download full IQ data in CSV format

Click this link to download all of the captured data into a CSV format file. The file is titled traceIqData.csv and saved to the Download folder.

Chapter 3 — Programming with SCPI

3-1 Introduction

This chapter provides an introduction to Standard Commands for Programming Instruments (SCPI) programming that includes descriptions of the command types, hierarchical command structure, command subsystems, data parameters and notational conventions.

3-2 Remote Programming Setup and Interface

Remote programming and operation of the instrument is accomplished via the Ethernet. The following sections provide information about the interface connections, cable requirements, and remote operation setup.

Caution	Consult with your network administrator when configuring the network interface to avoid potential loss of access or discovery of the device.
----------------	--

Ethernet Interface Connection and Setup

The MS2710xA fully supports the IEEE-802.3 standard. Most instrument functions (except power on/off) can be controlled via an Ethernet connection to a PC connected directly (with an Ethernet cross-over cable) or through a network. The instrument software supports the TCP/IP network protocol. Ethernet networking uses a bus or star topology in which all of the interfacing devices are connected to a central cable called the bus, or are connected to a hub. Ethernet uses the CSMA/CD access method to handle simultaneous transmissions over the bus. CSMA/CD stands for *Carrier Sense Multiple Access/Collision Detection*. This standard enables network devices to detect simultaneous data channel usage, called a *collision*, and provides for a contention protocol. When a network device detects a collision, the CSMA/CD standard dictates that the data is retransmitted after waiting a random amount of time. If a second collision is detected, the data is again retransmitted after waiting twice as long. This is known as exponential back off.

The TCP/IP setup requires the following:

- **IP Address:** Every computer and electronic device in a TCP/IP network requires an IP address. An IP address has four numbers (each between 0 and 255) separated by periods. For example: 128.111.122.42 is a valid IP address.
- **Subnet Mask:** The subnet mask distinguishes the portion of the IP address that is the network ID from the portion that is the station ID. The subnet mask 255.255.0.0, when applied to the IP address given above, would identify the network ID as 128.111 and the station ID as 122.42. All stations in the same local area network should have the same network ID, but different station IDs.
- **Default Gateway:** A TCP/IP network can have a gateway to communicate beyond the LAN identified by the network ID. A gateway is a computer or electronic device that is connected to two different networks and can move TCP/IP data from one network to the other. A single LAN that is not connected to other LANs requires a default gateway setting of 0.0.0.0. If you have a gateway, then the default gateway would be set to the appropriate value of your gateway
- **Ethernet Address:** An Ethernet address is a unique 48-bit value that identifies a network interface card to the rest of the network. Every network card has a unique Ethernet address (MAC address) permanently stored into its memory.

Interface between the instrument and other devices on the network is via a category five (CAT-5) interface cable connected to a network. This cable uses four twisted pairs of insulated copper wires terminated into an RJ45 connector. CAT-5 cabling is capable of supporting frequencies up to 100 MHz and data transfer speeds up to 1 Gbps, which accommodates 1000Base-T, 100Base-T, and 10Base-T networks. CAT-5 cables are based on the EIA/TIA 568 Commercial Building Telecommunications Wiring Standard developed by the Electronics Industries Association.

LAN Connection

The RJ45 connector is used to connect the instrument to a local area network. The instrument IP address can be set automatically using DHCP, or manually by entering the desired IP address, gateway address and subnet mask.

3-3 SCPI Common Commands

Some common commands are defined in the IEEE-488.2 standard and must be implemented by all SCPI compatible instruments. These commands are identified by the asterisk (*) at the beginning of the command keyword. These commands are defined to control instrument status registers, status reporting, synchronization, and other common functions. Examples of common commands supported by the instrument are shown below. See also [Section 5-1 “System Common Commands”](#).

*IDN?

Title: Identification Query

Description: This command returns the following information in <string> format separated by commas: manufacturer name (“Anritsu”), model number/options, serial number, firmware package number. The model number and options are separated by a “/” and each option is separated by a “.”.

For example, the return string might look like:

```
"Anritsu,MT8212E/3/2,62011032,1.23"
```

*RST

Title: Reset

Description: This command reboots the instrument. Note that the instrument will power-cycle after this command is executed and the IP address might change if the Ethernet configuration is set to DHCP. After executing this command communication will be lost. Wait a minimum of 30 seconds before re-establishing communication.

Note

If the instrument does not operate correctly, this command can be used to restore the instrument to the original default settings and running condition.

SCPI Required Commands

The required SCPI commands supported by the instrument are listed below. These command work in all measurement modes.

Table 3-1. SCPI Required Commands

:STATus
:SYSTem

SCPI Optional Commands

Optional SCPI commands that comprise the majority of the command set are described in this document. These commands control most of the programmable functions of the instrument listed in the table below.

Table 3-2. SCPI Optional Commands

:ABORT	:FETCh	:MEASure	:SOURce
:CALCulate	:INITiate	:MMEMory	:TRACe
:CONFigure	:INPut	:READ	:UNIT
:DISPlay	:INSTrument	:ROUte	[:SENSe]
:DIAGnostic			

The SCPI optional commands are sorted by measurement modes and commands may be repeated in more than one mode.

3-4 Subsystem Commands

Subsystem commands control all instrument functions and some general purpose functions. All subsystem commands are identified by the colon used between keywords, as in `:INITiate:CONTinuous`.

The following information is provided for each subsystem command described in the following chapters.

- The command name, see “Command Names” on page 3-5.
- The path from the subsystem root command, see “Hierarchical Command Structure” on page 3-6.
- The query form of the command (if applicable), see “Query Commands” on page 3-6.
- The command title.
- A description of the purpose of the command.
- The data parameters used as arguments for the command, see “Data Parameters” on page 3-8. This may include the parameter type and the available parameter choices.

Command Names

Typical SCPI commands consist of one or more keywords, parameters, and punctuation. SCPI command keywords can be a mixture of upper and lower case characters. Except for common commands, each keyword has a long and a short form. In this manual, the long form is presented with the short form in upper case and the remainder in lower case. For example, the long form of the command keyword to control the instrument display is `:DISPlay`.

The short form keyword is usually the first four characters of the long form (example: `DISP` for `DISPlay`). The exception to this is when the long form is longer than four characters and the fourth character is a vowel. In such cases, the vowel is dropped and the short form becomes the first three characters of the long form.

Example: the short form of the keyword `:POWer` is `:POW`.

Some command keywords may have a numeric suffix to differentiate between multiple instrument features such as multiple trace options. For example; keywords `:TRACe[:DATA]{1|2|3}`, `:TRACe1`, or `:TRACe3`.

Note	In the previous paragraph, <code>:TRACe</code> is identical to <code>:TRACe1</code> . If a numeric suffix it not included in a command, the first option is implied. Curly brackets <code>{ }</code> designate optional keyword parameters. Square brackets <code>[]</code> designate optional command keywords.
-------------	---

As with any programming language, the exact command keywords and command syntax must be used. The syntax of the individual commands is described in detail in the programming command chapters.

Unrecognized versions of long form or short form commands, or improper syntax, will generate an error.

Long Format vs. Short Format

Each keyword has a long format and a short format. The start frequency can be specified by `:SENSe:FREQuency:STARt` or `:SENS:FREQ:STAR`. The capital letters in the command specification indicate the short form of the command. A mixture of the entire short form elements with entire long form elements of each command is acceptable. For example, `:SENS:FREQuency:STAR` is an acceptable form of the command. However, `:SENS:FREQuen:STA` is not an acceptable form of the command because `:FREQuen` is not the entire short or long form of the command element.

Hierarchical Command Structure

All SCPI commands, except the common commands, are organized in a hierarchical structure similar to the inverted tree file structure used in most computers. The SCPI standard refers to this structure as “the Command Tree.” The command keywords that correspond to the major instrument control functions are located at the top of the command tree. The root command keywords for the SCPI command set are shown in [Figure 3-1](#).

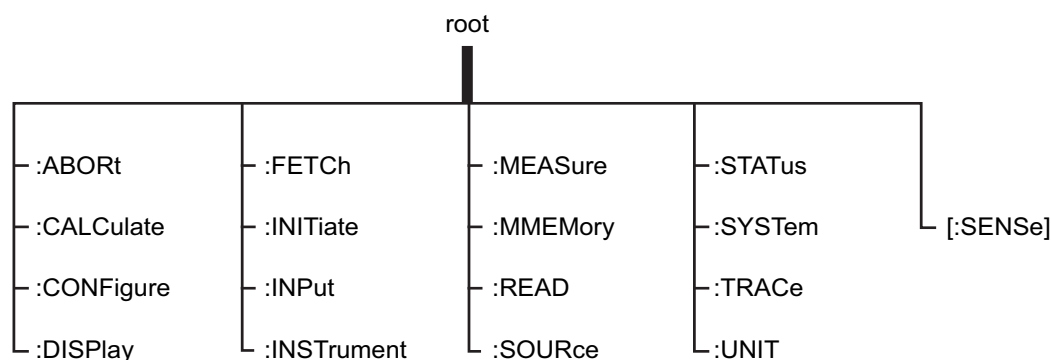


Figure 3-1. SCPI Command Tree

All instrument SCPI commands, except the `:ABORt` command, have one or more subcommands (keywords) associated with them to further define the instrument function to be controlled. The subcommand keywords may also have one or more associated subcommands (keywords). Each subcommand level adds another layer to the command tree. The command keyword and its associated subcommand keywords form a portion of the command tree called a command subsystem. A sample of the `:CONFigure` command subsystem is shown in [Figure 3-2](#).

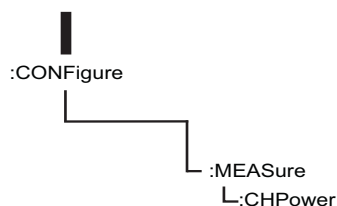


Figure 3-2. SCPI :Sample CONFigure Subsystem

A colon (:) separates each subsystem. For example, the command `:SENSe:FREQuency:STARt <freq>` sets the start frequency. The start frequency is part of the `:FREQuency` subsystem which is part of the `:SENSe` subsystem. Stop frequency is also part of the `:SENSe:FREQuency` subsystem. It is specified by `:SENSe:FREQuency:STOP`.

Query Commands

All commands, unless specifically noted in the commands syntax descriptions, have a query form. As defined in IEEE-488.2, a query is a command with a question mark symbol appended (examples: `*IDN?` and `:OPTions?`). When a query form of a command is received, the current setting associated with the command is placed in the output buffer. Query commands always return the short form of the parameter unless otherwise specified. Boolean values are returned as 1 or 0, even when they can be set as `on` or `off`.

Identifiers

The following identifiers have been used throughout the optional command definitions. Descriptions are provided here. In most cases, units are specified with the individual command.

Table 3-3. Description of Command Identifiers

Identifier	Description
<amplitude list>	Amplitude value. Units specified with the command.
<freq>	Frequency. Units specified with the command.
<integer>	Integer value, no units. Range specified with the command.
<number>	Numeric value, integer, or real.
<relative amplitude>	Relative amplitude. Units are always dB.

Data Parameters

Data parameters, referred to simply as “parameters,” are the quantitative values used as arguments for the command keywords. The parameter type associated with a particular SCPI command is determined by the type of information required to control the particular instrument function. For example, Boolean (ON | OFF) type parameters are used with commands that control switch functions.

Some command descriptions specify the type of data parameter to be used with each command. The most commonly used parameter types are numeric, extended numeric, discrete, and Boolean.

Numeric

Numeric parameters comprise integer numbers or any number in decimal or scientific notation, and may include polarity signs. This includes <NR1>, <NR2>, and <NR3> numeric data as defined in “[Data Parameter Notations](#)” below. Parameters that accept all three <NR> formats are designated <NRf> throughout this document.

Extended Numeric

Extended numeric parameters include values such as MAXimum and MINimum.

Discrete

Discrete parameters, such as INTernal and EXTernal, are used to control program settings to a predetermined finite value or condition.

Boolean

Boolean parameters represent binary conditions and may be expressed as ON, OFF or 1, 0.

Data Parameter Notations

The following syntax conventions are used for data parameter descriptions in this manual:

Table 3-4. Parameter Notations

<arg>	::=a generic command argument consisting of one or more of the other data types
<bNR1>	::=boolean values in <NR1> format; numeric 1 or 0
<boolean>	::=ON OFF. Can also be represented as 1 or 0, where 1 means ON and 0 means OFF Boolean parameters are always returned as 1 or 0 in <NR1> format by query commands
<integer>	::=an unsigned integer without a decimal point (implied radix point)
<NR1>	::=a signed integer without a decimal point (implied radix point)
<NR2>	::=a signed number with an explicit radix point
<NR3>	::=a scaled explicit decimal point numeric value with and exponent (e.g., floating point number)
<NRf>	::=<NR1> <NR2> <NR3>
<nv>	::=SCPI numeric value: <NRf> MINimum MAXimum UP DOWN DEFault NAN (Not A Number) INFinity NINFinity (Negative Infinity) or other types
<char>	::=<CHARACTER PROGRAM DATA> Examples: CW, FIXed, UP, and DOWN
<string>	::=<STRING PROGRAM DATA> ASCII characters enclosed by double quotes. For example: "OFF"
<block>	::=IEEE-488.2 block data format
<NA>	::=Not Applicable

Note

+/- infinity and Not-A-Number (NAN) values can be specified for parameters of type NR3 with the values of +/- 9.9e37 and 9.91e37, respectively.

Unit Suffixes

Unit suffixes are not required for data parameters, provided the values are scaled for the global default units. The instrument SCPI default units are: Hz (Hertz) for frequency related parameters s (seconds) for time related parameters, and m (meters) for distance related parameters.

3-5 Notational Conventions

The SCPI interface standardizes command syntax and style that simplifies the task of programming across a wide range of instrumentation. As with any programming language, the exact command keywords and command syntax must be used. Unrecognized commands or improper syntax will not function.

Table 3-5. Notational Conventions

:	A colon links command keywords together to form commands. The colon is not an actual part of the keyword, but is a signal to the SCPI interface parser. A colon must precede a root keyword immediately following a semicolon (see “Notational Examples” on page 3-11).
;	A semicolon separates commands if multiple commands are placed on a single program line.
[]	Square brackets enclose one or more optional keywords.
{ }	Braces enclose one or more keyword or command parameters that may be included one or more times.
	A vertical bar indicates “or” and is used to separate alternative parameter options. Example: ON OFF is the same as ON or OFF.
< >	Angle brackets enclose parameter descriptions.
::=	Means “is defined as” For example: <a>::=<c> indicates that <c> can replace <a>.
<i>sp</i>	Space, referred to as <i>white space</i> , must be used to separate keywords from their associated data parameters. It must not be used between keywords or inside keywords.
XXX	Indicates a root command name

For further information about SCPI command syntax and style, refer to the Standard Commands for Programmable Instruments (SCPI) 1999.0 document.

3-6 Notational Examples

Table 3-6 provides examples of valid command syntax:

Table 3-6. Creating Valid Commands

Command Specification	Valid Forms
<code>[[:SENSe]:FREQuency:STARt <freq></code>	The following all produce the same result: <code>:SENSe:FREQuency:STARt 1 MHZ</code> <code>:SENS:FREQ:STAR 1 MHZ</code> <code>:sense:frequency:start 1000000</code> <code>:FREQ:STAR 1000 KHZ</code>
<code>:CALCulate:MARKer{1 2 3 4 5 6}:X <x-parameter></code>	The first 2 commands set the location of marker 1. The third command sets the location of marker 2. <code>:CALC:MARK:X 1 GHZ</code> <code>:CALC:MARK1:X 1 GHZ</code> <code>:CALC:MARK2:X 2 GHZ</code>
<code>:UNIT:POWer DBM DBV DBMV DBUV V W</code>	The following commands are identical: <code>:UNIT:POWer DBM</code> <code>:unit:pow dbm</code>
<code>:INITiate:CONTInuous OFF ON 0 1</code>	The following commands are identical: <code>:INITiate:CONTInuous OFF</code> <code>:init:cont 0</code>

Command statements read from left to right and from top to bottom. In the command statement above, the `:FREQuency` keyword immediately follows the `:SENSe` keyword with no separating space. A space (*sp*) is used between the command string and its argument.

Note that the first keyword in the command string does not require a leading colon; however, it is good practice to always use a leading colon for all keywords. Note also that the `:SENSe` keyword is optional. This is a SCPI convention for all voltage or signal source type instruments that allows shorter command statements to be used.

The following is an example of a multiple command statement that uses two separate commands in a single statement:

```
:FREQuency:STARt 10E6;:FREQuency:STOP 20E9
```

Note	A semicolon is used to join the commands and a leading colon used immediately after the semicolon to start the second command.
-------------	--

Command Terminators

The `<new line>` character (ASCII 10) in the last data byte of a command string is used as a command terminator. Use of a command terminator will reset the command path to the root of the tree.

3-7 Formatting Conventions

This manual uses the following conventions in describing SCPI commands.

Table 3-7. Formatting Conventions

<code>:COMMands:LOOK:LIKE:THIS</code>	Commands are formatted to differentiate them from their description.
<code>:COMMand:QUERies:LOOK:LIKE:THIS?</code>	The query form of the command is followed by a “?”
<code><identifier></code>	Identifiers are enclosed in “< >”. They indicate that some type of data must be provided. See Table 3-3 for details on the types of identifiers.
<code> </code>	The “ ” indicates that a choice must be made.
<code>[optional input]</code>	Optional input is be enclosed in “[]”. The “[]” are not part of the command.

3-8 SCPI Command Programming Examples

This section provides information on spectrum trace data and I/Q data via SCPI commands.

Spectrum Trace Data via SCPI

SCPI commands are sent to port 9001 of the instrument. Below is a simple example to capture spectrum trace data.

```
SENS:FREQ:START 88 MHz
SENS:FREQ:STOP 108 MHz
```

```
//Set sweep mode
SWEEP:MODE FFT
```

```
//Set RBW 30 kHz
BANDWIDTH 30 KHz
```

```
//Set Reference Level to -30 dBm
DISP:WIND:TRAC:Y:SCAL:RLEV -30
```

```
//Set to single sweep
INIT:CONT OFF
```

```
//Get trace amplitude data
TRACE:DATA? 1
```

```
//Get number of display points to calculate frequency array
DISP:POIN?
```

3-9 Spectrum Trace Data Format

Trace data uses SCPI standard (IEEE 488.2) block data format. The data format is '#AXD', where D is a comma separated list of amplitudes (in ASCII), X is one or more ASCII digits specifying the number of bytes in D, and A is a single ASCII digit specifying the number of digits in X.

Trace data only contains amplitude. The frequency information for each point is

```
Frequency = [start_frequency + (span/(display_points-1))*N
N = 0, 1, ... display_points
```

3-10 I/Q Capture Block Mode

This mode captures a single block of IQ data. I/Q data is first stored to high speed DDR2 SDRAM buffer memory and then it can be saved to flash memory or sent to a remote user via Ethernet. The capture length (duration) is limited by the size of the buffer memory (256 Mbytes) and I/Q data rate, which is determined by the capture bandwidth.

The IQ capture bandwidth must be set to one of the available values listed in the table below. For each selectable bandwidth, the output data rate for a single I/Q data pair is listed in [Table 3-8](#). The output data rate does not change, regardless of bit resolution.

Table 3-8. IQ Capture Bandwidth Values

I/Q Bandwidth	Output Data Rate MSPS	IQ Sample Pairs/Sec
20 MHz	76.25 / 3	25416666.67
13.3 MHz	76.25 / 4	19062500
6.67 MHz	76.25 / 8	9531250
2.67 MHz	76.25 / 20	3812500
1.33 MHz	76.25 / 40	1906250
667 kHz	76.25 / 80	953125
267 kHz	76.25 / 200	381250
133 kHz	76.25 / 400	190625
66.7 kHz	76.25 / 800	95312.5
26.7 kHz	76.25 / 2000	38125
13.3 kHz	76.25 / 4000	19062.5

The maximum capture length is limited by memory, capture bandwidth and bit resolution. [Table 3-9 on page 3-15](#) shows the maximum capture length.

Table 3-9. Maximum I/Q Block Capture Length

I/Q Bandwidth	24 bits	16 bits	10 bits	8 bits
20 MHz ^a	1.3 s	2.5 s	3.8 s	5.0 s
13.3 MHz	1.7 s	3.4 s	5.0 s	6.7 s
6.67 MHz	3.4 s	6.7 s	10.1 s	13.4 s
2.67 MHz	8.4 s	16.8 s	25.2 s	33.6 s
1.33 MHz	16.8 s	33.6 s	50.4 s	1.12 min
667 kHz	33.6 s	1.12 min	1.68 min	2.24 min
267 kHz	1.40 min	2.80 min	4.20 min	5.60 min
133 kHz	2.80 min	5.60 min	8.39 min	11.19 min
66.7 kHz	5.60 min	11.19 min	16.79 min	22.38 min
26.7 kHz	13.99 min	27.98 min	41.97 min	55.96 min
13.3 kHz	27.98 min	55.96 min	1.40 hr	1.87 hr
6.67 kHz	55.96 min	1.87 hr	2.80 hr	3.73 hr
2.67 kHz	2.33 hr	4.66 hr	6.99 hr	9.33 hr
1.33 kHz	4.66 hr	9.33 hr	13.99 hr	18.65 hr

a. For 20 MHz capture bandwidth, when IQ bit resolution is set to 32 bits, the lower 8 bits are zeros. Therefore the maximum effective bit resolution is 24 bits for 20 MHz bandwidth.

I/Q Block Capture via SCPI

```
SENS:FREQ:CENTER 100 MHz
SENS:FREQ:SPAN 20 MHz
SWEEP:MODE FFT
//Set RBW 30 kHz
BANDWIDTH 30 KHz
//Set Reference Level to -30 dBm
DISP:WIND:TRAC:Y:SCAL:RLEV -30
//Set to single sweep
INIT:CONT OFF
//abort any sweep in progress
:ABORT
```

```
//Set Capture bandwidth. Not same as RBW.
IQ:BANDWIDTH 20 MHz
```

```
//Set 16 bit resolution
IQ:BITS 16
```

```
//Set to I/Q block capture mode
IQ:MODE SINGLE
//enable time stamp
SENS:IQ:TIME 1
```

```
//Set capture length to 5 msec
IQ:LENGTH 5 ms
```

```
//Start IQ Capture. Triggers single capture. Data is saved to DDR2 SDRAM memory.
MEAS:IQ:CAPT
```

```
//Check if capture is completed normally
STATus:OPERation?
```

```
//The STATus:OPERation? query responds with a integer. Convert this integer to binary.
//Bit 9 is set to 1 when the MEAS:IQ:CAPT command is issued.
//Bit 9 is set to 0 when the capture is completed normally in block mode.
```

I/Q Data Format

The `TRAC:IQ:DATA?` query returns a modified version of the SCPI standard (IEEE 488.2) block data format. The header contains three fields with a newline delimiter separating the header from the I/Q binary data:

#AXL\n: **A** is a single ASCII digit specifying the number of digits in X.

X is one or more ASCII digits specifying the number of bytes of binary I/Q data and ASCII GPS location coordinates.

L is the ASCII string containing the GPS location in the form 'latitude, longitude' in decimal degrees. The coordinates record where the I/Q capture was triggered.

\n is a single byte newline delimiter marking the end of the GPS location component and start of the I/Q data. The I/Q data is in binary format and is described below.

I/Q Frame Structure

I/Q data is organized into three levels: frame, extended frame, and super frame. The lowest level is a 64 bit frame, which may contain one to four I/Q sample pairs depending on the selected I/Q bit resolution.

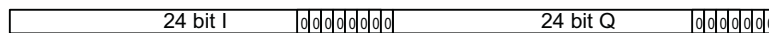
64 bit Frame



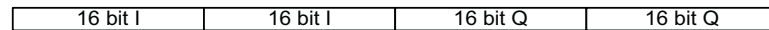
The 64 bit frame contains one to four I/Q sample pairs depending on the selected I/Q bit resolution.

I/Q Bit Resolution	IQ Sample Pairs per 64 Bit Frame
24	1
16	2
10	3
8	4

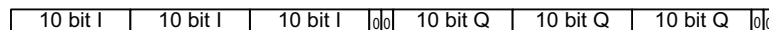
24 Bit Resolution



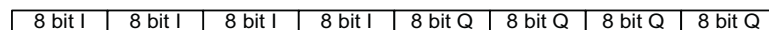
16 Bit Resolution



10 Bit Resolution



8 Bit Resolution

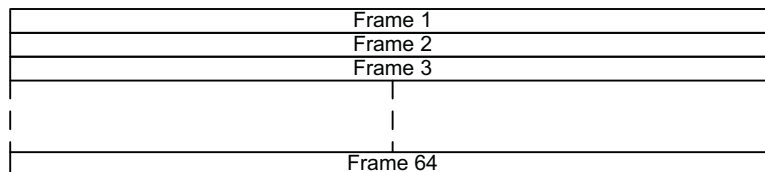


Note The frame structure will be modified slightly when there is a time stamp. This will be described in a later section.

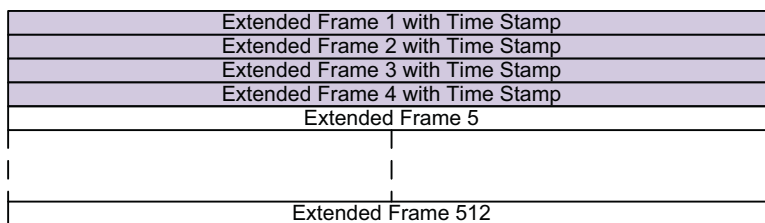
I/Q Extended Frame and Super Frame

An extended frame consists of 64 frames and a super frame has 512 extended frames. Only the first four extended frames in each super frame contain time stamp information.

Extended Frame



Super Frame

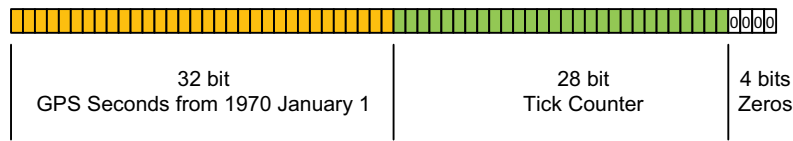


Extended Frames 1 – 4 have time stamp
Extended Frames 5 – 512 do not have time stamp

I/Q Time Stamp

This section describes how the time stamp is embedded into the I/Q data. Within each super frame, only the first four extended frames contain time stamp information. Refer to Super Frame diagram. The time stamp contains 64 bits.

64 bit Time Stamp



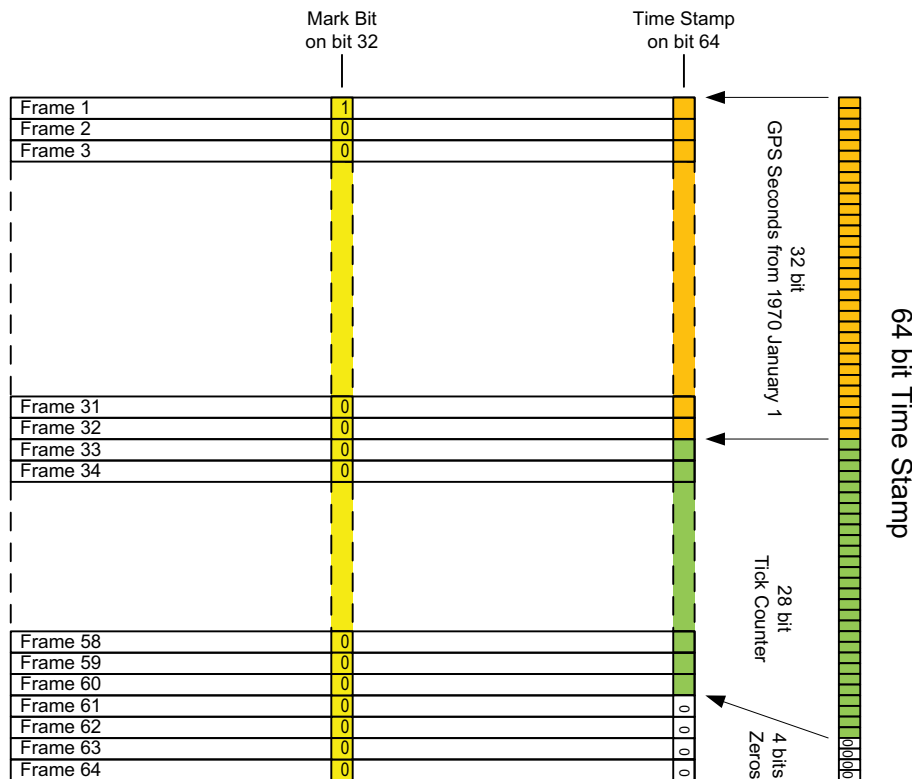
The GPS seconds is the time in seconds from Jan 1, 1970. The tick counter counts at a rate of 114.375 MHz and it is reset to 0 on every second, triggered by the GPS PPS signal.

The time stamp records the time at the beginning of each extended frame. The elapsed time between each frame is calculated with this formula:

$$\text{Elapsed Time Between Each Frame} = \frac{1}{\text{Output Data Rate}} \times \text{IQ Sample Pairs per Frame}$$

To insert the time stamp without interrupting the I/Q data sequence, the 64 bit time stamp is rotated and inserted into the extended frame by using bit 64 from each frame. To indicate the beginning of an extended frame with a time stamp, a mark bit is set to '1' for the first frame and '0' for the remaining 63 frames. The mark bit uses bit 32 of each frame.

Extended Frame with Mark Bit and Time Stamp embedded



I/Q Frame Structure with Time Stamp

Embedding the time stamp requires using two bits from each frame, which requires modifying the I/Q frame structure.

I/Q Bit Resolution = 24



Each frame contains only 1 I/Q sample pair (one I and one Q). All the frames will have 24 bits each for I and Q. Each I and Q sample is followed by 7 zeros, then the mark or time stamp bit. Only the first four extended frames will have time stamping.

The remaining extended frames will have zero valued mark and time stamp bit.

I/Q Bit Resolution = 16



Each frame contains two I/Q sample pairs (two I and two Q). The first I and first Q sample in the frame will always have 16 bits. In the first four extended frames, the second I and second Q sample will have 15 bits, followed by the mark and time stamp bit.

The remaining extended frames in the capture will contain 16 bits each for the second I and Q.

I/Q Bit Resolution = 10



Each frame contains three I/Q sample pairs (three I and three Q). All the frames will have 10 bits each for I and Q. Each I and Q sample is followed by one zero, then the mark or time stamp bit. Only the first four extended frames will have time stamping.

The remaining extended frames will have zero valued mark and time stamp bit.

I/Q Bit Resolution = 8



Each frame contains four I/Q sample pairs (four I and four Q). The first three I and first three Q samples in the frame will always have 8 bits. The fourth I and fourth Q sample will have 7 bits if the frame is in the first four extended frames, which uses one bit for mark and one bit for the time stamp.

The remaining extended frames in the superframe will contain 8 bits each for the all four I and Q samples. Having only 7 effective bits instead of 8 bits on every fourth sample for the first 1024 samples will slightly increase the noise floor.

Time Stamp Boundary Conditions

Note Sometimes, the first mark bit does not always begin with at the start of the I/Q capture. There could be a number of I/Q samples recorded before the first time the mark bit is set to 1. In the example below, there are 5 frames before the first timestamp, which doesn't start until the sixth frame.

N Frame Data (one I, one Q sample per frame)

0 [I-----0Q-----T]

1 [I-----0Q-----T]

2 [I-----0Q-----T]

3 [I-----0Q-----T]

4 [I-----0Q-----T]

5 [I-----1Q-----T] <- The first mark bit is here. This is where you start to build the first timestamp; this 'T' is the MSB of the timestamp

6 [I-----0Q-----T] <- 'T' is MSB - 1 bit of the timestamp

7 [I-----0Q-----T] <- 'T' is MSB - 2 bit of the timestamp

8 [I-----0Q-----T] <- etc.

...

To get the timestamp for frames N=0 though N=4, you must extrapolate the timestamp from frame 5 backwards. To get the timestamps for frames 6-68, you must extrapolate the timestamp forwards. The time between each frame is equal to $(1/\text{Output Data Rate}) \times (\text{Number of I or Q samples per frame})$.

I/Q Bit Resolution	Time Between Each Frame
24	$1/(\text{Output Data Rate})$
16	$2/(\text{Output Data Rate})$
10	$3/(\text{Output Data Rate})$
8	$4/(\text{Output Data Rate})$

Once the 64 bits of timestamp is put together, you get a number that looks like:

[S-----T-----0000]

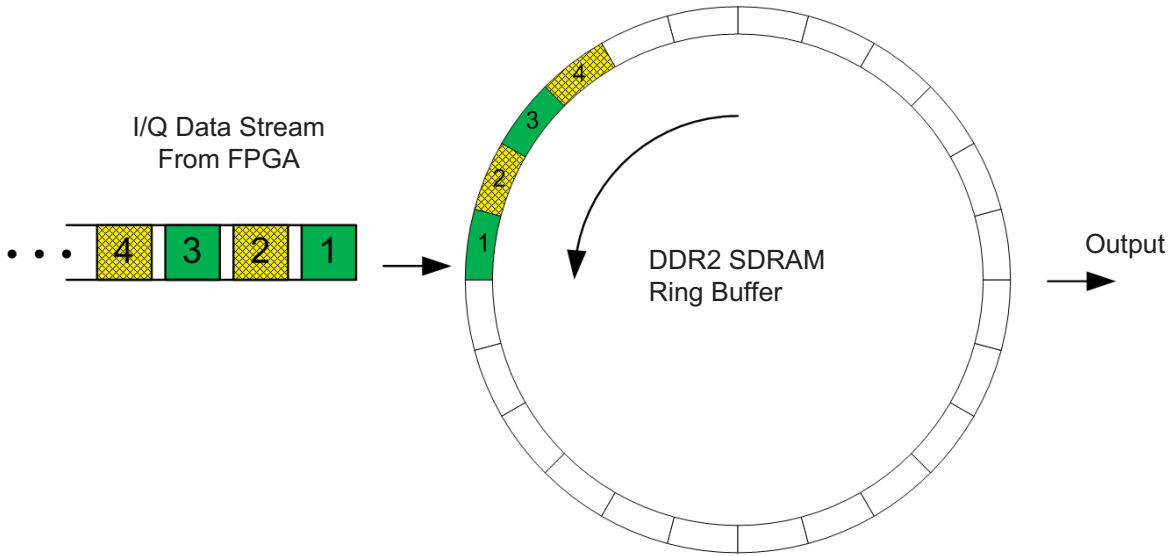
Where 'S-----' is 32 bits specifying the timestamp in seconds since 1970 (time_t), 'T-----' is 28 bits specifying the offset from that second (in clock ticks at 114.375MHz), and '0000' are 4 unused bits.

Note There could be some frames at the very end of the capture that have an incomplete timestamp because the capture stops before there is a complete group of 64 frames to make an extended frame . In that case you could extrapolate from the previous timestamp.

I/Q Capture Streaming Mode

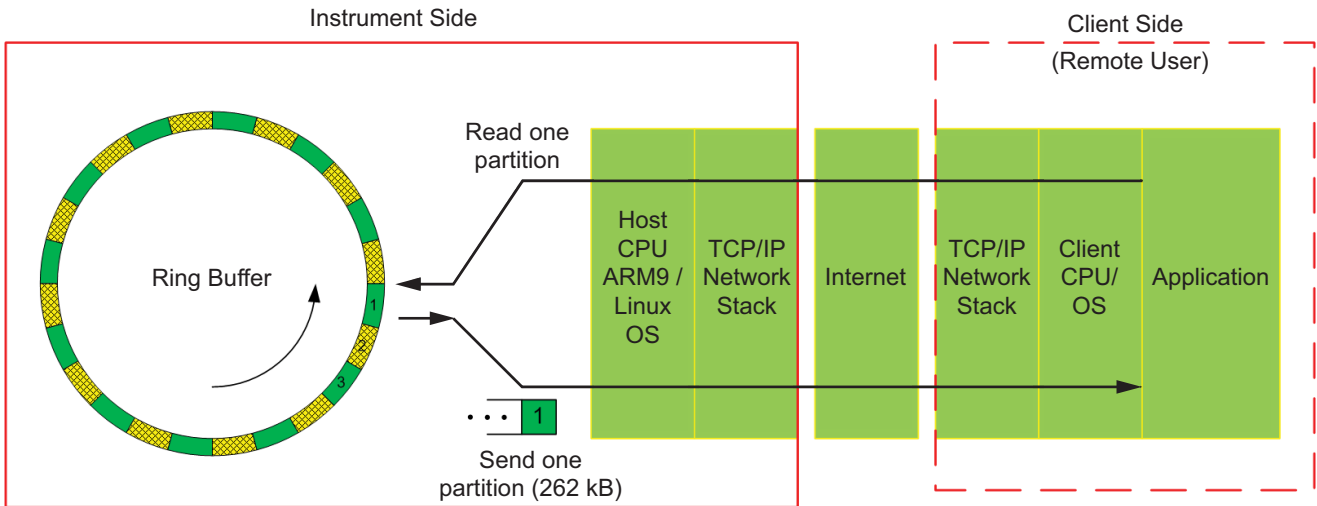
Data Capture to Buffer Memory

In streaming, the I/Q data uses the same frame, extended frame, and super frame structure as in block mode. I/Q data is captured to high speed DDR2 SDRAM memory, configured as a ring buffer. The buffer memory is 256 MB (256×1024^2 bytes) and it is divided into 1024 partitions. Each partition is 262,144 bytes, which holds 32,768 I/Q frames. I/Q data fills each partition in sequence. The data stream rate to memory is determined by the selected I/Q bandwidth. When the buffer is full, new I/Q data is stored from the first partition again.



Data Transmission to Remote User

When the I/Q is sent out from the memory to the remote user, the data flow rate has to be managed. The simplest way to manage the data flow is to send out one partition and wait for a read command from the remote user before sending another partition. The user may not be able to receive all the partitions if the read command for each partition is delayed due to latency in the CPU, OS, network, and user application. The I/Q data is continuously filling the memory partitions at a rate proportional to the selected I/Q capture bandwidth. If the read command arrives after the start of a partition, that partition is skipped and will not be sent. The next partition will be sent instead.



I/Q Streaming Capture via SCPI

```
SENS:FREQ:CENTER 100 MHz
SENS:FREQ:SPAN 20 MHz
SWEEP:MODE FFT
//Set RBW 30 kHz
BANDWIDTH 30 KHz
//Set Reference Level to -30 dBm
DISP:WIND:TRAC:Y:SCAL:RLEV -30
//Set to single sweep
INIT:CONT OFF
//abort any sweep in progress
:ABORT

//Set Capture bandwidth. Not same as RBW.
IQ:BANDWIDTH 20 MHz

//Set 16 bit resolution
IQ:BITS 16

//streaming block capture
IQ:MODE STREAM
//enable time stamp
SENS:IQ:TIME 1

//Start IQ Capture. Triggers streaming capture. Data is continuously saved to DDR2
memory in a ring buffer.

MEAS:IQ:CAPT

//Use loop to continuously send command to retrieve I/Q data partitions and parse
data as it is being received.

LOOP BEGIN
    //Get most recent I/Q partition from memory.
    TRAC:IQ:DATA?

    //Check if capture is aborted.
    STATus:OPERation?

    //If capture is not aborted, parse data and decode time stamp for the received
    data
LOOP END
```

To read the I/Q data, use the `TRAC:IQ:DATA?` SCPI command. This returns the partition with the most recently captured I/Q data. During streaming, the client has to continuously send `TRAC:IQ:DATA?` SCPI command to another partition's I/Q data.

The capture of I/Q data and filling of partitions will continue until it is aborted with the `:ABORT` command or other commands that change frequency or attenuation settings. To determine if the capture was aborted, check the output of `STATus:OPERation?`.

The `STATus:OPERation?` query responds with a integer. Convert this integer to binary.

Bit 9 is set to 1 when the `MEAS:IQ:CAPT` command is issued.

Bit 9 is set to 0 if the capture is aborted by `:ABORT` command or other command which invalidates the capture.

Error Conditions: Overpower or Overheat

The I/Q capture will be paused if the instrument detects an overpower or overheat condition. In this situation, any pending `TRAC:IQ:DATA?` query will immediately return #0 and a device-specific error will be added to the SCPI error queue. When the condition is rectified, the capture will automatically restart. For example, if there was an overpower event, remove the overpower source and close the overpower relay. If there was an overheat event, wait for the instrument to cool down.

Error Condition: Timing Reference Source Change

If the instrument detects any of the four conditions below, a device-specific error will be added to the SCPI error queue. In either block or streaming mode, the instrument will not abort a capture that is already in progress.

1. Loss of GPS
2. Newly acquired GPS lock
3. Disconnect/Connect External Reference
4. Large timing drift during GPS Hi-Accuracy Mode

3-11 SCPI Command Files

Refer to the following for the programming commands:

- [Chapter 4, “SCPI SPA Commands”](#)
- [Chapter 5, “SCPI System Commands”](#)

Refer to the following for SCPI error definitions and Command Listing:

- [Appendix A, “SCPI Error Table”](#)
- [Appendix B, “SCPI Command Listing”](#)

Chapter 4 — SCPI SPA Commands

4-1 Mode Commands

SCPI SPA commands control all instrument spectrum analyzer functions and some general purpose functions. The commands are grouped into the following functional subsystems:

- Section 4-2 “:ABORt Subsystem”
- Section 4-3 “:CALCulate Subsystem”
- Section 4-4 “:CONFigure Subsystem”
- Section 4-5 “:DIAGnostic Subsystem”
- Section 4-6 “:DISPlay Subsystem”
- Section 4-7 “:FETCh Subsystem”
- Section 4-8 “:INITiate Subsystem”
- Section 4-9 “:INPut Subsystem”
- Section 4-10 “:MEASure Subsystem”
- Section 4-11 “:MMEMory Subsystem”
- Section 4-12 “:READ Subsystem”
- Section 4-13 “:ROUTE Subsystem”
- Section 4-14 “:STATus Subsystem”
- Section 4-15 “:TRACe Subsystem”
- Section 4-16 “:UNIT Subsystem”
- Section 4-17 “[:SENSe] Subsystem”

4-2 :ABORt Subsystem

The abort subsystem includes commands that allow the user to stop current measurement activities on the instrument.

:ABORt

Title: Abort

Description: Resets the trigger system. This has the effect of aborting the sweep or any measurement that is currently in progress. Additionally, any pending operation flags that were set by initiation of the trigger system will be set to false. If :INITiate:CONTinuous is OFF (i.e. the instrument is in single sweep mode), send the command: :INITiate[:IMMEDIATE] to trigger the next sweep. If :INITiate:CONTinuous is ON (i.e. the instrument is in continuous sweep mode) a new sweep will start immediately.

4-3 :CALCulate Subsystem

The commands in this subsystem process data that has been collected via the SENSE subsystem.

```
:CALCulate:LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :CONTrol[:DATA] <frequency list>  
:CALCulate:LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :CONTrol[:DATA] ?
```

Title: Limit Control Data

Description: This command sets or queries the control data (X-axis values) for the specified limit.

The numeric suffix on LIMit specifies which limit number to query or set data. If the suffix is omitted, the command will refer to limit 1.

If a limit of the specified number does not already exist, a default limit will be created first (having empty data, with state set to ON).

This command takes a list of one or more frequency values as parameters. For example:
CALC:LIM1:CONT:DATA 1 MHz, 2MHz, 3MHz

Note that it is permitted to set one or more invalid 'placeholder' values of Not-A-Number (NAN). The placeholder value for NAN is 9.91e37. If a control data point contains a value of 9.91e37, limit line interpolation from the previous data point, and to the next data point, will not occur. This is useful for defining discontinuous (or segmented) limit lines within a single limit.

For example, to define a limit line of two discontinuous segments, one from 1 MHz to 10 MHz, and another from 20 MHz to 30 MHz, send the following control data:

```
CALC:LIM1:CONT:DATA 1MHz, 10MHz, 9.91e37, 20MHz, 30MHz.
```

Note that the upper (or lower) data, if used, should contain the same amount of points as the control data (see CALC:LIM:FAIL? for details on what happens when this is not true). Thus, when using placeholders in control data, it is recommended that placeholders are also used in the upper (or lower) data.

For example:

```
CALC:LIM1:CONT:UPP 0dBm, 10dBm, 9.91e37, 10dBm, 0dBm
```

The exact value for the middle point does not matter, as interpolation will always be skipped due to the control data containing NAN, but using NAN for the corresponding upper (or lower) data value will make it easier to remember that the point is a placeholder.

Parameters: <frequency list>

Syntax Example: :CALC:LIM1:CONT:DATA 1MHz, 2MHz, 3MHz

```
:CALCulate:LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :LOWer[:DATA] <amplitude list>  
:CALCulate:LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :LOWer[:DATA] ?
```

Title: Lower Limit Data

Description: This command sets or queries the lower limit data (Y-axis values) for the specified limit. The numeric suffix on LIMit specifies which limit number to query or set data. If the suffix is omitted, the command will refer to limit 1. If a limit of the specified number does not already exist, a default limit will be created first (having empty data, with state set to ON). This command takes a list of one or more amplitude values as parameters. For example,

```
CALC:LIM1:LOW:DATA 1 dBm, 2 dBm, 3 dBm
```


Note that it is permitted to set one or more data values of +/- infinity. The placeholder value for +/- infinity is +/-9.9e37. If a lower data point contains a value of +/-9.9e37, the amplitude at that point will be treated as if it were +/- infinity (i.e. the lower limit will either always fail or always pass at that point).

It is also permitted to set one or more invalid 'placeholder' values of Not-A-Number (NAN). This is useful for defining discontinuous (or segmented) limit lines within a single limit. For details, and an example, of using placeholder values, see `CALC:LIM:CONT:DATA`.

Parameters: <amplitude list>

Syntax Example: `:CALC:LIM1:LOW:DATA 1 dBm, 2 dBm, 3 dBm`

`:CALCulate:LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :UPPer[:DATA] <amplitude list>`
`:CALCulate:LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :UPPer[:DATA] ?`

Title: Upper Limit Data

Description: This command sets or queries the upper limit data (Y-axis values) for the specified limit. The numeric suffix on `LIMit` specifies which limit number to query or set data. If the suffix is omitted, the command will refer to limit 1. If a limit of the specified number does not already exist, a default limit will be created first (having empty data, with state set to ON). This command takes a list of one or more amplitude values as parameters. For example, `CALC:LIM1:UPP:DATA 1 dBm, 2dBm, 3 dBm`.

Note that it is permitted to set one or more data values of +/- infinity. The placeholder value for +/- infinity is +/-9.9e37. If an upper data point contains a value of +/-9.9e37, the amplitude at that point will be treated as if it were +/-infinity (i.e. the upper limit will either always pass or always fail at that point). It is also permitted to set one or more invalid 'placeholder' values of Not-A-Number (NAN). This is useful for defining discontinuous (or segmented) limit lines within a single limit. For details, and an example, of using placeholder values, see `CALC:LIM:CONT:DATA`.

Parameters: <amplitude list>

Syntax Example: `:CALC:LIM1:UPP:DATA 1 dBm, 2 dBm, 3 dBm`

`:CALCulate{ [1] } :LIMit:ACTive?`

Title: Limit Active

Description: Queries the numbers of all active limit lines in ascending order. This command returns a empty string if no limits are active.

`:CALCulate{ [1] } :LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :COMMeNt <string>`
`:CALCulate{ [1] } :LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :COMMeNt?`

Title: Limit Comment

Description: Associates a user-defined comment with each limit. The set version of this command takes a single parameter that is a string containing the desired comment. The query version returns the comment that is set.

If a limit of the specified number does not already exist, a default limit will be created first (having empty data, with state set to ON).

Parameters: <string>

:CALCulate{ [1] }:LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :CONTrol:MODE <char>
:CALCulate{ [1] }:LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :CONTrol:MODE?

Title: Limit Control Mode

Description: Choose either ABSolute or RELative limit.

In ABSolute mode, the control value of the limit line is defined by absolute physical values (Hz).

In RELative mode, the control value of the limit line is relative to the center frequency (Hz).

If a limit of the specified number does not already exist, a default limit will be created first (having empty data, with state set to ON).

Parameters: <char>

:CALCulate{ [1] }:LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :CONTrol:SHIFt <freq>

Title: Limit Control Shift

Description: Move a limit line along the control axis. This command changes the value of:

:CALCulate<n>:LIMit<k>:CONTrol[:DATA]

Issuing this command multiple times will change the limits each time will shift the control axis by 5 Hz.

If a limit of the specified number does not already exist, a default limit will be created first (having empty data, with state set to ON).

Parameters: <freq>

Syntax Example: Issuing this command multiple times will change the limits each time.

CALC:LIM1:CONT:SHIFt 1 Hz

CALC:LIM1:CONT:SHIFt 1 Hz

CALC:LIM1:CONT:SHIFt 1 Hz

CALC:LIM1:CONT:SHIFt 1 Hz

CALC:LIM1:CONT:SHIFt 1 Hz

Remark: This will shift the control axis by 5 Hz

:CALCulate{ [1] }:LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :COPY <number>

Title: Limit Copy

Description: Copies a limit line. For example, :CALC:LIM1:COPY 2 copies limit 1 to line 2. If a limit of the specified number does not already exist, a default limit will be created first (having empty data, with state set to ON).

Parameters: <number>

:CALCulate{ [1] }:LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :DELeTe

Title: Limit Delete

Description: Deletes a limit line. If a limit of the specified number does not already exist, a default limit will be created first (having empty data, with state set to ON).

:CALCulate{ [1] } :LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :FAIL?

Title: Limit Fail

Description: This command queries the result of a limit check. All traces that have had checking enabled (via `CALC:TRAC:CHEC`) will be evaluated against the upper and lower data of the specified limit, unless the limit `STATE` is `OFF` (in which case this command will always return 0), or the upper or lower `STATE` is `OFF` (in which case only the data with `STATE` `ON` will be checked).

If the sweep has not completed yet, the partial trace will be evaluated. If `INITiate:CONTinuous` is `ON`, a snapshot of the trace at the time this command was received will be evaluated against the limit. This command returns 1 if any of the checked traces violate the limit, otherwise it returns 0.

When a limit is evaluated, there are some rules that are followed if the cardinality of the limits control, upper, and lower data are not equal. If there are fewer control data points than upper or lower data points, then only the first `n` upper or lower points will be evaluated, where `n` is the number of control points. If there are fewer upper or lower points than control points, then the effective number of upper or lower points will be increased to the number of control points, with the 'extrapolated' points having a value equal to the last upper or lower point.

If a limit of the specified number does not already exist, a default limit will be created first (having empty data, with state set to `ON`).

:CALCulate{ [1] } :LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :LOWer:MODE <char>
:CALCulate{ [1] } :LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :LOWer:MODE?

Title: Limit Lower Mode

Description: Choose either `ABSolute` or `RELative` limit.

In `ABSolute` mode, the control value of the limit line is defined by absolute physical values (dBm).

In `RELative` mode, the control value of the limit line is relative to the reference level (dB).

If a limit of the specified number does not already exist, a default limit will be created first (having empty data, with state set to `ON`).

Parameters: <char>

**:CALCulate{ [1] }:LIMit{ [1] |2|3|4|5|6|7|8|9|10 }:LOWer:SHIFt
<relative amplitude>**

Title: Lower Limit Shift

Description: Move the lower limit up or down by a relative amplitude. This command changes the value of:

:CALCulate<n>:LIMit<k>:LOWer[:DATA]

:CALCulate<n>:LIMit<k>:LOWer[:DATA]

Remark: Issuing this command multiple times will change the limits each time.

Parameters: <relative amplitude>

Syntax Example: CALC:LIM1:LOW:SHIFT 1 dB
CALC:LIM1:LOW:SHIFT 1 dB
CALC:LIM1:LOW:SHIFT 1 dB
CALC:LIM1:LOW:SHIFT 1 dB
CALC:LIM1:LOW:SHIFT 1 dB

If a limit of the specified number does not already exist, a default limit will be created first (having empty data, with state set to ON).

Remark: Will shift the lower limit by 5 dB

**:CALCulate{ [1] }:LIMit{ [1] |2|3|4|5|6|7|8|9|10 }:LOWer:STATe <boolean>
:CALCulate{ [1] }:LIMit{ [1] |2|3|4|5|6|7|8|9|10 }:LOWer:STATe?**

Title: Lower Limit State

Description: Turns ON or OFF the lower limit.

If a limit of the specified number does not already exist, a default limit will be created first (having empty data, with state set to ON).

Parameters: <boolean>

**:CALCulate{ [1] }:LIMit{ [1] |2|3|4|5|6|7|8|9|10 }:NAME <string>
:CALCulate{ [1] }:LIMit{ [1] |2|3|4|5|6|7|8|9|10 }:NAME?**

Title: Limit Name

Description: Associates a user-defined name with each limit. The set version of this command takes a single parameter that is a string containing the desired limit name. The query version returns the name that is set.

If a limit of the specified number does not already exist, a default limit will be created first (having empty data, with state set to ON).

Parameters: <string>

**:CALCulate{ [1] }:LIMit{ [1] |2|3|4|5|6|7|8|9|10 }:STATe <boolean>
:CALCulate{ [1] }:LIMit{ [1] |2|3|4|5|6|7|8|9|10 }:STATe?**

Title: Limit State

Description: Turns the limit check for a specific limit ON or OFF.

If a limit of the specified number does not already exist, a default limit will be created first (having empty data, with state set to ON).

Parameters: <boolean>

```
:CALCulate{ [1] } :LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :TRACe:CHECK <boolean>  
:CALCulate{ [1] } :LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :TRACe:CHECK?
```

Title: Limit Trace Check

Description: This command turns the limit check for a specific trace on and off.

If a limit of the specified number does not already exist, a default limit will be created first (having empty data, with state set to ON).

Parameters: <boolean>

```
:CALCulate{ [1] } :LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :UPPer:MODE <char>  
:CALCulate{ [1] } :LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :UPPer:MODE?
```

Title: Upper Limit Mode

Description: Choose either ABSolute or RELative limit.

In ABSolute mode, the control value of the limit line is defined by absolute physical values (dBm).

In RELative mode, the control value of the limit line is relative to the reference level (dB).

If a limit of the specified number does not already exist, a default limit will be created first (having empty data, with state set to ON).

Parameters: <char>

```
:CALCulate{ [1] } :LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :UPPer:SHIFt  
<relative amplitude>
```

Title: Upper Limit Shift

Description: Move the upper limit up or down by a relative amplitude. This command changes the value of

:CALCulate<n>:LIMit<k>:UPPer[:DATA].

Issuing this command multiple times will change the limits each time.

```
CALC:LIM1:UPP:SHIFt 1 dB
```

```
CALC:LIM1:UPP:SHIFt 1 dB
```

```
CALC:LIM1:UPP:SHIFt 1 dB
```

```
CALC:LIM1:UPP:SHIFt 1 dB
```

```
CALC:LIM1:UPP:SHIFt 1 dB
```

Will shift the upper limit by 5 dB

If a limit of the specified number does not already exist, a default limit will be created first (having empty data, with state set to ON).

Parameters: <relative amplitude>

```
:CALCulate{ [1] } :LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :UPPer:STATe <boolean>  
:CALCulate{ [1] } :LIMit{ [1] | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 } :UPPer:STATe?
```

Title: Upper Limit State

Description: Turns ON or OFF the upper limit.

If a limit of the specified number does not already exist, a default limit will be created first (having empty data, with state set to ON).

Parameters: <boolean>

4-4 :CONFigure Subsystem

This set of commands prepares the instrument for the selected measurement. It disables any currently-enabled measurements and activates the specified measurement. It sets the instrument to single sweep mode, waiting for an `:INITiate` command. It will not initiate the taking of a measurement. Current instrument settings may be changed to default values. These changes are identified with their respective measurement commands.

`:CONFigure:CHPower`

Title: Configure Channel Power

Description: Configures the default channel power measurement. Disables any other active one-button measurements, including ACPR, occupied bandwidth, AM/FM demodulation and C/I. Sets the integration bandwidth equal to the span. Sets the detection method to RMS. Sets the instrument to single sweep mode (`:INITiate:CONTinuous OFF`). Measurement settings can be modified by using the `[:SENSe] :CHPower` commands before initiating a sweep. Note that this measurement is not valid in zero span.

`:CONFigure:OBWidth`

Title: Configure Occupied Bandwidth

Description: Configures the default occupied bandwidth measurement. Disables any other active one-button measurements, including channel power, ACPR, AM/FM demodulation and C/I. Sets the method to %. Sets the % of power to 99%. Sets the instrument to single sweep mode (`:INITiate:CONTinuous: OFF`). Measurement settings can be modified by using the `[:SENSe] :OBWidth` commands before initiating a sweep. Note that this measurement is not valid in zero span.

4-5 :DIAGnostic Subsystem

`:DIAGnostic:SWEep:TIME?`

Title: Measured Sweep Time

Description: This command queries the measured sweep time, in number of milliseconds. This command will return "nan" if no measured sweep time is available, which happens if the sweep was reset and the instrument has not yet swept enough to measure a full sweep.

4-6 :DISPlay Subsystem

This subsystem provides commands that modify the display of data for the user. They do not modify the way in which data are returned to the controller.

`:DISPlay:POINTcount <number>`

`:DISPlay:POINTcount?`

Title: Display Point Count

Description: Changes the number of display points the instrument currently measures. Increasing the number of display points can improve the resolution of measurements but will also increase the sweep time.

Parameters: <number>

Display Value: 501

:DISPlay[:WINDow]:TRACe:Y:SCALe:RLEVel <number>
:DISPlay[:WINDow]:TRACe:Y:SCALe:RLEVel?

Title: Reference Level

Description: Sets the reference level amplitude value for the y-axis. This value is the display reference level, which means it has the reference level offset applied. It also means that a change to the reference level offset will change this setting (though the actual, unadjusted reference level will stay the same).

Note that this may cause a change in attenuation if the automatic input attenuation coupling is enabled. For the purpose of coupling, the actual reference level (without the offset applied) is used, though this command will always reflect the display value.

For example, suppose a starting reference level offset of 0 dB and a reference level of 10 dBm. If the offset is set to 20 dB, the display reference level will be set to 10 dBm - 20 dB = -10 dBm; no attenuation change will occur. Likewise, if the starting reference level offset is 20 dB and the (display) reference level is set to 0 dBm, the display reference level will remain at 0 dBm, though the (actual) reference level value used in auto attenuation coupling is 0 dBm + 20 dB = 20 dBm.

To obtain the actual reference level, either add in the reference level offset, or temporarily set the offset to 0 (in which case the display reference level will reflect the actual one).

Parameters: <number>

Default Value: 10 dBm

Default Unit: dBm

Range: -150 dBm to 30 dBm

:DISPlay[:WINDow]:TRACe:Y[:SCALe]:RLEVel:OFFSet <relative amplitude>
:DISPlay[:WINDow]:TRACe:Y[:SCALe]:RLEVel:OFFSet?

Title: Reference Level Offset

Description: Sets the reference level offset value for the y-axis. This offset is used for display purposes only, and does not affect the actual reference level used for auto attenuation coupling, or any other settings that depend on reference level.

See `DISP:WIND:TRAC:Y:SCAL:RLEV` for details on the interaction between reference level offset and display reference level.

Parameters: <relative amplitude>

Default Value: 0 dB

Default Unit: dB

Range: -99.9 dB to 99.9 dB

4-7 :FETCh Subsystem

This set of commands returns the most recent measurement data of the active measurement. They will not switch to another measurement. To make a new measurement, use the `INITiate` command. To get new measurement data, use the `READ` or `MEASure` query commands.

:FETCh:AMPLitude? <freq>

Title: Fetch Amplitude

Description: Returns the amplitude at the given frequency. The command does not wait for the sweep to complete. If the trace data at the requested frequency is invalid (or out of span) then NAN is returned and error code -230 is indicated.

Parameters: <freq>

:FETCh:CHPower?

Title: Fetch Channel Power and Density

Description: This command returns the most recent channel power measurement results: channel power and channel power density. If the instrument is sweeping, it will not return until the sweep is complete. If the instrument is not sweeping and the current data is not valid it will return error -230. This could occur if there was a `*RST` immediately before the `:FETCh?` or if a measurement parameter was changed without an `:INITiate`. Data is returned as 2 comma-separated values: channel power, channel power density. If the measurement is not enabled with `[:SENSe] :CHPower :STATe` then, the instrument will indicate error -400 and return the string "nan,nan"

:FETCh:CHPower:CHPower?

Title: Fetch Channel Power and Density

Description: Returns the most recent channel power measurement result. It returns only the channel power, not the channel power density. Use `FETCh:CHPower?` to get both channel power and channel power density. If the instrument is sweeping, it will not return until the sweep is complete. If the instrument is not sweeping and the current data is not valid it will return error -230. This could occur if there was a `*RST` immediately before the `:FETCh?` or if a measurement parameter was changed without an `:INITiate`. If the measurement is not enabled with `[:SENSe] :CHPower :STATe` then, the instrument will indicate error -400 and return the string "nan,nan".

:FETCh:CHPower:DENSity?

Title: Fetch Channel Power Density

Description: Returns the most recent channel power density measurement result. It returns only the channel power density, not the channel power. Use `:FETCh:CHPower?` to get both channel power and channel power density. If the instrument is sweeping, it will not return until the sweep is complete. If the instrument is not sweeping and the current data is not valid it will return error -230. This could occur if there was a `*RST` immediately before the `:FETCh?` or if a measurement parameter was changed without an `:INITiate`. If the measurement is not enabled with `[:SENSe] :CHPower :STATe` then, the instrument will indicate error -400 and return the string "nan,nan".

:FETCh:OBWidth?

Title: Fetch Occupied Bandwidth

Description: Returns the most recent occupied bandwidth measurement results: occupied bandwidth, percent of power and dB down. One of either percent of power or dB down is measured and the other is set. That is determined by the value set using [:SENSE]:OBWidth:METHOD. If the instrument is sweeping, it will not return until the sweep is complete. If the instrument is not sweeping and the current data is not valid it will return error -230. This could occur if there was a *RST immediately before the :FETCh? or if a measurement parameter was changed without an :INITiate. If the measurement is not enabled with :SENSE:OBWidth:STATE then, the instrument will indicate error -400 and return the string "nan,nan,nan".

:FETCh:PEAK?

Title: Fetch Peak

Description: Returns a pair (amplitude, frequency in Hz) of the peak amplitude in the current sweep. The command does not wait for the sweep to complete. If the trace data is invalid then both numbers in the pair will be NAN and error code -230 will be indicated.

4-8 :INITiate Subsystem

This subsystem controls the triggering of measurements.

:INITiate:CONTinuous <boolean>**:INITiate:CONTinuous?**

Title: SweepType

Description: Specifies whether the sweep/measurement is triggered continuously. If the value is set to ON or 1, another sweep/measurement is triggered as soon as the current one completes. If continuous is set to OFF or 0, the instrument remains initiated until the current sweep/measurement completes, then enters the idle state and waits for the :INITiate[:IMMEDIATE] command or for :INITiate:CONTinuous ON.

If :INITiate:CONTinuous is changed to ON before the current sweep/measurement completes, a new sweep/measurement will be continuously triggered as soon as the current sweep/measurement completes. If :INITiate[:IMMEDIATE] is received before the current sweep/measurement completes, it will be ignored. Clients must either wait for the current sweep/measurement to complete before triggering a 'single sweep', or :ABORT the sweep/measurement after setting :INITiate:CONTinuous to OFF (which will cause the instrument to immediately enter the idle state where it can accept new triggers).

The default value is ON. That is, sending :INIT:CONT is equivalent to sending :INIT:CONT ON. The query version of the command returns a 1 if the instrument is continuously sweeping/measuring and returns a 0 if the instrument is in single sweep/measurement mode.

Parameters: <boolean>

Default Value: ON

:INITiate:SPA:SELFtest?

Title: Initiate Self-test

Description: Perform a self-test and return the results. The response is formatted as a JSON (<http://json.org/>) array of name,value pair result objects. Some result objects also include a 'status' property that will be either 'pass' or 'fail' based on whether the criteria for that test was met.

For tests of voltages, the test passes if the measured voltage is within 10% of the expected voltage.

:INITiate[:IMMediate]

Title: Initiate Single Sweep

Description: Initiates a sweep/measurement. If :INITiate:CONTinuous is set to ON, or if :INITiate:CONTinuous is set to OFF but the current sweep has not completed yet, this command is ignored. Use this command in combination with :STATus:OPERation? or *OPC? to synchronize the capture of one complete set of data. When this command is sent, the sweep complete bit of :STATus:OPERation? is set to 0, indicating that the measurement has not completed. The data collection is then triggered. The controlling program can poll :STATus:OPERation? to determine the status. When the sweep complete bit is set to 1, data is ready to be retrieved.

This command is also overlapped, so alternatively, *OPC? can be used to wait for completion of the measurement without polling. When this command is received, the pending operation bit is set. The pending operation will finish once the sweep/measurement is done. Clients can use *OPC? to 'block' until the sweep/measurement is completed.

4-9 :INPut Subsystem**:INPut:OPower:RELy[:STATe] CLOSeD|OPEN****:INPut:OPower:RELy[:STATe]?**

Title: Set Relay State

Description: Query the state of the overpower relay, or close it. During an overpower condition, the relay will open automatically to prevent damage to RF circuitry, and the device dependent error bit in the ESR will be set to indicate that an overpower condition occurred. To recover, remove the offending input source and then issue this command with a parameter of CLOSeD to close the relay.

Note that while this command returns the relay state as "CLOSeD|OPEN", this command only accepts "CLOSeD as a parameter" (that is, the relay cannot be manually opened, only closed).

Recovering from an overpower condition requires user interaction, either manually or via an automated program that can send this SCPI command to the instrument.

Additionally, if the relay is CLOSeD without removing the source of the overpower, it will immediately revert to OPEN.

Parameters: CLOSeD|OPEN

Default Value: CLOSeD

4-10 :MEASure Subsystem

These commands take the instrument from its current state, enable the specified measurement and put the instrument into single sweep mode. They correct any parameters that are invalid given the new measurement state such that a valid measurement can take place. Other settings may be changed; see the documentation of `CONFigure` for each measurement. They then initiate the measurement. When the measurement is complete, they return the result.

To make a measurement with settings other than the “default” measurement settings applied by `CONFigure`, do the following:

- Send the appropriate `CONFigure` command to set the desired measurement.
- Modify the settings as required.
- Send the appropriate `READ` command to measure and return the result.

To get the current measurement data, use the appropriate `FETCh` command.

:MEASure:CHPower?

Title: Measure Channel Power And Density

Description: Sets the active measurement to channel power, sets the default measurement parameters, triggers a new measurement and returns the channel power and channel power density results. It is a combination of the commands `:CONFigure:CHPower;` `:READ:CHPower?` For a description of the default channel power measurement parameters see `:CONFigure:CHPower`. To make a channel power measurement with settings other than the default values send: `:CONFigure:CHPower` Commands to set desired settings `:READ:CHPower?` Data is returned as 2 comma-separated values: channel power, channel power density.

:MEASure:CHPower:CHPower?

Title: Measure Channel Power

Description: Sets the active measurement to channel power, sets the default measurement parameters, triggers a new measurement and returns channel power as the result. To measure both channel power and channel power density use `MEASure:CHPower?` It is a combination of the commands `:CONFigure:CHPower;` `:READ:CHPower?` For a description of the default channel power measurement parameters see `:CONFigure:CHPower`. To make a channel power measurement with settings other than the default values send: `:CONFigure:CHPower` Commands to set desired settings `:READ:CHPower?`

:MEASure:CHPower:DENSity?

Title: Measure Channel Power Density

Description: Sets the active measurement to channel power, sets the default measurement parameters, triggers a new measurement and returns channel power density as the result. To measure both channel power and channel power density use `MEASure:CHPower?` It is a combination of the commands `:CONFigure:CHPower;` `:READ:CHPower?` For a description of the default channel power measurement parameters see: `:CONFigure:CHPower`. To make a channel power measurement with settings other than the default values send: `:CONFigure:CHPower` Commands to set desired settings `:READ:CHPower?`

:MEASure : IQ : CAPTure

Title: Measure IQ Capture

Description: This set command is used to start the IQ capture measurement. If `IQ:MODE` is `SINGLE`, this command will trigger a single I/Q block capture. While the capture is in progress the I/Q Capture bit of `STATUS:OPERation?` will be set to 1. Clients can read the captured data with the `TRAC:IQ:DATA?` query.

If `IQ:MODE` is `STREAM`, this command will start streaming capture of I/Q data. The most recently captured block of I/Q data can be read with the `TRAC:IQ:DATA?` query. In `STREAM` capture mode, the capture will not complete until aborted. While streaming is going, clients will need to continuously read captured blocks with `TRAC:IQ:DATA?`.

Regardless of the capture mode, the capture can be aborted. The capture can be aborted with the `ABORT` command preferably, though most commands which change hardware settings will also abort the capture (clients should assume that any non-query command sent while a capture is in progress will abort the capture). To determine if the capture was aborted, check the output of `STATUS:OPERation?`.

The capture will also be 'paused' if the instrument detects an overpower or overheat condition: in this situation, any pending `TRAC:IQ:DATA?` query will immediately return `#0` and a device-specific error will be added to the SCPI error queue. When the condition is rectified (either by removing the source of the overpower and closing the overpower relay, or waiting for the instrument to cool down), the capture will automatically restart. Additionally if the instrument detects a change in reference source (either due to a loss/acquisition of GPS or a connection/disconnection of external reference) a device-specific error will be added to the SCPI error queue.

In either capture mode, this command will do nothing if a capture is already in progress.

The device-specific errors this command adds to the SCPI error queue include a description that looks like the following:

- Device-specific error;Reference source changed during capture @ Thu Jun 18 17:02:03 2015
- Device-specific error;Capture paused due to overheating @ Thu Jun 18 17:02:03 2015
- Device-specific error;Capture paused due to RF overpower @ Thu Jun 18 17:02:03 2015

Each description contains the reason for the error and a timestamp when the error occurred.

4-11 :MMEMory Subsystem

The commands in the Mass MEMory subsystem contain functions that provide access to the instrument setup and data storage.

:MMEMory:LOAD:LIMit <string>,<string>,<string>

Title: Load Limit From File

Description: This command loads limit data from the limit file specified by file name. The three parameters for this command are label, file name and current storage location. File name is relative file path to the current storage location including the file name to be loaded and it should not be empty. Current location can be an external device path. Current location defaults to the internal memory, if an empty string is passed. Currently label is not being used. Send an empty string.

Parameters: <string>,<string>,<string>

:MMEMory:STOEvent:CLEarall

Title: Clear All Save On Event

Description: Turns off all save on event types that are active.

:MMEMory:STOEvent:EOSweep:MODE CONTInuous|SINGle

:MMEMory:STOEvent:EOSweep:MODE?

Title: End of Sweep Save On Event Mode

Description: Specifies the stop mode of the end of sweep save on event system. Setting the value to CONTInuous will cause the instrument to keep saving traces at the completion of every valid sweep. Setting the value to SINGle will trigger a save trace on the next complete valid sweep and then automatically turn the end of sweep save on event feature OFF.

Parameters: CONTInuous|SINGle

Default Value: CONTInuous

:MMEMory:STOEvent:EOSweep[:STATe] <boolean>

:MMEMory:STOEvent:EOSweep[:STATe]?

Title: End of Sweep Save on Event State

Description: Turn the end of sweep save on event ON or OFF. Turning the feature on will cause the instrument to automatically save a trace whenever a sweep completes.

A common cause of the command failure is not having enough space available on the storage location. Use :MMEMory:CATalog:DIRectory query command to retrieve the total space available on the storage location.

Parameters: <boolean>

Default Value: OFF

:MMEMory:STOEvent:LIMit:INTerval <time>

:MMEMory:STOEvent:LIMit:INTerval?

Title: Limit Save On Event Interval

Description: Sets the time interval to keep saving after a limit line failure has occurred when :MMEMory:STOEvent:LIMit:MODE is set to INTerval.

Parameters: <time>

Default Value: 60000 ms

Default Unit: ms

Range: 0 ms to 2.16e+08 ms

:MMEMory:STOEvent:LIMit:MODE CONTInuous|SINGle|INTerval

:MMEMory:STOEvent:LIMit:MODE?

Title: End of Sweep Save On Event Mode

Description: Specifies the stop mode of the limit save on event system. Setting the value to CONTInuous will cause the instrument to keep saving traces at every limit line failure. Setting the value to SINGle will trigger a save trace on the next limit line failure and then automatically turn the end of sweep save on event feature OFF automatically. Setting the value to INTerval will trigger a save on the next limit line failure and continue to save at every end of sweep until the set time interval has expired.

Syntax: CONTInuous|SINGle|INTerval

Default Value: CONTInuous

:MMEMory:STOEvent:LIMit[:STATe] <boolean>

:MMEMory:STOEvent:LIMit[:STATe]?

Title: Limit Save on Event State

Description: Turn the limit save on event ON or OFF. Turning the feature on will cause the instrument to automatically save a trace whenever a limit line failure occurs.

A common cause of the command failure is not having enough space available on the storage location. Use :MMEMory:CATalog:DIRectory query command to retrieve the total space available on the storage location.

Parameters: <boolean>

Default Value: OFF

:MMEMory:STORe:LIMit <string>,<string>,<string>

Title: Store Limit to File

Description: This command stores the limit data into the file specified by file name. The three parameters for this command are label, file name and current storage location. File name is relative file path to the current storage location including the file name to be saved and it should not be empty. Current location can be an external device path. Current location defaults to the internal memory, if an empty string is passed. Currently label is not being used. Send an empty string.

A common cause of the command failure is not having enough space available on the storage location. Use :MMEMory:CATalog:DIRectory query command to retrieve the total space available on the storage location.

Parameters: <string>,<string>,<string>

4-12 :READ Subsystem

This set of commands combines the `ABORT`, `INITiate` and `FETCh` commands. It aborts any current triggering sequence and sets the trigger state to idle. It then initiates a new active measurement (i.e. begins the collection of new data). When the measurement is complete, it returns the result. These commands will not switch to another measurement.

To get the current measurement data, use the `FETCh` command.

:READ:CHPower?

Title: Read Channel Power And Density

Description: Triggers a new channel power measurement and returns the results: channel power and channel power density. It is a combination of the commands `:ABORT;` `:INITiate;` `:FETCh:CHPower?` The channel power measurement must be the active measurement (specified by the command `:CONFigure:CHPower`). Data is returned as 2 comma-separated values: channel power, channel power density. If the measurement is not active, the instrument will indicate error -400 and return the string "nan,nan". If `:INITiate` command fails it returns a string "nan,nan".

:READ:CHPower:CHPower?

Title: Read Channel Power And Density

Description: Triggers a new channel power measurement and returns the channel power result: channel power and channel power density. It is a combination of the commands `:ABORT;` `:INITiate;` `:FETCh:CHPower?` The channel power measurement must be the active measurement (specified by the command `:CONFigure:CHPower`). Data is returned as 2 comma-separated values: channel power, channel power density. If the measurement is not active, the instrument will indicate error -400 and return the string "nan" If `:INITiate` command fails it returns a string "nan".

:READ:CHPower:DENSity?

Title: Read Channel Power Density

Description: Triggers a new channel power measurement and returns the channel power density results. It is a combination of the commands `:ABORT;` `:INITiate;` `:FETCh:CHPower:DENSity?` Data returned is channel power density. The channel power measurement must be the active measurement (specified by the command `:CONFigure:CHPower`). If the measurement is not active, the instrument will indicate error -400 and return the string "nan". If `:INITiate` command fails it returns a string "nan".

4-13 :ROUTe Subsystem

:ROUTe:INPut:CLoSe <number>

:ROUTe:INPut:CLoSe? <number>

Title: Switch RF Input

Description: Set the port number of an Antenna Multiplexer Device. Both the set and query command take a parameter specifying a port number. The query version returns 1 if the specified port is currently set, otherwise it returns 0. Available number of ports on the antenna multiplexer device is determined by model number and option number of the system.

Parameters: <number>

Default Value: 1

:ROUTe:INPut:CLoSe:STAtE?

Title: Query RF Input Switch

Description: Query the instrument for the state of the an Antenna Multiplexer Device. The response is in the form of a SCPI channel list (i.e. IEEE definite length arbitrary block response '#AX<block>', where A is the number of digits in X, X is the number of bytes in <block>, and <block> is the ASCII representation of the currently closed port). Available number of ports on the antenna multiplexer device is determined by model number and option number of the system.

4-14 :STATus Subsystem

The commands in this subsystem relate to the current operating state of the instrument.

:STATus:OPERation[:EVENT]?

Title: Get Operation Status

Description: This command requests information about the current status of the instrument. Each bit of the return value represents some operation. Only a subset of the bits are implemented for each application. The number returned is the decimal representation of the bit-wise OR of the enabled bits:

Bit	Decimal	Value Description
0	1	Not implemented
1	2	Not implemented
2	4	Not implemented
3	8	Not implemented
4	16	Not implemented
5	32	Not implemented
6	64	Not implemented
7	128	Not implemented
8	256	Sweep Complete

This bit is set to 0 when the command :INITiate[:IMMediate] is sent to trigger a sweep. It will have a value of 1 when the sweep has completed.

9	512	I/Q Capture
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This bit indicates whether the instrument is currently capturing I/Q data. It is set to 1 when the MEAS:IQ:CAPT command is issued. This bit will be set to 0 when the capture is completed normally (in block mode), or is aborted, either due to the ABORT command or some other command which invalidates the capture.

10	1024	Not implemented
11	2048	Not implemented
12	4096	Not implemented
13	8192	Not implemented
14	16384	Not implemented
15	0	Will always be 0

:SWEep:MODE FFT|NOFFt

:SWEep:MODE?

Title: Sweep Mode

Description: Changes the current sweep mode.

Parameters: FFT|NOFFt

Default Value: NOFFt

Range: FFT|NOFFt

4-15 :TRACe Subsystem

This subsystem contains commands related to the transfer of trace data to and from the instrument.

:TRACe:IQ:DATA:FORMat PACKed|ASCii

:TRACe:IQ:DATA:FORMat?

Title: IQ Data Format

Description: This command selects the data format for transferring I/Q data via the `TRACe:IQ:DATA?` query. Supported data formats include `PACKed`, which is a binary format that includes embedded timestamps, and `ASCii`, which is a human-readable, comma-delimited list of samples. The `PACKed` format is recommended for applications that require precision timestamps, high data throughput, and processing in real time, such as TDOA. The `ASCii` format can be much slower to transfer, but it has the advantage of being human readable.

When the data format is `PACKed`, `TRAC:IQ:DATA?` query uses SCPI standard (IEEE 488.2) definite length block data format for responses. The data format is `#AXD`, where X is one or more ASCII digits specifying the number of bytes in D, and A is a single ASCII digit specifying the number of digits in X. D contains binary data. The whole 'D' part looks like 'L B', where L is an ASCII string of the form 'latitude, longitude' in decimal degrees, ' ' is a single byte newline delimiter marking the end of the GPS location component, and B is the I/Q data taken from the instrument's RAM. The binary structure of B includes timestamps embedded within the samples and is described in detail in the I/Q Data Format Description document published on the Library tab of this product's official web page.

The values of the GPS latitude and longitude in the header are undefined if the GPS is not actually fixed (i.e. `FETCH:GPS?` returns "NO FIX"). When the data format is `ASCii`, `TRAC:IQ:DATA?` query returns an definite length block data response in Comma Separated Values (CSV) Standard File Format, which is easily imported into popular spreadsheet programs:

- Each record is on one line
- Lines are separated by carriage return and line feed (CRLF)
- Fields are separated by commas
- Trailing and leading whitespace is insignificant
- No quotes, embedded commas, or embedded newlines in this output

The data format is `#AXD` where X is one or more ASCII digits specifying the number of bytes in D, and A is the number of digits in X. D contains a list of I/Q samples.

Parameters: `PACKed|ASCii`

Default Value: `PACKed`

:TRACe:STATus? <number>

Title: Trace Status

Description: This command returns a response of the same format as a valid TRACe[:DATA] response, except that instead of amplitude, each comma-delimited value is a decimal integer representing the bitwise-OR of one or more status bits. Each bit of the integer is set according to the table below to indicate that the corresponding trace point has the indicated status:

Bit	Decimal Value	Description
0	1	ADC Overrange
1	Not Implemented	Not Implemented
2	Not Implemented	Not Implemented
3	8	LO1 Lock Failure
4	16	LO2 Lock Failure
5	32	TG LO Lock Failure
6-31	Not Implemented	Not Implemented

Parameters: <number>

:TRACe[:DATA]? <number>

Title: Trace Data

Description: This command transfers trace data from the instrument to the controller. Data is transferred from the instrument as an IEEE definite length arbitrary block response, which has the form <header><block>.

This command takes a single integer parameter specifying the trace number to transfer. If the parameter value is out of the range of valid trace numbers, the first trace (1) will be transferred. (Currently only one trace is supported, so this parameter has no effect).

The ASCII header specifies the number of data bytes. It looks like #AX, where A is the number of digits in X and X is the number of bytes in the <block>.

The first character is the literal ascii hash '#' 043. The second character (A) is a single ascii digit '1' to '9' describing the number of bytes in the length section (X). This number is called nlength. The next nlength bytes make up an ascii string of digits '1' to '9' describing the length of the <block> data.

For example, if the first 6 bytes are #49999, then the nlength is 4. The 4 bytes of length are 9999. After that follows the <block>, which would be 9999 bytes in size.

The format of the block data is a comma-delimited list of 32-bit real amplitudes in dBm. The number of amplitudes returned is equal to the current number of display points (DISPlay:POINTcount).

The query command will return a #0 if data is invalid for the active trace.

Parameters: <number>

:TRACe{[0]}:IQ:DATA?

Title: IQ Data

Description: This command transfers IQ data from the instrument to the controller. Data is transferred from the instrument as an IEEE definite length arbitrary block response, which has the form <header><block>.

4-16 :UNIT Subsystem

This subsystem sets the default measurement units.

:UNIT:POWer DBM|DBUV

:UNIT:POWer?

Title: Measurement Units

Description: Sets the default amplitude units for input, output and display. Available units: dBm, dBuV

Parameters: DBM|DBUV

Default Value: DBM

4-17 [:SENSe] Subsystem

The commands in this subsystem relate to device-specific parameters, not signal-oriented parameters.

[:SENSe]:AVERage:COUNT <number>

[:SENSe]:AVERage:COUNT?

Title: Sense Average Count

Description: Sets the effective number of averages and the length of the rolling min and max hold. Due to memory limitations the actual length of buffers for rolling min and max hold are limited to 2,000,000 / number of trace points.

Parameters: <number>

Default Value: 10

[:SENSe]:AVERage:TYPE NORMal|MINimum|MAXimum|AVERage|RMAXimum|RMINimum

[:SENSe]:AVERage:TYPE?

Title: Sense Average Type

Description: Specifies how successive traces are combined to produce the resulting display value. Setting the TYPE to NORMal will cause the displayed value for a point to be the current measured value for that point. Setting the TYPE to AVERage will cause the displayed value for a point to be the average of the last <integer> measured values where <integer> is set by [:SENSe]:AVERage:COUNT. Setting the TYPE to MAXimum will cause the displayed value for a point is the maximum measured value for that point over sweeps. Setting the TYPE to MINimum will cause the displayed value for a point is the minimum measured value for that point over sweeps. Setting the TYPE to RMAXimum will cause the displayed value for a point to be the maximum of the last <integer> measured values where <integer> is set by [:SENSe]:AVERage:COUNT. Setting the TYPE to RMINimum will cause the displayed value for a point to be the minimum of the last <integer> measured values where <integer> is set by [:SENSe]:AVERage:COUNT.

Parameters: NORMal|MINimum|MAXimum|AVERage|RMAXimum|RMINimum

Default Value: NORMal

[:SENSe]:BANDwidth:VIDeo:AUTO <boolean>

[:SENSe]:BANDwidth:VIDeo:AUTO?

Title: VBW Auto

Description: Sets the state of the coupling of the video bandwidth to the resolution bandwidth. Setting the value to ON or 1 will result in the video bandwidth being coupled to the resolution bandwidth. That is, when the resolution bandwidth changes, the video bandwidth changes. Setting the value to OFF or 0 will result in the video bandwidth being un-coupled from the resolution bandwidth. That is, changing the resolution bandwidth will not change the video bandwidth.

Parameters: <boolean>

Default Value: ON

[:SENSe]:BANDwidth[:RESolution]:AUTO <boolean>

[:SENSe]:BANDwidth[:RESolution]:AUTO?

Title: RBW Auto

Description: Sets the state of the coupling of the resolution bandwidth to the frequency span. Setting the value to ON or 1 will result in the resolution bandwidth being coupled to the span. That is, when the span changes, the resolution bandwidth changes. Setting the value to OFF or 0 will result in the resolution bandwidth being un-coupled from the span. That is, changing the span will not change the resolution bandwidth. When this command is issued, the resolution bandwidth setting itself will not change.

Parameters: <boolean>

Default Value: ON

[:SENSe]:BANDwidth|BWIDth:VIDeo <freq>

[:SENSe]:BANDwidth|BWIDth:VIDeo?

Title: VBW

Description: Sets the video bandwidth. Note that using this command turns the automatic video bandwidth setting OFF.

Parameters: <freq>

Default Value: 1e+06 Hz

Default Unit: Hz

Range: 1 Hz to 3e+06 Hz

[:SENSe]:BANDwidth|BWIDth:VIDeo:RATio <number>

[:SENSe]:BANDwidth|BWIDth:VIDeo:RATio?

Title: VBW RBW Ratio

Description: Sets the ratio of the video bandwidth to the resolution bandwidth for use when the video to resolution bandwidth coupling is enabled. Note that the front panel interface sets the inverse ratio: the resolution bandwidth to the video bandwidth which is an integer, in other words, if you send 0.35, the display will show 2 not 2.857.

Parameters: <number>

Default Value: 0.33

[:SENSe]:BANDwidth|BWIDth:VIDeo:TYPE LINear|LOGarithmic

[:SENSe]:BANDwidth|BWIDth:VIDeo:TYPE?

Title: VBW Averaging

Description: Changes the VBW/Average type.

Parameters: LINear|LOGarithmic

Default Value: LINear

```
[:SENSe]:BANDwidth|BWIDth[:RESolution] <freq>  
[:SENSe]:BANDwidth|BWIDth[:RESolution]?
```

Title: RBW

Description: Sets the resolution bandwidth. Note that using this command turns the automatic resolution bandwidth setting OFF.

Parameters: <freq>

Default Value: 3e+06 Hz

Default Unit: Hz

Range: 10 Hz to 3e+06 Hz

```
[:SENSe]:BANDwidth|BWIDth[:RESolution]:RATio <number>  
[:SENSe]:BANDwidth|BWIDth[:RESolution]:RATio?
```

Title: RBW Span Ratio

Description: Sets the ratio of the resolution bandwidth to the span for use when the resolution bandwidth to span coupling is enabled. Note that the front panel interface sets the inverse ratio span to the resolution bandwidth.

Parameters: <number>

Default Value: 0.01

```
[:SENSe]:CHPower:BANDwidth|BWIDth:INTEgration <freq>  
[:SENSe]:CHPower:BANDwidth|BWIDth:INTEgration?
```

Title: Channel Power Integration Bandwidth

Description: Sets the integration bandwidth for channel power measurement. Integration bandwidth must be less than equal to span.

Parameters: <freq>

Default Value: 1.035e+07 Hz

Default Unit: Hz

Range: 10 Hz to 6e+09 Hz

```
[:SENSe]:CHPower:STATE <boolean>  
[:SENSe]:CHPower:STATE?
```

Title: Channel Power State

Description: Sets the state of the channel power measurement, ON or OFF. When using :CONFigure:CHPower, the state is automatically set to ON.

Parameters: <boolean>

Default Value: OFF

[:SENSe]:DETEctor[:FUNction] POSitive|RMS|NEGative

[:SENSe]:DETEctor[:FUNction]?

Title: Detection Mode

Description: Sets the detection method for calculating each display point. Each display point represents several measurements. The detection type determines how the display point is derived from its associated measurements. POSitive Peak detection displays the maximum value of the associated measurements. RMS detection displays the average power of the associated measurements. NEGative Peak detection displays the minimum value of the associated measurements.

Syntax Example: POSitive|RMS|NEGative

Default Value: POSitive

[:SENSe]:FREQuency:CENTer <freq>

[:SENSe]:FREQuency:CENTer?

Title: Center Frequency

Description: Sets the center frequency. Note that changing the value of the center frequency will change the value of the coupled parameters Start Frequency and Stop Frequency. It may also change the value of the span.

Parameters: <freq>

Default Value: 3e+09 Hz

Default Unit: Hz

Range: 5 Hz to 6e+09 Hz

[:SENSe]:FREQuency:REFerence:SOURce?

Title: Frequency Reference Source

Description: Returns the current frequency reference source used by the instrument, as specified in the following table:

Return value	Description
GPS	GPS High Accuracy
ACQ	Acquiring GPS Reference
INV	Invalid (error locking to external reference)
INT	Internal Standard Accuracy
EXT	External (10 MHz) Reference

[:SENSe]:FREQUENCY:SPAN <freq>

[:SENSe]:FREQUENCY:SPAN?

Title: Span

Description: Sets the frequency span. Setting the value of <freq> to 0 Hz is the equivalent of setting the span mode to zero span. Note that changing the value of the frequency span will change the value of the coupled parameters Start Frequency and Stop Frequency and may change the Center Frequency.

Parameters: <freq>

Default Value: 6e+09 Hz

Default Unit: Hz

Range: 10 Hz to 6e+09 Hz

[:SENSe]:FREQUENCY:SPAN:FULL

Title: Set to Full Span

Description: Sets the frequency span to full span. Note that changing the value of the frequency span will change the value of the coupled parameters, Start Frequency and Stop Frequency and may change the Center Frequency.

[:SENSe]:FREQUENCY:SPAN:LAST

Title: Set to Last Span

Description: Sets the frequency span to the previous span value. Note that changing the value of the frequency span will change the value of the coupled parameters, Start Frequency and Stop Frequency and may change the Center Frequency.

[:SENSe]:FREQUENCY:START <freq>

[:SENSe]:FREQUENCY:START?

Title: Start Frequency

Description: Sets the start frequency. Note that in the spectrum analyzer, changing the value of the start frequency will change the value of the coupled parameters, Center Frequency and Span.

Parameters: <freq>

Default Value: 0 Hz

Default Unit: Hz

Range: 0 Hz to 6e+09 Hz

[:SENSe]:FREQUENCY:STOP <freq>

[:SENSe]:FREQUENCY:STOP?

Title: Stop Frequency

Description: Sets the stop frequency. Note that in the spectrum analyzer, changing the value of the stop frequency will change the value of the coupled parameters, Center Frequency and Span.

Parameters: <freq>

Default Value: 6e+09 Hz

Default Unit: Hz

Range: 10 Hz to 6e+09 Hz

[:SENSe]:IQ:BANDwidth <freq>**[:SENSe]:IQ:BANDwidth?**

Title: Capture Bandwidth

Description: Sets or queries the capture bandwidth of I/Q data captured by MEASURE:IQ:CAPTURE. Only these values are valid:

20000000, 13300000, 6670000, 2670000, 1330000, 667000, 267000, 133000, 66700, 26700, 13300, 6670, 2670, 1330, 667, 267, 133, 67

This setting configures data decimation factors in the I/Q capture engine to provide an effective capture bandwidth of at least the amount specified.

Parameters: <freq>

Default Value: 2.67e+06 Hz

Default Unit: Hz

Range: 0 Hz to 1e+08 Hz

[:SENSe]:IQ:BITS <number>**[:SENSe]:IQ:BITS?**

Title: IQ Bits per Sample

Description: The number of IQ bits per sample. Lower values enable higher throughput (continuous IQ capture) or longer maximum capture length (block IQ capture). The number of samples per frame increases as the bits per sample decreases:

Bits per sample	Samples per frame
24	1
16	2
10	3
8	4

Parameters: <number>

Default Value: 24

[:SENSe]:IQ:LENGth <time>**[:SENSe]:IQ:LENGth?**

Title: Capture Length

Description: The set form of this command sets the iq length in milliseconds and query form returns the IQ length in milliseconds.

Parameters: <time>

Default Value: 10 ms

Default Unit: ms

Range: 0.001 ms to 10000 ms

[:SENSe]:IQ:MODE SINGLE|STREAm <SINGLE|STREAm>

[:SENSe]:IQ:MODE?

Title: Capture Mode

Description: Specifies the type of capture mode:

- Single mode does a single block capture
- Streaming mode does real time streaming capture.

Parameters: SINGLE|STREAm

Default Value: SINGLE

[:SENSe]:IQ:SAMPlE:CONFIguration?

Title: IQ Configuration

Description: Returns a comma delimited list of I/Q measurement configuration information with 5 fields:

- Base Sample rate
- Number of bytes per frame,
- Effective bits per sample (see SENSE:IQ:BITS),
- Decimation factor
- Timestamp (see SENSE:IQ:TIMESTAMP)

The base sample rate is generally fixed in a specific hardware revision; its value is provided here to enable calculation of the data rate, or time between samples, which is equal to the base sample rate divided by the decimation factor. The data rate is used when extrapolating embedded timestamps to other samples. For example, assuming a data rate of 1 MHz, if the nth sample contains an embedded timestamp of

$$\begin{aligned}
 &1444753342s + 37531655ns, \text{ the } n+1\text{th sample would have an effective timestamp of} \\
 &1444753342s + 37531655ns + (1/1\text{MHz}) \\
 &= 1444753342s + 37531655ns + 1ms \\
 &= 1444753342s + 37532655ns.
 \end{aligned}$$

The number of samples per frame is calculated by:

- $\text{floor}(\text{bitsPerFrame} / \text{bitsPerSample})$, where $\text{bitsPerFrame} = 8 * \text{bytesPerFrame}$

Decimation factor is read only, and its value is derived from the current capture bandwidth setting. There is a 1-to-1 correspondence between an IQ:BAND value and a decimation factor.

Number of bytes per sample is 8 for I/Q and 2 for raw ADC capture. The raw ADC capture must be parsed differently. See TRAC:IQ:DATA? for the data format.

This command provides the information necessary for clients to reconstruct I/Q data samples and timestamps from the raw data returned by TRAC:IQ:DATA?.

[:SENSe]:IQ:TIMEstamps <boolean>

[:SENSe]:IQ:TIMEstamps?

Title: IQ Timestamps

Description: Enables or disables IQ timestamps. When I/Q timestamps are enabled, timestamps will be embedded in the binary response data returned by TRACe:IQ:DATA?. The first 256 frames of each 1024 frame chunk use the least-significant bit of each I and Q sample in each frame for timestamping.

If SENS:IQ:BITS is 24 or 10, the timestamp does not reduce resolution.

If SENS:IQ:BITS is 16 or 8, the timestamp reduces the resolution by one bit for 256/1024 frames.

In the 16 bit case, 256/2048 samples are 15 bits. In the 8 bit case, 256/4096 samples are 7 bits.

If SENS:IQ:TIMESTAMPS is OFF, then the IQ data cannot be absolutely positioned in time, but all samples have full resolution.

This setting is ignored if SENSE:IQ:BITS is 24 or 10 bits because there are extra, otherwise unused bits. The timestamps are shift-encoded in groups of 64 in bit 0, and there is a shift-encoded mark in bit 32.

Parameters: <boolean>

Default value: ON

[:SENSe]:OBWidth:METHod XDB|PERCent

[:SENSe]:OBWidth:METHod?

Title: Occupied Bandwidth Method

Description: Sets the method for calculating occupied bandwidth. XDB calculates the occupied bandwidth based on points a specified number of dB below the carrier.

Issue command [:SENSe]:OBWidth:XDB to set the number of dB to be used. PERCent calculates the occupied bandwidth based on points a specified percentage of the carrier power below the carrier.

Issue command [:SENSe]:OBWidth:PERCent to set the percentage to be used.

The measurement always gives a result, even if there is no signal. For example, the 100 dBc Occupied Bandwidth is the current full span.

Parameters: XDB|PERCent

Default Value: PERCent

[:SENSe]:OBWidth:PERCent <number>

[:SENSe]:OBWidth:PERCent?

Title: Occupied Bandwidth Percent

Description: This command sets the percentage of carrier power used to measure the occupied bandwidth. This value is used in the measurement if :SENSe:OBWidth:METHod is set to PERCent.

Parameters: <number>

Default Value: 99

[:SENSe]:OBWidth:STATE <boolean>

[:SENSe]:OBWidth:STATE?

Title: Occupied Bandwidth State

Description: Sets the state of the occupied bandwidth measurement, ON or OFF. When using :CONFigure:OBWidth, the state is automatically set to ON.

Parameters: <boolean>

Default Value: OFF

[:SENSe]:OBWidth:XDB <relative amplitude>

[:SENSe]:OBWidth:XDB?

Title: Occupied Bandwidth XDB

Description: This command sets the number of dB below the carrier used to measure the occupied bandwidth. This value is used in the measurement if :SENSe:OBWidth:METhod is set to XDB.

Parameters: <relative amplitude>

Default Value: 3 dB

Default Unit: dB

Range: 0.001 dB to 100 dB

[:SENSe]:POWer:RF:ATTenuation <relative amplitude>

[:SENSe]:POWer:RF:ATTenuation?

Title: Input Attenuation

Description: Sets the input attenuation. Note that issuing this command will set the automatic input attenuation OFF.

Parameters: <relative amplitude>

Default Value: 30 dB

Default Unit: dB

Range: 0 dB to 50 dB

[:SENSe]:POWer:RF:ATTenuation:AUTO <boolean>

[:SENSe]:POWer:RF:ATTenuation:AUTO?

Title: RF Attenuation Auto

Description: Sets the input attenuation coupling. Setting the value to ON or 1 will result in the input attenuation being coupled to the reference level.

Setting the value to OFF or 0 will result in the input attenuation being uncoupled from the reference level. That is, changing the reference level will not change the input attenuation. When this command is issued, the input attenuator setting itself will not change.

The default value is ON. That is, sending: :SENS:POW:ATT:AUTO is equivalent to sending: :SENS:POW:ATT:AUTO ON.

Parameters: <boolean>

Default Value: ON

[:SENSE]:POWER:RF:GAIN:STATE <boolean>

[:SENSE]:POWER:RF:GAIN:STATE?

Title: Preamp

Description: Sets the state of the preamp. Note that this may cause a change in the reference level and/or attenuation.

Parameters: <boolean>

Default Value: OFF

Chapter 5 — SCPI System Commands

5-1 System Common Commands

The set of system common commands are primarily used to control the state of the instrument for system diagnostics, hardware calibration, and troubleshooting.

***CLS**

Title : Clear Status Command

Description : This command clears all status data structures in the device (registers and error queue) and forces the Operaton Complete state to Idle.

***ESE <number>**

***ESE?**

Title : Standard Event Status Enable

Description : This command provides access the Standard Event Status Enable Register. Refer to IEEE 488.2 for more information on the contents of this register. Value ranges from 0 to 255.

Parameters : <number>

***ESR?**

Title : Standard Event Status

Description : This command queries the Standard Event Status Register. Refer to IEEE 488.2 for more information on the contents of this register.

***IDN?**

Title : Identification Query

Description : This command returns the following information in <string> format separated by commas: manufacturer name ("Anritsu"), model number/options, serial number, firmware package number. The model number and options are separated by a "/" and each option is separated by a ".".

***OPC**

***OPC?**

Title : Operation Complete

Description : The *OPC command causes the device to set the OPC bit of the Standard Event Status Register on the next transition of the No Operation Pending flag from false to true. The *OPC? command returns 1 in the response whenever the No Operation Pending Flag is true.

***RST**

Title : Reset

Description : This command restores parameters in the current application as well as system settings to their factory default values. System settings affected by this command are Ethernet configuration. Note that the unit will power-cycle after this command is executed. After executing this command communication will be lost. Wait a minimum of 30 seconds before re-establishing communication.

SRE <number>**SRE?**

Title : Service Request Enable

Description : This command provides access to the Service Request Enable Register. Refer to IEEE 488.2 for more information on the contents of this register.

Parameters : <number>

***STB?**

Title : Status Byte Query

Description : This command queries the Status Byte Register. Refer to IEEE 488.2 for more information on the contents of this register.

***WAI**

Title : Wait-to-Continue Command

Description : This command causes the device to execute no further commands or queries until the No Operation Pending flag is TRUE.

5-2 System Mode Commands

System mode commands control all instrument functions and some general purpose functions. All system mode commands are grouped into the following functional subsystems:

- [Section 5-3 “:FETCh Subsystem”](#)
- [Section 5-4 “:INSTrument Subsystem”](#)
- [Section 5-5 “:MMEMory Subsystem”](#)
- [Section 5-6 “:SYSTem Subsystem”](#)

5-3 :FETCh Subsystem

Use this command to get GPS information.

:FETCh:GPS?

Title : Basic GPS Information

Description : This command retrieves the latitude and longitude of the device.

:FETCh:GPS:FULL?

Title : Full GPS Information

Description : This command retrieves the latitude, longitude, altitude, and satellite count of the device.

:FETCh:GPS:LAST?

Title : Last GPS Fix

Description : This command retrieves the latitude and longitude of the last fixed GPS result.

5-4 :INSTrument Subsystem

One instrument may contain many logical instruments (“modes”). This subsystem controls the selection of the current instrument mode.

:INSTrument:CATalog:FULL?

Title : Full Instrument Catalog

Description : This query returns a list of string - number pairs. The string contains the name of the logical instrument. The immediately following NR1-formatted number is its associated logical instrument number. All response data elements are comma separated. If no logical instrument is defined, a null string followed by a zero is returned.

:INSTrument:NSElect <number>

:INSTrument:NSElect?

Title : Instrument Next Select

Description : Sets the instrument mode based on the value of <integer>. The query version returns the number associated with the current mode.

Parameters : <number>

:INSTrument[:SElect] <string>

:INSTrument[:SElect]?

Title : Instrument Select

Description : Sets the instrument mode based on the mode name specified by <string>. The query version returns the name of the current mode.

Parameters : <string>

5-5 :MMEMory Subsystem

The Mass MEMory subsystem contains functions that provide access to the instrument's setup and data storage.

:MMEMory:CATalog:DIRectory? <string>,<string>

Title : Memory Catalog Directory

Description : Returns the non-recursive contents of the memory specified by the MSUS and DIRECTORY parameters. Both parameters are case sensitive.

Parameters : <string> Directory. Use "/" as a directory separator

: <string> MSUS (Use :MMEMory:CATalog:MSUSs command to retrieve the list of available storage devices).

Remark : The response is formatted as follows: <total space used on MSUS>,<total space available on MSUS>,{<file entry1>},...{<file entryN>} where <file entry> is: <file or directory name>,<file type>,<file size>

:MMEMory:CATalog:MSUSs?

Title : Memory Catalog Mass Storage

Description : Returns a list of all available mass storage devices present, formatted as follows:

<Device Name 1>,<Device Name 2>,...<Device Name N>

:MMEMory:CDIRectory <string>

:MMEMory:CDIRectory?

Title : Default Mass Storage Directory

Description : This command selects the default directory on the default mass storage device (see :MMEMory:MSIS) for use with MMEMory commands. The parameter is case sensitive. Use "/" as a directory separator.

Parameters : <string>

:MMEMory:CREate:DIRectory <string>,<string>

Title : Create Directory

Description : Creates a directory at the specified mass storage device. The two parameters for this command are directory name and mass storage device. Both parameters are case sensitive.

Use "/" as a directory separator. The available mass storage devices can be retrieved by using the command:

:MMEMory:CATalog:MSUSs

If the intermediate directories in the path don't exist, the command will automatically create them. The command will fail if the mass storage device is not present.

Parameters : <string>,<string>

:MMEMory:DELeTe:DIRectory <string>,<string>

Title : Delete Directory

Description : Deletes the specified directory and all its content at the specified mass storage device. The two paramters for this command are directory name and mass storage device. Both parameters are case sensitive.

Use "/" as a directory separator. To delete the root folder in a specified mass storage device, enter "/" for directory name parameter. The available mass storage devices can be retrieved by using the command:

:MMEMory:CATalog:MSUSs

The command will fail if the directory doesn't exist or the mass storage device is not present.

Parameters : <string>,<string>

:MMEMory:DELeTe:FILE <string>,<string>

Title : Delete File

Description : Deletes the specified file at the specified mass storage device. The two parameters for this command are file name with relative path and mass storage device. Both parameters are case sensitive.

Use "/" as a directory separator. The available mass storage devices can be retrieved by the command:

:MMEMory:CATalog:MSUSs

The command will fail if the file doesn't exist or the mass storage device is not present.

Parameters : <string>,<string>

:MMEMory:MSIS <string>**:MMEMory:MSIS?**

Title : Default Mass Storage Device

Description : This command selects the default device for use with MMEMory commands. The mass storage device parameter is case sensitive and must match a device returned from the command:

:MMEMory:CATalog:MSUSs?

Parameters : <string>

:MMEMory:STORe:TRACe <string>,<string>,<string>

Title : Memory Store Trace

Description : This command saves the current trace to the specified file location. The file location is resolved using the MSUS and file path parameters. These parameters are case sensitive.

- Label- currently unused. Send an empty string
- File path- The file path (including file name) relative to the MSUS root directory. File extension should not be specified.
- MSUS- Device to save the file on. See MMEMory:MSUSs? for information on obtaining the list of available devices.

Parameters : <string>,<string>,<string>

5-6 :SYSTEM Subsystem

This subsystem contains commands that affect instrument functionality that does not directly relate to data collection, display or transfer.

:SYSTEM:COMMunicate:LAN:CONFig <string>,<string>,<string>

:SYSTEM:COMMunicate:LAN:CONFig?

Title : Static LAN Configuration

Description : This command set and queries the static ethernet configuration of the device. The static configuration allows user to specify the ip, gateway, and subnet mask of the unit on a network.

Parameters: <string> static IP address: The desired IP address of the unit.
 <string> gateway: The network gateway.
 <string> the subnet mask of the network the device is connected to.

A new valid configuration will automatically be applied to the device. The user will be required to access the unit through the new configuration.

:SYSTEM:COMMunicate:LAN:CONFig:CURRent?

Title : Current LAN Configuration

Description : This command queries the current ethernet configuration of the device.

:SYSTEM:COMMunicate:LAN:DHCP <ON|OFF>

:SYSTEM:COMMunicate:LAN:DHCP?

Title : DHCP Configuration

Description : This command sets and queries the DHCP configuration of the device.

If the DHCP configuration is set to OFF, the device is configured to the static Ethernet configuration (see :SYSTEM:COMMunicate:LAN:CONFig).

If the DHCP configuration is set to ON, the device will obtain its IP address, gateway, and subnet mask from the DHCP server in the network.

This set command should be used to caution, as changing the Ethernet configuration will result in temporary loss of communication with the device.

Parameters : <ON|OFF>

:SYSTEM:COMMunicate:LAN:DNS <string>,<string>,<string>

:SYSTEM:COMMunicate:LAN:DNS?

Title : DNS Configuration

Description : This command sets and queries the DNS configuration of the device. Currently, only http://www.noip.com is available for use.

DNS Host Name: Desired host name of the device.

DNS Username: noip.com username.

DNS Password: noip.com password.

Parameters : <string>,<string>,<string>

:SYSTEM:COMMunicate:LAN:HOSTname <string>

:SYSTEM:COMMunicate:LAN:HOSTname?

Title : Local Host Name

Description : This command sets and retrieves the local host name of the instrument. A valid hostname may contain only the ASCII letters 'a' through 'z' (in a case-insensitive manner), the digits '0' through '9', and the hyphen ('-'). They cannot start/end with '-'. No other symbols, punctuation characters, or white space are permitted.

Parameters : <string>

:SYSTEM:COMMunicate:LAN:NFS:MOUNT:LIST:REMHost?

Title : NFS Mount Remote Host

Description : This command retrieves the IP address of the remote host and the path to the remotely mounted folder, if NFS is mounted.

:SYSTEM:DATE <number>, <number>, <number>

:SYSTEM:DATE?

Title : System Date

Description : This command sets and queries the system's internal calendar. The three parameters for this command are <year>, <month> and <day>. The query response message will consist of three fields separated by commas: <year>, <month>, <day>. The year will be entered as a four-digit number, including century and millennium information. This will not be affected by a *RST command.

Parameters : <number>, <number>, <number>

:SYSTEM:DEFault:RESet:FACTory

Title : Reset System to Factory Default

Description : This command presets parameters in all applications as well as system settings to their factory default values. Last saved settings will be deleted.

:SYSTEM:DEFault:RESet:MASTer

Title : Master Reset System to Default

Description : This command presets parameters in all applications as well as system settings to their factory default values. Last saved settings, log files, and user files will all be deleted.

:SYSTem:ERRor[:NEXT]?

Title : System Error Queue

Description : If an error occurs, the error number and message are placed in the error queue, which can be read by this query command. Errors are cleared by reading them.

- Error code 0, is "No error".
- Error codes from -100 to -199 belongs to the Command error category and sets bit 5 of the standard ESR register.
- Error codes from -200 to -299 belongs to the Command error category and sets bit 4 of the standard ESR register.
- Error codes from -400 to -499 belongs to the Query error category and sets bit 2 of the standard ESR register.
- Error codes from -300 to -399 and 1 to 32767 belongs to the Device-specific error and sets bit 3 of the standard ESR register.

Negative error numbers (command error, execution error, device-dependent error, query error) are standard SCPI errors.

Positive error numbers are device specific errors, not standard SCPI errors.

The error queue is also cleared by *CLS, *RST, and when power is turned on. If more errors have occurred than can fit in the buffer, the last error stored in the queue (the most recent error) is replaced with -350, Queue overflow. No additional errors are stored until removing errors from the queue. If no errors have occurred when reading the error queue, the instrument responds with 0, No error.

:SYSTem:FIRMware:UPDate:REMote <string>

Title : Remote Firmware Update

Description : Initiate a remote firmware update to the package whose name is specified as a parameter. Use :SYSTem:FIRMware:UPDate:REMote:LIST? to inspect the packages that can be installed. If the requested firmware package is not recognized, an appropriate error will be added to the error. Otherwise, the instrument will download the specified firmware package, verify that the package is safe to install, update to the new firmware, and finally reboot. Before rebooting all remote clients will be disconnected.

Parameters : <string>

:SYSTem:FIRMware:UPDate:REMote:LATest?

Title : Check For Firmware Update

Description : Check whether the instrument firmware is at the latest version. This command will access the package list specified by SYST:FIRM:UPD:REM:SOUR and return a response of the form <string>,<number> where <string> is the name of the latest firmware package, and <number> is 1 if the latest firmware package is newer than the version of firmware currently installed (a firmware update is available), or 0 if the current instrument firmware version matches the latest version (the instrument is up to date). Clients can update the instrument to the latest firmware by passing the <string> component of the response as a parameter to the SYST:FIRM:UPD:REM command.

:SYSTEM:FIRMWARE:UPDATE:REMOTE:LIST?

Title : Remote Firmware Package List

Description : This command queries the instrument for a list of firmware packages that can be installed remotely. The package list will be populated from a resource file that is downloaded from a URL specified by the current value of `:SYSTEM:FIRMWARE:UPDATE:REMOTE:SOURCE`. The response is ASCII response consisting of one or more comma-delimited package names.

For example: 2.0.0,1.0.0 These package names enumerate the valid parameter values to the `:SYSTEM:FIRMWARE:UPDATE:REMOTE` command.

:SYSTEM:FIRMWARE:UPDATE:REMOTE:SOURCE <string>**:SYSTEM:FIRMWARE:UPDATE:REMOTE:SOURCE?**

Title : Remote Firmware Package Source

Description : This command sets or queries the instrument's remote firmware update package list source. This source must be an http URL that is accessible to the instrument over the current network interface.

The set version of this command takes a string that spells the URL to the package list file. The query version returns that string. The default value points to the repository on `anritsu.com` where official firmware packages for this instrument are distributed. Most users will never need to change this setting from the default.

The package list file must be a JSON file that has a minimum structure. The root object must contain a "version" string (which is reserved but currently unused), a "packages" array of zero or more package objects (each at minimum have a "name" and a "url"), and a "default" string that matches one of the package names, or is "".

An example package list file is shown below:

```
{
  "version" : "0.0.1",
  "packages" : [
    {
      "name" : "2.0.0",
      "url" : "http://files.us.anritsu.com/firmware/sh/2.0.0.tar"
    }
    { "name" : "1.0.0",
      "url" : "http://files.us.anritsu.com/firmware/sh/1.0.0.tar"
    }
  ],
  "default" : "1.0.0"
}
```

When the package source is set, the instrument will attempt to download the file and validate it according to the above rules before making the change permanent. If the file cannot be accessed or the file does not conform to the minimum criteria, a device specific error will be added to the error queue and the package source will remain unchanged.

Parameters : <string>

:SYSTEM:GPS:VOLTage? <number>

Title : GPS Voltage

Description : Supplies either 3.3V or 5V to power the attached GPS.

Parameters : <number>

:SYSTEM:LOG:ERRor?

Title : System Log Error

Description : This command retrieves the error log. The log is encrypted and can be saved to a file and sent to Anritsu Service if required.

:SYSTEM:MACaddress?

Title : Configure MAC Address

Description : This command accesses the mac address of the device.

:SYSTEM:OPTions?

Title : Query Options

Description : This command retrieves the options that are currently set. The response is returned in "/" delimited form.

:SYSTEM:PRESet

Title : System Preset

Description: This command presets parameters in the current application to their factory default values.

:SYSTEM:TEMPerature?

Title : Get System Temperature

Description : This command retrieves the device temperature.

:SYSTEM:TIME <number>,<number>,<number>**:SYSTEM:TIME?**

Title : System Time

Description : This command sets and queries the system's internal clock. The three parameters for this command are <hour>,<minute> and <second>. The query response message shall consist of three fields separated by commas: <hour>,<minute>,<second>.

Parameters : <number>,<number>,<number>

Appendix A — SCPI Error Table

This section lists the error code/messages returned from the device when an error occurs during the execution of the SCPI command.

Error messages are classified by error number as listed in table below.

Error Number	Error String	Description
0	No error	The queue is completely empty. Every error/event in the queue has been read or the queue was purposely cleared by power-on, *CLS, etc.
-100	Command error	Command error
-101	Invalid character	A syntactic element contains a character which is invalid for that type.
-102	Syntax error	An unrecognized command or data type was encountered.
-103	Invalid separator	The parser was expecting a separator and encountered an illegal character.
-104	Data type error	The parser recognized a data element different than one allowed.
-108	Parameter not allowed	More parameters were received than expected for the header.
-109	Missing parameter	Fewer parameters were received than required for the header.
-110	Command header error	An error was detected in the header.
-120	Numeric data error	Error is generated when parsing a data element which appears to be numeric, including the non-decimal numeric types.
-121	Invalid character in number	An invalid character for the data type being parsed was encountered.
-123	Exponent too large	The magnitude of the exponent was larger than 32000.
-124	Too many digits	The mantissa of a decimal numeric data element contained more than 255 digits excluding leading zeros.
-131	Invalid suffix	The suffix does not follow the syntax or suffix is inappropriate for this device.
-141	Invalid character data	Either the character data element contains an invalid character or the particular element received is not valid for the header.
-160	Block data error	Error is generated when parsing a block data element.
-171	Invalid Expression	The expression data element was invalid; for example, unmatched parentheses or an illegal character.
-200	Execution error	Execution error
-213	Init ignored	Indicates that a request for a measurement initiation was ignored as another measurement was already in progress.
-224	Illegal parameter value	Indicates that an exact value, from a list of possibles, was expected.
-230	Invalid trace data	Data corrupt or stale
-251	Missing mass storage	Indicates that a legal program command or query could not be executed because of missing mass storage.
-256	File name not found	Indicates that a legal program command or query could not be executed because the file name on the device was not found.

Error Number	Error String	Description
-300	Device-specific error	Device-specific error
-340	Calibration Failed	Calibration Failed
-350	Queue overflow	A specific code entered into the queue in lieu of the code that caused the error. This code indicates that there is no room in the queue and an error occurred but was not recorded.
-363	Input buffer overrun	Software or hardware input buffer on incoming port overflows with data caused by improper or nonexistent pacing.
-400	Query error	Query error

Appendix B — SCPI Command Listing

The commands in this section are listed in alphabetical order.

:ABORt	4-1
:CALCulate:LIMit{[1] 2 3 4 5 6 7 8 9 10}:CONTrol[:DATA]<frequency list>	
:CALCulate:LIMit{[1] 2 3 4 5 6 7 8 9 10}:CONTrol[:DATA]?	4-2
:CALCulate:LIMit{[1] 2 3 4 5 6 7 8 9 10}:LOWer[:DATA] <amplitude list>	4-2
:CALCulate:LIMit{[1] 2 3 4 5 6 7 8 9 10}:LOWer[:DATA]?	4-2
:CALCulate:LIMit{[1] 2 3 4 5 6 7 8 9 10}:UPPer[:DATA] <amplitude list>	4-3
:CALCulate:LIMit{[1] 2 3 4 5 6 7 8 9 10}:UPPer[:DATA]?	4-3
:CALCulate {[1]}:LIMit:ACTive?	4-3
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:COMMeNt <string>	4-3
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:COMMeNt?	4-3
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:CONTrol:MODE <char>	4-4
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:CONTrol:MODE?	4-4
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:CONTrol:SHIFt <freq>	4-4
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:COpy <number>	4-4
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:DELeTe	4-4
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:FAIL?	4-5
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:LOWer:MODE <char>	4-5
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:LOWer:MODE?	4-5
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:LOWer:SHIFt <relative amplitude>	4-6
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:LOWer:STATe <boolean>	4-6
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:LOWer:STATe?	4-6
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:NAME <string>	4-6
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:NAME?	4-6
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:STATe <boolean>	4-6
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:STATe?	4-6
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:TRACe:CHECk <boolean>	4-7
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:TRACe:CHECk?	4-7
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:UPPer:MODE <char>	4-7
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:UPPer:MODE?	4-7
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:UPPer:SHIFt <relative amplitude>	4-7
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:UPPer:STATe <boolean>	4-7
:CALCulate {[1]}:LIMit{[1] 2 3 4 5 6 7 8 9 10}:UPPer:STATe?	4-7
:CONFigure:CHPower	4-8
:CONFigure:OBWidth	4-8
:DIAGnostic:SWEEp:TIME?	4-8
:DISPlay:POINtcount <number>	4-8
:DISPlay:POINtcount?	4-8
:DISPlay[:WINDow]:TRACe:Y:SCALe:RLEVel <number>	4-9
:DISPlay[:WINDow]:TRACe:Y:SCALe:RLEVel?	4-9
:DISPlay[:WINDow]:TRACe:Y[:SCALe]:RLEVel:OFFSet <relative amplitude>	4-9
:DISPlay[:WINDow]:TRACe:Y[:SCALe]:RLEVel:OFFSet?	4-9
:FETCh:AMPLitude? <freq>	4-10
:FETCh:CHPower:CHPower?	4-10
:FETCh:CHPower:DENSity?	4-10

:FETCh:CHPower?	4-10
:FETCh:GPS:FULL?	5-3
:FETCh:GPS:LAST?	5-3
:FETCh:GPS?	5-3
:FETCh:OBWidth?	4-11
:FETCh:PEAK?	4-11
:INITiate:CONTInuous <boolean>	4-11
:INITiate:CONTInuous?	4-11
:INITiate:SPA:SELfTest?	4-12
:INITiate[:IMMediate]	4-12
:INPut:OPower:RELAy[:STATe] CLOSeD OPEN	4-12
:INPut:OPower:RELAy[:STATe]?	4-12
:INSTrument:CATalog:FULL?	5-3
:INSTrument:NSElect <number>	
:INSTrument:NSElect?	5-3
:INSTrument[:SElect] <string>	
:INSTrument[:SElect]?	5-3
:MEASure:CHPower:CHPower?	4-13
:MEASure:CHPower:DENSity?	4-13
:MEASure:CHPower?	4-13
:MEASure:IQ:CAPTure	4-14
:MMEMory:CATalog:DIRectory? <string>,<string>	5-4
:MMEMory:CATalog:MSUSs?	5-4
:MMEMory:CDIRectory <string>	
:MMEMory:CDIRectory?	5-4
:MMEMory:CREate:DIRectory <string>,<string>	5-4
:MMEMory:DELete:DIRectory <string>,<string>	5-5
:MMEMory:DELete:FILE <string>,<string>	5-5
:MMEMory:LOAD:LIMit <string>,<string>,<string>	4-15
:MMEMory:MSIS <string>	
:MMEMory:MSIS?	5-5
:MMEMory:STOEvent:CLearall	4-15
:MMEMory:STOEvent:EOSWeep:MODE CONTInuous SINGle	4-15
:MMEMory:STOEvent:EOSWeep:MODE?	4-15
:MMEMory:STOEvent:EOSWeep[:STATe] <boolean>	4-15
:MMEMory:STOEvent:EOSWeep[:STATe]?	4-15
:MMEMory:STOEvent:LIMit:INTerval <time>	4-16
:MMEMory:STOEvent:LIMit:INTerval?	4-16
:MMEMory:STOEvent:LIMit:MODE CONTInuous SINGle INTerval	4-16
:MMEMory:STOEvent:LIMit:MODE?	4-16
:MMEMory:STOEvent:LIMit[:STATe] <boolean>	4-16
:MMEMory:STOEvent:LIMit[:STATe]?	4-16
:MMEMory:STORe:LIMit <string>,<string>,<string>	4-16
:MMEMory:STORe:TRACe <string>,<string>,<string>	5-5
:READ:CHPower:CHPower?	4-17
:READ:CHPower:DENSity?	4-17
:READ:CHPower?	4-17
:ROUte:INPut:CLoSe <number>	4-18

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:ROUTE:INPut:CLOSE:STATe?	4-18
:ROUTE:INPut:CLOSE? <number>	4-18
:STATus:OPERation[:EVENT]?	4-19
:SWEep:MODE FFT NOFFt	4-19
:SWEep:MODE?	4-19
:SYSTem:COMMunicate:LAN:CONFig <string>,<string>,<string>	
:SYSTem:COMMunicate:LAN:CONFig?	5-6
:SYSTem:COMMunicate:LAN:CONFig:CURRent?	5-6
:SYSTem:COMMunicate:LAN:DHCP <ON OFF>	
:SYSTem:COMMunicate:LAN:DHCP?	5-6
:SYSTem:COMMunicate:LAN:DNS <string>,<string>,<string>	
:SYSTem:COMMunicate:LAN:DNS?	5-6
:SYSTem:COMMunicate:LAN:HOSTname <string>	
:SYSTem:COMMunicate:LAN:HOSTname?	5-7
:SYSTem:COMMunicate:LAN:NFS:MOUNT:LIST:REMHost?	5-7
:SYSTem:DATE <number>,<number>,<number>	
:SYSTem:DATE?	5-7
:SYSTem:DEFault:RESet:FACTory	5-7
:SYSTem:DEFault:RESet:MASTer	5-7
:SYSTem:ERRor[:NEXT]?	5-8
:SYSTem:FIRMware:UPDate:REMOte <string>	5-8
:SYSTem:FIRMware:UPDate:REMOte:LATEST?	5-8
:SYSTem:FIRMware:UPDate:REMOte:LIST?	5-9
:SYSTem:FIRMware:UPDate:REMOte:SOURce <string>	
:SYSTem:FIRMware:UPDate:REMOte:SOURce?	5-9
:SYSTem:GPS:VOLTage? <number>	5-10
:SYSTem:LOG:ERRor?	5-10
:SYSTem:MACaddress?	5-10
:SYSTem:OPTions?	5-10
:SYSTem:PRESet	5-10
:SYSTem:TEMPerature?	5-10
:SYSTem:TIME <number>,<number>,<number>	
:SYSTem:TIME?	5-10
:TRACe:IQ:DATA:FORMat PACKed ASCii	4-20
:TRACe:IQ:DATA:FORMat?	4-20
:TRACe:STATus? <number>	4-21
:TRACe[:DATA]? <number>	4-21
:TRACe{[0]}:IQ:DATA?	4-21
:UNIT:POWer DBM DBUV	4-22
:UNIT:POWer?	4-22
[:SENSe]:AVERage:COUNt <number>	4-23
[:SENSe]:AVERage:COUNt?	4-23
[:SENSe]:AVERage:TYPE NORMal MINimum MAXimum AVERage RMAXimum RMINimum	4-23
[:SENSe]:AVERage:TYPE?	4-23
[:SENSe]:BANDwidth:VIDeo:AUTO <boolean>	4-23
[:SENSe]:BANDwidth:VIDeo:AUTO?	4-23
[:SENSe]:BANDwidth[:RESolution]:AUTO <boolean>	4-24
[:SENSe]:BANDwidth[:RESolution]:AUTO?	4-24

[:SENSe]:BANDwidth BWIDth:VIDeo <freq>	4-24
[:SENSe]:BANDwidth BWIDth:VIDeo:RATio <number>	4-24
[:SENSe]:BANDwidth BWIDth:VIDeo:RATio?	4-24
[:SENSe]:BANDwidth BWIDth:VIDeo:TYPE LINEar LOGarithmic	4-24
[:SENSe]:BANDwidth BWIDth:VIDeo:TYPE?	4-24
[:SENSe]:BANDwidth BWIDth:VIDeo?	4-24
[:SENSe]:BANDwidth BWIDth[:RESolution] <freq>	4-25
[:SENSe]:BANDwidth BWIDth[:RESolution]:RATio <number>	4-25
[:SENSe]:BANDwidth BWIDth[:RESolution]:RATio?	4-25
[:SENSe]:BANDwidth BWIDth[:RESolution]?	4-25
[:SENSe]:CHPower:BANDwidth BWIDth:INTegration <freq>	4-25
[:SENSe]:CHPower:BANDwidth BWIDth:INTegration?	4-25
[:SENSe]:CHPower:STATe <boolean>	4-25
[:SENSe]:CHPower:STATe?	4-25
[:SENSe]:DETEctor[:FUNCTion] POSitive RMS NEGative	4-26
[:SENSe]:DETEctor[:FUNCTion]?	4-26
[:SENSe]:FREQuency:CENTEr <freq>	4-26
[:SENSe]:FREQuency:CENTEr?	4-26
[:SENSe]:FREQuency:REFerence:SOURce?	4-26
[:SENSe]:FREQuency:SPAN <freq>	4-27
[:SENSe]:FREQuency:SPAN:FULL	4-27
[:SENSe]:FREQuency:SPAN:LAST	4-27
[:SENSe]:FREQuency:SPAN?	4-27
[:SENSe]:FREQuency:STARt <freq>	4-27
[:SENSe]:FREQuency:STARt?	4-27
[:SENSe]:FREQuency:STOP <freq>	4-27
[:SENSe]:FREQuency:STOP?	4-27
[:SENSe]:IQ:BANDwidth <freq>	4-28
[:SENSe]:IQ:BANDwidth?	4-28
[:SENSe]:IQ:BITS <number>	4-28
[:SENSe]:IQ:BITS?	4-28
[:SENSe]:IQ:LENGth <time>	4-28
[:SENSe]:IQ:LENGth?	4-28
[:SENSe]:IQ:MODE SINGLE STREAm <SINGLE STREAm>	4-29
[:SENSe]:IQ:MODE?	4-29
[:SENSe]:IQ:SAMPlE:CONFIguration?	4-29
[:SENSe]:IQ:TIMEstamps <boolean>	4-30
[:SENSe]:IQ:TIMEstamps?	4-30
[:SENSe]:OBWidth:METHod XDB PERCent	4-30
[:SENSe]:OBWidth:METHod?	4-30
[:SENSe]:OBWidth:PERCent <number>	4-30
[:SENSe]:OBWidth:PERCent?	4-30
[:SENSe]:OBWidth:STATe <boolean>	4-31
[:SENSe]:OBWidth:STATe?	4-31
[:SENSe]:OBWidth:XDB <relative amplitude>	4-31
[:SENSe]:OBWidth:XDB?	4-31
[:SENSe]:POWer:RF:ATTenuation <relative amplitude>	4-31
[:SENSe]:POWer:RF:ATTenuation:AUTO <boolean>	4-31

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[[:SENSE]:POWER:RF:ATTenuation:AUTO?	4-31
[[:SENSE]:POWER:RF:ATTenuation?	4-31
[[:SENSE]:POWER:RF:GAIN:STATE <boolean>	4-32
[[:SENSE]:POWER:RF:GAIN:STATE?	4-32
*CLS	5-1
*ESE <number>	
*ESE?	5-1
*ESR?	5-1
*IDN?	3-3
*IDN?	5-1
*OPC	
*OPC?	5-1
*RST	3-3
*RST	5-2
*SRE <number>	
*SRE?	5-2
*STB?	5-2
*WAI	5-2