User Guide

Remote Spectrum Monitor

MS2710xA

9 kHz to 6 GHz
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Chapter 1 — General Information

1-1 Introduction

Anritsu offers three models of remote spectrum monitoring products, designed to both mitigate interference problems and to identify illegal or unlicensed signal activity.

- The MS27101A is housed in a ½ rack enclosure with 1U height, designed exclusively for indoor applications.
- The MS27102A is an IP67 rated device which operates outdoors, with the ability to be mounted on poles or walls (using the included mounting bracket).
- The MS27103A is a multi-port spectrum monitor (12 RF In ports or optionally 24 RF In ports), which is ideal for cellular, DAS and other applications requiring the use of multiple antennas.
- For OEM solutions, Anritsu offers the MS27100A receiver board design. With the same remote monitoring features as the MS27101A and the MS27102A, users can mount the MS27100A in their own rack configurations or place the boards in their own enclosures for a customized design.

This Remote Spectrum Monitor User Guide is part of a set of manuals that describe all of the instrument functions and their use. This manual covers the instrument overview, installation, system functions and other common features, along with a brief guide to basic measurement concepts and setups.

Getting Started

Initial connection to the instrument must be made directly from the PC to the instrument using a crossover cable. Turn off any Wi-Fi connectivity to your PC and configure its Ethernet IP settings corresponding to the default factory settings of the Anritsu remote spectrum monitor. Once a direct Ethernet connection to the instrument is established, it can be manually operated using a browser-based graphical user interface (GUI) that is hosted on the instrument, or the instrument can be controlled via SCPI command programming. The embedded GUI facilitates access to all instrument features and their controls, in addition to live display of measurement data. The GUI provides Help content that covers both manual and programmatic means of operation. Simply click the Help tab to open links for each topic.

Setup your Ethernet IP corresponding to default factory settings of the Anritsu remote spectrum monitor with the following IP configuration:

- **DHCP**: OFF (Static IP Address)
- **Static IP Address**: 10.0.0.2
- **Static Subnet**: 255.255.255.0
- **Static Gateway**: 10.0.0.0

**Note**

Designed for use with HTML5 compliant browsers. Google Chrome version 44 and Mozilla Firefox version 40 have been verified for full feature support.

- For more information on setting up the remote spectrum monitor, PC, and Ethernet communication, see Chapter 5, “Setting Up the Remote Spectrum Monitor Communication”.


1-2 Remote Spectrum Monitor (RSM) System Description

Additional Documentation

Instrument operations are explained in various document types as listed below.

<table>
<thead>
<tr>
<th>Document Part Number</th>
<th>Description (Required Option)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10100-00064</td>
<td>Important Product Information, Compliance, and Safety Notices</td>
</tr>
<tr>
<td>10580-00428</td>
<td>SpectraVision™ User Guide</td>
</tr>
<tr>
<td>10580-00435</td>
<td>MX280001A Vision Programming Manual</td>
</tr>
<tr>
<td>10580-00420</td>
<td>MS2710xA Maintenance Manual</td>
</tr>
<tr>
<td>11410-00898</td>
<td>MS27100A Spectrum Monitor Module Technical Data Sheet</td>
</tr>
<tr>
<td>11410-00853</td>
<td>MS27101A Indoor Remote Spectrum Monitor Technical Data Sheet</td>
</tr>
<tr>
<td>11410-00847</td>
<td>MS27102A Outdoor Remote Spectrum Monitor Technical Data Sheet</td>
</tr>
<tr>
<td>11410-00854</td>
<td>MS27103A Remote Spectrum Monitor Technical Data Sheet</td>
</tr>
</tbody>
</table>

MS2710xA Product Manuals and Literature

https://www.anritsu.com/en-us/test-measurement/products/ms27100a
https://www.anritsu.com/en-us/test-measurement/products/ms27101a
https://www.anritsu.com/en-us/test-measurement/products/ms27102a
https://www.anritsu.com/en-us/test-measurement/products/ms27103a

Contacting Anritsu for Sales and Service

To contact Anritsu, visit the following URL and select the services in your region:
http://www.anritsu.com/contact-us.

1-2 Remote Spectrum Monitor (RSM) System Description

Spectrum monitoring systems facilitate the identification and removal of interference signals that degrade network capacity. By monitoring spectrum on a continual basis, problem signals can be identified as they occur in real time. In addition to interference detection, spectrum monitoring is also used to identify the types of signals present in the environment, characterize signal quality and continuously scan frequency channels for signal activity.

RSM systems are further enhanced with software applications that include:

- TETRA/SAT analysis
- Signal ID
- Power monitoring
- High-Speed Port Scanner
- Database collection and interrogation
- Spectrum health reporting
- Geo-location of signals
- Power of Arrival
- Time Difference and Angle of Arrival

These spectrum monitoring components described in this User Guide provide interference detection, identification, and characterization of the interfering signal(s).

- MS27100A – OEM Module (Available for Customer customized design enclosure)
- MS27101A – Indoor Module for RSM Applications
- MS27102A – Outdoor Module for RSM Applications
- MS27103A – Remote Spectrum Monitor Enclosure
Available Options

Refer to the MS2710xA TDS for performance specifications, additional features, available options and accessories.

ESD Caution

The Remote Spectrum Monitoring (RSM) System components, like other high performance instruments, is susceptible to ESD (electrostatic discharge) damage. Coaxial cables and antennas often build up a static charge, which may damage the MT8220T input circuitry (if allowed to discharge by connecting directly to the RSM without previously discharging the static charge). Operators must be aware of the potential for ESD damage and take all necessary precautions.

Operators should exercise practices outlined within industry standards such as JEDEC-625 (EIA-625), MIL-HDBK-263, and MIL-STD-1686, which pertain to ESD and ESDS devices, equipment, and practices. Because these apply to the RSM, Anritsu Company recommends that any static charges that may be present be dissipated before connecting coaxial cables or antennas to the RSM.

RF Input Warning

The RSM components are sensitive measuring instruments designed to measure low power levels. Avoid damaging this sensitive circuitry by observing the maximum input levels printed on the instrument connector labeling and specified in the product technical data sheet.

Typical maximum RF input is +30 dBm (±50 VDC) and could be less if additional features, such as a preamplifier, are in use. Be sure to review the product technical data sheet or Anritsu website for recommended components and accessories that can help you protect your instrument. These include a variety of adapters, attenuators, filters, and RF detection accessories.
Chapter 2 — MS27101A Overview and Installation

2-1 Introduction

The MS27101A is designed for indoor rack-mount environments. Typically these MS27101A probes are positioned in a permanent or semi-permanent location for radio surveillance and monitoring. The MS27101A remote spectrum monitor can be ordered with optional rack mounting hardware that allows it to be mounted into a standard 48 cm equipment rack in either a single unit installation or a side-by-side installation. Section 2-3 describes single unit rack mounting, Section 2-4 describes side-by-side rack mounting.

The MS27101A must be installed by a trained service person who is familiar with RF system integration and local regulatory and compliance requirements for the region in which the instrument is being installed. Read the MS2710xA Product Information, Compliance, and Safety Guide (PN: 10100-00064) for important safety, legal, and regulatory notices.

For additional information and literature covering your product, visit the product page of your instrument and select the Library tab:


2-2 Instrument Overview

This section provides a brief overview of the instrument and the supplied accessories.

The MS27101A instrument consists of the following main components:

- MS27101A Remote Spectrum Monitor
- Indoor power supply and power cable
- Optional mounting brackets and fasteners (Option 1)
**MS27101A Chassis and Connectors**

An overview of the MS27101A chassis and connectors is shown in Figure 2-1.

![Figure 2-1. MS27101A Overview](image)

1. Power Switch
2. Ethernet
3. USB Type A (2)
4. RF Input, N(f)
5. Reference Input, BNC
6. GPS Antenna, SMA(f)
7. Instrument Lock
8. DC Power Input, 5.5 mm Barrel Connector

**Mounting Hardware**

An overview of the MS27101A mounting hardware is shown in Figure 2-2

![Figure 2-2. MS27101A Optional Rack Mounting Hardware](image)

**Required Tools**

The installation requires a medium size Phillips screwdriver.
2-3 Single Unit Rack Mounting

This section explains how to fit a single MS27101A monitor into an instrument rack using the two single mounting brackets.

1. Prepare the MS27101A by removing the front panel handles as shown in Figure 2-3. Retain the screws.

2. Slide the two mounting brackets into the aluminum extrusions as shown in Figure 2-4 (1), then reinstall the front panel handles (2 and 3) using the same screws that were removed in Step 1.

3. Install finished assembly into the rack mount per the cabinet manufacturers instructions.
2-4 Side-by-Side Unit Rack Mounting

This section explains how to fit two MS27101A remote spectrum monitors into an instrument rack using the side-by-side mounting brackets.

1. Prepare both MS27101A instruments by removing the front panel handles and inside rear panel screws as shown in Figure 2-5 (1 and 2). Retain the screws.

2. Assemble the inside mounting bracket as shown in Figure 2-5 (3).

3. Slide the mounting brackets into the aluminum extrusions as shown in Figure 2-6 (1 and 3), then reinstall the front panel handles (2 and 4) using the same screws that were removed in Step 1.

4. Install finished assembly into the rack mount per the cabinet manufacturers instructions.
Chapter 3 — MS27102A Overview and Installation

3-1 Introduction

The MS27102A is designed for outdoor environments. Typically these MS27102A probes are positioned in a permanent or semi-permanent location for radio surveillance and monitoring. The MS27102A remote spectrum monitor can be ordered with optional rack mounting hardware that allows it to be mounted in a variety of wall or pole structures.

The MS27102A must be installed by a trained service person who is familiar with RF system integration and local regulatory and compliance requirements for the region in which the instrument is being installed. Read the MS2710xA Product Information, Compliance, and Safety Guide (PN: 10100-00064) for important safety, legal, and regulatory notices.

Caution

Safe and reliable installation must follow the local electrical and building regulations. In the United States, the National Electrical Code (NEC) is the generally adopted standard. Verify that the installation follows the NEC or your local regulations.

For additional information and literature covering your product, visit the product page of your instrument and select the Library tab:

• http://www.anritsu.com/en-US/test-measurement/products/ms27102a

3-2 Instrument Overview

This section provides a brief overview of the instrument and the supplied accessories.

The MS27102A instrument consists of the following main components:

• MS27102A Remote Spectrum Monitor
• Mounting brackets and fasteners
• IP67 Ethernet and power connector glands
• Indoor power supply and power cable with assembled connector gland
• GPS antenna
Chassis and Connectors

An overview of the MS27102A chassis and connectors is shown in Figure 3-1

1. GPS Antenna, SMA(f)
2. No Connection
3. 3-pin Power Input
4. Ethernet
5. RF Input Port 2, N(f) (optional)
6. RF Input Port 1, N(f)

Figure 3-1. MS27102A Monitor Probe Overview
Mounting Hardware

An overview of the MS27102A mounting hardware is shown in Figure 3-2

1. Universal mounting bracket detail
2. Mounting bracket extensions and nuts (6 mm hex nuts, 2 each, used for wall mounting only)
3. Stainless machine screw set (10 mm M6 x 0.8, 4 each)
4. Stainless strap clamps (101 mm maximum diameter, 2 each)

Figure 3-2. MS27102A Mounting Hardware
Connector Glands
The figure below illustrates the IP67 rated Ethernet (top) and power connector (bottom) gland assemblies.

![Connector Glands](image)

| 1. O-ring | 5. Connector body |
| 2. Housing with connector pins | 6. Seals |
| 3. Lock nut | 7. Inner collet clip |
| 4. Gasket | 8. Sealing nut |

Figure 3-3. MS27101A Connector Glands

Power Supply
The MS27102A Remote Spectrum Monitor comes with an indoor AC/DC power converter with a pre-assembled power cable and gland. This is to be used only for indoor applications. For outdoor usage, a DC power supply must be supplied by the user and must meet the following criteria:

- **Voltage rating:** 11 VDC to 24 VDC (supplied at instrument connector)
- **Power dissipation:** 11 W
- **Environmental ratings:** IP67 rating recommended or otherwise suitable outdoor supply, including supply cabling
- **Power cabling:** appropriate weather resistant cabling with adequately sized conductors for the length of run and power demand. The provided connector has screw terminals and will work for wire sizes from 14 AWG to 18 AWG with an outside cable diameter of 5.5 mm to 8.0 mm (0.22 to 0.31 in).
3-3 Surveying the Installation Site

To ensure optimal performance of the MS27102A Remote Spectrum Monitor, conduct a site survey to determine the optimal placement of the instrument for maximum range, coverage, and network integrity. The site must have available utilities (power and network connection). A site survey accounts for the following:

- **Location**: The instrument and antenna must be placed in an area that is accessible for routine inspection and servicing. The antenna must be placed such that obstructions to the radio signal path are minimized and that the antenna is installed in a safe location, away from interfering signals.

- **Power**: Ensure that an available AC line power connection is close enough to the instrument’s DC power supply.

- **Ethernet**: The Ethernet connection is ruggedized and weatherproof, and supports up to Gbit CAT6 LAN installations. For consistent operation, ensure that the cable run length to the network switch or repeater is less than 100 meters (328 feet).

- **Antenna**: Proper antenna type and placement is essential for maximizing radio coverage and range. Prioritize antenna height over ground, then antenna gain for increasing the coverage area and range. Consider a directional antenna and its orientation when maximum range is required. Consider an omni directional antenna when maximum coverage area is required.

### Mounting Considerations

The MA27102A Remote Spectrum Monitor is designed to be IP67 compliant and can be mounted either indoors or outdoors. The instrument should be installed with the connectors facing downward to provide additional protection from water seepage into the instrument chassis. In extremely harsh environments, additional shielding from direct sunlight in hot climates should be considered. The mounting location must also facilitate clearance to all of the connectors, and cabling should be of sufficient length for servicing.
Required Equipment for Installation
The following is required to install the MA27102A Remote Spectrum Monitor:

- #2 Phillips screwdriver (for bracket to chassis and ground fasteners)
- Flat blade screwdriver (for strap clamps)
- 1.5 mm Allen key (for power wire connectors)
- Wall mounting: appropriate fasteners to attach the metal bracket assembly to the specific wall type; 6 mm wrench to attach bracket extensions
- DC Power Supply: see requirements discussed in “Power Supply” on page 3-4.

3-4 Installing the Mounting Bracket
The mounting bracket can be installed for either vertical or horizontal mounting. This procedure illustrates the vertical orientation.

1. Inspect the installation area and determine the appropriate bracket orientation on the instrument.
2. Ensure that the bracket is oriented with the V-groove facing outward as illustrated in Figure 3-4.
3. Use the M6 mounting screws with both the flat and spring lock washers to secure the bracket to the instrument. The screws are tightened with a #2 Phillips screwdriver

Figure 3-4. MA27102A Vertical Bracket Mounting

Once the bracket is installed onto the instrument, the assembly can then be installed onto a pole.
3-5 Pole and Tower Mounting Instructions

Install the universal mounting bracket as instructed in Section 3-4. The bracket can accommodate mounting to a pipe diameter up to 101 mm (4 in). Refer to Figure 3-5 during this procedure.

Note  The illustration shows the instrument being installed to a vertical pipe. For installing onto a horizontal pipe, the universal bracket can be rotated 90 degrees when attaching to the instrument.

1. Thread strap clamps through the raised slots in the mounting bracket.
2. Secure the instrument and bracket assembly to the pole by tightening the strap clamps.

Figure 3-5. MA27102A Vertical Pole Mounting
3-6 Wall Mounting Instructions

The MA27102A universal mounting bracket can accommodate mounting to a variety of wall structures. The user is responsible for selecting the appropriate wall fasteners for the structure of the wall, and the fastening system must be sufficient to carry the load of the instrument and cabling. Refer to Figure 3-5 during this procedure.

1. Install the universal bracket extensions as shown in Figure 3-5 (1).
2. Place the universal mounting bracket assembly against the wall at the desired location and mark the four mounting holes at the extension.
3. Install the universal mounting bracket assembly to the instrument as instructed in Section 3-4.
4. Attach the instrument and bracket assembly to the wall with the appropriate user-supplied wall fasteners (Figure 3-5 (2)). Use all four mounting holes on the universal bracket extensions. These slotted holes accept screws up to 6.3 mm (1/4 inch).

Note: The illustration shows the instrument being installed vertically. The universal mounting bracket can be rotated 90 degrees and installed horizontally.

Figure 3-6. MA27102A Wall Mounting
### 3-7 Installing the Antenna Cables

Always install an antenna in accordance with local regulatory code and with best practices, and follow the mounting and installation instructions that were supplied with your antenna. Ensure that all antenna connections are grounded to the instrument ground terminal.

### 3-8 Installing the Ethernet Cable

The instrument’s Ethernet connector accepts any standard 8P8C (RJ45) plug. However, for the connection to be weatherproof, the weatherproofing gland must be installed around the connector and cable. The following illustration shows how to install the Ethernet connector’s weatherproof gland.

1. Screw gland body to instrument front panel
2. Thread Ethernet cable through the gland’s components and secure the seal.
3. Plug the Ethernet cable into the instrument and tighten the sealing nut.

**Figure 3-7.** Ethernet Gland Assembly
3-9 Installing the Power Supply Cables

The MS27102A features an IP67 rated power connector. However, for the connection to be weatherproof, the weatherproofing gland must be installed around the connector and cable. The following illustration shows how to install the power connector’s weatherproof gland.

1. Thread power conductors through the gland’s components and secure the seal.
2. Connect the conductors to the connector and tighten the Allen screw to secure.
3. Install the connector to the instrument with the O-ring as shown.

**Figure 3-8. Power Supply Gland Assembly**

The following illustration shows the polarity of the power connector as viewed from the front of the instrument casing.

1. Positive DC lead (11 V to 24 V)
2. Negative DC lead (ground)
3. Note: the third pin has no internal connection.

**Figure 3-9. Power Supply Pin-out**

**Caution**

The MS27102A chassis provides two earth ground connections. Be sure to ground the instrument chassis and any antenna installations in accordance with your local regulatory requirements. Failure to properly ground the equipment may present an electric shock hazard and contribute to static noise interference.
Chapter 4 — MS27103A Overview and Installation

4-1 Introduction

The MS27103A is a multi-port RF In monitoring platform employed in systems requiring multiple antennas to cover a large frequency range. This monitor is often used with cellular infrastructure equipment with multiple sectors and multiple frequencies per sector.

The MS27103A remote spectrum monitor is configured with integral front panel handle and rack mounting bracket that allows it to be mounted into a standard 48 cm equipment rack. This chapter illustrates how to fit the monitor into an instrument rack.

The MS27103A must be installed by a trained service person who is familiar with RF system integration and local regulatory and compliance requirements for the region in which the instrument is being installed. Read the MS2710xA Product Information, Compliance, and Safety Guide (PN: 10100-00064) for important safety, legal, and regulatory notices.

For additional information and literature covering your product, visit the product page of your instrument and select the Library tab:


4-2 Instrument Overview

This section provides a brief overview of the instrument and the supplied accessories.

The MS27103A instrument consists of the following main components:

- MS27103A Remote Spectrum Monitor

Power Supply

The standard MS27103A Remote Spectrum Monitor requires a user supplied DC power supply with voltage rating of ±20 VDC to ±70 VDC with minimum power output of 11 W. Option 110 replaces the DC connector screw terminal with an internal AC-DC supply with a 3-pin line receptacle.
Connectors and Chassis

1. Power LED
2. RF Input Ports, 12 or 24 SMA(f)
3. Power Input Screw Terminal (or 110 VAC line connector with Option 110)
4. Ethernet Port
5. Ethernet Port (optional)
6. USB Type A (2)
7. GPS Antenna, SMA(f)
8. External Reference Input, BNC(f)

Figure 4-1. MS27103A Overview

Required Tools for Installation
The installation requires a medium size Phillips screwdriver.
4-3 MS27103A Rack Mounting

This section illustrates how to fit a single monitor into an instrument rack.

1. Slide the instrument into the rack and secure with 4 screws as instructed by the cabinet manufacturer.
Chapter 5 — Setting Up the Remote Spectrum Monitor Communication

5-1 Introduction
To communicate with the MS2710xA Remote Spectrum Monitoring system, or to change its IP configuration, a PC must be correctly set up to communicate with the instrument via a direct connection using a static IP. The sections in this guide explain using:

- a Windows PC to directly communicate with the Anritsu spectrum monitor
- SCPI commands for configuring the Ethernet and DNS settings
- the Anritsu Windows network discovery tool to find the instrument IP address

The spectrum monitor is shipped with the following default IP configuration:

- DHCP: OFF (Static IP Address)
- Static IP Address: 10.0.0.2
- Static Subnet: 255.255.255.0
- Static Gateway: 10.0.0.0

5-2 Setting Up Windows 7
The following example illustrates how to set up Windows 7 for a static IP address. Refer to your operating system documentation or consult with your network administrator for other Windows versions or operating systems.

Static IP
1. Connect an Ethernet crossover cable between a PC and the instrument.
2. Open Control Panel, Network, and Internet.
3. Select Network and Sharing Center.
4. Select the Local Area Connection link as shown in Figure 5-1
5. Select Properties as shown in Figure 5-2, Step 1.
6. Highlight Internet Protocol Version 4 (TCP/IPv4) and select Properties as shown in Figure 5-2, Step 2.
7. Select Use the following IP address: and enter the following IP properties as shown in Figure 5-2, Step 3 as listed:
   - Static IP Address: 10.0.0.1
   - Static Subnet: 255.255.255.0
   - Static Gateway: 10.0.0.0

Figure 5-1. Local area connection link

1. Local Area Connection Status Screen
2. Local Area Connection Properties Screen

Figure 5-2. Windows configuration steps
8. To specify a domain name system (DNS) server, enter the preferred and alternate server addresses as shown in Figure 5-2, Step 3. You may need to contact your network administrator for details about using specific DNS servers; otherwise, select Obtain DNS server address automatically.

9. Click OK.

The PC is now configured for a direct connection to the instrument using a static IP.
Dynamic IP

1. Select the Local Area Connection link as shown in Figure 5-3.

   ![Figure 5-3. Select the Local Area Connection Link](image)

2. Select Properties as shown in Figure 5-4, Step 1.
3. Highlight Internet Protocol Version 4 (TCP/IPv4) and select Properties as shown in Figure 5-4, Step 2.
4. Change the properties to match the illustration as shown in Figure 5-4, Step 3 as listed below:
   - Obtain an IP address automatically
   - Obtain DNS server address automatically

   ![Figure 5-4. Windows configuration steps](image)
5-3 Locating Instruments on the Network Using Windows

Clients may execute the UDP Anritsu Discovery program on their PC to discover instruments on the same subnet as the PC. The program prints out a list of instruments with information such as the instrument host name, firmware version, MAC address, IPv4 and IPv6 addresses. The discovery program is available from Anritsu product page. [https://www.anritsu.com/en-US/test-measurement#ProductCategory](https://www.anritsu.com/en-US/test-measurement#ProductCategory)

1. To start the discovery program, download and run the “RunDiscoveryProgram.bat” file.

2. Select a filtering method. Since there could be many instruments already connected to the network, a selection filter can be used to narrow the search results. The search filter has four options:
   - (M)ac – Mac Address of the probe
   - (S)erial – Serial number of the probe
   - (H)ostname – Host name of the probe
   - (N)one – No filters selected. All instruments attached to the local area network will be listed.

3. If M, S, or H was selected in Step 2, enter a search string. The search query term is not case sensitive. The search string can be a partial match or a full match to the MAC address, serial number, or host name. For example, selecting “S” and entering “0000003” will search for the instrument with serial number 0000003.

4. The program will start listing all instruments connected on the same subnetwork that match the search criteria.
5-4 Configuring for Static IP through SCPI Commands

To change from DHCP to Static IP, send these commands to port 9001 of the instrument’s dynamic IP address:

1. Set the static values of the Ethernet configuration that are used when DHCP is OFF:
   
   SYSTem:COMMunicate:LAN:CONFig <Static IP>,<Static Gateway>, <Static Subnet>

   The <Static IP>, <Static Gateway>, and <Static Subnet> must be enclosed in quotes like the following example:
   
   SYST:COMM:LAN:CONF "124.168.1.1","124.168.1.0","255.255.255.0"

2. Confirm the static IP settings by querying the static Ethernet configuration:
   
   SYSTem:COMMunicate:LAN:CONFig?

3. Turn off DHCP and set the instrument to static IP mode:
   
   SYSTem:COMMunicate:LAN:DHCP OFF

4. Reboot the instrument.

5-5 Using TCP_NODELAY

TCP_NODELAY is an option that client applications can set on the TCP socket they use to connect to the instrument’s SCPI interface. This socket option disables Nagle's Algorithm, which is an optimization of the TCP/IP layer that causes small reads and writes to be buffered together, therefore reducing network bandwidth usage at the expense of increased latency. Application writers may see improved performance when setting TCP_NODELAY.

5-6 FTP Access

A FTP server has been included in the instrument to allow user access to files stored on the instrument or in a USB drive connected to the instrument. To access the FTP server, use a FTP client of choice and enter the IP address of the instrument as the host. The user name is “ftp” and the password is the serial number of the instrument. The serial number can be obtained through SCPI using the “*IDN?” command.
5-7  System Override

In the event that the instrument does not respond to SCPI commands (due to circumstances like a long sweep used in conjunction with *OPC?) and needs to be reset remotely, the system override feature can be used. System override can be accessed through TCP port 8001 of the instrument. All commands except a password reset will require the instrument’s password to be sent. The default password for an instrument is the MAC address interleaved with the word “system” between MAC address pairs. As an example, an instrument with the MAC address “1a:2b:3c:4d:5e:6f” will have a default password of “1as2by3cs4dt5ee6fm”. Currently, system override only supports three commands as described below:

1. Reboot the instrument:
   To reboot the instrument, send the following string to the instrument through port 8001:
   
   “force_reboot,<instrument_password>”
   
   Replace <instrument_password> with the password of the instrument. After the command has been sent, the instrument will respond with “ok” if the command has been successfully processed. If the password is incorrect, “password_match_fail” will be returned.

2. Set a new password:
   To set a new password for the instrument, the following string should be sent through port 8001:
   
   “change_password,<old_instrument_password>,<new_instrument_password>”
   
   Note that the max length of a password is 50 characters. If the new password has been successfully set, “ok” will be returned. If the password is too long, a “password_over_50_characters_fail” will be returned. If the old password does not match, a “password_set_fail” message will be returned.

3. Reset the password:
   In the case where the system override password needs to be reset to default, the following command can be sent through port 8001:
   
   “reset_password”
   
   Note that this command DOES NOT require the instrument password. If the password has been successfully reset, “ok” will be returned.

4. Disconnect SCPI connections:
   This command causes all currently established SCPI connections (on TCP port 9001) to be disconnected.
   
   reset_scpi_connection

   It can be used to immediately clean up connections that were left open due to network interruption (e.g. close handshake packets were dropped, client thinks it is disconnected but the instrument thinks the connection is still there) or to establish sole control of an instrument by forcing all other clients to reconnect. This command is automatically executed when secure mode is turned on.

If an improperly formatted command is sent to the instrument, a “command_match_fail” will be sent back.
Chapter 6 — Graphical User Interface

6-1 Introduction

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 Graphical User Interface (GUI) measurement display provides manual measurements control and measured trace data. The Graphical User Interface (GUI) is shown below in Figure 6-1.

Figure 6-1. Remote Spectrum Monitor GUI Overview
6-1 Introduction Graphical User Interface

Model and Option Number(s) Web Address
Displays the model of the remote probe and the option(s) installed.

Web Address Model and Option Number(s)
The IP address of the Remote Spectrum Monitor entered into the Web Browser's address window.

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.

Markers
Set up markers on the trace displayed. Eight markers are available for trace analysis.

GPS Coordinates
Displays the GPS coordinates of the measured signal.

Date and Time
Displays the date and time of the real time display.

Limit Line
Displays a limit line from the limit line setup panel.

Center Frequency and Span
Displays the Center Frequency and Span settings.

Stop Frequency
Displays the stop frequency of the displayed sweep.

Spectrogram
Spectrogram is a representation of the frequency spectrum as it varies with time.

Setup Panel
Displays the parameter entry fields of the selected Setup Tabs.

Setup Tabs
The setup tabs are described in Section 6-2 “Setup Tabs” on page 6-3.

Start Frequency
Displays the start frequency of the displayed sweep.

Instrument Settings Summary
Displays the default or selected settings that are entered into the Setup Tabs.
6-2 Setup Tabs

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 Tab

Select the Frequency Tab to set up the start, stop, and center frequency of the trace displayed.

![Frequency Tab Diagram]

**Figure 6-2.** Frequency Tab

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

Using Start and Stop Frequencies

1. Enter the start frequency in the **Start** entry box.
2. Click the **Units** list associated with the start frequency entry box.
3. 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.
4. Enter the start frequency in the **Stop** entry box.
5. Click the **Units** list associated with the stop frequency entry box.
6. 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.
Amplitude and BW Tab
Select the Amplitude and BW tab to set the amplitude, bandwidth, and input parameters for measurement.

### Setting the 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. Select the desired VBW type from the **VBW Type** drop-down list - linear or logarithmic.
Setting 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**.

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

Figure 6-4. Sweep Tab

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 (default) or No FFT. 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 6-1. Sweep Modes Table

<table>
<thead>
<tr>
<th></th>
<th>FFT</th>
<th>No FFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweep Speed</td>
<td>Fastest</td>
<td>Slowest</td>
</tr>
<tr>
<td>Capturing Short Burst</td>
<td>Better</td>
<td>Good</td>
</tr>
<tr>
<td>Amplitude Accuracy</td>
<td>Good</td>
<td>Specified</td>
</tr>
<tr>
<td>Spurious</td>
<td>Good</td>
<td>Best</td>
</tr>
<tr>
<td>FFT Artifacts</td>
<td>Small</td>
<td>None</td>
</tr>
<tr>
<td>Frequency Accuracy</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
</tbody>
</table>
Measurements Tab

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

An Auto-Save function is available to save traces to Monitor Memory or to a USB stick. When initially run, the active measurement is spectrum.

Continuous Measurement Saving

This feature allows you to save measurements at the defined interval.

- **Measurement Save Interval**: This is the frequency that measurements are saved. If the interval is set to 5 minutes, it will save every 5 minutes.

- **Amount of Memory Space to Allocate**: Set the memory space allocation. This setting ensures that no more than the amount of space set is used to save measurements with this feature. If the value is 100 MB, once 100 MB have been allocated for measurement files, the next measurement save will cause the OLDEST measurement file saved to be deleted and the new one to be saved.

- **Directory Location**: Select **Internal** or **USB** if a USB memory device is available.

- **Save Directory**: Select **Choose** to enter or navigate to the location where the measurement files are to be saved.

- **Set Path**: Press when the Directory Location and Save Directory have been entered. Setting this path also sets the Save On Event path.
Markers Tab

Select the Markers tab to set up Markers Setup Panel.

1. Click the check box of the desired Marker.

2. Click on the Ref X entry box. Place the mouse cursor over the measurement display and a vertical line is drawn with its associated frequency and amplitude displayed in the Marker table.

3. 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. Deselect the marker/s by clicking on the desired check box.
Limit Lines Tab

Select the Limit Line tab to create and edit limit lines, limit masks and save on event functions.

The Limit Line setup panel allows you to create upper and lower 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 Enable Limit Checking is checked. Also, editing a limit line will automatically enable limit checking. If Enable Limit Checking is unchecked and the user changes a limit, the box becomes checked.

To create a Limit Mask, click the check box left of the Limit Mask title. Multiple segments will be drawn above and below the trace.

A Limit Sound Volume can be adjusted.

Figure 6-7. Limit Lines Tab
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 sound level.

Limit Setup

- **Set Max Hold**: The signal that violates the upper threshold will trigger to save that trace.

- **Set Min Hold**: The signal that violates the lower threshold will trigger to save that trace.

- **Mask Offset**: Sets the a upper and lower mask distance from the trace. Set Mask Offset before clicking the Limit Mask checkbox.

Limit Segments & Mask Buttons

- **Add Limit Segment**: Press to automatically place 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 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.

Edit the frequency or amplitude value of the limit line by highlighting the limit line in the limit line table. Then change these values in their entry boxes. After a value has been entered, press the “check” button to use the value or press the “x” button to cancel the entry.

Save On Event

Limit alarm failures are reported whenever a signal is above the upper limit line or below the lower limit line. By using save-on-event, a signal that exceeds the limit alarm can be automatically saved. Click on Enable Limit Checking and Save On Event check boxes to activate Save On Event.

- **Pre-Trigger**: When checked, the trace before the failed trace and the failed trace will be saved.

- **Save Duration**: After a fail trigger has occurred, the program will save traces for the time entered. Enter a numerical value or use the up/down arrow buttons to increment/decrement to the desired value. Click the desired unit from the units drop-down list.

- **Directory Location**: Select **Internal** or **USB** if a USB memory device is available.

- **Save Directory**: Select **Choose** to enter or navigate to the location where the measurement files are to be saved.

- **Set Path**: Press when the Directory Location and Save Directory have been entered. Setting this path also sets the Continuous Measurement Saving path.

**Note**: If a Save On Event is triggered, the next triggered event will take place only after the first event recording is complete.
Display Tab
Select the Display tab to set display resolution and correction.

![Display Tab Diagram](image)

**Figure 6-8.** Display Tab

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

Select 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 the USB memory stick is removed from the instrument port during file navigation, the navigation window will automatically close. 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 and become inactive. |

Recall
1. Press the drop-down arrow for **File Type** to display the 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.
After recalling a measurement, you can continue real-time measurements using the settings of the measurement just recalled or return to the measurement settings before the measurement recall was performed. Press either of the two buttons to select the desired real-time mode - Load Previous Measurement and Keep Current Measurement.

- **Load Previous Measurement**: Press this button to load the measurement settings that were in use before the Recall measurement process was executed. The unit returns to real-time measurements using those settings.

- **Keep Current Measurement**: The unit returns to real-time measurements using the settings from the “recalled measurement”.

You can also return to the real-time measurement settings that were used before executing Recall measurement by clicking the **System Preset** button in the System panel.

**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.
Help Tab
Select the Help tab to view links to the Remote Spectrum Monitor Help file and SCPI Programming documents.

Figure 6-10. Help Tab
Configuring the System

Select the System tab to perform firmware updates, presets, other functions that affect the whole system, and view GPS information.

The System section contains system information such as firmware version, installed options, Remote Spectrum Monitor GPS status, and RSM-in-use setting. 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 6-2 Primary Factory Settings.

Table 6-2. Primary Factory Settings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start Frequency</td>
<td>0 Hz</td>
</tr>
<tr>
<td>Stop Frequency</td>
<td>6 GHz</td>
</tr>
<tr>
<td>Center</td>
<td>3 GHz</td>
</tr>
<tr>
<td>Span</td>
<td>6 GHz</td>
</tr>
<tr>
<td>RBW</td>
<td>3 MHz</td>
</tr>
<tr>
<td>VBW</td>
<td>1 MHz</td>
</tr>
<tr>
<td>SPAN/RBW</td>
<td>100</td>
</tr>
<tr>
<td>RBW/VBW</td>
<td>3</td>
</tr>
<tr>
<td>VBW type</td>
<td>Linear</td>
</tr>
<tr>
<td>Reference Level</td>
<td>+10 dBm</td>
</tr>
<tr>
<td>Reference Level Offset</td>
<td>0 dB</td>
</tr>
</tbody>
</table>
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.)

**Firmware Version** and **Installed Options** display the current version of the firmware and the options included in the firmware.

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.

### Table 6-2. Primary Factory Settings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y-Axis Scale</td>
<td>10 dB/div</td>
</tr>
<tr>
<td>Attenuation</td>
<td>30 dB</td>
</tr>
<tr>
<td>Preamp</td>
<td>Off</td>
</tr>
<tr>
<td>Detection</td>
<td>Positive</td>
</tr>
<tr>
<td>Antenna Number</td>
<td>1</td>
</tr>
<tr>
<td>Trace Operation</td>
<td>Normal</td>
</tr>
<tr>
<td>Sweep Type</td>
<td>Continuous</td>
</tr>
<tr>
<td>Sweep Mode</td>
<td>FFT</td>
</tr>
<tr>
<td>Display Point Count</td>
<td>501</td>
</tr>
<tr>
<td>Font Size</td>
<td>10 pt</td>
</tr>
<tr>
<td>Show Spectrogram</td>
<td>Yes</td>
</tr>
<tr>
<td>GPS Supply Voltage</td>
<td>3.3V</td>
</tr>
</tbody>
</table>
For more information on Updating Firmware, refer to Appendix A, “Updating MS2710xA Firmware”.

---

**Firmware Update in Progress**

The firmware on this instrument is being updated. When completed, the instrument will reboot.

- If the instrument does not reboot, but is still sweeping, please reboot manually using this GUI (System → Reboot the Instrument) and try again.
- If the instrument is using a static IP, the instrument will automatically reconnect, typically within 5 minutes.
- If the instrument is using DHCP, it may receive a different IP address. In this case:
  - **With dynamic DNS**: There will be a delay (dictated by the dynamic DNS provider and your DNS server; typ. 1-10 minutes) before the DNS updates to the new IP address. In this case, the GUI will automatically reconnect.
  - **Without dynamic DNS**: The GUI cannot automatically reconnect. You will need to find the new IP address manually.

Download update from: [http://](http://)

---

**Figure 6-12. Firmware Update in Progress Dialog**

To inform users that the RSM is in use, click the **RSM in Use** check box. Red text in browser will inform users that the RSM is in use.

**Install New Options**

To install new options, go into the **System** tab and select **Installing Options**. The **Installing Options** dialog will appear. See **Figure 6-13**.

---

**Figure 6-13. Install Options in Progress Dialog**

Follow the instructions that appear in the dialog box. If the license installation was unsuccessful, a red **Failed!** message will appear in the **Status** field. If the license installation was successful, a green a **Successful!** message will appear in the **Status** field.

Continue with the option installation process by rebooting the instrument to activate the new options.
Network Tab

Select Network tab to configure and view the instrument’s Ethernet and dynamic DNS settings.

![Network Tab](image)

**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. Complete the requested 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, User name, 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.

**GPS**

The following are GPS information for the Remote Spectrum Monitor when GPS is enabled.

- **Fix:** States the quality of the last fixed GPS result.
- **Enabled:** Displays if the GPS function of the Remote Spectrum Monitor is enabled.
- **Position:** The latitude and longitude of the last fixed GPS result.
- **Altitude:** The altitude of the last fixed GPS result.
- **Num Satellites:** The number of satellites used in determining the location of the Remote Spectrum Monitor.
SCPI Tab

Select the SCPI Tab to open 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.

![Diagram of SCPI Tab]

Figure 6-15. SCPI Tab

For example, you may want to add a custom name or label to identify a particular RSM unit, enter the command string SYST:UNIT:“name”. 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 7, “Programming with SCPI”.

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.
2. Select the desired SCPI script from Open dialog window.
3. Press Open and the script is immediately executed.

Enter a Unit Name/Label

1. Type the SCPI command line - SYST:UNIT:“name”. The name/label desired is placed within the quotation marks.
2. Press Send. The unit name/label will be displayed on the application window under the model number.
IQ Capture

Select the IQ Capture tab to configure the parameters for IQ Capture and to view captured data in the Data Display.

![IQ Capture Tab](image)

**Figure 6-16. IQ Capture Tab**

IQ Capture attains raw data, magnitude/phase or real/imaginary, components of a waveform. See Figure 6-17, “IQ Capture Measurement Sample”. Configure the following IQ capture parameters and execute a 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.

**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.

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

![IQ Capture Measurement Sample](image_url)

**Figure 6-17.** IQ Capture Measurement Sample
6-3 Setting Secure Mode

Overview

Secure Mode prevents unauthorized access to both the setup parameters and measurement data stored on the monitor. The following sections detail the method and commands for securing a Remote Spectrum Monitor (RSM). Steps are listed to turn On or Off the Secure Mode for the desired remote spectrum monitor. Placing the RSM in secure mode requires a password. Users should determine that password before going through the setup. The default password is described in Setup Step 5. Communication to the RSM is done through port 8001. Port 8001 is always available whether Secure Mode is on or off.

A command is also provided to reset passwords to default. If this command is used, all setup parameters and measurement data stored on the RSM unit will be cleared. This ensures that unauthorized users will not have access to this information if they are able to gain physical access to the monitor. The secure mode will be off.

To communicate to the RSM unit, you must download Anritsu RSM Secure Mode.zip from the Anritsu website. This allows you to run the utility program, Anritsu RSM Secure Mode.exe, that communicates with the remote spectrum monitor.

Setup

Utility Program

1. Download from the Anritsu website Anritsu RSM Secure Mode.zip. Unzip the file onto the computer.
2. Insure you are connected to the remote spectrum monitor either via Ethernet or wireless. You will need to know either the monitor’s IP address or DNS name.
3. Double-click Anritsu RSM Secure Mode.exe to run the utility script. Insure that all the unzipped files are in the same directory. The following command window opens.

![Command Window for Secure Mode](image)

Figure 6-18. Command Window for Secure Mode
4. At the prompt, enter the DNS name or the IP address of the remote spectrum monitor.

5. Enter the default password if setting up Secure Mode for the first time. The default password is a combination of the RSM MAC address and the word “system”. For example, if the MAC address is 00:00:82:e1:63:40, the password is 00s00y82se1t63e40m. Successfully entering the password will return the following response and Secure Mode commands shown in Figure 6-20. The MAC address can be found on a label on the RSM unit.

6. Enter the number of the desired command to execute the corresponding action.

7. To end the Secure Mode, enter 7 to exit the Anritsu RSM Secure Mode.exe utility program.
Commands

**set_secure_mode,<system override password>,<on/off>**

Description: Sets Secure Mode on or off. Responds with “ok” if secure mode has been successfully turned ON or OFF. If secure mode is OFF, sending “on” turns secure mode ON (blocking all users not on the whitelist from accessing any port except 8001) and adds the user to a whitelist. If secure mode is ON already and the user sends “on”, the user is simply added to the whitelist. Sending “off” triggers a master reset and unblocks ports for all users. Responds with “password_match_fail” if provided System Override password is incorrect. Responds with “command_match_fail” if “on” or “off” is not sent.

The maximum number of registered clients is 100. Responds with “exceeded_max_secure_mode_users_fail” if max number of secure mode users have already been reached prior to the command being sent.

Parameters: <system override password>,<on or off>

Syntax Example: set_secure_mode,<demopassword>,<on>

**force_reboot,<system override password>**

Description: Reboots the remote spectrum analyzer. Responds with “ok” if command is accepted. A response of “password_match_fail” is returned if the provided System Override password is incorrect.

Parameters: <system override password>

Syntax Example: force_reboot,<demopassword>

**change_password,<System Override Password>,<New Password>**

Description: Changes the System Override Password. A response of “ok” if password has successfully been changed.

- “password_match_fail” is returned if the provided System Override password is incorrect.
- “command_match_fail” is returned if the new password is empty.
- “password_over_50_characters_fail” is returned if the password length is greater than 50 characters.

Parameters: <system override password>,<new password>

Syntax Example: change_password,<demopassword>,<newdemopassword>

**reset_password**

Description: Resets the System Override password back to the default value. A response of “ok” is returned when the password has successfully been reset.

Parameters: None

Syntax Example: reset_password

**query_secure_mode_state**

Description: Retrieves secure mode state, ON or OFF. A response of “on” is returned if secure mode is ON or “off” if secure mode is OFF.

Parameters: None

Syntax Example: query_secure_mode_state
Chapter 7 — Programming with SCPI

7-1 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.

7-2 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.

**Ethernet Interface Connection and Setup**

The MS2710xA fully supports the IEEE-802.3 standard. 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.
7-3 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 9-1 “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 7-1. SCPI Required Commands

<table>
<thead>
<tr>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>:STATus</td>
</tr>
<tr>
<td>:SYSTem</td>
</tr>
</tbody>
</table>

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 7-2. SCPI Optional Commands

<table>
<thead>
<tr>
<th>Command</th>
<th>Command</th>
<th>Command</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>:ABORt</td>
<td>:FETCH</td>
<td>:MEASURE</td>
<td>:SOURCE</td>
</tr>
<tr>
<td>:CALCulate</td>
<td>:INITiate</td>
<td>:MMEMory</td>
<td>:TRACE</td>
</tr>
<tr>
<td>:CONFigure</td>
<td>:INPut</td>
<td>:READ</td>
<td>:UNIT</td>
</tr>
<tr>
<td>:DISPLAY</td>
<td>:INSTRument</td>
<td>:ROUTE</td>
<td>[:SENSe]</td>
</tr>
</tbody>
</table>

The SCPI optional commands are sorted by measurement modes and commands may be repeated in more than one mode.
7-4 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 7-4.
- The path from the subsystem root command, see “Hierarchical Command Structure” on page 7-5.
- The query form of the command (if applicable), see “Query Commands” on page 7-5.
- 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 7-7. 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, :TRACe is identical to :TRACe1. If a numeric suffix it not included in a command, the first option is implied. Curly brackets {} designate optional keyword parameters. Square brackets [ ] 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 7-1.

![Figure 7-1. SCPI Command Tree](image)

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 7-2.

![Figure 7-2. SCPI :Sample CONFigure Subsystem](image)

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 7-3. Description of Command Identifiers

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;amplitude list&gt;</td>
<td>Amplitude value. Units specified with the command.</td>
</tr>
<tr>
<td>&lt;freq&gt;</td>
<td>Frequency. Units specified with the command.</td>
</tr>
<tr>
<td>&lt;integer&gt;</td>
<td>Integer value, no units. Range specified with the command.</td>
</tr>
<tr>
<td>&lt;number&gt;</td>
<td>Numeric value, integer, or real.</td>
</tr>
<tr>
<td>&lt;relative amplitude&gt;</td>
<td>Relative amplitude. Units are always dB.</td>
</tr>
</tbody>
</table>
Data Parameters

Data parameters, referred to 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>.

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>
<thead>
<tr>
<th>Table 7-4. Parameter Notations</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;arg&gt; ::=a generic command argument consisting of one or more of the other data types</td>
</tr>
<tr>
<td>&lt;bNR1&gt; ::=boolean values in &lt;NR1&gt; format; numeric 1 or 0</td>
</tr>
<tr>
<td>&lt;boolean&gt; ::=ON</td>
</tr>
<tr>
<td>&lt;integer&gt; ::=an unsigned integer without a decimal point (implied radix point)</td>
</tr>
<tr>
<td>&lt;NR1&gt; ::=a signed integer without a decimal point (implied radix point)</td>
</tr>
<tr>
<td>&lt;NR2&gt; ::=a signed number with an explicit radix point</td>
</tr>
<tr>
<td>&lt;NR3&gt; ::=a scaled explicit decimal point numeric value with and exponent (e.g., floating point number)</td>
</tr>
<tr>
<td>&lt;NRf&gt; ::=&lt;NR1&gt;</td>
</tr>
<tr>
<td>&lt;nv&gt; ::=SCPI numeric value: &lt;NRf&gt;</td>
</tr>
<tr>
<td>&lt;char&gt; ::=&lt;CHARACTER PROGRAM DATA&gt; Examples: CW, FIXed, UP, and DOWN</td>
</tr>
<tr>
<td>&lt;string&gt; ::=&lt;STRING PROGRAM DATA&gt; ASCII characters enclosed by double quotes. For example: &quot;OFF&quot;</td>
</tr>
<tr>
<td>&lt;block&gt; ::=IEEE-488.2 block data format</td>
</tr>
<tr>
<td>&lt;NA&gt; ::=Not Applicable</td>
</tr>
</tbody>
</table>

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.

7-5 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 7-5. Notational Conventions

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>:</td>
<td>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 7-9).</td>
</tr>
<tr>
<td>;</td>
<td>A semicolon separates commands if multiple commands are placed on a single program line.</td>
</tr>
<tr>
<td>[]</td>
<td>Square brackets enclose one or more optional keywords.</td>
</tr>
<tr>
<td>{}</td>
<td>Braces enclose one or more keyword or command parameters that may be included one or more times.</td>
</tr>
<tr>
<td></td>
<td>A vertical bar indicates “or” and is used to separate alternative parameter options. Example: ON</td>
</tr>
<tr>
<td>&lt;&gt;</td>
<td>Angle brackets enclose parameter descriptions.</td>
</tr>
<tr>
<td>::=</td>
<td>Means “is defined as” For example: &lt;a&gt;::=&lt;b&gt;&lt;c&gt; indicates that &lt;b&gt;&lt;c&gt; can replace &lt;a&gt;.</td>
</tr>
<tr>
<td>sp</td>
<td>Space, referred to as white space, must be used to separate keywords from their associated data parameters. It must not be used between keywords or inside keywords.</td>
</tr>
<tr>
<td>XXX</td>
<td>Indicates a root command name</td>
</tr>
</tbody>
</table>

For further information about SCPI command syntax and style, refer to the Standard Commands for Programmable Instruments (SCPI) 1999.0 document.
**7-6 Notational Examples**

Table 7-6 provides examples of valid command Syntax.

**Table 7-6. Creating Valid Commands**

<table>
<thead>
<tr>
<th>Command Specification</th>
<th>Valid Forms</th>
</tr>
</thead>
<tbody>
<tr>
<td>[:SENSe]:FREQuency:STARt &lt;freq&gt;</td>
<td>The following all produce the same result:</td>
</tr>
<tr>
<td></td>
<td>:SENSe:FREQuency:START 1 MHZ</td>
</tr>
<tr>
<td></td>
<td>:SENSe:FREQ:STAR 1 MHZ</td>
</tr>
<tr>
<td></td>
<td>:sense:frequency:start 1 MHZ</td>
</tr>
<tr>
<td></td>
<td>:FREQ:STAR 1000 KHZ</td>
</tr>
<tr>
<td>:CALCulate:MARKer{1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>:CALC:MARK:X 1 GHZ</td>
</tr>
<tr>
<td></td>
<td>:CALC:MARK1:X 1 GHZ</td>
</tr>
<tr>
<td></td>
<td>:CALC:MARK2:X 2 GHZ</td>
</tr>
<tr>
<td>:UNIT:POWer {DBM</td>
<td>DBV</td>
</tr>
<tr>
<td></td>
<td>:UNIT:POWer DBM</td>
</tr>
<tr>
<td></td>
<td>:unit:pow dbm</td>
</tr>
<tr>
<td>:INITiate:CONTinuous {OFF</td>
<td>ON</td>
</tr>
<tr>
<td></td>
<td>:INITiate:CONTinuous OFF</td>
</tr>
<tr>
<td></td>
<td>:init:cont 0</td>
</tr>
</tbody>
</table>

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:

:FEQuency: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.
# 7-7 Formatting Conventions

This manual uses the following conventions in describing SCPI commands.

<table>
<thead>
<tr>
<th>Table 7-7. Formatting Conventions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>:COMMands:LOOK:LIKE:THIS</td>
<td>Commands are formatted to differentiate them from their description.</td>
</tr>
<tr>
<td>:COMMand:QUERies:LOOK:LIKE:THIS?</td>
<td>The query form of the command is followed by a “?”</td>
</tr>
<tr>
<td>&lt;identifier&gt;</td>
<td>Identifiers are enclosed in “&lt; &gt;”. They indicate that some type of data must be provided. See Table 7-3 for details on the types of identifiers.</td>
</tr>
<tr>
<td></td>
<td>The “</td>
</tr>
<tr>
<td>[optional input]</td>
<td>Optional input is be enclosed in “[]”. The “[]” are not part of the command.</td>
</tr>
</tbody>
</table>
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.

```plaintext
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

//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?
```

**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

\[
\text{Frequency} = \left[\text{start\_frequency} + \left(\frac{\text{span}}{(\text{display\_points}-1)}\right)\right] * N
\]

\[
N = 0, 1, \ldots \text{display\_points}
\]
7-9 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 7-8. The output data rate does not change, regardless of bit resolution.

### Table 7-8. IQ Capture Bandwidth Values

<table>
<thead>
<tr>
<th>I/Q Bandwidth</th>
<th>Output Data Rate MSPS</th>
<th>IQ Sample Pairs/Sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 MHz</td>
<td>76.25 / 3</td>
<td>25416666.67</td>
</tr>
<tr>
<td>13.3 MHz</td>
<td>76.25 / 4</td>
<td>19062500</td>
</tr>
<tr>
<td>6.67 MHz</td>
<td>76.25 / 8</td>
<td>9531250</td>
</tr>
<tr>
<td>2.67 MHz</td>
<td>76.25 / 20</td>
<td>3812500</td>
</tr>
<tr>
<td>1.33 MHz</td>
<td>76.25 / 40</td>
<td>1906250</td>
</tr>
<tr>
<td>667 kHz</td>
<td>76.25 / 80</td>
<td>953125</td>
</tr>
<tr>
<td>267 kHz</td>
<td>76.25 / 200</td>
<td>381250</td>
</tr>
<tr>
<td>133 kHz</td>
<td>76.25 / 400</td>
<td>190625</td>
</tr>
<tr>
<td>66.7 kHz</td>
<td>76.25 / 800</td>
<td>95312.5</td>
</tr>
<tr>
<td>26.7 kHz</td>
<td>76.25 / 2000</td>
<td>38125</td>
</tr>
<tr>
<td>13.3 kHz</td>
<td>76.25 / 4000</td>
<td>19062.5</td>
</tr>
<tr>
<td>6.67 kHz</td>
<td>76.25 / 8000</td>
<td>9531.5</td>
</tr>
<tr>
<td>2.76 kHz</td>
<td>76.25 / 20000</td>
<td>3812.5</td>
</tr>
<tr>
<td>1.33 kHz</td>
<td>76.25 / 40000</td>
<td>1906.3</td>
</tr>
</tbody>
</table>

The maximum capture length is limited by memory, capture bandwidth and bit resolution. Table 7-9 on page 7-13 shows the maximum capture length.
### Table 7-9. Maximum I/Q Block Capture Length

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

\(^a\)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.
Raw Socket Connection

```python
import socket
from time import sleep, time

class SocketConnection:
    """Provides a means to connect and send SCPI commands to the DUT using a raw TCP socket."""
    def __init__(self, ipAddress):
        """Initializes an instance of SocketConnection class
        @param ipAddress The IP address of the device
        """

        # split out port number if given
        splitIpAddress = ipAddress.split(':')

        assert len(splitIpAddress) > 0
        assert len(splitIpAddress) <= 2
        self._ipAddress = splitIpAddress[0]

        # assign port
        if len(splitIpAddress) == 2:
            self._portNumber = int(splitIpAddress[1])
        else:
            self._portNumber = 9001

        self._socketConnection = None

        self._timeoutInSec = 120
        self._socketReadSize = 4096
        self.__nonBulkDataSizeCutoff = 32768
        # Time to let the other end of the connection close
        self.__timeoutAfterCloseInSec = 1
        self._terminatedBlockResponse = False
        self.prefix = ''
        self._verbose = False

        self._establishConnection()

    def __del__(self):
        """This gets called by the garbage collector so it is possible that the connection will remain open for a while before this gets collected."""

        self._closeConnection()
```
def getpeername(self):
    return self._ipAddress, self._portNumber

def settimeout(self, *args, **kwargs):
    return self._socketConnection.settimeout(*args, **kwargs)

def expectTerminatedBlockResponse(self, newval=None):
    if newval is not None:
        self._terminatedBlockResponse = newval
    return self._terminatedBlockResponse

def sendWriteCommand(self, scpiCommand):
    """
    Sends a SCPI write command.
    @param scpiCommand The SCPI command to send.
    """
    scpiCommand = self.prefix + scpiCommand
    try:
        returnValue = self._socketConnection.sendall(scpiCommand + "\n")
        assert returnValue is None, "Error sending command: " + scpiCommand
        if self._verbose:
            if len(scpiCommand) < self.__nonBulkDataSizeCuttoff:
                print(scpiCommand + " sent successfully")
            else:
                print("sent long scpi command of length: " +
                      str(len(scpiCommand)))
        except socket.error as msg:
            assert False, "Failed to send SCPI command: a socket error occurred
            (Error code: " + str(msg[0]) + ", Error message: " + str(msg[1]) + ")"
        return

def sendQueryCommand(self, scpiCommand):
    """
    Sends a SCPI query command and return the response.
    @param scpiCommand The SCPI query to send.
    @return The result of the SCPI command.
    """
    scpiCommand = self.prefix + scpiCommand
    try:
        returnValue = self._socketConnection.sendall(scpiCommand + "\n")
        assert returnValue is None, "failed to send command"
        if self._verbose:
            print(scpiCommand + " sent successfully")
        # Read 1 byte to check for a block data response header
        data = self._socketConnection.recv(1)
        assert len(data) > 0, "No data returned for query"
if len(data) > 0 and data[0] == '#':
    # Block data response
    data = self._getBlockDataResponse()
elif len(data) > 0 and data[0] == '\n':
    # Check for a response string that only contains a newline.
    data = data[:-1]
elif len(data) > 0:
    # ASCII response: receive until the entire response is read
    while True:
        data += self._socketConnection.recv(self._socketReadSize)
        assert len(data) < self.__nonBulkDataSizeCuttoff, 
        "No newline character found in response to " + scpiCommand + " SCPI command."

    # Check for a new line at the end of the response
    if data[-1] == '\n':
        break;

    # Remove the trailing \n from the response
    data = data[:-1]
    if self._verbose:
        print('Data received: "%s"' % data)

except socket.error as msg:
    assert False, "Failed to send SCPI command: a socket error occurred \n" + msg.__str__()
    return data

    def _establishConnection(self):
        """Establishes a connection. The call will fail if a connection is already open."
        assert self._socketConnection is None, "connection should not already be open"
        try:
            self._socketConnection = socket.socket(socket.AF_INET,
            socket.SOCK_STREAM)
            self._socketConnection.setsockopt(socket.SOL_SOCKET,
            socket.SO_REUSEADDR, 1)
            self._socketConnection.settimeout(self._timeoutInSec)
            self._socketConnection.connect((self._ipAddress,
            self._portNumber))
            self._socketConnection.setsockopt(socket.IPPROTO_TCP,
            socket.TCP_NODELAY, 1)
        except socket.error as msg:
            assert False, "Failed to establish DUT connection (Error code: " +
str(msg[0]) + ", Error message: " + str(msg[1]) + ")"

def _closeConnection(self):
    """
    Closes the socket connection and asserts that it closed. This informs
    the other end of the
    socket that it should close but it may take some time depending on
    implementation,
    network conditions, etc.
    """
    if self._socketConnection is not None:
        self._socketConnection.shutdown(socket.SHUT_RDWR)
        self._socketConnection.close()
        self._socketConnection = None
        sleep(self.__timeoutAfterCloseInSec)
        assert self._socketConnection is None, "Socket connection not closed"

    def _getBlockDataResponse(self):
        """
        Receives a SCPI block data response of the form 'AXD' where A is a
        single ASCII byte
        specifying the number of digits in X, X is one or more ASCII bytes
        specifying the number
        of bytes in D, and D is one or more bytes containing the response
        binary data.
        """
        numSizeBytes = int(self._socketConnection.recv(1))
        assert numSizeBytes > 0, "The definite-length empty block response must
        be #10 not #0."

        numDataBytesLeft = int(self._socketConnection.recv(numSizeBytes))
        responses = []
        readBuffer = bytearray(numDataBytesLeft)
        view = memoryview(readBuffer)
        timeoutSeconds = self._socketConnection.gettimeout()
        lastReadTime = time()

        while numDataBytesLeft > 0:
            numBytesRead = self._socketConnection.recv_into(view, numDataBytesLeft)
            if numBytesRead > 0:
                lastReadTime = time()
                dt = time() - lastReadTime
                if dt > timeoutSeconds:
                    break

            break
        return responses
raise Exception('Timeout after %d ms: Only read %d/%d bytes' % (dt, len(readBuffer),
    len(readBuffer) + numDataBytesLeft))

view = view[numBytesRead:]
numDataBytesLeft = numDataBytesLeft - numBytesRead

if self._terminatedBlockResponse:
    blockTerminator = self._socketConnection.recv(2)
    assert blockTerminator in ('
', '
')

if self._verbose:
    print("Read bytes of block data: ", len(readBuffer))
return readBuffer

def reset(self, delay_seconds=-1):
    """
    Resets the established connection
    @param delay_seconds: Wait time between closing the connection and
    attempting to re-establish the connection. This is useful when rebooting an
    instrument.
    """
    self._closeConnection()

    if delay_seconds >= 0:
        sleep(delay_seconds)
        try:
            self._establishConnection()
        except socket.error as msg:
            assert False, "Failed to establish DUT connection (Error code: "+ str(msg[0]) + ", Error message: " + str(msg[1]) + ")"
        else:
            reset_timeout = 300  # 300 seconds == 5 minutes == max polling time
time.sleep(5)  # Fixed delay before attempting to reconnect
            while reset_timeout > 0:
                try:
                    self._socketConnection = socket.socket(socket.AF_INET,
socket.SOCK_STREAM)
            self._socketConnection.setsockopt(socket.SOL_SOCKET,
socket.SO_REUSEADDR, 1)
            self._socketConnection.settimeout(self._timeoutInSec)
            self._socketConnection.connect((self._ipAddress,
self._portNumber))
break
except Exception as msg :
    self._socketConnection.close()
self._socketConnection = None
sleep(1)
reset_timeout -= 1
if reset_timeout <= 0:
    assert False, "Failed to establish DUT connection (Error code: " + str(msg[0]) + ", Error message: " + str(msg[1]) + ")"
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
//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 I/Q 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.
IQ Capture Data to Absolute Power Level

This is a sample Matlab/Octave program that shows how Raw IQ capture data can be related to an Absolute power level.

```matlab
%Copy data into captureData array
%Separate the data and build the complex IQ vector.
%First column contains Q and the second I
quadphase = captureData(:,1);
inphase = captureData(:,2);
IQData = (inphase+1i*quadphase);

%Send SCPI Command [:SENSe]:iQ:SAMPle:CALibration:CONFiguration?

%and get absolute reference offset
absolute_ref_offset = -2.007958;
fs = 13.3e6;%Sampling frequency
n = 1024; %number of samples

%Perform fft
y = abs(fft(IQData, n));
y = fftshift(y);
%Scale fft output
y = y/n;
%To power
y = 20 * log10(y);
%To Absolute power level
y = y + absolute_ref_offset;
%Peak Value
peak = max(y);
f = fs*(-n/2:n/2-1)/n;
plot(f, y);
xlabel("Frequency in Hz"); % x-axis label
ylabel("Power in dBm"); % y-axis label
```
Stand Alone IQ

```python
# -*- coding: utf-8 -*-

Created on Wed Jul  8 14:21:47 2015

@author: austin

```

```python
from rawsocketconnection import RawSocketConnection
from scpi_wrappers.sleepyspawrapper import SleepySpaWrapper
from helpers.unitconversions import *

from helpers.iqhelpers import getDeltas
import time
import itertools
from multiprocessing import Pool
try:
    import matplotlib
    matplotlib.rcParams['axes.formatter.limits'] = [-4,4]
    from matplotlib import pyplot as plt
    import numpy as np

    plottingAvailable = True
except:
    plottingAvailable = False

try:
    from mayavi.mlab import quiver3d
    from mpl_toolkits.mplot3d import axes3d
    mayaviAvailable = True
except:
    mayaviAvailable = False

mayaviAvailable = False

def plotIQData(samples, timestep, figureText):
    print("Getting deltas")
    indexes, timevals, dt, inphase, di, quadphase, dq = getDeltas(samples)

    print("Sum of time steps: " + str(sum(dt[:-1])))
```
pointLow = len(timevals) - 60
pointHigh = pointLow + 30
for point in range(pointLow, pointHigh):
    print("Time: " + str(timevals[point]) + " I: " + str(inphase[point]) + " Q: " + str(quadphase[point]))

assert(len(inphase) == len(quadphase))

minPoint = 0
maxPoint = -1
step = 1
fig = plt.figure()
ax1 = fig.add_subplot(321)
ax1.scatter(inphase[minPoint:maxPoint:step], quadphase[minPoint:maxPoint:step], marker = '.')
ax1.set_xlabel("I")
ax1.set_ylabel("Q")
ax1.axis('equal')

ax2 = fig.add_subplot(322)
ax2.plot(indexes[minPoint:maxPoint:step], timevals[minPoint:maxPoint:step])
ax2.set_xlabel("sample index")
ax2.set_ylabel("Time since start in ns")

ax3 = fig.add_subplot(323)
ax3.scatter( indexes[minPoint:maxPoint:step], dt[minPoint:maxPoint:step], marker='.' )
ax3.set_xlabel("sample index")
ax3.set_ylabel("time step in ns")

points = [x.Q + 1j * x.I for x in samples[:2**17]]

#averageTimeStep = np.mean(dt)

w = np.fft.fft(points)

defs = np.fft.fftfreq(len(points), d=timestep )

ax4 = fig.add_subplot(324)
ax4.plot(freqs, w.real)
ax4.set_title("FFT")
ax4.set_xlabel("Frequency Hz")
ax4.set_ylabel("Amplitude (real part from FFT)")

ax5 = fig.add_subplot(325)
ax5.psd(points)

ax6 = fig.add_subplot(326)
av6.text(0,0, figureText)

ax6.set_axis_off()
plt.tight_layout()

if mayaviAvailable:
    step = 1
    minPoint = 0

    obj = quiver3d( np.array(timevals[minPoint:maxPoint:step])*1,
inphase[minPoint:maxPoint:step],
quadphase[minPoint:maxPoint:step],
np.array(dt[minPoint:maxPoint:step])*1,
di[minPoint:maxPoint:step], dq[minPoint:maxPoint:step])

    ...

    obj = plot3d( np.array(timevals[minPoint:maxPoint:step])*10000,
inphase[minPoint:maxPoint:step],
quadphase[minPoint:maxPoint:step])

    ...

    obj = quiver3d( np.array(timevals[minPoint:maxPoint:step])*1,
inphase[minPoint:maxPoint:step],
quadphase[minPoint:maxPoint:step])

    ...

    plt.show()

def test_iqTransfer(dut):
    ""
    Verifies that the instrument can send IQ data
    """
    assert isinstance(dut, SleepySpaWrapper)
#dut.preset()
#dut._connection.sendQueryCommand("*opc?")
#dut._connection.sendQueryCommand("*idn?")
iqBandwidth = 3 *MHz
dut.setIqBandwidth(iqBandwidth)
dut._connection.sendWriteCommand("IQ:BITS 24")
dut._connection.sendWriteCommand("IQ:LENGth 0.1 s")

dut.triggerIqCapture()
dut.waitForOperationComplete()
sampleSource = dut.queryIQData()

timestep = sampleSource._nanosecondsPerSample *1e-9
print ("Timestep: " + str(timestep))

samples = [sample for sample in sampleSource.getSamples()]

figureText = "Number of samples: " +str(len(samples)) +'
figureText +="Time per tick in ns:
{:.3f}\n".format(sampleSource._nanosecondsPerTick)
figureText +="DecimatedSampleRate: "+ str(sampleSource._decimatedSampleRate)+
'\n'
figureText +="Ticks per sample: " + str(sampleSource._tickPerSample)+'\n'
figureText +="Time per sample in nanoseconds:
{:.3f}\n".format(sampleSource._nanosecondsPerSample)

print (figureText)
plotIQData(samples, timestep, figureText)

def test_streamPlot(dut):
    """
    Verifies that the instrument can send IQ data
    """
    assert isinstance(dut, SleepySpaWrapper)

    # This test requires a GPS fix since we need it for timestamp precision
dut.waitForGpsFix()
dut._connection.sendWriteCommand("IQ:BITS 8")

    iqBandwidth = 1330 *kHz
    dut.setIqBandwidth(iqBandwidth)
dut.setIQStreaming()

dut.triggerIQCapture()

numChunks = 10

sampleSources = []
for chunkNumber in range(numChunks):
    sampleSources.append(dut.queryIQData())

dut.abortSweep()
sampleSource = sampleSources[0]

timestep = sampleSource._nanosecondsPerSample * 1e-9
print("Timestep: " + str(timestep))

samples = []
for sampleSource in sampleSources:
    for sample in sampleSource.getSamples():
        samples.append(sample)

figureText = "Number of samples: " + str(len(samples)) + 
figureText +="Time per tick in ns: " + str(sampleSource._nanosecondsPerTick) + 
figureText +="DecimatedSampleRate: " + str(sampleSource._decimatedSampleRate) + 
figureText +="Ticks per sample: " + str(sampleSource._tickPerSample) + 
figureText +="Time per sample in nanoseconds: " + str(sampleSource._nanosecondsPerSample) + 
print("plotting")
plotIQData(samples, timestep, figureText)

if __name__ == "__main__":
    import argparse
    parser = argparse.ArgumentParser(description='Runs iq plotting test')
    parser.add_argument('--address', dest='address', default= "172.26.202.128")
    args = parser.parse_args()
    # edit this
ipAddress = args.address + ":9001"
connection = RawSocketConnection(ipAddress)

dut = SleepySpaWrapper(connection, None)

# Change this to test_streamPlot(dut) if you want the streaming example
test_iqTransfer(dut)
from socketconnection import SocketConnection
from time import time
from math import log, ceil
connection = SocketConnection("172.26.201.208")
#connection._verbose = True

hist = {0:0}
count = 0
while True:
    start = time()
    connection.sendQueryCommand("\:FREQ:START?\")
    connection.sendQueryCommand("\:FREQ:STOP?\")
    connection.sendQueryCommand("\:TRAC? 1")
    connection.sendQueryCommand("\:TRAC? 1")
    connection.sendQueryCommand("\:TRAC? 1")
    stop = time()
    delta = stop - start
    #print( delta)
    bucket = ceil(log(delta, 2 ))
    #print( bucket)
    if bucket not in hist:
        hist[bucket] = 1
    else:
        hist[bucket] += 1
    count += 1
    if count == 10000:
        count = 0
        print("\nTime bucket, count")
        for key in sorted(hist):
            print("{},{}".format(2**key, hist[key] ))
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 two levels: frame and extended 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. The second level is an extended frame which can be used for the stamp information. The first column of the IQ vector contains Q and the second column contains I.

---

**64 bit Frame**

```
------------------------------------------------------------------
```

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

<table>
<thead>
<tr>
<th>I/Q Bit Resolution</th>
<th>IQ Sample Pairs per 64 Bit Frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>

**24 Bit Resolution**

```
24 bit Q       24 bit I
```

**16 Bit Resolution**

```
16 bit Q       16 bit I
```

**10 Bit Resolution**

```
10 bit Q       10 bit I
```

**8 Bit Resolution**

```
8 bit Q       8 bit I
```

---
I/Q Extended Frame

An extended frame consists of 64 frames. When time stamp information is used, each frame contains one bit of a 64 bit time stamp data. An extended frame is 64 frames that contain a time stamp.

Note

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

I/Q Time Stamp

This section describes how the time stamp is embedded into the I/Q data. Within each 64 bit frame, only the first four extended frames contain time stamp information. Refer to 64 bit Time Stamp frame diagram below.

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.

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). The first column of the IQ vector contains Q and the second column contains I. 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. The second I and second Q sample will have 15 bits, followed by the mark and time stamp bit.

I/Q Bit Resolution = 10

```
+----------------+----------------+----------------+----------------+
| 10 bit Q       | 10 bit Q       | 10 bit Q       |
| 10 bit I       | 10 bit I       | 10 bit I       |
+----------------+----------------+----------------+
```

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

```
+----------------+----------------+----------------+----------------+----------------+----------------+
| 8 bit Q        | 8 bit Q        | 8 bit Q        | 7 bit Q        | 8 bit I        | 8 bit I        |
| 8 bit I        | 8 bit I        | 7 bit I        |
+----------------+----------------+----------------+----------------+----------------+----------------+
```

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.

Having only 7 effective bits instead of 8 bits on every fourth sample 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.

The first column of the IQ vector contains Q and the second column contains I.

N  Frame Data (one I, one Q sample per frame)
0  [ Q-------0I------T ]
1  [ Q-------0I------T ]
2  [ Q-------0I------T ]
3  [ Q-------0I------T ]
4  [ Q-------0I------T ]
5  [ Q-------0I------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  [ Q-------0I------T ] <- 'T' is MSB - 1 bit of the timestamp
7  [ Q-------0I------T ] <- 'T' is MSB - 2 bit of the timestamp
8  [ Q-------0I------T ] <- etc.
...

To get the timestamp for frames N=0 through 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/Output Data Rate)x(Number of I or Q samples per frame).

I/Q Bit Resolution | Time Between Each Frame
---|---
24 | 1/(Output Data Rate)
16 | 2/(Output Data Rate)
10 | 3/(Output Data Rate)
8  | 4/(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 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 x 1024² 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
//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 an 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

**7-10 SCPI Command Files**

Refer to the following for the programming commands:

- Chapter 8, “SCPI SPA Commands”
- Chapter 9, “SCPI System Commands”

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

- Appendix C, “SCPI Error Table”
- Appendix B, “SCPI Command Listing”
Chapter 8 — SCPI SPA Commands

8-1 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 8-2 “:ABORt Subsystem”
- Section 8-3 “:CALCulate Subsystem”
- Section 8-4 “:CONFigure Subsystem”
- Section 8-5 “:DIAGnostic Subsystem”
- Section 8-6 “:DISPlay Subsystem”
- Section 8-7 “:FETCh Subsystem”
- Section 8-9 “:INITiate Subsystem”
- Section 8-10 “:INPut Subsystem”
- Section 8-11 “:MEASure Subsystem”
- Section 8-12 “:MMEMory Subsystem”
- Section 8-13 “:OUTPut Subsystem (for MS27100A models only)”
- Section 8-14 “:READ Subsystem”
- Section 8-15 “:ROUTe Subsystem”
- Section 8-16 “:STATus Subsystem”
- Section 8-17 “:TRACe Subsystem”
- Section 8-18 “:UNIT Subsystem”
- Section 8-19 “[SENSe] Subsystem”

8-2 :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.

Parameters: none
8-3  :CALCulate Subsystem

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

:CALCulate:ACPower:LIMit:ADJacent:ABSolute <numeric_value> {DBM}
:CALCulate:ACPower:LIMit:ADJacent:ABSolute?

  Name: Adjacent Channel Power Adjacent Absolute Limit
  Description: Sets and queries the amplitude of absolute limit for acpr adjacent power.
  Parameters: <numeric_value> {DBM}
  Query Return: Numeric (dBm)
  Default Header: 10 dBm
  Default Unit: dBm
  Range: -200 dBm to 200 dBm

:CALCulate:ACPower:LIMit:ADJacent:LOWer:FAIL?

  Name: ACpower Limit Adjacent Lower Fail
  Description: This command queries the result of a limit check on lower adjacent channel power
  Parameters: none

:CALCulate:ACPower:LIMit:ADJacent:RELative <numeric_value> {DBM}
:CALCulate:ACPower:LIMit:ADJacent:RELative?

  Name: Adjacent Channel Power Adjacent Relative Limit
  Description: Sets and queries the amplitude of relative limit for acpr adjacent power.
  Parameters: <numeric_value> {DBM}
  Query Return: Numeric (dBm)
  Default Header: 10 dBm
  Default Unit: dBm
  Range: -200 dBm to 200 dBm

:CALCulate:ACPower:LIMit:ADJacent:UPPer:FAIL?

  Name: Acpr Limit Adjacent Upper Fail
  Description: This command queries the result of a limit check on upper adjacent channel power
  Parameters: none

:CALCulate:ACPower:LIMit:ALTernate:ABSolute <numeric_value> {DBM}
:CALCulate:ACPower:LIMit:ALTernate:ABSolute?

  Name: Adjacent Channel Power Alternate Absolute Limit
  Description: Sets and queries the amplitude of absolute limit for acpr alternate power.
  Parameters: <numeric_value> {DBM}
  Query Return: Numeric (dBm)
  Default Header: 10 dBm
  Default Unit: dBm
  Range: -200 dBm to 200 dBm
:CALCulate:ACPower:LIMit:ALTername:LOWer:FAIL?

Name: Acpr Limit Alternate Lower Fail
Description: This command queries the result of a limit check on lower alternate channel power
Parameters: none

:CALCulate:ACPower:LIMit:ALTername:RELative <numeric_value> {DBM}
:CALCulate:ACPower:LIMit:ALTername:RELative?

Name: Adjacent Channel Power Alternate Relative Limit
Description: Sets and queries the amplitude of relative limit for acpr alternate power.
Parameters: <numeric_value> {DBM}
Query Return: Numeric (dBm)
Default Header: 10 dBm
Default Unit: dBm
Range: -200 dBm to 200 dBm

:CALCulate:ACPower:LIMit:ALTername:UPPer:FAIL?

Name: Acpr Limit Alternate Upper Fail
Description: This command queries the result of a limit check on upper alternate channel power
Parameters: none

:CALCulate:ACPower:LIMit:FAIL?

Name: Acpr Limit Fail
Description: This command queries the result of a limit check on adjacent channel power ratio
Parameters: none

:CALCulate:ACPower:LIMit:MAIN <numeric_value> {DBM}
:CALCulate:ACPower:LIMit:MAIN?

Name: Adjacent Channel Power Main Limit
Description: Sets and queries the amplitude of limit for main power.
Parameters: <numeric_value> {DBM}
Query Return: Numeric (dBm)
Default Header: 10 dBm
Default Unit: dBm
Range: -200 dBm to 200 dBm
:CALCulate:ACPower:LIMit:MODE <ABSolute|RELative>
:CALCulate:ACPower:LIMit:MODE?

Name: Adjacent Channel Power Limit Mode
Description: Sets the acpr limit mode to be absolute or relative
Parameters: <ABSolute|RELative>
Query Return
Parameters: ABS|REL
Default: ABSolute

:CALCulate:ACPower:LIMit:MODE <ABSolute|RELative>
:CALCulate:ACPower:LIMit:MODE?

Name: Adjacent Channel Power Limit Mode
Description: Sets the acpr limit mode to be absolute or relative
Parameters: <ABSolute|RELative>
Query Return
Parameters: ABS|REL
Default: ABSolute

:CALCulate:ACPower:LIMit:STATE <0 | 1 | ON | OFF>
:CALCulate:ACPower:LIMit:STATE?

Name: Adjacent Channel Power Limit State
Description: Sets the acpr limit state to be ON or OFF
Parameters: <0 | 1 | ON | OFF>
Query Return: 0 | 1
Default Header: OFF

:CALCulate:CHPower:LIMit <numeric_value> {DBM}
:CALCulate:CHPower:LIMit?

Name: Channel Power Limit
Description: Sets and queries the amplitude of limit on channel power.
Parameters: <numeric_value> {DBM}
Query Return: Numeric (dBm)
Default Header: 10 dBm
Default Unit: dBm
Range: -200 dBm to 200 dBm

:CALCulate:CHPower:LIMit:FAIL?

Name: Channel Power Limit Fail
Description: This command queries the result of a limit check on channel power
Parameters: none
:CALCulate:CHPower:LIMit:PSDensity <numeric_value> {DBM}
:CALCulate:CHPower:LIMit:PSDensity?

Name: Channel Power Spectral Density Limit
Description: Sets and queries the amplitude of limit on channel power spectral density.
Parameters: <numeric_value> {DBM}
Query Return: Numeric (dBm)
Default Header: 10 dBm
Default Unit: dBm
Range: -200 dBm to 200 dBm

:CALCulate:CHPower:LIMit:PSDensity:STATe <0 | 1 | ON | OFF>
:CALCulate:CHPower:LIMit:PSDensity:STATe?

Name: Channel Power Spectral Density Limit State
Description: Sets and queries the state of limit on channel power spectral density. The set form of this command sets the limit state to be ON or OFF
Parameters: <0 | 1 | ON | OFF>
Query Return: 0 | 1
Default Header: OFF

:CALCulate:CHPower:LIMit:PSD:FAIL?

Name: Power Spectral Density Limit Fail
Description: This command queries the result of a limit check on channel power spectral density
Parameters: none

:CALCulate:CHPower:LIMit:STATe <0 | 1 | ON | OFF>
:CALCulate:CHPower:LIMit:STATe?

Name: Channel Power Limit State
Description: Sets and queries the state of limit on channel power. The set form of this command sets the limit state to be ON or OFF
Parameters: <0 | 1 | ON | OFF>
Query Return: 0 | 1
Default Header: OFF

:CALCulate<n>:LIMit:ACTive?

Name: Limit Active
Description: Queries the numbers of all active limit lines in ascending order. This command returns an empty string if no limits are active.
Parameters: none
Suffix Range
Description: CALCulate Suffix Range: 1, Default = 1
:CALCulate:LIMit:ALARm <0 | 1 | ON | OFF>

Name: Limit Alarm

Description: This command enables/disables the AAE notification for limit failures.

Parameters: <0 | 1 | ON | OFF>

Query Return: 0 | 1

Default Header: OFF

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

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, 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 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 an empty string if no limits are active.
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>

Title: Limit Alarm

Description: This command enables/disables the AAE notification for limit failures.

Parameters: <0 | 1 | ON | OFF>

Query Return: 0 | 1

Default Value: OFF

Name: 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>

Suffix Range

Description: CALCulate Suffix Range: 1, Default = 1

LIMit Suffix Range: 1-10, Default = 1
:CALCulate:LIMit<n>:CONTrol[:DATA] <numeric_value> {HZ | KHZ | MHZ | GHZ}, {<numeric_value> {HZ | KHZ | MHZ | GHZ}}, ...

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 discontiguous (or segmented) limit lines within a single limit.

For example, to define a limit line of two discontiguous 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: <numeric_value> {HZ | KHZ | MHZ | GHZ}, {<numeric_value> {HZ | KHZ | MHZ | GHZ}}, ...

Suffix Range

Description: LIMit Suffix Range: 1-10, Default = 1
:CALCulate{[1]}:LIMit<n>:CONTrol:MODE  <char>
:CALCulate{[1]}:LIMit<n>: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>
Suffix Range
Description: CALCulate Suffix Range: 1, Default = 1
LIMit Suffix Range: 1-10, Default = 1

:CALCulate{[1]}:LIMit<n>:CONTrol:SHIFT  <numeric_value> {HZ | KHZ | MHZ | GHZ}

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. For example,
  sending  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 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:  <numeric_value> {HZ | KHZ | MHZ | GHZ}
Suffix Range
Description: CALCulate Suffix Range: 1, Default = 1
LIMit Suffix Range: 1-10, Default = 1

:CALCulate{[1]}:LIMit<n>:COPY  <numeric_value>

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:  <numeric_value>
Suffix Range
Description: CALCulate Suffix Range: 1, Default = 1
LIMit Suffix Range: 1-10, Default = 1
:CALCulate{[1]}:LIMit<n>:_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).
Parameters: none
Suffix Range
Description: CALCulate Suffix Range: 1, Default = 1
LIMit Suffix Range: 1-10, Default = 1

:CALCulate:LIMit:ENVelope:OFFSet <numeric_value> {DBM}
:CALCulate:LIMit:ENVelope:OFFSet?

Title: Limit Envelope Offset
Description: This command sets/gets the limit envelope offset. This defines how far away from the measured signal indicated the limit envelope is placed. Use :CALCulate:LIMit:TYPe to set the currently active limit line.
Parameters: <numeric_value> {DBM}
Query Return: Numeric (dBm)
Default Value: 3 dBm
Default Unit: dBm
Range: -100 dBm to 100 dBm

:CALCulate:LIMit:ENVelope:POINt <numeric_value>
:CALCulate:LIMit:ENVelope:POINt?

Title: Number of Limit Envelope Points
Description: This command sets the number of inflection point for the limit envelope.
Parameters: <numeric_value>
Query Return: Numeric
Default Value: 21
Range: 2 to 41

:CALCulate:LIMit:ENVelope:SHAPe <SQUare|SLOPe>
:CALCulate:LIMit:ENVelope:SHAPe?

Title: Limit Envelope Shape
Description: This command sets/gets the currently active limit envelope shape.
Parameters: <SQUare|SLOPe>
Default Value: SQUare
Range: SQUare | SLOPe
:CALCulate:LIMit{[1]|2|3|4|5|6|7|8|9|10}:ENVelope:UPDate:Y

Title: Update Limit Envelope Amplitude
Description: This command updates the amplitude of the upper and lower limits without changing the frequencies of the inflection points.
Parameters: none

: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:LIMit{[1]|2|3|4|5|6|7|8|9|10}:LOWer[:DATA] <numeric_value>{DBM}, {<numeric_value>{DBM}}

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 discontiguous (or segmented) limit lines within a single limit. For details, and an example, of using placeholder values, see CALC:LIM:CONT::DATA.

Parameters: <numeric_value> {DBM}, {<numeric_value> {DBM}}, ...
:CALCulate:LIMit{[1]|2|3|4|5|6|7|8|9|10}:LOWer:ENvelope:CREate

Title: Create Lower Limit Envelope
Description: This command is used to create an Lower limit envelope on the selected trace.
Parameters: none

: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 <0 | 1 | ON | OFF>

Title: Limit State

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

When CALC:LIM:STATE is ON, any changes to the limit data or control for that limit will cause CALC:LIM:UPP:STATE and CALC:LIM:LOW:STATE to automatically be set ON.

When CALC:LIM:STATE is OFF, any changes to the limit data or control for that limit will cause CALC:LIM:UPP:STATE and CALC:LIM:LOW:STATE to automatically be set OFF.

Parameters: <0 | 1 | ON | OFF>

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

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: <0 | 1 | ON | OFF>

: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, 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 an upper data point contains a value of +/-9.9e37, the amplitude at that point will be treated as if it were +/-inifinity (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 discontiguous (or segmented) limit lines within a single limit. For details, and an example, of using placeholder values, see CALC:LIM:CONT:DATA.

Parameters: <numeric_value> {DBM}, {<numeric_value> {DBM}}, ...

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

Title: Create Upper Limit Envelope

Description: This command is used to create an Upper limit envelope on the selected trace.

Parameters: none
: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: <0 | 1 | ON | OFF>

:CALCulate:PEAK:COUNt <numeric_value>
:CALCulate:PEAK:COUNt?

Title: Peak Count

Description: The desired number of peaks to be reported by FETC:PEAK? query.
Parameters: <numeric_value>
Query Return: Numeric
Default Value: 1
Range: 1 to 6
:CALCulate:PEAK:THReshold <numeric_value> {DBM}

Title: Peak Threshold Level
Description: Sets the threshold level which peak powers must exceed to be reported by FETC:PEAK? query.
Parameters: <numeric_value> {DBM}
Query Return: Numeric (dBm)
Default Value: 0 dBm
Default Unit: dBm
Range: -150 dBm to 30 dBm

:CALCulate:PEAK:THReshold:STATe <0 | 1 | ON | OFF>

Title: Peak Threshold State
Description: Turn ON|OFF the threshold that peak powers must exceed to be reported by PEAKS? query.
Parameters: <0 | 1 | ON | OFF>
Query Return: 0 | 1
Default Value: OFF

8-4 :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.
8-5  :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.

8-6  :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>
Default Value:  501
Range:  10 to 4001

:DISPlay[:WINDow]:SWEep[:CURRent]:POINt?

Title:  Current Display Point
Description:  This command returns the newest display point index of current sweep. This index can be used to calculate the current sweep progress.
Parameters:  none

:DISPlay:WINDow:TRACe:Y[:SCALe]:PDIVision <numeric_value>
:DISPlay:WINDow:TRACe:Y[:SCALe]:PDIVision?

Title:  Scale Per Division
Description:  Set or query the scale per division setting of trace graph. This command doesn't change any behavior in the backend, but will be included in save/recall operations.
Parameters:  <numeric_value>
Default Value:  10
Range:  1 to 15
:DISPlay[:WINDow]:TRACe:Y:SCAlE:RLEVel <number>

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:AUTO[:IMMediate] <numeric_value> {DB}

Title: Automatic Reference Level
Description: This command causes the reference level to immediately be set to an automatically computed value that best displays the particular data. The reference level is set to a specified dB above the selected trace max value. This command is semantically equivalent to :DISPlay[:WINDow]:TRACe[:SCAlE]:RLEVel <amplitude> with the computed value for amplitude.

Parameters: <numeric_value> {DB}

: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.


Parameters: <relative amplitude>
Default Value: 0 dB
Default Unit: dB
Range: -99.9 dB to 99.9 dB
8-7  :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:ACPower?

Name:  Fetch Adjacent Channel Power Ratio
Description: Returns the most recent adjacent channel power ratio measurement results. 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 9 comma-separated values: main channel power, absolute lower adjacent channel power, absolute upper adjacent channel power, absolute lower alternate channel power, absolute upper alternate channel power, relative lower adjacent channel power, relative upper adjacent channel power, relative lower alternate channel power, relative upper alternate channel power. If the measurement is not enabled with [:SENSe]:ACPower:STATe then, the instrument will indicate error -400 and return the string "nan,nan,nan,nan,nan,nan,nan,nan,nan"

Parameters: none

:FETCh:AMPLitude? <numeric_value> {HZ | KHZ | MHZ | GHZ}

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: <numeric_value> {HZ | KHZ | MHZ | GHZ}

: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 a different set of measurement information depending on the suffix. The default suffix of 1 will return 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 measurement is not enabled with :SENSe:OBWidth:STATe then, the instrument will indicate error -400 and return the string "nan,nan,nan". Using suffix 2 will return the most recent channel power, x dB bandwidth, percent bandwidth, and transmit frequency error. The channel power and occupied bandwidth measurements will be calculated regardless of CHP:STAT and OBW:STAT settings. For both suffixes, 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.

: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.
8-8 FORMat Subsystem

The Format Subsystem specifies programming data format.

:FORMat[:TRACe][:DATA] <ASCii|INTeger|FLOAT|DOUBLE>,
:FORMat[:TRACe][:DATA]?

Name: Trace Data Format

Description: This command specifies the format in which data is returned in TRAC:DATA queries. The optional numeric parameter is needed for REAL format only. It defines the length of the floating point number in bits. Valid values are 32 and 64. If the optional numeric parameter is omitted, the default length of REAL data is set to 64 bits. ASCII format returns the data in comma-separated ASCII format. The units are the current measurement units. INTeger,32 values are signed 32-bit integers in little-endian byte order. This format returns the data in 4-byte blocks. The values are scaled by 1000, so if the current measurement units are dBm the integer values would be mdBm. For example, if the measured result was -12.345 dBm, that value would be sent as -12345. REAL,32 values are 32-bit floating point numbers conforming to the IEEE 754 standard in little-endian byte order. This format returns the data in 4-byte binary format. The units are the current measurement units. REAL,64 values are 64-bit floating point numbers conforming to the IEEE 754 standard in little-endian byte order. This format returns the data in 8-byte binary format. The units are the current measurement units.

Parameters: <ASCii|INTeger|FLOAT|DOUBLE>,

Query Return
Parameters: ASC|INT|FLOAT|DOUB

Default: ASCII
8-9 :INITiate Subsystem

This subsystem controls the triggering of measurements.

:INITiate:CONTinuous <0 | 1 | ON | OFF>

: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: <0 | 1 | ON | OFF>

Query Return: 0 | 1

Default Value: ON

: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.

:INITiate[:IMMediate]:ALL

Title: Initiate Average Count Sweep

Description: Initiates sweep untill all active traces reach its average count

Parameters: none
:INITiate:SPA:SELFtest?

Title: 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.

Parameters: none
### 8-10 :INPut Subsystem

**:INPut:OPOWer:RELay[:STATe] CLOSed|OPEN**

**:INPut:OPOWer:RELay[: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. Additionally the instrument will automatically try to close the relay every hour after it detects that the relay is opened.

To recover, remove the offending input source and then issue this command with a parameter of CLOSed to close the relay or wait for an hour from the time when the relay was opened for the instrument to close the relay automatically.

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

### 8-11 :MEASure Subsystem

These commands take the instrument from its current state, enable the specified measurement and put the instrument into single sweep mode. The MEASure Subsystem commands 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. The MEASure commands then initiate the measurement. The result is returned as the measurement completes.

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.
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?

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.
8-12 :MEMory Subsystem

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

:MEMory: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>

:MEMory:LOAD:RAM <numeric_value>,<numeric_value>,<string>

  Title: Load RAM
  Description: Load data from RAM to a file. This command takes three parameters: 1. data block size: that needs to be loaded in bytes (must be a word aligned) 2. offset: in bytes from start of RAM address to load from 3. filename: name of the file without the full path. This is the destination file where the contents of RAM are copied over
  Parameters: <numeric_value>,<numeric_value>,<string>

:MEMory:STOEvent:CLEarall

  Title: Clear All Save On Event
  Description: Turns off all save on event types that are active.

:MEMory:STOEvent:EOSWeep:MODE CONTinuous|SINGle

:MEMory: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

:MEMory:STOEvent:EOSWeep[:STATe] <boolean>

:MEMory: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 :MEMory:CATalog:DIRectory query command to retrieve the total space available on the storage location.
  Parameters: <boolean>
  Default Value: OFF
:MMEMory:STOEvent:LIMit:INTerval <numeric_value> {US | MS | S | MIN | HR}

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

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:PTRigger[:STATe] <0 | 1 | ON | OFF>

Title: Limit Pretrigger Save on Event State
Description: Turn the limit pre-trigger save on event ON or OFF. Turning the feature ON will cause the instrument to automatically save a trace captured prior to the limit line failure trace. The :MMEMory:STOEvent:LIMit[:STATe] and :INITiate:CONTinuous needs to be turned ON for the pre-trigger feature to apply.
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: <0 | 1 | ON | OFF>
Query Return: 0 | 1
Default Value: OFF

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

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 \texttt{MMEMory:CATalog:DIrectory} query command to retrieve the total space available on the storage location.

Parameters: \texttt{<boolean>}

Default Value: \texttt{OFF}

\texttt{:MMEMory:STORE:LIMit <string>,<string>,<string>}

\textbf{Title: } Store Limit to File

\textbf{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 \texttt{MMEMory:CATalog:DIrectory} query command to retrieve the total space available on the storage location.

Parameters: \texttt{<string>,<string>,<string>}

\texttt{:MMEMory:STORE:RAM <numeric_value>,<numeric_value>,<string>}

\textbf{Title: } Store RAM

\textbf{Description: } Store data to RAM from a file. This command takes three Parameters 1. data block size: that needs to be stored in bytes (must be a word aligned) 2. offset: in bytes from start of RAM address to store data at 3. filename: name of the file without the full path. Contents of this file will be copied over to RAM

Parameters: \texttt{<numeric_value>,<numeric_value>,<string>}

\section*{8-13: OUTPut Subsystem (for MS27100A models only)}

\texttt{:OUTPut:IF:STATe ON|OFF}

\texttt{:OUTPut:IF:STATe?}

\textbf{Title: } Set IF State

\textbf{Description: } Toggles the analog IF output on/off. Also queries the current state of IF.

Parameters: \texttt{ON | OFF/1/0}

Default Value: \texttt{OFF}
8-14 :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".
8-15 :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:MODE <RECall|STATic>
:ROUTE:INPut:CLOSE:MODE?

Title: Switch RF Input Recall Setup Mode
Description: Sets whether the port specific setup will be recalled when switching the port number of the Antenna Multiplexer Device. Note that this setting is not persistent through a power cycle, but keeps the value through recalling user setup files or user measurement files. When recalling a user setup in the STATic mode, the setup of the Antenna Mux value in the setup file will be used as the static port setup when toggling Antenna Mux ports. The query returns either REC or STAT. If the setting is set to REC, the instrument will recall the port specific setup during every port change of the Antenna Multiplexer Device. A STAT setting value means that the port setup will not change when changing the port of the Antenna Multiplexer Device.
Parameters: <RECall|STATic>
Default Value: RECall
Range: RECall|STATic

:ROUTE:INPut:CLOSE:STATe?

Title: Query RF Input Switch
Description: Query the instrument for the state of the 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.
8-16 :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:

<table>
<thead>
<tr>
<th>Bit</th>
<th>Decimal</th>
<th>Value Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>Not implemented</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>Not implemented</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>Not implemented</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>Not implemented</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>Not implemented</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
<td>Not implemented</td>
</tr>
<tr>
<td>6</td>
<td>64</td>
<td>Not implemented</td>
</tr>
<tr>
<td>7</td>
<td>128</td>
<td>Not implemented</td>
</tr>
<tr>
<td>8</td>
<td>256</td>
<td>Sweep Complete</td>
</tr>
<tr>
<td>9</td>
<td>512</td>
<td>I/Q Capture</td>
</tr>
<tr>
<td>10</td>
<td>1024</td>
<td>Not implemented</td>
</tr>
<tr>
<td>11</td>
<td>2048</td>
<td>Not implemented</td>
</tr>
<tr>
<td>12</td>
<td>4096</td>
<td>Not implemented</td>
</tr>
<tr>
<td>13</td>
<td>8192</td>
<td>Not implemented</td>
</tr>
<tr>
<td>14</td>
<td>16384</td>
<td>Not implemented</td>
</tr>
<tr>
<td>15</td>
<td>0</td>
<td>Will always be 0</td>
</tr>
</tbody>
</table>

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.

:SWEp:MODE FFT|NOFFt

Description: Changes the current sweep mode.

Parameters: FFT|NOFFt

Default Value: FFT

Range: FFT|NOFFt
8-17 :TRACe Subsystem

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

:TRACe::CLEar <numeric_value>

Title: Trace Clear
Description: This command clear the trace’s history and trace data.
Parameters: <numeric_value>

:TRACe::CLEar:ALL

Title: All Traces Clear
Description: This command clear all traces’ history and trace data.
Parameters: none

:TRACe[:DATA]? <numeric_value>

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{1|2|3|4|5|6}:DETEctor[:FUnCTion] <POSitive|RMS|NEGative>

Title: Trace Detector Type
Description: Sets the detection method for the specific trace. 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.
Parameters: <POSitive|RMS|NEGative>
Default Value: POSitive
Range: POSitive|RMS|NEGative

:TRACe{1|2|3|4|5|6}:DISPlay[:STATe] <0 | 1 | ON | OFF>
:TRACe{1|2|3|4|5|6}:DISPlay[:STATe]?

Title: Trace Display State
Description: The trace visiability state. If it is OFF, the :TRAC:DATA? command will return nan.
Parameters: <0 | 1 | ON | OFF>

: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>.

For a detailed Description of the response format, see TRACe:IQ:DATA:FORMat?.

If IQ:MODE? is STREAM, this command will block until the next block of streaming data is available, then return it. If IQ:MODE? is SINGle, this command will return data immediately if a capture has been already completed, or it will wait for an in-progress capture to complete before returning data, or it will return #0 if a capture has never been started.

Regardless of capture mode, this command will return #0 if an error condition is encountered during an in-progress capture (see MEAS:IQ:CAPT). Clients should check the SCPI error queue with SYST:ERR:NEXT? to determine what action to take.

Parameters: none

: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:PRESet:ALL**

**Title:** Preset All Trace

**Description:** This command preset all traces which turn Traces 2-6 off and set Trace 1 to Clear/Write, Active, Peak Detector.

**Parameters:** none

**:TRACe:SELect <numeric_value>**

**:TRACe:SELect?**

**Title:** Select Trace

**Description:** The selected trace will be used by operations that use a single trace.

**Parameters:** <numeric_value>

**Query Return:** Numeric

**Default Value:** 1

**Range:** 1 to 1
: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:

<table>
<thead>
<tr>
<th>Bit</th>
<th>Decimal Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>ADC Overrange</td>
</tr>
<tr>
<td>1</td>
<td>Not Implemented</td>
<td>Not Implemented</td>
</tr>
<tr>
<td>2</td>
<td>Not Implemented</td>
<td>Not Implemented</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>LO1 Lock Failure</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>LO2 Lock Failure</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
<td>TG LO Lock Failure</td>
</tr>
<tr>
<td>6-31</td>
<td>Not Implemented</td>
<td>Not Implemented</td>
</tr>
</tbody>
</table>

Parameters: <number>

:TRACe{[1]|2|3|4|5|6}:SWEeep:COUNt[:CURRent]?

Title: Trace Sweep Count

Description: The trace sweep count return current sweep count which can be useful for multiple-sweep measurements like average and min/max hold.

Parameters: none

:TRACe{[1]|2|3|4|5|6}:TYPE <NORMal|MINimum|MAXimum|AVERage|RMAXimum|RMINimum|RAVerage>

:TRACe{[1]|2|3|4|5|6}:TYPE?

Title: Trace Type

Description: Specifies how successive sweeps 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|RAVerage>

Default Value: NORMal

Range: NORMal | MINimum | MAXimum | AVERage | RMAXimum | RMINimum | RAverage
:TRACe{[1]|2|3|4|5|6}:UPDate[:STATe] <0 | 1 | ON | OFF>
:TRACe{[1]|2|3|4|5|6}:UPDate[:STATe]?

Title: Trace Update State
Description: The trace update state determines whether the trace is updated in every sweep.
Parameters: <0 | 1 | ON | OFF>

8-18 :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
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: <numeric_value>
Query Return: Numeric
Default Value: 10
Range: 2 to 1000

[: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|BWIDth[:RESolution] <numeric_value> {HZ | KHZ | MHZ | GHZ}
[:SENSe]:BANDwidth|BWIDth[:RESolution]?

Title: RBW
Description: Sets the resolution bandwidth. Note that using this command turns the automatic resolution bandwidth setting OFF.
Parameters: <numeric_value> {HZ | KHZ | MHZ | GHZ}
Query Return: Numeric (Hz)
Default Value: 3000000 Hz
Default Unit: Hz
Range: 10 Hz to 3000000 Hz
[:SENSe]:BANDwidth|BWIDth[:RESolution]:RATio <numeric_value>
[: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: the span to the resolution bandwidth.
Parameters: <numeric_value>
Query Return: Numeric
Default Value: 0.01
Range: 1e-05 to 1

[:SENSe]:BANDwidth|BWIDth:SHAPe <FLATtop|NUTall>
[:SENSe]:BANDwidth|BWIDth:SHAPe?

Title: Rbw Filter Type
Description: This command sets the rbw filter type, Flat Top window or Nutall.
Parameters: <FLATtop | NUTall>
Default Value: FLATtop
Range: FLATtop | NUTall

[:SENSe]:BANDwidth|BWIDth:VIDeo <numeric_value> {HZ | KHZ | MHZ | GHZ}
[:SENSe]:BANDwidth|BWIDth:VIDeo?

Title: VBW
Description: Sets the video bandwidth. Note that using this command turns the automatic video bandwidth setting OFF.
Parameters: <numeric_value> {HZ | KHZ | MHZ | GHZ}
Query Return: Numeric (Hz)
Default Value: 1000000 Hz
Default Unit: Hz
Range: 1 Hz to 3000000 Hz

[:SENSe]:BANDwidth|BWIDth:VIDeo:RATio <numeric_value>
[: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: <numeric_value>
Query Return: Numeric
Default Value: 0.33
Range: 1e-05 to 1
[: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
Range: LINear|LOGarithmic

[:SENSe]:BANDwidth[:RESolution]:AUTO <0 | 1 | ON | OFF>
[: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: <0 | 1 | ON | OFF>
Query Return: 0 | 1
Default Value: ON

[: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]:DETection[:FUNCTION] POSitive|RMS|NEGative
[:SENSe]:DETection[: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:OFFSet <numeric_value> {HZ | KHZ | MHZ | GHZ}
[:SENSe]:FREQuency:OFFSet?

- **Title:** Frequency Offset
- **Description:** Set a frequency offset, which will be added to the start, stop, and center frequencies. This offset is for display purposes only and does not affect the frequency range being measured. This command is only applicable when making CPRI measurements.
- **Parameters:** `<numeric_value>` {HZ | KHZ | MHZ | GHZ}
- **Query Return:** Numeric (Hz)
- **Default Value:** 0 Hz
- **Default Unit:** Hz
  - **Range:** -10000000000 Hz to 10000000000 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:

<table>
<thead>
<tr>
<th>Return value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS</td>
<td>GPS High Accuracy</td>
</tr>
<tr>
<td>ACQ</td>
<td>Acquiring GPS Reference</td>
</tr>
<tr>
<td>INV</td>
<td>Invalid (error locking to external reference)</td>
</tr>
<tr>
<td>INT</td>
<td>Internal Standard Accuracy</td>
</tr>
<tr>
<td>EXT</td>
<td>External (10 MHz) Reference</td>
</tr>
</tbody>
</table>

[:SENSe]:FREQuency:SPAN <numeric_value> {HZ | KHZ | MHZ | GHZ}

[: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: <numeric_value> {HZ | KHZ | MHZ | GHZ}
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 <numeric_value> {HZ | KHZ | MHZ | GHZ}
[: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: <numeric_value> {HZ | KHZ | MHZ | GHZ}
  Default Value: 0 Hz
  Default Unit: Hz
  Range: 0 Hz to 6e+09 Hz

[:SENSe]:FREQuency:STOP <numeric_value> {HZ | KHZ | MHZ | GHZ}
[: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: <numeric_value> {HZ | KHZ | MHZ | GHZ}
  Default Value: 6e+09 Hz
  Default Unit: Hz
  Range: 10 Hz to 6e+09 Hz

[:SENSe]:IQ:BANDwidth <numeric_value> {HZ | KHZ | MHZ | GHZ}
[: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: <numeric_value> {HZ | KHZ | MHZ | GHZ}
  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:

<table>
<thead>
<tr>
<th>Bits per sample</th>
<th>Samples per frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>

Parameters: <number>
Default Value: 24

[:SENSe]:IQ:LENGth <numeric_value> {US | MS | S | MIN | HR}
[: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: <numeric_value> {US | MS | S | MIN | HR}
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:CALibration:CONFiguration?

Title: IQ Calibration Configuration
Description: In order to get the valid IQ correction factor, user should issue MEAS:IQ:CAPT command first.
• Center frequency
• Preamp state
• Input attenuation
• IQ base sample rate
• Decimation factor
• IQ capture bandwidth
• IQ correction factor in dB
An invalid value of -20000 is returned if any of Center frequency, Preamp state, Input attenuation, IQ capture bandwidth settings is modified after issuing MEAS:IQ:CAPT command.

To apply the IQ correction factor, please refer to the Remote Spectrum Monitoring System Help Introduction. Information is available in I/Q Capture Block Mode section of the manual (full path: Remote Spectrum Monitor/Programming with SCPI/I/Q Capture Block Mode).

[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

1444753342s + 37531655ns, the n+1th sample would have an effective timestamp of

1444753342s + 37531655ns + (1/1MHz)
= 1444753342s + 37531655ns + 1ms
= 1444753342s + 37532655ns.
The number of samples per frame is calculated by:

- floor(bitsPerFrame / bitsPerSample), where bitsPerFrame = 8 * 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 TRAC: 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.

For 8-bit and 16-bit captures, the timestamp is attached to every extended frame.

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 <0 | 1 | ON | OFF>
[: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: <0 | 1 | ON | OFF>
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 <numeric_value> {DB}
[: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: <numeric_value> {DB}
Default Value: 30 dB
Default Unit: dB
Range: 0 dB to 50 dB
[:SENSe]:POWer:RF:ATTenuation:AUTO <0 | 1 | ON | OFF>
[: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: :SENSe:POw:ATT:AUTO is equivalent to sending: :SENSe:POw:ATT:AUTO ON.

Parameters: <0 | 1 | ON | OFF>
Default Value: ON

[:SENSe]:POWer:RF:GAIN:STATe <0 | 1 | ON | OFF>
[: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: <0 | 1 | ON | OFF>
Default Value: OFF

[:SENSe]:REFerence:EXTernal <0 | 1 | ON | OFF>
[:SENSe]:REFerence:EXTernal?

Title: External Reference State

Description: Enable or disable the use of an external 10 MHz reference as a reference source.

Parameters: <0 | 1 | ON | OFF>
Query Return: 0 | 1
Default Value: OFF
9-1 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>

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>

*ESE?

*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 "/".

Parameters: none

*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.

Parameters: none
9-2 System Mode Commands

*RST

Title: Reset
Description: <MS2710xA> 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. <MS2760A> This command clears any pending operations on the instrument.

*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.
Parameters: none

*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.
Parameters: none

9-2 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 9-3 “:FETCh Subsystem”
- Section 9-4 “:INSTrument Subsystem”
- Section 9-5 “:MMEMor Subsystem”
- Section 9-6 “:SYSTem Subsystem”
9-3 :FETCh Subsystem

Use this command to get GPS information.

:FETCh:GPS?

Name: Basic GPS Information

Description: This command returns the timestamp, latitude, and longitude of the device. The response is a comma-delimited ASCII response of one of the following forms: NO FIX or GOOD FIX,<timestamp>,<latitude>,<longitude> If no GPS fix is currently available, the first response form (NO FIX) is returned. If the GPS does have a fix, the second response form (GOOD FIX) is returned. <timestamp> is in ISO8601 format. The timestamp provides the 24-hour time, and will include the year/date and/or UTC offset if the hardware supports it. If no UTC offset is provided, the time is in UTC time. <latitude> and <longitude> are specified in decimal degrees.

Parameters: none

:FETCh:GPS:FULL?

Name: Full GPS Information

Description: This command returns the timestamp, latitude, longitude, altitude, and satellite count of the device. The response is a comma-delimited ASCII response of one of the following forms: NO FIX or GOOD FIX,<timestamp>,<latitude>,<longitude>,<altitude>,<satellites> If no GPS fix is currently available, the first response form (NO FIX) is returned. If the GPS does have a fix, the second response form (GOOD FIX) is returned. <timestamp> is in ISO8601 format. The timestamp provides the 24-hour time, and will include the year/date and/or UTC offset if the hardware supports it. If no UTC offset is provided, the time is in UTC time. <latitude> and <longitude> are specified in decimal degrees. <altitude> specifies the current altitude relative to mean sea level, in meters. <satellites> specifies an integer count of the number of satellites currently used in the fix.

Parameters: none

:FETCh:GPS:LAST?

Name: Last GPS Fix

Description: This command returns the timestamp, latitude, longitude, and altitude of the last fixed GPS result. The response is a comma-delimited ASCII response of one of the following forms: NO FIX or GOOD FIX,<timestamp>,<latitude>,<longitude>,<altitude> If a GPS fix has never been acquired, the first response form (NO FIX) is returned. If a GPS fix was previously acquired, the second response form (GOOD FIX) is returned. <timestamp> is in ISO8601 format. The timestamp provides the 24-hour time, and will include the year/date and/or UTC offset if the hardware supports it. If no UTC offset is provided, the time is in UTC time. <latitude> and <longitude> are specified in decimal degrees. <altitude> specifies the current altitude relative to mean sea level, in meters.

Parameters: none
9-4 :INSTrument Subsystem

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

:INSTrument:ACTive:STATe <0 | 1 | ON | OFF>

:INSTrument:ACTive:STATe?

Title: RSM in Use

Description: The state of this setting indicates whether the Remote Spectrum Monitor is On or Off.

Parameters: <0 | 1 | ON | OFF>

Query Return : 0 | 1

Default Value : 0

:INSTrument:APPLication:STATe <char>,<0 | 1 | ON | OFF>

Name: Activate or Deactivate Application

Description: This command turns the specified application ON or OFF. When an application is turned ON (i.e. activated), it is loaded into memory and can be used to make measurements. An application must be activated before it will respond to commands. When an application is turned OFF (i.e. deactivated), any measurements it is making are stopped and it is unloaded from memory. Attempting to turn ON the same application twice or turn OFF an application that is not currently ON is not permitted and will result in an execution error (-200). Unlike INSTrument:SELect, which selects a given application and makes it active if it is not already active, this command can be used to activate an application without selecting it. If the requested application is the selected application (which can be queried with INSTrument:SELect?), turning it OFF will cause the current application selection to automatically change to whatever active application, of those remaining, was turned ON last. For example, consider an instrument with Spectrum Analyzer, VNA, and Power Meter applications available. After the following compound command sequence INST:SEL "spa"; APPL:STAT "vna" ON; APPL:STAT "pm" ON; APPL:STAT "spa" OFF the currently selected application will be "pm". If the last active application is turned OFF, the current application selection will be reported as NONE via INSTrument:SELect?. This command takes two parameters. The first parameter is a string value that specifies which application should be turned ON or OFF. The permitted values of this parameter are the same as those used by the INSTrument:SELect command. The second parameter is a Boolean value that specifies whether the application should be turned ON or OFF. After a reset, the default selected application is always active, and all other applications are inactive.

Parameters: <char>,<0 | 1 | ON | OFF>

:INSTrument:CATalog:ACTive?

Name: List Active Applications

Description: This command queries all active applications. The response is returned as a comma delimited list of application names. The application names are the same as those returned by the INSTrument:CATalog:FULL? query or used as parameters to the INSTrument:SELect command. If no applications are currently active, this query will return NONE.

Parameters: none
: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 <numeric_value>

Name: Select Mode by Number

Description: Sets the selected application based on the value of <integer>. The query version returns the number associated with the current application. The list of valid integers and the applications they correspond to can be queried with INSTrument:CATalog:FULL? If no applications are active, the query version of this command will return 0.

Parameters: <numeric_value>

:INSTrument[:SELeCt] <char>

Name: Select Mode by Name

Description: Sets the selected application based on the application name specified by <identifier>. The <identifier> is a valid application name (character data). The list of valid application names can be queried with INSTrument:CATalog:FULL? The query version returns the name of the current application. If no applications are active, the query version of this command will return NONE.

Parameters: <char>
9-5 :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. Parameter 1: Directory. Use "/" as a directory separator. Note that this parameter should NOT be an empty string. To access the root directory, pass in "/" as the first parameter. Parameter 2: MSUS (Use :MMEMory:CATalog:MSUSs query command to retrieve the list of available storage devices). 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>

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

:MMEMory:CATalog:MSUSs?

Name: Memory Catalog Msuss

Description: Returns a list of all available mass storage devices present, formatted as follows: <Device Name 1>,<Device Name 2>,...<Device Name N>

Parameters: none

:MMEMory:CDIRectory <string>

:MMEMory:CDIRectory?

Name: 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. The set command will fail and an error is reported if the requested directory does not exist. Note that the query command returns the name of the default directory that was previously set and the device does not check whether the directory is still present.

Parameters: <string>

:MMEMory:COPY <string>,<string>,<string>,<string>

Title: Copy File

Description: This command copies the specified source file into a new file located at the specified destination location. Four Parameters are required for this command: 1. Source File Location: The file path to the file to be copied. 2. Source MSUS: The mass storage device the file is located in (i.e. Internal). 3. Destination File Location: The destination file path that the file should be copied to. 4. Destination MSUS: The mass storage device that the destination file should be written to (i.e. Internal). Please note that if a file already exists at the destination location or if the source file does not exist, the command will fail to execute and add an execution error into the SCPI error queue. This command will only copy files. If a directory path is passed in as a parameter, the command will fail to execute.

Parameters: <string>,<string>,<string>,<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:DATA <string>,<string>,<block data>
:MMEMory:DATA? <string>,<string>

Title: File Transfer
Description: This command imports/exports a file to/from the instrument. Data is transferred to/from the instrument as an IEEE definite length arbitrary block response, which has the form <header><block>.

This set command takes three parameters. 1. File Path: The path of the file to be written 2. Msus: The mass storage device to write the file to 3. Block Data: The data to be written to the instrument in block data format

If any directories in the file path do not exist, the instrument will automatically create the required directories. Please note that the maximum file transfer size to the instrument is 25 MB.

The ASCII header specifies the number of data bytes of the file. 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 query command takes two parameters. 1. File Path: The path to the file to be retrieved. 2. Msus: The mass storage device to retrieve the file from.

The file is returned in block data format with an ASCII header The query command will return a #10 if the file cannot be found.

Parameters: <string>,<string>,<block data>
Query 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 parameters 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:LOAD:STATe <numeric_value>,<string>,<string>

Title: Load State
Description: This command recalls the specified setup. The file location is resolved using the MSUS and file path parameters. These Parameters are case sensitive. Parameters:
1. Numeric Value: currently unused. Send a 0.
2. File path: The file path (including file name) relative to the MSUS root directory. File extension is optional.
3. MSUS: Device to recall the file from. See MMEMory:MSUSs? for information on obtaining the list of available devices.
The model of the device that the setup was created in must match the model of the device to recall in; otherwise, the recall will be rejected. The options of the device that the setup was created in must be enabled in the device to recall in; otherwise, the recall will be rejected.
Parameters: <numeric_value>,<string>,<string>
:MMEMory:LOAD:TRACe <string>,<string>,<string>

Title: Load Trace

Description: This command recalls the specified measurement. The file location is resolved using the MSUS and file path parameters. These Parameters are case sensitive. Parameters:
1. Label: Used to specify which trace to recall. Currently, the label only supports recalling all traces. Send an empty string or "ALL" to load all traces. 2. File path: The file path (including file name) relative to the MSUS root directory. File extension is optional. 3. MSUS: Device to recall the file from. See MMEMory:MSUSs? for information on obtaining the list of available devices. The model of the device that the measurement was saved in must match the model of the device to recall in; otherwise, the recall will be rejected. The options of the device that the measurement was saved in must be enabled in the device to recall in; otherwise, the recall will be rejected.

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

:MMEMory:LOAD:TRACe:EXIT <char>

Title: Exit Recall State

Description: This command exits recall state if the instrument currently has a measurement file recalled. An enumerable parameter is accepted to determine whether to revert back to the setup prior to recalling a measurement (LOADprevious) or to keep the setup from the measurement file (KEEPcurrent).

Parameters: <char>

:MMEMory:LOAD:TRACe:STATus?

Title: Get Recall State Status

Description: This command retrieves the status of whether or not the instrument is in a state where a measurement file has been recalled. A return value of 0 means that the instrument is not in a state where a measurement file has been recalled. A return value of 1 means that the instrument has recalled a measurement file and is in a state where SCPI commands are restricted. To exit this state, use the :MMEMory:LOAD:TRACe:EXIT SCPI command.

Parameters: none

: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 :MMEMory:CATalog:MSUSs? command.

Parameters: <string>
:MMEMory:STORe:STATe <numeric_value>,<string>,<string>

Title: Store State

Description: This command saves the current setup to the specified file location. The file location is resolved using the MSUS and file path parameters. These Parameters are case sensitive. If a file with the resolved name already exists, it will be overwritten.

Parameters:
1. Numeric Value: currently unused. Send a 0.
2. File path: The file path (including file name) relative to the MSUS root directory. File extension should not be specified.
3. MSUS: Device to save the file on. See :MMEMory:MSUSs? for information on obtaining the list of available devices.

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

Parameters: <numeric_value>,<string>,<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>
9-6 :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: - Static IP Address: The desired IP address of the unit. - Gateway: The network gateway. - Subnet Mask: 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. CAUTION: Consult with your network administrator when configuring the network interface to avoid potential loss of access or discovery of the device.

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.

Parameters: none

: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>
: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>

:SYSTem:COMMunicate:LAN:DNSServer<n> <string>
:SYSTem:COMMunicate:LAN:DNSServer<n>?

Name: Domain Name System Server
Description: This command sets Domain Name System Server (DNS Server) 1 or 2. The DNS Server is used to resolve a Domain Name. This DNS Server will be contacted after any DNS Server assigned by DHCP Setting, if applicable, and will be contacted first (1) or second (2) if no DNS Name Server is assigned by DHCP Server or DHCP Feature is Disabled. To remove a DNS Server, set its value to the empty string.

Parameters: <string>
Suffix Range
Description: DNSServer Suffix Range: 1-2, Default = 1

: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>


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.

Parameters: none

:SYSTem:DATE <numeric_value>,<numeric_value>,<numeric_value>
: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: <numeric_value>,<numeric_value>,<numeric_value>
:SYSTem:DEFault:RESet:DATA <char>

Name: Reset System Files

Description: This command deletes the instrument data files as specified in the following table:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>USER</td>
<td>Deletes all user files in the instrument's internal memory including measurements, setup files, and screen shots. User-customized system files will not be deleted.</td>
<td></td>
</tr>
<tr>
<td>SYSTem</td>
<td>Deletes all user-customized system files including keyboard EZ names, cable lists, antenna lists, and log files.</td>
<td></td>
</tr>
</tbody>
</table>

Parameters: <char>
: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 with the exception of ethernet settings (DHCP On/Off, static IP, Static Gateway, Static Subnet) to 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 <string>,<string>

Title: Firmware Update

Description: Initiate a firmware update from the MSUS whose path is specified as parameters. If the requested firmware package is not recognized, an appropriate error will be added to the error queue. Otherwise, the instrument will verify that the package is safe to install, update to the new firmware, and finally reboot. Before rebooting all remote clients will be disconnected.

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

Parameters: <string>,<string>
**: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.

If the `<string data>` argument begins with (case insensitive) any of

- http://
- https://
- ftp://

then the firmware update will be downloaded from that URL. The URL must be percent encoded per RFC-2396 section 2.4.1.

**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.

**Parameters:** none

**: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.

**Parameters:** none
: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:

```json
{
    "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:FIRMware:VERSiOn?

Title: Firmware Version

Description: This command queries the device firmware version.

Parameters: none
:SYSTem:GPS:VOLTage? <number>

Title: GPS Voltage

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

Parameters: <number>

Query Return: Numeric

Default Header: 3.3

Range: 3.3 to 5

: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.

Parameters: none

:SYSTem:MACaddress?

Title: Configure MAC Address

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

Parameters: none

:SYSTem:OPTions?

Title: Query Options

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

Parameters: none

:SYSTem:OPTions:CONFig?

Title: Option Configuration

Description: This command returns a quoted string containing the configuration of currently enabled options installed in the instrument.

Parameters: none

:SYSTem:OPTions:UPGRade <string>

Name: Option Upgrade

Description: This command upgrades the options of the device with a valid license key provided as a quoted string parameter. The device must be reboot immediately after this command for the installation of the new options to complete. The device must not be powered off while the command is executing. The recommended way to restart the device safely is sending the *RST command after this command. This command might report the following error code: -200: The command failed to complete. Detailed error message will be provided in the response of :SYStem:ERRor[:NEXT]? command.

Parameters: <string>
:SYSTem:PRESet

Title: System Preset
Description: This command presets Parameters in the current application to their factory default values.

:SYSTem:SSLCertificate?

Name: SSL Certificate Information
Description: This command reports information about the SSL certificate being used by the webserver to support HTTPS connections. The information will be returned in JSON format and will consist of the following fields:
1. Start Date("notBefore"): When the certificate was generated.
2. End Date("notAfter"): When the certificate will expire.
5. Location("L"): City of origin.
7. Organizational Unit("OU"): Department of origin.
8. Common Name("CN"): Associated host name. All fields will be populated into a JSON array.

The resulting response will be similar to the following: [{"C": "<country>", "ST": "<state>", "L": "<city>", "O": "<organization>", "OU": "<unit>", "CN": "<host_name>", "notAfter": "<notAfter_date>", "notBefore": "<notBefore_date>"}]

For the default self-signed certificate that the instrument will automatically generate when no user certificate is available, the Organization field will be set to "Anritsu Default SSL Certificate". An example of the certificate data is shown below for the default self-signed certificate: [{"C": "US", "CN": "anritsu.com", "L": "Morgan Hill", "O": "Anritsu Default SSL Certificate", "OU": "Engineering", "ST": "California", "notAfter": "Oct 26 19:05:26 2917 GMT", "notBefore": "Jun 1 19:05:26 2018 GMT"}]

Parameters: none

:SYSTem:TEMPerature?

Title: Get System Temperature
Description: This command retrieves the device temperature.
Parameters: none

:SYSTem:TIME <numeric_value>,<numeric_value>,<numeric_value>
:SYSTem:TIME?

Title: System Time
Description: This command sets and queries the system's internal clock. Changing the system time does not affect the system time zone (if time zone is available). 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: <numeric_value>,<numeric_value>,<numeric_value>
:SYStem:UNIT:NAMe <string>
:SYStem:UNIT:NAMe?

Title: System Unit Name
Description: This command sets/queries the unit name of the current system. The name of the unit must not be greater than 45 ASCII characters.
Parameters: <text>

:SYSTem:OPTions:UPGRade <string>

Title: Option Upgrade
Description: This command upgrades the options of the device with a valid license key provided as a quoted string parameter.
The device must be reboot immediately after this command for the installation of the new options to complete.
The device must not be powered off while the command is executing. The recommended way to restart the device safely is sending the *RST command after this command.
This command might report the following error code: -200: The command failed to complete. Detailed error message will be provided in the response of :SYStem:ERRor[:NEXT]? command.
Parameters: <string>

:TEST:SELFtest?

Name: 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.
Parameters: none
Appendix A — Updating MS2710xA Firmware

A-1 Introduction

There are several options available to upgrade MS2710XA firmware depending on the Remote Spectrum Monitor application environment.

1. When the monitor is connected to the internet, you can update to the most current firmware version by accessing the Anritsu website for a download.

2. The target monitor has a USB port available to the user (MS27100A, MS27101A, and MS27103A) and you would like to update over this connection.

3. Use an FTP process to transfer a firmware file over a LAN connection between a PC and the MS2710XA.

4. The monitor is not connected to the internet but you want to update the firmware over the LAN connection on a private network. This is similar to the auto update from the Anritsu website but the process is re-directed to a location on the private network.

Download Firmware From the Internet

Firmware Updates are available from the Internet. See Figure A-1.

1. System Button
2. Check for Updates Button

Figure A-1. Check For Updates

1. Select the System button.
2. Select the Check for Updates Button. 
Either of two dialog boxes will appear. See Figure A-2.

![Firmware Update Dialogs](image)

**Figure A-2.** Firmware Update Dialogs

If the Firmware Up to Date message appears, select Reinstall or Dismiss. By selecting Reinstall, the firmware will automatically reinstall into the MS2710xA. By selecting Dismiss, the dialog box will disappear and the display screen will be available again.

If the Firmware Update Available appears, select Install Update and the firmware will automatically install into the MS2710xA. By selecting cancel, the dialog will disappear and the display screen will be available again.

**Download Firmware by the USB Port**

Download firmware to a USB memory device. Go to the Anritsu web-page to download the Firmware Update for the Remote Spectrum Monitor MS2710xA here:

The Download page for the MS2710xA will appear. See Figure A-3.

1. Select the Download button.
2. Copy the .tar file to the USB memory device.
3. Insert the USB in any one of the USB ports on the target MS2710XA.
   - The system will automatically update the monitor firmware. If you are using the web browser; the application will stop, updating will take approximately two minutes, and then the browser will reconnect.
4. Check under the system tab of the browser to confirm the desired firmware version is loaded.

Use an FTP Process to Update the Firmware

You can use File Transfer Protocol (FTP) to upload files from the local PC to the remote probe. There are multiple methods that can be used to enable an FTP process. Windows PCs come with a command line FTP client built in, Windows Explorer can be used as an FTP client.

Requirements
- The firmware package file that is to be installed (*.tar)
- A PC that has network access to the instrument
- An FTP client for the PC

Example
The following example uses Windows Explorer as an FTP client

Note
Windows Explorer has FTP support built-in since Windows 7.
On your keyboard, open Windows Explorer by pressing the Windows key plus E simultaneously. See Figure A-4.

Figure A-4. Open Windows Explorer

The Windows Explorer screen will appear. Enter the IP address or hostname of the remote probe you are trying to connect with. ('ftp://[probe IP or hostname]') in the Windows Explorer Address bar. See Figure A-5.

Figure A-5. Enter IP Address
In this example, the IP address entered in the Windows Explorer address bar as ftp://172.26.201.195. Once entered, a Log on As dialog box will appear. See Figure A-6.

Figure A-6. Log On As Dialog Box

Enter the ftp user-name and password as prompted (‘ftp’ and probe serial number.) If you do not know the unit’s serial number, you can find the serial number by using the *IDN? SCPI command in the SCPI panel of the Web browser interface. The Password is the target serial number.

Open the Internal folder.

Figure A-7. Internal Folder

Copy the new firmware .tar file to the internal folder:

Use the SYST:FIRM:UPD SCPI command to install the uploaded firmware package.

1. This SCPI command requires parameters of the file name and the memory location:
   - SYST:FIRM:UPD “release-MS2710xA_T2017.3.6.tar”, “Internal”

2. This will initiate the automatic update process.

Using a Server Node Process to Download Firmware

This process will simulate the automated firmware update process described in the Section “Download Firmware From the Internet” on page A-1, but will be configured to operate in a private network. This approach is accomplished by directing the remote monitors to a server location different than the Internet Anritsu web site.

Requirements

- A web (http) server accessible over port 80 on the instrument’s network.
- A custom manifest file describing what firmware packages are available and where they can be downloaded from:
  - The file contains JSON (JavaScript Object Notation) describing the packages; For an example, see the official, default file at: http://softwareupdates.anritsu.com/en-us/packagelist.txt.

```json
{
  "default": "V2017.8.1 (MS2710xA)",
  "packages": [
    {
      "name": "V2017.8.1 (MS2710xA)",
      "version": "V2017.8.1",
      "model": "MS2710xA",
    }
  ],
  "version": "1.0.0"
}
```

- For most customer use cases, it should be sufficient to start with the official file as a template and simply change the package name, version, URL of the .tar file, and the reference “default” (this will prioritize the version to be accessed).
- The name of the manifest file does not matter (it does not need to be called packagelist.txt)
- The firmware package file that is to be installed (*.tar)

Using a Server Node Process to Download Firmware

1. Set up/configure the http server so that it can be accessed by the instrument.
2. Place the firmware package in the web server’s content tree and verify it can be downloaded within the network from some other computer
   - Note the URL of the package, e.g. http://myserver/MS2710xA_V2016.11.2.tar
3. Ensure that the custom manifest file contains the correct URL for the package that was downloaded in step ii.
4. Place the custom manifest file in the web server’s content tree and verify it can be downloaded within the network from some other computer
   - Note the URL of the manifest file, e.g. http://myserver/packagelist.txt
5. Send the SYST:FIRM:UPD:REM:SOUR SCPI command to the instrument to set the custom manifest file. This command will require a string parameter that is the URL for the manifest file.
6. Verify that the new firmware package source is being recognized by the instrument by either
   1. Reboot or refresh the web GUI and check in the:
      - System > Firmware Update > Advanced dropdown.
   2. Send the SYST:FIRM:UPD:REM:LIST? SCPI query to retrieve the list of available firmware packages.
7. Install the selected firmware package either through the web GUI or via the SYST:FIRM:UPD:REM SCPI command.
Appendix B — SCPI Command Listing

B-1 Introduction

This chapter contains all of the SCPI commands (required and native) that are implemented in the RSM. The SCPI commands are grouped by their respective subsystems. For each subsystem, the commands are described in detail in the listing. The commands in this section are listed in alphabetical order.

Alphabetical Command Listing

:ABORt

:CALCulate:ACPower:LIMit:ADJacent:ABSolute <numeric_value> {DBM}

:CALCulate:ACPower:LIMit:ADJacent:ABSolute?

:CALCulate:ACPower:LIMit:ADJacent:LOWer:FAIL?

:CALCulate:ACPower:LIMit:ADJacent:RELative <numeric_value> {DBM}

:CALCulate:ACPower:LIMit:ADJacent:RELative?

:CALCulate:ACPower:LIMit:ADJacent:UPPer:FAIL?

:CALCulate:ACPower:LIMit:ALTernate:ABSolute <numeric_value> {DBM}

:CALCulate:ACPower:LIMit:ALTernate:ABSolute?

:CALCulate:ACPower:LIMit:ALTernate:LOWer:FAIL?

:CALCulate:ACPower:LIMit:ALTernate:RELative <numeric_value> {DBM}

:CALCulate:ACPower:LIMit:ALTernate:RELative?

:CALCulate:ACPower:LIMit:ALTernate:UPPer:FAIL?

:CALCulate:ACPower:LIMit:FAIL?

:CALCulate:ACPower:LIMit:MAIN <numeric_value> {DBM}

:CALCulate:ACPower:LIMit:MAIN?

:CALCulate:ACPower:LIMit:MODE <ABSolute|RELative>

:CALCulate:ACPower:LIMit:MODE?

:CALCulate:ACPower:LIMit:STATE <0 | 1 | ON | OFF>

:CALCulate:ACPower:LIMit:STATE?

:CALCulate:CHPower:LIMit <numeric_value> {DBM}

:CALCulate:CHPower:LIMit:FAIL?

:CALCulate:CHPower:LIMit:PSD:FAIL?

:CALCulate:CHPower:LIMit:PSDensity <numeric_value> {DBM}

:CALCulate:CHPower:LIMit:PSDensity:STATE <0 | 1 | ON | OFF>

:CALCulate:CHPower:LIMit:PSDensity:STATE?

:CALCulate:CHPower:LIMit:STATE <0 | 1 | ON | OFF>

:CALCulate:CHPower:LIMit:STATE?

:CALCulate:LIMit:ALARm <0 | 1 | ON | OFF>

:CALCulate:LIMit:ALARm?

:CALCulate:LIMit:ENVelope:OFFSet <numeric_value> {DBM}

:CALCulate:LIMit:ENVelope:OFFSet?
:CALCulate\{1\}::LIMit<n>::COPY <numeric_value> ........................................... 8-10
:CALCulate\{1\}::LIMit<n>::DELete ................................................................. 8-11
:CALCulate<n>::LIMit<ACTIVE> ........................................................................ 8-5
:CALCulate<n>::LIMit<n>::COMMent <string> ..................................................... 8-8
:CALCulate<n>::LIMit<n>::COMMent? .................................................................. 8-8
:CONFigure:CHPower. ....................................................................................... 8-17
:CONFigure:OBWidth. ....................................................................................... 8-17
:DIAgnostic:SWEep:TIme? ................................................................................ 8-18
:DISPlay:POINtcount <number> ...................................................................... 8-18
:DISPlay:POINtcount?. ..................................................................................... 8-18
:DISPlay:WINDow:TRACe:y[:SCALE]:PDIVision <numeric_value> ................. 8-18
:DISPlay:WINDow:TRACe:y[:SCALE]:PDIVision? ........................................... 8-18
:DISPlay[:WINDow]:SWEep:[CURRENT]:POINt? ............................................. 8-18
:DISPlay[:WINDow]:TRACe:y[:SCALE]:RLEVel <numeric_value> ................. 8-19
:DISPlay[:WINDow]:TRACe:y[:SCALE]:RLEVel? .............................................. 8-19
:DISPlay[:WINDow]:TRACe:y[:SCALE]:RLEVel:AUTO[:IMMediate] <numeric_value> {DB}8-19
:DISPlay[:WINDow]:TRACe:y[:SCALE]:RLEVel:OFFSet <relative amplitude> ... 8-19
:DISPlay[:WINDow]:TRACe:y[:SCALE]:RLEVel:OFFSet? ................................ 8-19
:FETCh:ACPower? ............................................................................................. 8-20
:FETCh:AMPLitude? <numeric_value> {HZ | KHZ | MHZ | GHZ} ....................... 8-20
:FETCh:CHPower:CHPower? .......................................................................... 8-20
:FETCh:CHPower:DENSity? ............................................................................ 8-21
:FETCh:CHPower? ............................................................................................ 8-20
:FETCh:GPS:FULL? ......................................................................................... 9-3
:FETCh:GPS:LAST? ......................................................................................... 9-3
:FETCh:GPS? ..................................................................................................... 9-3
:FETCh:OBWidth? ............................................................................................ 8-21
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:FORmat[:TRACe][:DATA] <ASCii|INTeger|FLOAT|DOUBLE> ......................... 8-22
:FORmat[:TRACe][:DATA]? ............................................................................ 8-22
:INITiate:CONTInuous <0 | 1 | ON | OFF> ......................................................... 8-23
:INITiate:CONTInuous? ................................................................................... 8-23
:INITiate:SPA:SELFtest? ................................................................................. 8-24
:INITiate[:IMMediate] ..................................................................................... 8-23
:INITiate[:IMMediate]:ALL ............................................................................. 8-23
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:INStrument:ACTive:STATe <0 | 1 | ON | OFF> ........................................... 9-4
:INStrument:ACTive:STATe? ......................................................................... 9-4
:INStrument:APPLication:STATe <char>,<0 | 1 | ON | OFF> ......................... 9-4
:INStrument:CATalog:ACTive? ....................................................................... 9-4
:INStrument:NSELect <numeric_value> .......................................................... 9-5
:INStrument:NSELect? ..................................................................................... 9-5
:INStrument[:SELect] <char> ........................................................................ 9-5
:INStrument[:SELect]? .................................................................................... 9-5
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SCPI Command Listing

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:MEASure:IQ:CAPTure ............................................... 8-27
:MMEMory:CATalog:DIRectory? <string>,<string> ............ 9-6
:MMEMory:CATalog:MSUSs? ......................................... 9-6
:MMEMory:CDIRectory <string> ................................... 9-6
:MMEMory:CDIRectory? ............................................. 9-6
:MMEMory:COPY <string>,<string>,<string>,<string> ....... 9-6
:MMEMory:CREate:DIRectory <string>,<string> ............. 9-7
:MMEMory:DATA <string>,<string>,<block data> ............ 9-7
:MMEMory:DATA? <string>,<string> ............................... 9-7
:MMEMory:DELete:DIRectory <string>,<string> ............. 9-8
:MMEMory:DELete:FILE <string>,<string> ..................... 9-8
:MMEMory:LOAD:LIMin <string>,<string>,<string> .......... 8-28
:MMEMory:LOAD:STATe <numeric_value>,<numeric_value>,<string> ............................................. 8-30
:MMEMory:LOAD:STATe? ........................................... 8-30
:MMEMory:LOAD:TRACe:EXIT <char> ............................. 9-9
:MMEMory:LOAD:TRACe <string>,<string>,<string> ........... 9-9
:MMEMory:LOAD:RAM <numeric_value>,<numeric_value>,<string> ............................................. 8-30
:MMEMory:LOAD:LIMit <string>,<string>,<string> .......... 8-28
:MMEMory:LOAD:LIMit[:STATe]? ................................ 8-29
:MMEMory:LOAD:LIMit[:STATe] <boolean> ..................... 8-29
:MMEMory:LOAD:LIMit:PTRigger[:STATe]? ..................... 8-29
:MMEMory:LOAD:LIMit:PTRigger[:STATe] <0 | 1 | ON | OFF> 8-29
:MMEMory:LOAD:LIMit:MODE? ..................................... 8-29
:MMEMory:LOAD:LIMit:MODE CONTinuous|SINGle .......... 8-29
:MMEMory:LOAD:LIMit:INTerval? ................................. 8-29
:MMEMory:LOAD:LIMit:INTerval <numeric_value> {US | MS | S | MIN | HR} ...................................................... 8-29
:MMEMory:LOAD:LIMit:INTerval? ................................. 8-29
:MMEMory:LOAD:LIMit:MODE CONTinuous|SINGle|INTerval ........ 8-29
:MMEMory:LOAD:LIMit:MODE? ..................................... 8-29
:MMEMory:LOAD:LIMit:PTRigger[:STATe] <0 | 1 | ON | OFF> 8-29
:MMEMory:LOAD:LIMit:PTRigger[:STATe] ..................... 8-29
:MMEMory:LOAD:LIMit[:STATe] <boolean> ..................... 8-29
:MMEMory:LOAD:LIMit[:STATe]? ................................ 8-29
:MMEMory:STORE:RAM <numeric_value>,<numeric_value>,<string> ............................................. 8-30
:MMEMory:STORE:RAM <numeric_value>,<numeric_value>,<string> ............................................. 8-30
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:READ:CHPower:DENSity? ........................................ 8-31
:READ:CHPower .................................................. 8-31
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:ROUTE:INPut:CLOSE:MODE <RECall|STATic> .................. 8-32
:ROUTE:INPut:CLOSE:STATe? .................................... 8-32
:ROUTE:INPut:CLOSE? <number> .................................. 8-32
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SCPI Command Listing

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:TRACe{[0]}:IQ:DATA? ............................................................... 8-35
:TRACe{[1]23456}:DETector[:FUNCtion] <POSitive|RMS|NEGative> ................................. 8-35
:TRACe{[1]23456}:DETector[:FUNCtion]? ........................................ 8-35
:TRACe{[1]23456}:DISPlay[:STATe] <0 | 1 | ON | OFF> ................................. 8-35
:TRACe{[1]23456}:DISPlay[:STATe]? .............................................. 8-35
:TRACe{[1]23456]:SWEep:COUNT[.CURRent]? ...................................... 8-37
:TRACe{[1]23456}:TYPE <NORMal|MINimum|MAXimum|AVERage|RMAXimum|RMINimum|RAVerage> ................................. 8-37
:TRACe{[1]23456]:TYPE? ............................................................ 8-37
:TRACe{[1]23456}:UPdate[:STATe] <0 | 1 | ON | OFF> ................................. 8-38
:TRACe{[1]23456}:UPdate[:STATe]? .............................................. 8-38
:UNIT:POWer DBM|DBUV ............................................................ 8-38
:UNIT:POWer? ............................................................................ 8-38
[:SENSe]:AVERage:COUNt <number> ................................................. 8-39
[:SENSe]:AVERage:COUNt? ............................................................ 8-39
[:SENSe]:AVERage:TYPE <norm|RAVerage|MINimum|MAXimum|AVERage|RMAXimum|RMINimum> ................................. 8-39
[:SENSe]:AVERage:TYPE? ............................................................ 8-39
[:SENSe]:BANDwidth:VIDeo:AUTO <boolean> ....................................... 8-41
[:SENSe]:BANDwidth:VIDeo:AUTO? .................................................. 8-41
[:SENSe]:BANDwidth:VIDeo:AUTO <0 | 1 | ON | OFF> ................................. 8-41
[:SENSe]:BANDwidth:VIDeo:RESolution:RESolution <boolean> ................................. 8-41
[:SENSe]:BANDwidth:VIDeo:RESolution:RESolution? ........................................ 8-41
[:SENSe]:BANDwidth:VIDeo:RESolution:RESolution AUTO <0 | 1 | ON | OFF> ................................. 8-41
[:SENSe]:BANDwidth:VIDeo:TYPE <FLATtop|NUTall> ........................................ 8-40
[:SENSe]:BANDwidth:VIDeo:<freq> .................................................. 8-42
[:SENSe]:BANDwidth:VIDeo <numeric_value> {HZ | KHZ | MHZ | GHZ} ................................. 8-40
[:SENSe]:BANDwidth:VIDeo:VIDeo:RATio <numeric_value> ................................. 8-40
[:SENSe]:BANDwidth:VIDeo:VIDeo:RATio <number> ........................................ 8-40
[:SENSe]:BANDwidth:VIDeo:VIDeo:RATio? ........................................... 8-40
[:SENSe]:BANDwidth:VIDeo:VIDeo:RATio? <POSitive|RMS|NEGative> ................................. 8-40
[:SENSe]:BANDwidth:VIDeo:VIDeo:TYPE <LINear|LOGarithmic> ................................. 8-41
[:SENSe]:BANDwidth:VIDeo:VIDeo:TYPE <LINear|LOGarithmic> ................................. 8-42
[:SENSe]:BANDwidth:VIDeo:VIDeo:TYPE? ........................................... 8-41
[:SENSe]:BANDwidth:VIDeo:<freq> .................................................. 8-42
[:SENSe]:BANDwidth:VIDeo:RATio <numeric_value> {HZ | KHZ | MHZ | GHZ} ................................. 8-39
[:SENSe]:BANDwidth:VIDeo:RATio <number> ........................................ 8-43
[:SENSe]:BANDwidth:VIDeo:RATio <numeric_value> ........................................ 8-43
[:SENSe]:BANDwidth:VIDeo:RATio? .................................................. 8-40
[:SENSe]:BANDwidth:VIDeo:RATio? <POSitive|RMS|NEGative> ................................. 8-40
[:SENSe]:BANDwidth:VIDeo:RATio? <numeric_value> ........................................ 8-43
[:SENSe]:BANDwidth:VIDeo:RATio? .................................................. 8-39
[:SENSe]:BANDwidth:VIDeo:RESolution? ........................................... 8-42
[:SENSe]:CHPower:BANDwidth|BWIDth:INTegration <freq> ................................. 8-43

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[:SENSe]:CHPower:STATe <boolean> ......................................................... 8-43
[:SENSe]:CHPower:STATe? ................................................................. 8-43
[:SENSe]:DETector[:FUNCtion] POSitive|RMS|NEGative ............................... 8-43
[:SENSe]:DETector[:FUNCtion]? ......................................................... 8-43
[:SENSe]:FREQuency:CENTer <freq> ..................................................... 8-44
[:SENSe]:FREQuency:CENTer? ............................................................. 8-44
[:SENSe]:FREQuency:OFFSet <numeric_value> {HZ | KHZ | MHZ | GHZ} .......... 8-44
[:SENSe]:FREQuency:OFFSet? ............................................................. 8-44
[:SENSe]:FREQuency:REFerence:SOURce? ............................................. 8-45
[:SENSe]:FREQuency:SPAN <numeric_value> {HZ | KHZ | MHZ | GHZ} .......... 8-45
[:SENSe]:FREQuency:SPAN? .................................................................. 8-45
[:SENSe]:FREQuency:STARt <numeric_value> {HZ | KHZ | MHZ | GHZ} ........ 8-46
[:SENSe]:FREQuency:START? ................................................................ 8-46
[:SENSe]:FREQuency:STOP <numeric_value> {HZ | KHZ | MHZ | GHZ} .......... 8-46
[:SENSe]:FREQuency:STOP? .................................................................. 8-46
[:SENSe]:IQ:BANDwidth <numeric_value> {HZ | KHZ | MHZ | GHZ} .......... 8-46
[:SENSe]:IQ:BANDwidth? ................................................................. 8-46
[:SENSe]:IQ:BITS <number> ................................................................. 8-47
[:SENSe]:IQ:BITS? ........................................................................... 8-47
[:SENSe]:IQ:LENGth <numeric_value> {US | MS | S | MIN | HR} ............... 8-47
[:SENSe]:IQ:LENGth? ....................................................................... 8-47
[:SENSe]:IQ:MODE SINGLE|STREam <SINGLE|STREam> ............................. 8-48
[:SENSe]:IQ:MODE? ........................................................................... 8-48
[:SENSe]:IQ:SAMPle:CALibration:CONFiguration? ................................. 8-48
[:SENSe]:IQ:SAMPle:CONFiguration? .................................................. 8-48
[:SENSe]:IQ:TIMEstamps <boolean> ....................................................... 8-49
[:SENSe]:IQ:TIMEstamps? ................................................................. 8-49
[:SENSe]:OBWidth:METHod XDB|PERCent .......................................... 8-49
[:SENSe]:OBWidth:METHod? ............................................................. 8-49
[:SENSe]:OBWidth:PERCent <number> ............................................... 8-50
[:SENSe]:OBWidth:PERCent? ............................................................. 8-50
[:SENSe]:OBWidth:STATe <0 | 1 | ON | OFF> ........................................ 8-50
[:SENSe]:OBWidth:STATe? ............................................................... 8-50
[:SENSe]:OBWidth:XDB <relative amplitude> ........................................ 8-50
[:SENSe]:OBWidth:XDB? ................................................................. 8-50
[:SENSe]:POWer:RF:ATTenuation <numeric_value> {DB} ..................... 8-50
[:SENSe]:POWer:RF:ATTenuation <numeric_value> {DB} ..................... 8-50
[:SENSe]:POWer:RF:ATTenuation:AUTO <0 | 1 | ON | OFF> ............... 8-51
[:SENSe]:POWer:RF:ATTenuation:AUTO? .............................................. 8-51
[:SENSe]:POWer:RF:ATTenuation? ...................................................... 8-50
[:SENSe]:POWer:RF:GAIN:STATe <0 | 1 | ON | OFF> .......................... 8-51
[:SENSe]:POWer:RF:GAIN:STATe? ...................................................... 8-51
[:SENSe]:REFerence:EXTernal <0 | 1 | ON | OFF> .............................. 8-51
[:SENSe]:REFerence:EXTernal? ........................................................... 8-51
*CLS .................................................. 9-1
*ESE <number> .................................................. 9-1
*ESE? ................................................................. 9-1
*ESR? ................................................................. 9-1
*IDN? ................................................................. 7-3
*IDN? ................................................................. 9-1
*OPC ................................................................. 9-1
*OPC? ................................................................. 9-1
*RST ................................................................. 7-3
*RST ................................................................. 9-2
*SRE <number> .................................................... 9-2
*SRE? ................................................................. 9-2
*STB? ................................................................. 9-2
*WAI ................................................................. 9-2
change_password,<System Override Password>,<New Password> ................. 6-27
force_reboot,<system override password> ........................................ 6-27
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reset_password ............................................................. 6-27
set_secure_mode,<system override password>,<on/off> ....................... 6-27
## Appendix C — 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.

<table>
<thead>
<tr>
<th>Error Number</th>
<th>Error String</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No error</td>
<td>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.</td>
</tr>
<tr>
<td>-100</td>
<td>Command error</td>
<td>Command error</td>
</tr>
<tr>
<td>-101</td>
<td>Invalid character</td>
<td>A syntactic element contains a character which is invalid for that type.</td>
</tr>
<tr>
<td>-102</td>
<td>Syntax error</td>
<td>An unrecognized command or data type was encountered.</td>
</tr>
<tr>
<td>-103</td>
<td>Invalid separator</td>
<td>The parser was expecting a separator and encountered an illegal character.</td>
</tr>
<tr>
<td>-104</td>
<td>Data type error</td>
<td>The parser recognized a data element different than one allowed.</td>
</tr>
<tr>
<td>-108</td>
<td>Parameter not allowed</td>
<td>More parameters were received than expected for the header.</td>
</tr>
<tr>
<td>-109</td>
<td>Missing parameter</td>
<td>Fewer parameters were received than required for the header.</td>
</tr>
<tr>
<td>-110</td>
<td>Command header error</td>
<td>An error was detected in the header.</td>
</tr>
<tr>
<td>-120</td>
<td>Numeric data error</td>
<td>Error is generated when parsing a data element which appears to be numeric, including the non-decimal numeric types.</td>
</tr>
<tr>
<td>-121</td>
<td>Invalid character in number</td>
<td>An invalid character for the data type being parsed was encountered.</td>
</tr>
<tr>
<td>-123</td>
<td>Exponent too large</td>
<td>The magnitude of the exponent was larger than 32000.</td>
</tr>
<tr>
<td>-124</td>
<td>Too many digits</td>
<td>The mantissa of a decimal numeric data element contained more than 255 digits excluding leading zeros.</td>
</tr>
<tr>
<td>-131</td>
<td>Invalid suffix</td>
<td>The suffix does not follow the syntax or suffix is inappropriate for this device.</td>
</tr>
<tr>
<td>-141</td>
<td>Invalid character data</td>
<td>Either the character data element contains an invalid character or the particular element received is not valid for the header.</td>
</tr>
<tr>
<td>-160</td>
<td>Block data error</td>
<td>Error is generated when parsing a block data element.</td>
</tr>
<tr>
<td>-171</td>
<td>Invalid Expression</td>
<td>The expression data element was invalid; for example, unmatched parentheses or an illegal character.</td>
</tr>
<tr>
<td>-200</td>
<td>Execution error</td>
<td>Execution error</td>
</tr>
<tr>
<td>-213</td>
<td>Init ignored</td>
<td>Indicates that a request for a measurement initiation was ignored as another measurement was already in progress.</td>
</tr>
<tr>
<td>-224</td>
<td>Illegal parameter value</td>
<td>Indicates that an exact value, from a list of possibles, was expected.</td>
</tr>
<tr>
<td>-230</td>
<td>Invalid trace data</td>
<td>Data corrupt or stale</td>
</tr>
<tr>
<td>-251</td>
<td>Missing mass storage</td>
<td>Indicates that a legal program command or query could not be executed because of missing mass storage.</td>
</tr>
<tr>
<td>-256</td>
<td>File name not found</td>
<td>Indicates that a legal program command or query could not be executed because the file name on the device was not found.</td>
</tr>
<tr>
<td>Error Number</td>
<td>Error String</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>-300</td>
<td>Device-specific error</td>
<td>Device-specific error</td>
</tr>
<tr>
<td>-340</td>
<td>Calibration Failed</td>
<td>Calibration Failed</td>
</tr>
<tr>
<td>-350</td>
<td>Queue overflow</td>
<td>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.</td>
</tr>
<tr>
<td>-363</td>
<td>Input buffer overrun</td>
<td>Software or hardware input buffer on incoming port overflows with data caused by improper or nonexistent pacing.</td>
</tr>
<tr>
<td>-400</td>
<td>Query error</td>
<td>Query error</td>
</tr>
</tbody>
</table>