

Agilent N9340B Spectrum Analyzer

Programmer's Guide



Agilent Technologies

Notices

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N9340-90010

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In This Guide...

This guide contains programming information for the N9340B Spectrum Analyzer.

1 Getting Started

Prepare for the remote control.

2 Programming Fundamentals

A quick overview of the SCPI programming.

3 Status Registers

Introduction of the status registers.

4 Programming Example

How to accomplish the basic applications in programming.

5 Command Reference

Describe every programming command and the related softkeys' functions in detail.

For more information about N9340B handheld spectrum analyzer, please refer to

www.agilent.com/find/n9340b

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1 Getting Started

The purpose of this chapter is to serve as a reminder of SCPI (Standard Commands for Programmable Instruments) fundamentals to those who have previous experience in programming SCPI. This chapter is not intended to teach you everything about the SCPI programming language. If you are using an optional programming compatibility modes, you should refer to the manual that came with the option.

Remotely Operating Your N9340B

The N9340B provides both the USB and LAN connection which allows you to set up a remote operation environment with a controller computer. A controller computer could be a personal computer (PC), a minicomputer. Some intelligent instruments also function as controllers.

Computer Requirement for Remote Operation

Usually, you need to prepare an compatible PC with the following requirements to set up a remote operation environment:

Processor: 450 MHz Pentium® II or higher required

Operating system: Microsoft® Windows® XP or Home Editon, Service Pack 1 or later; Windows® 2000 Professional, service pack 4 or later

Available memory: 128 MB or higher required

Available disk space: 175 MB or greater required

Connecting the N9340B to a PC via the USB Port

No extra driver is required to connect the N9340B via the USB port to a PC. All you need is the Agilent IO libraries suite and you can find this IO libraries suite in the documentation CD in the shipment along with your N9340B. Or download the IO libraries suite from Agilent website:

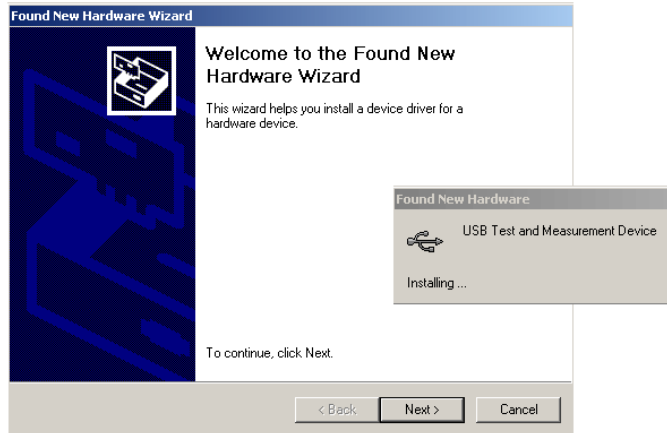
<http://www.agilent.com/find/iolib>

Refer to the following steps to finish the connection:

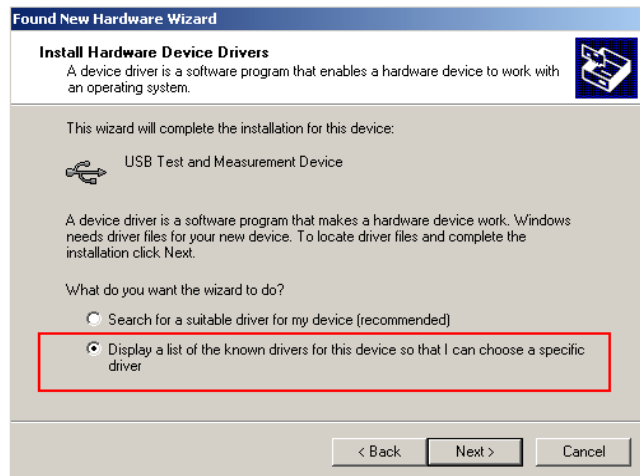
- 1 Install Agilent IO libraries suite on your PC
- 2 Switch on the N9340B
- 3 Connect the analyzer to a PC with a USB cable.



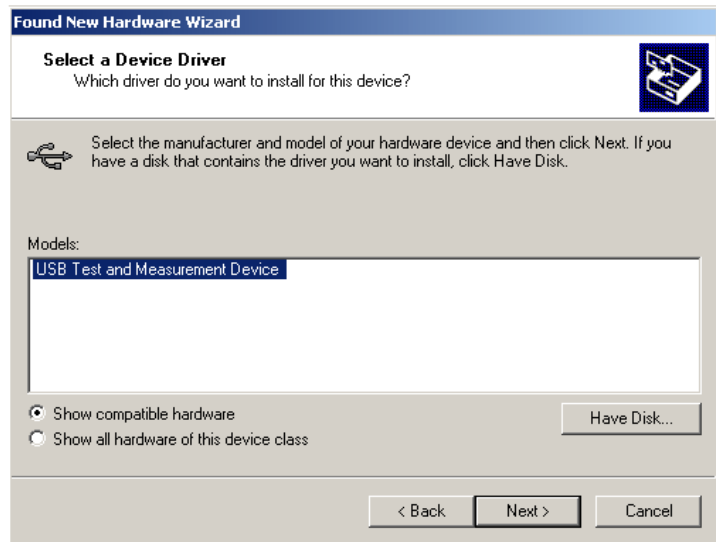
- 4 After a while, the PC finds your N9340B as a new hardware and prompts a message saying “Found new hardware...”. A **Found New Hardware Wizard** is initiated immediately.



- 5 Select **Display a list...**



- 7 PC will detect the instrument automatically. The item **“USB Test and Measurement Device”** displays in the pop-up window. Select it and press **Next**.



The wizard will guide you through the rest of installation till the driver is installed. Run Agilent IO libraries suite, the N9340B will be detected automatically.

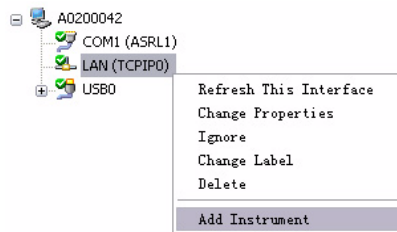
Connecting the N9340B to a PC via the LAN Port

No extra driver is required to connect the N9340B via the LAN port to a PC. All you need is the Agilent IO libraries suite and you can find this IO libraries suite in the Product CD *N9340B Help Kit* in the shipment. Or download the IO libraries suite from the website:

<http://www.agilent.com/find/iolib>

Please refer to the following steps to finish the connection:

- 1 Switch on the analyzer.
- 2 Connect the spectrum analyzer to a PC with a LAN cable.
- 3 Press **[SYS] > {Setting} > {IP Admin} > {IP address}** to set IP address for the instrument. For example, set “10.0.0.5” as the IP address for the instrument. Press **{Apply}** as
- 4 Run Agilent Connection Expert in IO libraries suite. Right-click on the LAN (TCPIP0) icon, select “Add Instrument” in the pop-up menu. The “Add LAN Instruments” window displays for the IP configuration.



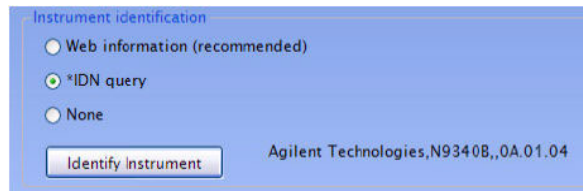
- 5 Select “Add Address”, check “Use IP Address” in the window and input the IP address as the instrument IP address you set before.



- 6 Press “Test Connection” to check the LAN connection. The figure below indicates that the connection is ready.



- 7 Check “*IDN query” and press “Identify Instrument”. The instrument information shows the firmware revision and product number. The analyzer is ready for your further programming.





2 Programming Fundamentals

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The purpose of this chapter is to serve as a reminder of SCPI (Standard Commands for Programmable Instruments) fundamentals to those who have previous experience in programming SCPI. This chapter is not intended to teach you everything about the SCPI programming language. If you are using an optional programming compatibility modes, you should refer to the manual that came with the option.



Overview

This section is not intended to teach you everything about the SCPI (Standard Commands for Programmable Instruments) programming language. The SCPI Consortium or IEEE provides that level of detailed information.

Programming with SCPI requires knowledge of:

- Computer programming languages, such as C, C++, and Microsoft®Visual Basic®.
- The language of your instrument. The N9340B employs SCPI as its programming language.

The semantic requirements of your controller's language determine how the programming commands and responses are handled in your application program.

SCPI Language Basics

SCPI is an ASCII-based instrument command language designed for test and measurement instruments, with the goal of reducing automatic test equipment (ATE) program development time.

SCPI accomplishes this goal by providing a consistent programming environment for instrument control and data usage. This consistent programming environment is achieved by the use of defined program messages, instrument responses, and data formats across all SCPI instruments.

By providing a consistent programming environment, replacing one SCPI instrument with another SCPI instrument in a system will usually require less effort than with non-SCPI instrument.

SCPI is not a standard which completely provides for interchangeable instrumentation. SCPI helps move toward interchangeability by defining instrument commands and responses, but not functionality, accuracy, resolution, etc.

Common Terms used in this Book

Terms	Description
Controller	Any computer used to communicate with an instrument. A controller can be a personal computer (PC), a minicomputer, or a plug-in card in a card cage. Some intelligent instruments can also function as controllers.
Instrument	Any device that implements SCPI. Most instruments are electronic measurement or stimulus devices, but this is not a requirement. Similarly, most instruments use a GPIB or RS-232 or USB interface for communication. The same concepts apply regardless of the instrument function or the type of interface used.
Command	An instruction. You combine commands to form messages that control instruments to complete a specified task. In general, a command consists of mnemonics (keywords), parameters and punctuation.
Query	A special type of command. Queries instruct the instrument to make response data available to the controller. Query keywords always end with a question mark, ? .

The SCPI Consortium or IEEE can provide detailed information on the subject of SCPI programming. Refer to IEEE Standard 488.1-1987, *IEEE Standard Digital Interface for Programmable Instrumentation*. New York, NY, 1987, or to IEEE Standard 488.2-1992, *IEEE Standard Codes, Formats, Protocols and Common Commands for Use with ANSI/IEEE Std 488.1-1987*. New York, NY, 1992.

Command Categories

The SCPI command falls into two categories:

- Subsystem commands that simulate front panel keystrokes
- Common commands that are unique and have no front panel equivalent

Use a computer to control the instrument (but operate the power/standby switch manually). Computer programming procedures for the instrument involve selecting a programming statement and then adding the specified programming codes to that statement to achieve the desired operating conditions.

For more specific command instructions, please refer to [Chapter 5](#), “Command Reference,” starting on page 51.

Command Syntax

A command consists of mnemonics (keywords), parameters and punctuation. Before you start to program your signal generator, familiarize yourself with the standard notation of each of them.

Command Mnemonics (keywords)	<p>Many commands have both a long and a short form: use either one. (a combination of the two is not allowed). Consider the :FREQuency command for example:</p> <ul style="list-style-type: none"> • Short form :FREQ • Long form :FREQUENCY <p>SCPI is not case sensitive, so fREquEncy is just as valid as FREQUENCY, but FREQ and FREQUENCY are the only valid forms of the FREQuency command.</p> <p>In this documentation, upper case letters indicate the short form of the keyword. The lower case letters indicate the long form of the keyword.</p>
Punctuation	<ul style="list-style-type: none"> • A vertical bar " " dictates a choice of one element from a list. For example: <A> indicates that either A or B can be selected, but not both. • Square brackets "[]" indicates that the enclosed items are optional. • Angle brackets "< >" indicates a variable items to be entered to represent user choices. • A question mark "?" after a subsystem command indicates that the command is a query. The returned information, <value> varies in format according to the type of the field.
Separator	<ul style="list-style-type: none"> • A colon ":" separates keywords of different levels. The colon before the root keyword is usually omitted. • A space separates a keyword and a parameter, as well as a parameter and a unit.

Command Statement Rules Overview

Besides the standard notation of SCPI described above, please remember the following rules in programming:

- command statements read from left to right
- use either long form or short form of keywords, but do not use both
- no separating space between the keywords, only use a colon to separate keywords of different levels
- always separating a keyword from a variable with a space
- always separating a variable from its unit with a space (if variable has a unit).

Command Example

A typical command is made up of key words set off by colons. The key words are followed by parameters that can be followed by optional units.

Example 1 `:TRIGger:SEQuence:VIDeo:LEVel 2.5V`

The instrument does not distinguish between upper and lower case letters. In the documentation, upper case letters indicate the short form of the key word. The upper and lower case letters, together, indicate the long form of the key word. Either form may be used in the command.

Example 2 `:Trig:Seq:Vid:Lev 2.5V` is the same as
`:trigger:sequence:video:level 2.5V`.

NOTE

The command `:TRIGG:Sequence:Video:Level 2.5V` is not valid because `:TRIGG` is neither the long, nor the short form of the command.

Creating Valid Commands

Commands are not case sensitive and there are often many different ways of writing a particular command. These are examples of valid commands for a given command syntax:

Command Syntax	Sample Valid Commands
<code>[:SENSe]:BANDwidth[:RESolution]<freq></code>	<p>The following sample commands are all identical. They will all cause the same result.</p> <pre>:Sense:Band:Res 1700 :BANDWIDTH:RESOLUTION 1.7e3 :sens:band 1.7KHZ :SENS:band 1.7E3Hz :band 1.7kHz :bandwidth:RES 1.7e3Hz</pre>
<code>:CALCulate:MARKer[1] 2 3 4:Y?</code>	<p>The last command below returns different results than the commands above it. The number 3 in the command causes this. See the command description for more information.</p> <pre>:CALC:MARK:Y? :calc:mark:y? :CALC:MARK2:Y?</pre>
<code>[:SENSe]:DETECTOR[:FUNCTION] NEGative POSitive SAMPlE</code>	<pre>DET:FUNC NEG :Sense:Detector:Function Sample</pre>
<code>:INITiate:CONTinuous OFF ON 0 1</code>	<p>The sample commands below are identical.</p> <pre>:INIT:CONT ON :init:continuous 1</pre>

Program and Response Messages

To understand how your instrument and controller communicate using SCPI, you must understand the concepts of program and response messages.

Program Messages

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

Response Messages

The controller may send commands at any time, but the instrument sends responses only when query commands is received. All query mnemonics end with a question mark. Queries return either measured values or internal instrument settings.

Forgiving Listening and Precise Talking

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

Forgiving listening means that instruments are very flexible in accepting various command and parameter formats. For example, the spectrum analyzer accepts either

```
:FREQUency:CENTer:STEP:AUTO ON or  
:FREQUency:CENTer:STEP:AUTO 1
```

Precise talking means that the response format for a particular query is always the same. For example, if you query RF output state when it is on (using

```
:FREQUency:CENTer:STEP:AUTO?), the response is  
always 1, regardless of if you previously sent  
:FREQUency:CENTer:STEP:AUTO ON or  
:FREQUency:CENTer:STEP:AUTO 1.
```

Parameters in Commands

There are four basic types of parameters: boolean, key words, variables and arbitrary block program data.

Boolean

The expression `OFF|ON|0|1` is a two state boolean-type parameter. The numeric value 0 is equivalent to OFF. Any numeric value other than 0 is equivalent to ON. The numeric values of 0 or 1 are commonly used in the command instead of OFF or ON, and queries of the parameter always return a numeric value of 0 or 1.

Key Word

The parameter key words that are allowed for a particular command are defined in the command description and are separated with a vertical slash.

Units

Numerical variables may include units. The valid units for a command depends on the variable type being used. See the following variable descriptions. If no units are sent, the indicated default units will be used. Units can follow the numerical value with, or without, a space.

Variable

A variable can be entered in exponential format as well as standard numeric format. The appropriate variable range and its optional units are defined in the command description.

Variable Parameters

- <ampl>**, **<rel_ampl>** The <ampl> (amplitude) parameter and the <rel_ampl> (relative amplitude) parameter consist of a rational number followed by optional units. Acceptable units for <ampl> include: V, mV, V, dBm, dBmV, dBuV, Watts, W. <rel_ampl> units are given in dB.
- <file_name>** A file name parameter is the name of your file, is not used in the SCPI command string.
- <freq>** A frequency parameter is a positive rational number followed by optional units. The default unit is Hz. Acceptable units include: Hz, kHz, MHz, GHz.
- <integer>** There are no units associated with an integer parameter.
- <number>** A number parameter is a member of the set of positive or negative integers and including zero. Fractional numbers are included in the number parameter. There are no units associated with a number parameter.
- <percent>** A percent parameter is a rational number between 0 and 100, with no units.
- <rel_power>** A relative power parameter is a positive rational number followed by optional units. The default units are dB. Acceptable units are dB only.
- <string>** A string parameter includes a series of alpha numeric characters.
- <time>** A time parameter is a rational number followed by optional units. The default units are seconds. Acceptable units include: S, MS, US.



3 Status Registers

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This chapter contains a comprehensive description of status registers explaining what status registers are and how to use them so you can use a program to monitor the instrument. Information about all of the bits of the status registers is also provided.

Overview

When you are programming the instrument you may need to monitor instrument status to check for error conditions or monitor changes. You need to determine the state of certain instrument events/conditions by programming the status register system.

IEEE common commands (those beginning with *) access the higher-level summary registers. To access the information from specific registers you would use the STATus commands. The STATus subsystem remote commands set and query the status hardware registers. This system of registers monitors various events and conditions in the instrument. Software written to control the instrument may need to monitor some of these events and conditions.

What are Status Registers

The status system contains multiple registers that are arranged in a hierarchical order. The lower-level status registers propagate their data to the higher-level registers in the data structures by means of summary bits. The status byte register is at the top of the hierarchy and contains general status information for the instrument's events and conditions. All other individual registers are used to determine the specific events or conditions.

Each register set is made up of five registers:

- | | |
|-------------------------------------|---|
| Condition Register | It reports the real-time state of the signals monitored by this register set. There is no latching or buffering for a condition register. |
| Positive Transition Register | This filter register controls which signals will set a bit in the event register when the signal makes a low to high transition (when the condition bit changes from 0 to 1). |

Negative Transition Register	This filter register controls which signals will set a bit in the event register when the signal makes a high to low transition (when the condition bit changes from 1 to 0).
Event Register	It latches any signal state changes, in the way specified by the filter registers. Bits in the event register are never cleared by signal state changes. Event registers are cleared when read. They are also cleared by *CLS and by presetting the instrument.
Event Enable Register	It controls which of the bits, being set in the event register, will be summarized as a single output for the register set. Summary bits are then used by the next higher register.

Access the status registers

There are two different methods to access the status registers:

- Common Commands Accesses and Controls
- Status Subsystem Commands

What are Status Register SCPI Commands

Most monitoring of the instrument conditions is done at the highest level using the IEEE common commands indicated below. Complete command descriptions are available in the IEEE commands section at the beginning of the language reference. Individual status registers can be set and queried using the commands in the STATus subsystem of the language reference.

- ***CLS** (clear status) clears the status byte by emptying the error queue and clearing all the event registers.
- ***ESE, *ESE?** (event status enable) sets and queries the bits in the enable register part of the standard event status register.
- ***ESR?** (event status register) queries and clears the event register part of the standard event status register.
- ***SRE, *SRE?** (service request enable) sets and queries the value of the service request enable register.
- ***STB?** (status byte) queries the value of the status byte register without erasing its contents.

How to use the Status Registers

A program often needs to detect and manage error conditions or changes in instrument status. The polling method for you to programmatically access the information in status registers.

In the polling method, the instrument has a passive role. It only tells the controller that conditions have changed when the controller asks the right question. In the SRQ method, the instrument takes a more active role. It tells the controller when there has been a condition change without the controller asking. Either method allows you to monitor one or more conditions.

The polling method works well if you do not need to know about changes the moment they occur. To detect a change using the polling method, the program must repeatedly read the registers.

To monitor a condition:

- Determine which register contains the bit that reports the condition.
- Send the unique SCPI query that reads that register.
- Examine the bit to see if the condition has changed.

You can monitor conditions in different ways.

- Check the instrument hardware and firmware status.

Do this by querying the condition registers which continuously monitor status. These registers represent the current state of the instrument. Bits in a condition register are updated in real time. When the condition monitored by a particular bit becomes true, the bit is set to 1. When the condition becomes false, the bit is reset to 0.

- Monitor a particular condition (bit).

You can enable a particular bit(s), using the event enable register. The instrument will then monitor that particular condition(s). If the bit becomes true (0 to 1 transition) in the event register, it will stay set until the event register is cleared. Querying the event register allows you to detect that

this condition occurred even if the condition no longer exists. The event register can only be cleared by querying it or sending the *CLS command.

- Monitor a particular type of change in a condition (bit).
 - The transition registers are preset to register if the condition goes from 0 to 1 (false to true, or a positive transition).
 - This can be changed so the selected condition is detected if the bit goes from 1 to 0 (true to false, or a negative transition).
 - It can also be set for both types of transitions occurring.
 - Or it can be set for neither transition. If both transition registers are set to 0 for a particular bit position, that bit will not be set in the event register for either type of change.

Status Register Examples

Each bit in a register is represented by a numerical value based on its location. See figure below. This number is sent with the command to enable a particular bit. If you want to enable more than one bit, you would send the sum of all the bits that you want to monitor.

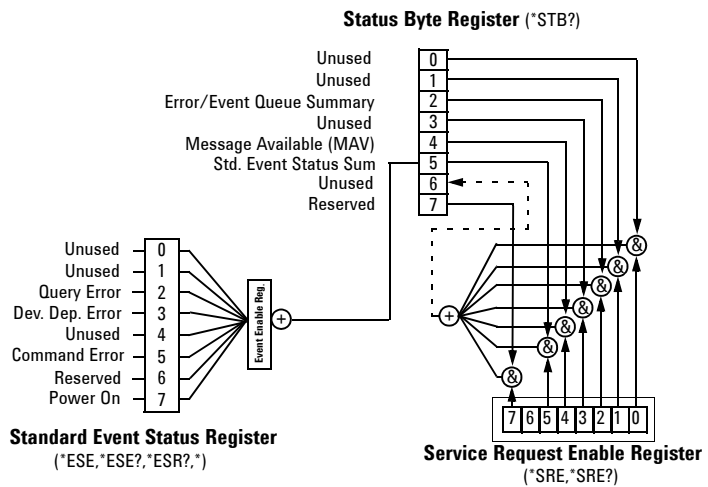
Example

- 1 To enable bit 0 and bit 6 of standard event status register, you would send the command *ESE 65 because $1 + 64 = 65$.
- 2 The results of a query are evaluated in a similar way. If the *STB? command returns a decimal value of 140, ($140 = 128 + 8 + 4$) then bit 7 is true, bit 3 is true and bit 2 is true.

Status Register System

The hardware status registers are combined to form the instrument status system. Specific status bits are assigned to monitor various aspects of the instrument operation and status. See the following diagram of the status system for information about the bit assignments and status register interconnections.

Figure 1 Agilent N9340B Status Register System



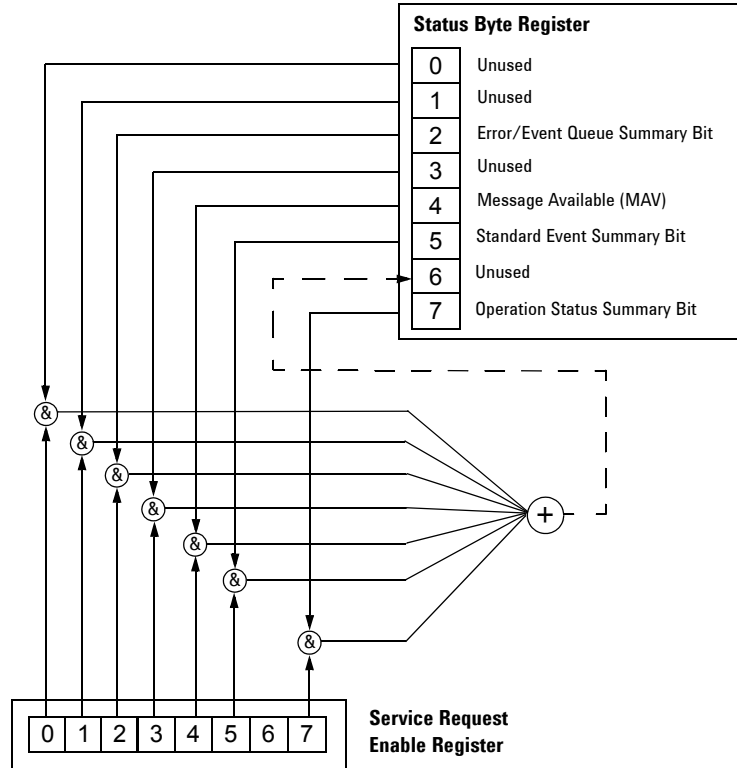
Setting and Querying the Status Register

Each bit in a register is represented by a numerical value based on its location. This number is sent with the command to enable a particular bit. To enable more than one bit, send the sum of all of the bits involved.

For example, to enable bit 0 and bit 6 of the standard event status register, you would send the command `*ESE 65 (1 + 64)`.

The results of a query are evaluated in a similar way. If the `*STB?` command returns a decimal value of 140, ($140 = 128 + 8 + 4$) then bit 7 is true, bit 3 is true, and bit 2 is true.

The Status Byte Register



The RQS bit is read and reset by a serial poll. The same bit position (MSS) is read, non-destructively by the *STB? command. If you serial poll bit 6 it is read as RQS, but if you send *STB it reads bit 6 as MSS. For more information refer to IEEE 488.2 standards, section 11.

The status byte register contains the following bits:

Bit	Description
0,1	Unused: These bits are always set to 0.
2	Error/Event Queue Summary Bit: A 1 in this bit position indicates that the SCPI error queue is not empty. The SCPI error queue contains at least one error message.
3	Questionable Status Summary Bit: A 1 in this bit position indicates that the questionable status summary bit has been set. The questionable status event register can then be read to determine the specific condition that caused this bit to be set.
4	Message Available (MAV): A 1 in this bit position indicates that the analyzer has data ready in the output queue. There are no lower status groups that provide input to this bit.
5	Standard Event Status Summary Bit: A 1 in this bit position indicates that the standard event status summary bit has been set. The standard event status register can then be read to determine the specific event that caused this bit to be set.
6	Request Service (RQS) Summary Bit: A 1 in this bit position indicates that the analyzer has at least one reason to report a status change. This bit is also called the master summary status bit (MSS).
7	Operation Status Summary Bit: A 1 in this bit position indicates that the operation status summary bit has been set. The operation status event register can then be read to determine the specific event that caused this bit to be set.

To query the status byte register, send the *STB command. The response will be the *decimal* sum of the bits that are set to 1. For example, if bit number 7 and bit number 3 are set to 1, the decimal sum of the 2 bits is 128 plus 8. So the decimal value 136 is returned.

In addition to the status byte register, the status byte group also contains the service request enable register. The status byte service request enable register lets you choose which bits in the Status Byte Register will trigger a service request.

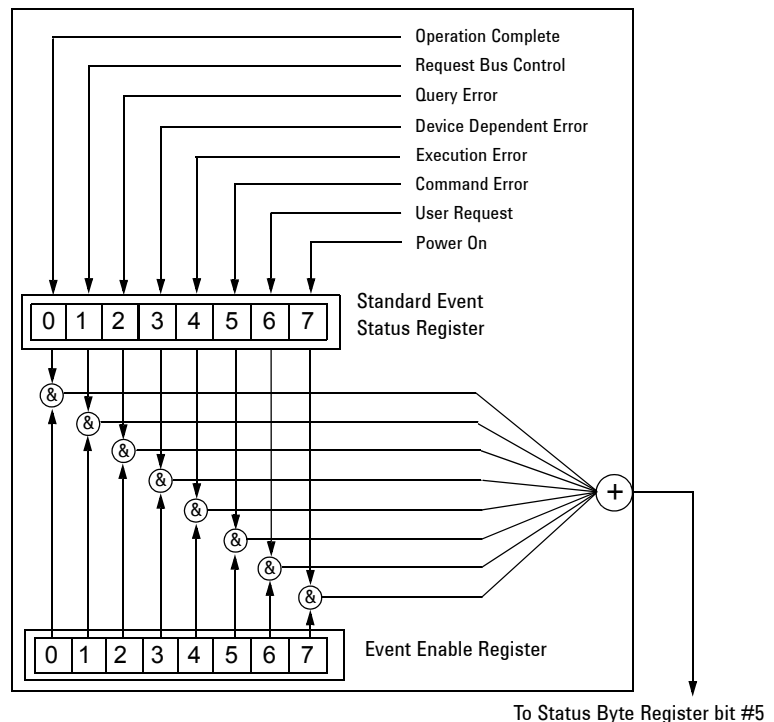
Standard Event Status Register

The standard event status register is used to determine the specific event that sets bit 5 in the status byte register. The standard event status register does *not* have negative and positive transition registers, nor a condition register. Use the IEEE common commands at the beginning of “[Command Reference](#)” on page 51 to access the register.

To query the standard event status register, send the ***ESR** command. The response will be the *decimal* sum of the bits which are set to 1. For example, if bit number 7 and bit number 3 are set to 1, the decimal sum of the 2 bits is 128 plus 8. So the decimal value 136 is returned.

See “[Setting and Querying the Status Register](#)” on page 25 for more information.

Figure 2 Standard Event Status Register Diagram



The standard event status register contains following bits:

Bit	Description
0	Unused
1	Request Bus Control: This bit is always set to 0. (The analyzer does not request control.)
2	Query Error: A 1 in this bit position indicates that a query error has occurred. Query errors have SCPI error numbers from 499 to 400.
3	Device Dependent Error: A 1 in this bit position indicates that a device dependent error has occurred. Device dependent errors have SCPI error numbers from -399 to -300 and 1 to 32767.
4	Execution Error: A 1 in this bit position indicates that an execution error has occurred. Execution errors have SCPI error numbers from -299 to -200.
5	Command Error: A 1 in this bit position indicates that a command error has occurred. Command errors have SCPI error numbers from -199 to -100.
6	User Request Key (Local): A 1 in this bit position indicates that the [Preset/System] (Local) key has been pressed. This is true even if the analyzer is in local lockout mode.
7	Power On: A 1 in this bit position indicates that the analyzer has been turned off and then on.

The standard event status register is used to determine the specific event that set bit 5 in the status byte register. To query the standard event status register, send the command *ESR?. The response will be the decimal sum of the bits which are enabled (set to 1). For example, if bit number 7 and bit number 3 are enabled, the decimal sum of the 2 bits is 128 plus 8. So the decimal value 136 is returned.

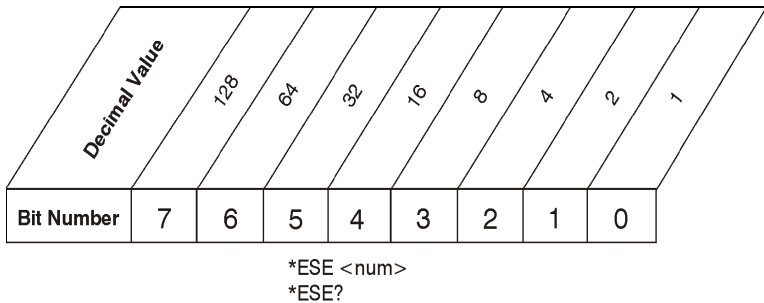
In addition to the standard event status register, the standard event status group also contains a standard event status enable register. This register lets you choose which bits in the standard event status register will set the summary bit (bit 5 of the status byte register) to 1. Send the

3 Status Registers

`*ESE <integer>` command where `<integer>` is the sum of the decimal values of the bits you want to enable. For example, to enable bit 7 and bit 6 so that whenever either of those bits is set to 1, the standard event status summary bit of the status byte register will be set to 1, send the command `*ESE 192` ($128 + 64$). The command `*ESE?` returns the decimal value of the sum of the bits previously enabled with the `*ESE <integer>` command.

The standard event status enable register presets to zeros (0).

Figure 3 Standard Event Status Event Enable Register





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This chapter provides some programming conventions and examples for your further reference.

Overview

The programming examples in this section keep to the following 3 conventions:

- The programming examples were written for use on an compatible PC.
- The programming examples use USB interface.
- The programming examples are written in C programming language and SCPI programming commands, using Agilent VISA transition library (Agilent VTL).

The Agilent VTL is installed when you installed the Agilent IO libraries suite.

The Agilent IO libraries suite contains the latest Agilent VTL and is available at:

<http://www.agilent.com/find/iolib>

NOTE

Agilent Technologies provides programming examples for illustration only. All sample programs assume that you are familiar with the programming language being demonstrated and the tools used to create and debug procedures.

You have a royalty-free right to use, modify, reproduce and distribute the sample application files in any way you find useful, provided that you agree that Agilent has no warranty, obligations, or liability for any sample application files.

Programming in C using the VTL

This section includes some basic information about programming in the C language using Agilent VISA transition library (VTL). Note that some of this information may not be relevant to your particular application. For example, if you are not using VXI instruments, the VXI references will not be relevant.

Typical Example Program Contents

The following table summaries the VTL function calls used in the example programs.

<code>visa.h</code>	This file is included at the beginning of the each file to provide the function prototypes and constants defined by VTL. For C and C++ programs, you must include the <code>visa.h</code> header file at the beginning of every file that contains VISA function calls: <code>#include "visa.h"</code>
<code>ViSession</code>	The <code>ViSession</code> is a VTL data type. Each object that will establish a communication channel must be defined as <code>ViSession</code> . Sessions must firstly be opened on the default resource manager, and then for each resource you will be using.
<code>viOpenDefaultRM</code>	You must first open a session with the default resource manager with the <code>viOpenDefaultRM</code> function, and then for each resource you will be using. This function will initialize the default resource manager and return a pointer to that resource manager session. <code>viOpenDefaultRM(&sesn)</code>
<code>viOpen</code>	This function establishes a communication channel with the device specified. A session identifier that can be used with other VTL functions is returned. This call must be made for each device you will be using. <code>viOpenDefaultRM(&sesn)</code> <code>viOpen(sesn, rsrcName, accessMode, timeout, &vi)</code>

4 Programming Example

<code>viPrintf</code> <code>viScanf</code>	These are the VTL formatted I/O functions that are patterned after those used in the C programming language. The <code>viPrintf</code> call sends the SCPI commands to the analyzer. The <code>viPrintf</code> call can also be used to query the analyzer. The <code>viScanf</code> call is then used to read the results.
<code>viWrite</code>	This function synchronously sends the data pointed to by <code>buf</code> to the device specified by <code>vi</code> . Only one synchronous write operation can occur at any one time. <code>viWrite(vi, buf, count, &retCount)</code>
<code>viRead</code>	This function synchronously reads raw data from the session specified by the <code>vi</code> parameter and stores the result in location where <code>buf</code> is pointing. Only one synchronous read operation can occur at any one time. <code>viRead(vi, buf, count, &retCount)</code>
<code>viClose</code>	This function must be used to close each session. When you close a device session, all data structures that had been allocated for the session will be set free. If you close the default resource manager session, all sessions opened using that resource manager session will be closed. <code>viClose(vi);</code> <code>viClose(defaultRM)</code>

Example Program

This example program queries a USB device for an identification string and prints the results. Note that you must change the address if something other than the default USB address value is required.

```
/*idn.c - program filename */  
#include "visa.h"  
#include <stdio.h>  
void main ()  
{  
/*Open session to USB device */  
viOpenDefaultRM(&defaultRM);
```



```

viStatus=viOpen(defaultRM, "USB0::2391::8472::000
0000000::0::INSTR", VI_NULL, VI_NULL, &viN9340B);
/*Initialize device */
viPrintf(viN9340B, "*RST\n");
/*Send an *IDN? string to the device */
printf(viN9340B, "*IDN?\n");
/*Read results */
viScanf(viN9340B, "%t", &buf);
/*Print results */
printf("Instrument identification string: %s\n",
buf);
/* Close the sessions */
viClose(viN9340B);
viClose(defaultRM);
}

```

Including the VISA Declarations File

For C and C++ programs, you must include the **visa.h** header file at the beginning of every file that contains VTL function calls:

```
#include "visa.h"
```

This header file contains the VISA function prototypes and the definitions for all VISA constants and error codes. The **visa.h** header file includes the **visatype.h** header file.

The **visatype.h** header file defines most of the VISA types. The VISA types are used throughout VTL to specify data types used in the functions. For example, the **viOpenDefaultRM** function requires a pointer to a parameter of type **ViSession**. If you find **ViSession** in the **visatype.h** header file, you will find that **ViSession** is eventually typed as an unsigned long.

Opening a Session

A session is a channel of communication. Sessions must first be opened on the default resource manager, and then for each device you will be using. The following is a summary of sessions that can be opened:

- A **resource manager session** is used to initialize the VISA system. It is a parent session that knows about all the opened sessions. A resource manager session must be opened before any other session can be opened.
- A **device session** is used to communicate with a device on an interface. A device session must be opened for each device you will be using. When you use a device session you can communicate without worrying about the type of interface to which it is connected. This insulation makes applications more robust and portable across interfaces. Typically a device is an instrument, but could be a computer, a plotter, or a printer.

NOTE

All devices that you will be using need to be connected and in working condition prior to the first VTL function call (`viOpenDefaultRM`). The system is configured only on the *first* `viOpenDefaultRM` per process. Therefore, if `viOpenDefaultRM` is called without devices connected and then called again when devices are connected, the devices will not be recognized. You must close **ALL** resource manager sessions and re-open with all devices connected and in working condition.

Device Sessions

There are two parts to opening a communications session with a specific device. First you must open a session to the default resource manager with the `viOpenDefaultRM` function. The first call to this function initializes the default resource manager and returns a session to that resource manager session. You only need to open the default manager session once. However, subsequent calls to `viOpenDefaultRM` returns a session to a unique session to the same default resource manager resource.

Next, you open a session with a specific device with the `viOpen` function. This function uses the session returned from `viOpenDefaultRM` and returns its own session to identify the device session. The following shows the function syntax:

```
viOpenDefaultRM (sesn);
viOpen (sesn, rsrcName, accessMode, timeout, vi);
```

The session returned from `viOpenDefaultRM` must be used in the `sesn` parameter of the `viOpen` function. The `viOpen` function then uses that session and the device address specified in the (*resource name*) parameter to open a device session. The `vi` parameter in `viOpen` returns a session identifier that can be used with other VTL functions.

Your program may have several sessions open at the same time by creating multiple session identifiers by calling the `viOpen` function multiple times.

The following summarizes the parameters in the previous function calls:

sesn	This is a session returned from the <code>viOpenDefaultRM</code> function that identifies the resource manager session.
rsrcName	This is a unique symbolic name of the device (device address).
accessMode	This parameter is not used for VTL. Use <code>VI_NULL</code> .
timeout	This parameter is not used for VTL. Use <code>VI_NULL</code> .
vi	This is a pointer to the session identifier for this particular device session. This pointer will be used to identify this device session when using other VTL functions.

Addressing a Session

As seen in the previous section, the *rsrcName* parameter in the `viOpen` function is used to identify a specific device. This parameter is made up of the VTL interface name and the device address. The interface name is determined when you run the VTL Configuration Utility. This name is usually the interface type followed by a number. The following table illustrates the format of the *rsrcName* for the different interface types:

The following describes the parameters used above:

board	This optional parameter is used if you have more than one interface of the same type. The default value for <i>board</i> is 0.
VXI logical address	This is the logical address of the VXI instrument.
primary address	This is the primary address of the USB device.
secondary address	This optional parameter is the secondary address of the USB device. If no secondary address is specified, none is assumed.
INSTR	This is an optional parameter that indicates that you are communicating with a resource that is of type INSTR , meaning instrument.

Closing a Session

The `viClose` function must be used to close each session. You can close the specific device session, which will free all data structures that had been allocated for the session. If you close the default resource manager session, all sessions opened using that resource manager will be closed.

Since system resources are also used when searching for resources (`viFindRsrc`) or waiting for events (`viWaitOnEvent`), the `viClose` function needs to be called to free up find lists and event contexts.

Checking USB Connection

Usually, using `*IDN?` verifies the data transferring between the controller PC and the instrument.

```
*****
#include "visa.h"
#include <stdio.h>

#define BufferSize 128

static ViStatus status;
static ViSession defaultRM;
static ViSession inst_N9340B;
static ViUInt32 rcount;
static unsigned char buffer[BufferSize];

int main(void)
{
    /* Connect N9340B and read its "IDN". */
    status = viOpenDefaultRM (&defaultRM);
    status = viOpen (defaultRM,
"USB0::2391::8472::0000000000::0::INSTR", VI_NULL,
VI_NULL, &inst_N9340B);
    if (status != VI_SUCCESS)
        return -1; //failed to connect N9340B/
    /* Read "IDN" from N9340B */
    status = viWrite (inst_N9340B, "*RST\n",
StringLength("*RST\n"), &rcount);
    status = viWrite (inst_N9340B, "*IDN?\n",
StringLength("*IDN?\n"), &rcount);
    status = viRead (inst_N9340B, buffer, BufferSize,
&rcount);

    /* Close connection to N9340B. */
    status = viClose (inst_N9340B);
    status = viClose (defaultRM); return 1;
}

```

Using C with Marker Peak Search and Peak Excursion

```

/*****
/* Using Marker Peak Search and Peak Excursion */
/* */
/* This example is for the N9340B Spectrum Analyzer. */
/* */
/* This C programming example does the following. */
/* The SCPI instrument commands used are given as reference. */
/* */
/* - Opens a USB session */
/* - Clears the Analyzer */
/* *CLS */
/* - Resets the Analyzer */
/* *RST */
/* - Sets the analyzer center frequency, span and units */
/* SENS:FREQ:CENT freq */
/* SENS:FREQ:SPAN freq */
/* UNIT:POW DBM */
/* - Set the input port to the 50 MHz amplitude reference */
/* CAL:SOUR:STAT ON */
/* - Set the analyzer to single sweep mode */
/* INIT:CONT 0 */
/* - Prompt the user for peak excursion and set them */
/* CALC:MARK:PEAK:EXC dB */
/* - Set the peak threshold to -90 dBm */
/* CALC:MARK:PEAK:THR:STAT ON */
/* CALC:MARK:PEAK:THR <ampl> */
/* - Trigger a sweep and delay for sweep to complete */
/* INIT:IMM */
/* - Set the marker to the maximum peak */
/* CALC:MARK:MAX */
/* - Query and read the marker frequency and amplitude */
/* CALC:MARK:X? */
/* CALC:MARK:Y? */
/* - Close the session */
*****/

```

```

#include <stdio.h>
#include <stdlib.h>
#include <math.h>
#include <ctype.h>
#include <string.h>
#include "visa.h"

ViSession defaultRM, viN9340B;
ViStatus errStatus;
ViChar cIdBuff[256]= {0};
char cEnter = 0;
int iResult = 0;

/*Set the input port to 50MHz amplitude reference*/
void Route50MHzSignal()
{
    viQueryf(viN9340B, "*IDN?\n", "%t", &cIdBuff);
    /* prompt the user*/
    /* to connect the amplitude reference output to the input*/
    printf ("Connect CAL OUT to the RF IN \n");
    printf (".....Press Return to continue \n");
    scanf( "%c",&cEnter);
    /*Externally route the 50MHz Signal*/
    viPrintf(viN9340B,"CAL:SOUR:STAT ON \n");
}

void main()
{
    /*Program Variables*/
    ViStatus viStatus = 0;
    double dMarkerFreq = 0;
    double dMarkerAmpl = 0;
    float fPeakExcursion =0;

```

4 Programming Example

```
/*Open a USB session.*/
viStatus=viOpenDefaultRM(&defaultRM);
viStatus=viOpen(defaultRM, "USB0::2391::8472::0000000000::0::INSTR",V
I_NULL,VI_NULL,&viN9340B);
if(viStatus)
{
printf("Could not open a session to USB device\n");
exit(0);
}
/*Clear the instrument*/
viClear(viN9340B);

/*Reset the instrument*/
viPrintf(viN9340B, "*RST\n");

/*Set Y-Axis units to dBm*/
viPrintf(viN9340B, "UNIT:POW DBM\n");

/*Set the analyzer center frequency to 50MHZ*/
viPrintf(viN9340B, "SENS:FREQ:CENT 50e6\n");

/*Set the analyzer span to 50MHZ*/
viPrintf(viN9340B, "SENS:FREQ:SPAN 50e6\n");

/*Display the program heading */
printf("\n\t\t Marker Program \n\n" );

/* Check for the instrument model number and route the 50MHz signal
accordingly*/
Route50MHzSignal();

/*Set analyzer to single sweep mode*/
viPrintf(viN9340B, "INIT:CONT 0 \n ");

/*User enters the peak excursion value*/
printf("\t Enter PEAK EXCURSION in dB: ");
scanf( "%f",&fPeakExcursion);
```



```

/*Set the peak excursion*/
viPrintf(viN9340B,"CALC:MARK:PEAK:EXC %1fDB \n",fPeakExcursion);

/*Set the peak threshold */
viPrintf(viN9340B,"CALC:MARK:PEAK:THR -90 \n");

/*Trigger a sweep and wait for completion*/
viPrintf(viN9340B,"INIT:IMM \n");

/*Set the marker to the maximum peak*/
viPrintf(viN9340B,"CALC:MARK:MAX \n");

/*Query and read the marker frequency*/
viQueryf(viN9340B,"CALC:MARK:X? \n","%lf",&dMarkerFreq);
printf("\n\t RESULT: Marker Frequency is: %lf MHZ \n\
n",dMarkerFreq/10e5);

/*Query and read the marker amplitude*/
viQueryf(viN9340B,"CALC:MARK:Y?\n","%lf",&dMarkerAmpl);
printf("\t RESULT: Marker Amplitude is: %lf dBm \n\n",dMarkerAmpl);

/*Close the session*/
viClose(viN9340B);
viClose(defaultRM);
}

```

Using Marker Delta Mode and Marker Minimum Search

```

/*****
/* Using Marker Delta Mode and Marker Minimum Search */
/* */
/* This example is for the N9340B Spectrum Analyzers */
/* */
/* This C programming example does the following. */
/* The SCPI instrument commands used are given as reference. */
/* */
/* - Opens a USB session */
/* - Clears the Analyzer */
/* - Resets the Analyzer */
/* *RST */
/* - Set the input port to the 50 MHz amplitude reference */
/* CAL:SOUR:STAT ON */
/* - Set the analyzer to single sweep mode */
/* INIT:CONT 0 */
/* - Prompts the user for the start and stop frequencies */
/* - Sets the start and stop frequencies */
/* SENS:FREQ:START freq */
/* SENS:FREQ:STOP freq */
/* - Trigger a sweep and delay for sweep completion */
/* INIT:IMM */
/* - Set the marker to the maximum peak */
/* CALC:MARK:MAX */
/* - Set the analyzer to activate the delta marker */
/* CALC:MARK:MODE DELT */
/* - Trigger a sweep and delay for sweep completion */
/* INIT:IMM */
/* - Set the marker to the minimum amplitude mode */
/* CALC:MARK:MIN */
/* - Query and read the marker amplitude */
/* CALC:MARK:Y? */
/* - Close the session */
*****/

```

```

#include <stdio.h>
#include <stdlib.h>
#include <math.h>
#include <ctype.h>
#include <string.h>
#include "visa.h"

ViSession defaultRM, viN9340B;
ViStatus errStatus;
ViChar cIdBuff[256] = {0};
char cEnter = 0;
int iResult = 0;

/*Set the input port to the 50MHz amplitude reference*/
void Route50MHzSignal()
{
    viQueryf(viN9340B, "*IDN?\n", "%t", &cIdBuff);
    /* prompt the user*/
    /* to connect the amplitude reference output to the
input*/
    printf ("Connect CAL OUT to the RF IN \n");
    printf (".....Press Return to continue \n");
    scanf( "%c",&cEnter);
    /*Externally route the 50MHz Signal*/
    viPrintf(viN9340B,"CAL:SOUR:STAT ON \n");
}

void main()
{
    /*Program Variable*/
    ViStatus viStatus = 0;
    double dStartFreq =0.0;
    double dStopFreq =0.0;
    double dMarkerAmplitude = 0.0;

    {

```

4 Programming Example

```
/* Open an USB session*/
    viStatus=viOpenDefaultRM(&defaultRM);
    viStatus=viOpen(
pen(defaultRM, "USB0::2391::8472::9876543210::0::INSTR", VI_NULL, V
I_NULL, &viN9340B);
    if(viStatus)

        printf("Could not open a session to USB device!\n");
        exit(0);
    }
/*Clear the instrument*/
viClear(viN9340B);

/*Reset the instrument*/
viPrintf(viN9340B, "*RST\n");
/*Display the program heading */
printf("\n\t\t Marker Delta Program \n\n" );

/*Check for the instrument model number and route the 50MHz
signal accordingly*/
Route50MHzSignal();

/*Set the analyzer to single sweep mode*/
viPrintf(viN9340B, "INIT:CONT 0\n");

/*Prompt the user for the start frequency*/
printf("\t Enter the Start frequency in MHz ");

/*The user enters the start frequency*/
scanf("%lf", &dStartFreq);

/*Prompt the user for the stop frequency*/
printf("\t Enter the Stop frequency in MHz ");

/*The user enters the stop frequency*/
scanf("%lf", &dStopFreq);
```

```

/*Set the analyzer to the values given by the user*/
//viPrintf(viN9340B,"SENS:FREQ:STAR %lf
//MHZ;:SENS:FREQ:STOP %lf MHZ\n",dStartFreq,dStopFreq);
viPrintf(viN9340B,":SENS:FREQ:STAR %lf MHz\n",dStart-
Freq);
viPrintf(viN9340B,":SENS:FREQ:STOP %lf MHZ\n",dStopFreq);

/*Trigger a sweep, delay for completion*/
viPrintf(viN9340B,"INIT:IMM\n");
//delay(1);

/*Set the marker to the maximum peak*/
viPrintf(viN9340B,"CALC:MARK:MAX\n");

/*Set the analyzer to activate delta marker mode*/
viPrintf(viN9340B,"CALC:MARK:MODE DELT\n");

/*Trigger a sweep, delay for completion*/
viPrintf(viN9340B,"INIT:IMM\n");
Sleep(1);

/*Set the marker to minimum amplitude*/
viPrintf(viN9340B,"CALC:MARK:MIN\n");

/*Query and read the marker amplitude*/
viQueryf(viN9340B,"CALC:MARK:Y?\n", "%lf",&dMarkerAmpli-
tude);

/*print the marker amplitude*/
printf("\n\n\tRESULT: Marker Amplitude Delta =%lf dB\n\
n",dMarkerAmplitude);

/*Close the session*/
viClose(viN9340B);
viClose(defaultRM);
}

```

Measuring Phase Noise

```

/*****
/* Measuring Phase Noise */
/* */
/* This example is for the N9340B Spectrum Analyzers */
/* */
/* This C programming example does the following. */
/* The SCPI instrument commands used are given as reference. */
/* */
/* - Opens a USB session */
/* - Clears the Analyzer */
/* - Resets the Analyzer */
/* *RST */
/* - Sets the center frequency and span */
/* SENS:FREQ:CENT 50 MHZ */
/* SENS:FREQ:SPAN 10 MHZ */
/* - Set the input port to the 50 MHz amplitude reference */
/* CAL:SOUR:STAT ON */
/* - Set the marker to the maximum peak */
/* CALC:MARK1:MAX */
/* - Activate the phase noise function */
/* CALC:MARK1:PHN ON*/
/* - Set offset to 20 kHz */
/* CALC:PHN:OFFS 20KHz */
/* - Query the phase noise */
/* CALC:MARK:PHN:Y? */
/* - Close the session */
*****/

#include <stdio.h>
#include <stdlib.h>
#include <math.h>
#include <ctype.h>
#include <string.h>
#include "visa.h"

```

```

ViSession defaultRM, viN9340B;
ViStatus errStatus;
ViChar cIdBuff[256]= {0};
char cEnter = 0;
int iResult = 0;

/*Set the input port to 50 MHz amplitude reference*/
void Route50MHzSignal()
{
    viQueryf(viN9340B, "*IDN?\n", "%t", &cIdBuff);
    /* prompt the user*/
    /* to connect the amplitude reference output to the input*/
    printf ("Connect CAL OUT to the RF IN \n");
    printf (".....Press Return to continue \n");
    scanf( "%c",&cEnter);

    /*Externally route the 50 MHz Signal*/
    viPrintf(viN9340B,"CAL:SOUR:STAT ON \n");
}
void main()
{
    /*Program Variables*/
    ViStatus viStatus = 0;
    double dMarkAmp =0.0;

    /*Open a USB session*/
    viStatus=viOpenDefaultRM(&defaultRM);
    viStatus=viOpen(
pen(defaultRM, "USB0::2391::8472::0000000000::0::INSTR", VI_NULL, VI_N
ULL,&viN9340B);
    if(viStatus)
    {
        printf("Could not open a session to USB device!\n");
        exit(0);
    }
    /*Clear the Instrument*/
    viClear(viN9340B);

```

4 Programming Example

```
/*Reset the Instrument*/
    viPrintf(viN9340B,"*RST\n");

/*Display the program heading */
    printf("\n\t\t Noise Program \n\n" );

    /* Check for the instrument model number and route the 50 MHz
signal accordingly*/
    Route50MHzSignal();

/*Set the analyzer center frequency to 50 MHz*/
viPrintf(viN9340B,"SENS:FREQ:CENT 50e6\n");

/*Set the analyzer span to 10 MHz*/
viPrintf(viN9340B,"SENS:FREQ:SPAN 10e6\n");

/*Set the marker to the maximum peak*/
viPrintf(viN9340B,"CALC:MARK1:MAX \n");

    /*Activate the noise marker function.*/
viPrintf(viN9340B,"CALC:MARK1:PHN ON \n");

/*Set the offset to 20 kHz. This places the
active marker two divisions to the right of the input sig-
nal.*/
viPrintf(viN9340B,":CALC:PHN:OFFS 20KHz \n");

/*Query and read the phase noise from the analyzer */
viQueryf(viN9340B,":CALC:MARK:PHN:Y? \n", "%lf", &dMarkAmp);

/*Report the phase noise */
printf("\t Marker Amplitude =%lf dBc/Hz\n",dMarkAmp);

/*Close the session*/
viClose(viN9340B);
viClose(defaultRM);
}
```




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This chapter contains SCPI (Standard Commands for Programmable Instruments) programming commands for the spectrum analyzer core operation.



IEEE Common Commands

The first few pages of this chapter contain common commands specified in IEEE Standard 488.2-1992, *IEEE Standard Codes, Formats, Protocols and Common Commands for Use with ANSI/IEEE Std 488.1-1987*. New York, NY, 1992.

Following these commands, the Agilent N9340B spectrum analyzers SCPI commands are listed.

Clear Status

*CLS

Clears the status byte register. It does this by emptying the error queue and clearing all bits in all of the event registers. The status byte register summarizes the states of the other registers. It is also responsible for generating service requests.

Remark: See *STB?

Standard Event Status Enable

*ESE <number>

*ESE?

Sets the bits in the standard event status enable register. This register monitors I/O errors and synchronization conditions such as operation complete, request control, query error, device dependent error, execution error, command error and power on. A summary bit is generated on execution of the command.

The query returns the state of the standard event status enable register.

Range: Integer, 0 to 255

Example: *ESE 36 Enables the Standard Event Status Register to monitor query and command errors (bits 2 and 5).

*ESE? Returns a 36 indicating that the query and command status bits are enabled.

Standard Event Status Register Query

*ESR?

Queries and clears the standard event status event register. (This is a destructive read.) The value returned reflects the current state (0/1) of all the bits in the register.

Range: Integer, 0 to 255

Example: *ESR? returns a 1 if there is either a query or command error, otherwise it returns a zero.

Identification Query

*IDN?

Returns an instrument identification information string. The string will contain the model number, serial number and firmware revision. The response is organized into four fields separated by commas. The field definitions are manufacturer, model, serial number and software version.

Example: *IDN? returns instrument information, such as:
Agilent Technologies, N9340B, 45310116, A.01.02

Key access: **SYS > More > Show System**

Operation Complete Query

*OPC

*OPC?

Sets bit 0 in the standard event status register to “1” when all pending operations have finished.

The query stops any new commands from being processed until the current processing is complete. Then it returns a “1”, and the program continues. This query can be used to synchronize events of other instruments on the external bus.

Returns a “1” if the last processing is complete. Use this query when there’s a need to monitor the command execution status, such as a sweep execution.

*OPC and *OPC? are currently effective only when immediately preceded by either the :INITiate:IMMEDIATE or a :CALibration command.

Reset

*RST

This command presets the instrument to a factory defined condition that is appropriate for remote programming operation. *RST is equivalent to performing the two commands :SYSTEM:PRESet and *CLS. This command always performs a factory preset.

NOTE

The preset performed by *RST is always a factory preset. That is, the same preset performed by :SYSTEM:PRESet when :SYSTEM:PRESet:TYPE is set to FACTORY.

Key access: Preset

Service Request Enable

*SRE <integer>

*SRE?

This command enables the desired bits of the service request enable register.

The query returns the value of the register, indicating which bits are currently enabled. The default value is 255.

Example: *SRE 16 enables bits 4 in the service request enable register.

Range: Integer, 0 to 255

Status Byte Query

*STB?

Returns the value of the status byte register without erasing its contents.

Range: Integer, 0 to 255

Example: If a 16 is returned, it indicates that bit 5 is set and one of the conditions monitored in the standard event status register is set.

Self Test Query

*TST?

This query is used by some instruments for a self test.

Range: Integer, 0 to 255

Wait-to-Continue

*WAI

This command causes the instrument to wait until all pending commands are completed before executing any additional commands. There is no query form to the command.

Range: Integer, 0 to 255

CALCulate Subsystem

This subsystem is used to perform post-acquisition data processing. In effect, the collection of new data triggers the CALCulate subsystem. In this instrument, the primary functions in this subsystem are markers and limits. CALCulate subsystem commands used for measurements in the **MEAS** menus are located in “SENSE Subsystem” on page 81.

Limit Line Subsection

Limit lines can be defined for your measurement. You can then have the instrument compare the data to your defined limits and indicate a pass/fail condition.

Please refer to TRACe subsystem for more trace commands.

Type of Limit Line

```
:CALCulate:LLINE[1]:TYPE UPPER|LOWER
:CALCulate:LLINE[1]:TYPE?
```

Sets a limit line to be either an upper or lower type limit line. An upper line will be used as the maximum allowable value when comparing with the data.

***RST:** Upper

Key access: **LIMIT > Limit Type**

Turn on/off the Buzzer

```
:CALCulate:LLINE[1]:BUZZer[:STATE]OFF|ON|0|1
:CALCulate:LLINE[1]:BUZZer[:STATE]?
```

Toggles the buzzer between on and off.

If the buzzer is turned on, the buzzer will beep when the trace doesn't meet the limit line criteria.

***RST:** Off

Key access: **LIMIT > Beep On Off**

Limit Line Testing

```
:CALCulate:LLINE[1]:[STATE] OFF|ON|0|1
```

```
:CALCulate:LLINE[1]:[STATE]?
```

Toggles the limit line testing between on and off.

If the limit line is turned on, limit pattern is automatically turned off.

***RST:** Off

Key access: **LIMIT > Limit Line On Off**

Limit Line Y-axis Value

```
:CALCulate:LLINE[1]:Y <ampl>
```

```
:CALCulate:LLINE[1]:Y?
```

Sets the Y-axis value of a limit line.

Limit line Y-axis value is set independently and is not affected by the X-axis units.

***RST:** 0 dBm

Key access: **LIMIT > Limit Line**

CALCulate:MARKer Subsection**Markers All Off on All Traces**

```
:CALCulate:MARKer:AOFF
```

Turns off all markers on all the traces.

Key access: **Marker > All Off**

Turn On 6 Makers on All Traces

```
:CALCulate:MARKer:ALL
```

Turns on all markers on all the traces and places them on six highest peaks.

Key access: **Marker > Peak Search > 6 Peaks Search**

Frequency Counter Marker

```
:CALCulate:MARKer[1] | 2 | 3 | 4 | 5 | 6:FCOunt[:STATe]
OFF | ON | 0 | 1
:CALCulate:MARKer[1] | 2 | 3 | 4 | 5 | 6:FCOunt[:STATe]?
```

Turns on/off the marker frequency counter. To query the frequency counter, use

```
:CALCulate:MARKer[1]:FCOunt:X? If the specified
marker number is not the active marker, it becomes the
active marker. If the specified marker number is not on, it is
turned on and becomes the active marker. A 1 is returned
only if marker count is on and the selected number is the
active marker.
```

***RST:** Off

Remarks: If a frequency count x value is generated when the frequency count state is off, then 0 is returned.

Key access: **Marker > More > Mode > Freq Count**

Marker Function

```
:CALCulate:MARKer[1] | 2 | 3 | 4 | 5 | 6:FUNCTion
FCOunt | NOISe | OFF
:CALCulate:MARKer[1] | 2 | 3 | 4 | 5 | 6:FUNCTion?
```

This command selects the marker function for the designated marker.

FCOunt refers to the frequency counter function.

NOISe refers to the noise measurement function.

OFF refers to the normal function.

***RST:** 1 kHz

Key access: **Marker > More > Mode**

Marker Peak Search

:CALCulate:MARKer[1] | 2 | 3 | 4 | 5 | 6:MAXimum
 Performs a peak search based on the search mode settings
 of :CALCulate:MARKer[1] | 2 | 3 | 4 | 5 | 6:FUNCTION
 FCOunt | NOISE | OFF.

Key access: Marker > Peak Search > Peak

Marker Peak Left/Right Search

:CALCulate:MARKer[1] | 2 | 3 | 4 | 5 | 6:MAXimum:LEFT
 :CALCulate:MARKer[1] | 2 | 3 | 4 | 5 | 6:MAXimum:RIGHT

Places the selected marker on the next highest signal peak
 to the left/right of the current marked peak.

Key access: Marker > Peak Search > Next Left\Right PK

Marker Mode

:CALCulate:MARKer[1] | 2 | 3 | 4 | 5 | 6:MODE POSi-
 tion | DELTa | OFF
 :CALCulate:MARKer[1] | 2 | 3 | 4 | 5 | 6:MODE?

Selects the type of markers that you want to activate.

Position selects a normal marker that can be positioned
 on a trace and from which trace information will be
 generated.

Delta activates a pair of markers, one of which is fixed at
 the current marker location. The other marker can then be
 moved around on the trace. The marker readout shows the
 difference between the two markers.

Off turns the designated marker off.

Remarks: If a marker is not active when the mode is queried, "Off"
 will be returned.

Key access: Marker > Normal/Delta/Off

Marker to Center

```
:CALCulate:MARKer[1] | 2 | 3 | 4 | 5 | 6 [:SET]:CENTer
```

This command sets the center frequency equal to the specified marker frequency, which moves the marker to the center of the screen. In delta marker mode, the center frequency is set to the marker delta value. This command is not available in zero span.

Remarks: This command is just available in Spectrum Analyzer and Tracking Generator mode.

Key access: **Marker > Marker To > To Center**

Marker On/Off

```
:CALCulate:MARKer[1] | 2 | 3 | 4 | 5 | 6:STATE OFF|ON|0|1
:CALCulate:MARKer[1] | 2 | 3 | 4 | 5 | 6:STATE?
```

This command toggles the selected marker status between on and off.

Key access: **Marker > Normal/Off**

Marker to Trace

```
:CALCulate:MARKer[1] | 2 | 3 | 4 | 5 | 6:TRACe <integer>
:CALCulate:MARKer[1] | 2 | 3 | 4 | 5 | 6:TRACe?
```

This command assigns the specified marker to the designated trace 1, 2, 3 or 4.

***RST:** 1

Key access: **Marker > More > Marker Trace**

Marker readout: X value

```
:CALCulate:MARKer[1] | 2 | 3 | 4 | 5 | 6:X <para>
:CALCulate:MARKer[1] | 2 | 3 | 4 | 5 | 6:X?
```

This command positions the designated marker on its assigned trace at the specified trace X value.

The value is in the X-axis units, which can be a frequency or time.

The query returns the current X value of the designated marker.

***RST:** Off

Key access: Marker > Normal

Marker readout: Y Value

```
:CALCulate:MARKer[1]|2|3|4|5|6:Y?
```

This command reads the current Y value for the designated marker or delta on its assigned trace. The value is in the Y-axis units for the current trace.

This command can be used to read the results of marker functions such as and noise that are displayed in the marker value field on the analyzer.

DEMOdulation Subsystem

This sub tree commands are used to control the demodulation after the measure has been loaded by [:SENSe] :FREQuency :SPAN :ZERO .

AM Demodulation

:DEMod:AM:STATe OFF | ON | 0 | 1

:DEMod:AM:STATe?

This command toggles AM demodulation function between on and off.

***RST:** Off

Key access: SPAN > Demod > AM (On)

FM Demodulation

:DEMod:FM:STATe OFF | ON | 0 | 1

:DEMod:FM:STATe?

This command toggles FM demodulation function between on and off.

***RST:** Off

Key access: SPAN > Demod > FM (On)

DISPlay Subsystem

The DISPlay subsystem controls the selection and presentation of textual, graphical, and trace information. Within a display, information may be separated into individual windows.

Trace Y-Axis Scaling

```
:DISPlay:WINDow:TRACe:Y[:SCALe]:PDIVision
1|2|5|10
:DISPlay:WINDow:TRACe:Y[:SCALe]:PDIVision?
```

This command sets the per-division display scaling for the y-axis when scale type of Y axis is set to Log.

***RST:** 10 dB
Range: 1, 2, 5 or 10
Key access: **AMPTD > Scale/DIV**

Trace Y-Axis Reference Level

```
:DISPlay:WINDow:TRACe:Y[:SCALe]:RLEVEL:OFFSet
<ampl>
:DISPlay:WINDow:TRACe:Y[:SCALe]:RLEVEL:OFFSet?
```

This command sets the amplitude value of the reference level for the Y-axis.

***RST:** 0 dB
Range: -120.00 to +30.00 dBm
Key access: **AMPTD > Ref Level**

Trace Y-Axis Reference Level Offset

```
:DISPlay:WINDow:TRACe:Y[:SCALe]:RLEVEL:OFFSet
<ampl>
:DISPlay:WINDow:TRACe:Y[:SCALe]:RLEVEL:OFFSet?
```

This command sets the amplitude level offset for the Y-Axis.

***RST:** 0 dB

Range: -327.60 to +327.60 dB

Key access: **AMPTD > Ref Offset**

Vertical Axis Scaling

```
:DISPlay:WINDow:TRACe:Y[:SCALe]:SPACing LIN-
ear|LOGarithmic
:DISPlay:WINDow:TRACe:Y[:SCALe]:SPACing?
```

Toggles the vertical graticule divisions between logarithmic or linear units. The default logarithmic unit is dBm, and the linear unit is mV.

***RST:** Log

Key access: **AMPTD > Scale Type**

Brightness

```
:DISPlay:MODE:BRIGHtness <integer>
:DISPlay:MODE:BRIGHtness?
```

This command adjusts the brightness of the current screen display. Set to 0 to turn off the backlight of the LCD screen.

Range: 0 to 10

Key Access: **SYS > Brightness**

INITiate Subsystem

The INITiate subsystem is used to control the initiation of the trigger. Refer to the TRIGger subsystems for related commands.

Continuous or Single Sweep

```
:INITiate:CONTinuous OFF|ON|0|1
:INITiate:CONTinuous?
```

Selects whether the trigger system is continuously initiated or not.

This command affects sweep if not in a measurement, and affects trigger when in a measurement. A “measurement” refers to any of the functions under the **MEAS** key. This corresponds to continuous sweep or single sweep operation when not in a measurement, and continuous measurement or single measurement operation when in a measurement. Commands used for measurements in the **MEAS** menus.

When not in a measurement, this command does the following:

- When ON at the completion of each sweep cycle, the sweep system immediately initiates another sweep cycle.
- When OFF, the sweep system remains in an “idle” state until CONTinuous is ON or :INITiate[:IMMediate] is received. On receiving the :INITiate[:IMMediate] command, it will go through a single sweep cycle, and then return to the “idle” state.
- The query returns 1 or 0 into the output buffer. 1 is returned when there is continuous sweeping. 0 is returned when there is only a single sweep.

When in a measurement, this command does the following:

- When ON at the completion of each trigger cycle, the trigger system immediately initiates another trigger cycle.

- When OFF, the trigger system remains in an “idle” state until CONTInuous is ON or :INITiate[:IMMediate] is received. On receiving the :INITiate[:IMMediate] command, it will go through a single trigger cycle, and then return to the “idle” state.
- The query returns 1 or 0 into the output buffer. 1 is returned when in a continuous measurement state. 0 is returned when there is only a single measurement.

***RST:** Continuous

Key access: **BW/SWP > Sweep > Sweep Single Cont**

Initiate a Single Sweep

:INITiate[:IMMediate]

This command initiates a sweep if not in a measurement. If in a measurement, it triggers the measurement. A “measurement” refers to any function under the **MEAS** key.

Remarks: See also the *TRG command

Use the :TRIGer[:SEquence]:SOURce EXTernal command to select the external trigger.

The analyzer must be in the single measurement mode. If :INITiate:CONTInuous is ON, the command is ignored.

If the analyzer is in signal identification mode, two sweeps are required, as this mode relies on the acquisition of data from two successive sweeps. Therefore, if the analyzer is in single sweep mode, two sweep triggers are needed to generate the sweep pair. In image suppress mode, synchronization is ensured by first turning off signal identification, initiating a single sweep, then turning on signal identification followed by two single sweeps.

Key access: **BW/SWP > Single Sweep**

INSTRUMENT Subsystem

The instrument subsystem includes commands for querying and selecting the measurement modes.

Instrument Mode

```
:INSTRument[:SElect] SA|TGENERator|DANalyse|POWERmeter
:INSTRument[:SElect]?
```

This command selects the instrument mode. CONFIGure subsystem commands used for measurements in the **MEAS** menus.

***RST:** SA
Key access: **MODE**

Power Measurement

```
:INSTRument:MEASure OFF|CHPower|ACPR|OBW|SEM
:INSTRument:MEASure?
```

This command selects the specific power measurement mode. When you select the specific measurement mode, the MEASure subsystem commands are available for the further measurement.

CHPower - Channel Power Measurement

ACPR - Adjacent Channel Power Ratio Measurement

OBW - Occupied Bandwidth Measurement

SEM - Spectrum Emission Mask

Key access: **MEAS**

MEASure Subsystem

This subsystem is used to make a measurement and return scalar data. MEASure saves you the time of re-making the measurement. You can only make a measurement from the measurement that is currently active, it will not change to a different measurement.

This subsystem command must be used after the measure has been loaded by :INSTRument:MEASure
ACPR | OBW | CHP | SEM.

OBW Subsection

Select the measurement method of OBW

```
:MEASure:OBW:METHOD PERCent | XDB
:MEASure:OBW:METHOD?
```

This command toggles the method of OBW measurement between percent or xdB.

Set percentage (%) method of OBW

```
:MEASure:OBW:PERCent <para>
:MEASure:OBW:PERCent?
```

edit the percentage of signal power used when determining the occupied bandwidth. Press {%} to set the percentage ranging from 10.00% to 99.99%.

Set dBc method of OBW

```
:MEASure:OBW:XDB <para>
:MEASure:OBW:XDB?
```

specify the power level used to determine the emission bandwidth as the number of dB down from the highest signal point, within the occupied bandwidth span.

Query OBW

```
:MEASure:OBW:XDB?
```

Use this command to query the occupied bandwidth according to the method you set.

ACPR Subsection**Center Freq**

```
:MEASure:ACPR:CENTer <freq>
:MEASure:ACPR:CENTer?
```

Sets the center frequency of the main channel power.

Main channel

```
:MEASure:ACPR:MAIN <freq>
:MEASure:ACPR:MAIN?
```

Specifies the range of integration used in calculating the power in the main channel. Use the knob and the arrow keys to set the bandwidth.

Adjacent channel

```
:MEASure:ACPR:ADJacent <freq>
:MEASure:ACPR:ADJacent?
```

Specifies the range of integration used in calculating the power in the adjacent channel. Use the knob and the arrow keys to set the bandwidth.

Channel space

```
:MEASure:ACPR:SPACE <freq>
```

```
:MEASure:ACPR:SPACE?
```

Sets the space value between the center frequency of main channel power and that of the adjacent channel power.

There are also some remote commands which are irrelative to the front-panel keys.

Main Channel Power

```
:MEASure:ACPR:MPOWER?
```

Return the main channel power of ACPR measurement.

Low Adjacent Channel Power

```
:MEASure:ACPR:LPOWER?
```

Return the lower adjacent channel power of ACPR measurement.

Upper Adjacent Channel Power

```
:MEASure:ACPR:UPOWER?
```

Return the upper adjacent channel power of ACPR measurement.

Low Adjacent Channel Power Ratio

```
:MEASure:ACPR:LRATIO?
```

Return the lower adjacent channel power to main channel power ratio.

Upper Adjacent Channel Power Ratio

```
:MEASure:ACPR:URATIO?
```

Return the upper adjacent channel power to main channel power ratio.

Channel Power Subsection

Center Freq

```
:MEASure:CHPower:CENTer <freq>
:MEASure:CHPower:CENTer?
```

Sets the center frequency of the display.

Int BW

```
:MEASure:CHPower:IBW <freq>
:MEASure:CHPower:IBW?
```

Specifies the integration bandwidth ranging from 100 Hz to 3 GHz to calculate the power.

Channel Span

```
:MEASure:CHPower:SPAN <freq>
:MEASure:CHPower:SPAN?
```

Sets the analyzer span for the channel power measurement. Be sure the span is set between 1 and 10 times the integration bandwidth.

There are also some remote commands which are irrelative to the front-panel keys.

Channel Power and Density

```
:MEASure:CHPower?
```

This command returns scalar results of main channel power, and power density.

```
:MEASure:CHPower:CHPower?
```

This command returns the value of the channel power in amplitude units.

```
:MEASure:CHPower:DENSity?
```

This command returns the value of the channel power density in amplitude units/Hz.

SEM Subsection

Set the Average

```
:MEASure:SEMask:AVERAge:COUNT <integer>
:MEASure:SEMask:AVERAge:COUNT?
```

```
:MEASure:SEMask:AVERAge[:STATe] OFF|ON|0|1
:MEASure:SEMask:AVERAge[:STATe]?
```

Specifies the number of measurement averages used when calculating the measurement result set **Avg Number** to ON. The average will be displayed at the end of each sweep.

***RST:** 10/Off

Range: 1 to 1000

Key access: **MEAS > SEM > Avg Number On Off**

Set the Chan Integ BW

```
:MEASure:SEMask:BANDwidth|BWIDth:INTEgration
<freq>
:MEASure:SEMask:BANDwidth|BWIDth:INTEgration?
```

Specifies the integration bandwidth used in calculating the power in the main channel.

***RST:** 3.84 MHz

Range: 10% to 100% of the setting of **Chan Span**

Example: :MEAS:SEM:BAND:INT 4 MHz
:MEAS:SEM:BWID:INT 4 MHz

Key access: **MEAS > SEM > Ref Channel > Chan Integ BW**

Set the Channel Res BW

```
:MEASure:SEMask:BANDwidth|BWIDth[:RESolu-
tion]:AUTO OFF|ON|0|1
:MEASure:SEMask:BANDwidth|BWIDth[:RESolu-
tion]:AUTO?
```

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

Specifies the resolution bandwidth used in measuring and the power in the main channel.

***RST:** 30 kHz

Range: 10% to 100% of the setting of **Chan Span**

Example: MEAS:SEM:BAND 4 MHz
MEAS:SEM:BWID 4 MHz

Key access: **MEAS > SEM > Ref Channel > Res BW**

Set Total Power Reference

```
:MEASure:SEMask:CARRier[:POWER] <ampl>
:MEASure:SEMask:CARRier[:POWER]?
```

Use this command to set the Total Power Reference value.

The query return a value of total power, with current ampt unit.

Key access: **MEAS > SEM > Ref Channel > Total Pwr Ref**

Set Chan Span

```
:MEASure:SEMask:FREQuency:SPAN <freq>
:MEASure:SEMask:FREQuency:SPAN?
```

Specifies the span used in measuring the power in the main channel.

***RST:** 5 MHz

Example: :MEAS:SEM:FREQ:SPAN 4 MHz

Key access: **MEAS > SEM > Chan Span**

Set Center Frequency

```
MEASure:SEMask:FREQuency:CENTer <freq>
```

```
MEASure:SEMask:FREQuency:CENTer?
```

Specifies the center frequency in the emission mask.

Key access: **FREQ > Center Freq**

Turn On/Off the Marker

```
MEASure:SEMask:MARKer[1] | 2 | 3 | 4 [:STATE]
```

```
OFF | ON | 0 | 1
```

```
MEASure:SEMask:MARKer[1] | 2 | 3 | 4 [:STATE]?
```

This command turns on/off the active marker in SEM mode.

Key access: **MARKER**

Marker Frequency

```
MEASure:SEMask:MARKer[1] | 2 | 3 | 4 :X <freq>
```

```
MEASure:SEMask:MARKer[1] | 2 | 3 | 4 :X?
```

This command controls the frequency of the markers. The query returns the current frequency of the designated marker.

Key access: **MARKER**

Marker Amplitude Query

```
MEASure:SEMask:MARKer[1] | 2 | 3 | 4 :Y?
```

The query returns the current amplitude of the designated marker.

Key access: **MARKER**

Set the Channel Res BW

```
MEASure:SEMask:OFFSet:LIST:Band-  
width|BWIDth[:RESolution] <real_number> ,
```



```
<real_number>, <real_number>,
<real_number>, <real_number>
MEASure:SEMask:BANDwidth|BWIDth[:RESolution]?
```

Specifies which resolution bandwidth filter to use when measuring the currently-selected offset, comma separated list of 5 values.

Range: 30 Hz to 1 MHz
Key access: **MEAS > SEM > Offset/Limit > Res BW**

Set the Offset Res BW

```
MEASure:SEMask:OFFSet:LIST:BAND-
width|BWIDth[:RESolution]:AUTO
OFF|ON|0|1, ... OFF|ON|0|1
```

(up to five values)

```
MEASure:SEMask:OFFSet:LIST:BAND-
width|BWIDth[:RESolution]:AUTO?
```

```
MEASure:SEMask:OFFSet:LIST:BAND-
width|BWIDth[:RESolution] <freq>, ... [<freq>]
```

(up to five values)

```
MEASure:SEMask:OFFSet:LIST:BAND-
width|BWIDth[:RESolution]?
```

Specifies the resolution bandwidth used in measuring the offset pair. When set to Auto, the Res BW from the default tables in *User's Guide* are used. When set to Man, the range of settings is the range of available Res BWs of the analyzer, except the maximum is further limited to not exceed (Stop Freq - Start Freq).

***RST:** Dependent upon Offset label selected.

Example: :MEAS:SEM:OFFS:LIST:BAND 40 kHz or
:MEAS:SEM:OFFS:LIST:BWID 40 kHz

Key access: **MEAS > SEM > Offset/Limit > Res BW**

Set the Start Freq

```
:MEASure:SEMask:OFFSet:LIST:FREQuency:START
<freq>, ... [<freq>] (up to five values)
:MEASure:SEMask:OFFSet:LIST:FREQuency:START?
```

```
:MEASure:SEMask:OFFSet:LIST:STATe
OFF|ON|0|1, ... OFF|ON|0|1 (up to five values)
:MEASure:SEMask:OFFSet:LIST:STATe?
```

Specifies the inner limit (frequency closest to the carrier) for both segments of the specified offset pair. When **Start Freq (Off)** is selected, the offset pair is not measured.

Offsets that are turned off, for the currently selected offset will return a -999.0 when queried.

***RST:** Dependent upon Offset selected, please refer to the *User's Guide* for more details.

Range: 0 Hz to the Stop Freq (for that offset) minus 10 Hz

Example: :MEAS:SEM:OFFS:LIST:FREQ:STAR 2 MHz
:MEAS:SEM:OFFS:LIST:STAT 1

Key access: **MEAS > Spectrum Emission Mask > Offset/Limits > Start Freq**

Set the Stop Freq

```
:MEASure:SEMask:OFFSet:LIST:FREQuency:STOP
<freq>, ... [<freq>] (up to five values)
:MEASure:SEMask:OFFSet:LIST:FREQuency:STOP?
```

Specifies the inner limit (frequency closest to the carrier) for both segments of the specified offset pair. When **Start Freq (Off)** is selected, the offset pair is not measured.

Offsets that are turned off, for the currently selected offset will return a -999.0 when queried.

***RST:** Dependent upon Offset selected, please refer to the *User's Guide* for more details.

Range: 0 Hz to the Stop Freq (for that offset) minus 10 Hz

Key access: **MEAS > Spectrum Emission Mask > Offset/Limits > Stop Freq**

Set the Sweep Time

```
:MEASure:SEMask:OFFSet:LIST:SWEeptime <time> ...
[<time>] (up to five values)
:MEASure:SEMask:OFFSet:LIST:SWEeptime?

:MEASure:SEMask:OFFSet:LIST:SWEeptime:AUTO
OFF|ON|0|1, ... OFF|ON|0|1 (up to five values)
:MEASure:SEMask:OFFSet:LIST:SWEeptime:AUTO?
```

Specifies the sweep time for the currently offset, and toggles this function between **Auto** and **Manual** for each offset.

***RST:** Dependent upon Offset selected, please refer to the *User's Guide* for more details.

Range: 5 ms to 4 ks

Example: :MEAS:SEM:OFFS:LIST:SWE:AUTO 40 ms

Key access: **MEAS > Spectrum Emission Mask > Offset/Limits > Sweep Time**

Set the Abs Start

```
:MEASure:SEMask:OFFSet:LIST:STARt:ABSolute
<ampl>, ... [<ampl>] (up to five values)
:MEASure:SEMask:OFFSet:LIST:STARt:ABSolute?
```

Enables you to enter an absolute level limit at **Start Freq** for the currently selected offset ranging from -200.00 to +50.00 dBm with 0.01 dB resolution.

***RST:** Dependent upon Offset selected, please refer to the *User's Guide* for more details.

Range: -200 dBm to 50 dBm

Example: MEAS:SEM:OFFS:LIST:STAR:ABS -20 dBm

Key access: **MEAS > Spectrum Emission Mask > Offset/Limits > More > Abs Start**

Set the Rel Start

```
:MEASure:SEMask:OFFSet:LIST:STARt:RCARrier
<ampl>, ... [<ampl>] (up to five values)
```

```
:MEASure:SEMask:OFFSet:LIST:START:RCARrier?
```

Enables you to enter a relative level limit at **Start Freq** ranging from -150.00 to +50.00 dB with 0.01 dB resolution.

***RST:** Dependent upon Offset selected, please refer to the *User's Guide* for more details.

Range: -150 dB to 50 dB

Example: :MEAS:SEM:OFFS:LIST:STAR:RCAR -20 dB

Key access: **MEAS > Spectrum Emission Mask > Offset/Limits > More > Rel Start**

Set the Abs Stop

```
:MEASure:SEMask:OFFSet:LIST:START:ABSolute
<ampl>, ... [<ampl>] (up to five values)
```

```
:MEASure:SEMask:OFFSet:LIST:START:ABSolute?
```

```
:MEASure:SEMask:OFFSet:LIST:STOP:ABSolute:COU-
Ple OFF|ON|0|1, ... OFF|ON|0|1 (up to five values)
```

```
:MEASure:SEMask:OFFSet:LIST:STOP:ABSolute:COU-
Ple?
```

Enables you to enter an absolute level limit at **Stop Freq** for the currently offset ranging from -200.00 to +50.00 dBm with 0.01 dB resolution, and to toggle this function between **Couple** and **Man**. If set to **Couple**, this is coupled to **Abs Start** to make a flat limit line. If set to **Man**, **Abs Start** and **Abs Stop** you can enter different values to make a sloped limit line.

***RST:** Dependent upon Offset selected, please refer to the *User's Guide* for more details.

Range: -200 dBm to 50 dBm

Example: :MEAS:SEM:OFFS:LIST:STOP:ABS -20 dBm

```
:MEAS:SEM:OFFS:LIST:STOP:ABS:COUP 0
```

Key access: **MEAS > Spectrum Emission Mask > Offset/Limits > More > Abs Stop**

Set the Rel Stop

```
:MEASure:SEMask:OFFSet:LIST:START:RCARrier
```

```
<ampl>, ... [<ampl>] (up to five values)
:MEASure:SEMask:OFFSet:LIST:STARt:RCARrier?
```

```
:MEASure:SEMask:OFFSet:LIST:STOP:RCARrier:COU-
Ple OFF|ON|0|1, ... OFF|ON|0|1 (up to five values)
:MEASure:SEMask:OFFSet:LIST:STOP:RCARrier:COU-
Ple?
```

Enables you to enter an absolute level limit at **Stop Freq** for the currently offset ranging from -150.00 to +50.00 dB with 0.01 dB resolution, and to toggle this function between **Couple** and **Man**. If set to **Couple**, this is coupled to **Rel Start** to make a flat limit line. If set to **Man**, **Abs Start** and **Rel Stop** you can enter different values to make a sloped limit line.

***RST:** Dependent upon Offset selected, please refer to the *User's Guide* for more details.

Range: -150 dB to 50 dB

Example: :MEAS:SEM:OFFS:LIST:STOP:RCAR -20 dB
:MEAS:SEM:OFFS:LIST:STOP:RCAR:COUP 0

Key access: **MEAS > Spectrum Emission Mask > Offset/Limits > More > Rel Stop**

Set the Fail Mask

```
:MEASure:SEMask:OFFSet:LIST:TEST ABSo-
lute|AND|OR|RELAtive,ABSolute|AND|OR|RELA-
tive,ABSolute|AND|OR|RELAtive,ABSolute|AND|OR|RE
Lative
:MEASure:SEMask:OFFSet[n]:LIST:TEST?
```

Displays the menu to select one of the following logic keys for fail conditions between the measurement results and the test limits: **Absolute**, **Relative**, **Abs AND Rel**, and **Abs OR Rel**. Please refer to *User's Guide* for further descriptions.

***RST:** Dependent upon Offset selected, please refer to the *User's Guide* for more details.

Example: :MEAS:SEM:OFFS:LIST:TEST ABS,REL,ABS AND REL,ABS
OR REL

Key access: **MEAS > Spectrum Emission Mask > Offset/Limits > More > More > Fail Mask**

Set the Sweep Time

```
:MEASure:SEMask:SWEeptime <number>  
:MEASure:SEMask:SWEeptime?
```

```
:MEASure:SEMask:SWEeptime:AUTO OFF|ON|0|1  
:MEASure:SEMask:SWEeptime:AUTO?
```

Specifies the sweep time used in measuring the power in the main channel.

***RST:** Auto

Range: 8.37 ms through 4 ks

Example: :MEAS:SEM:SWE 4 s

Key access: **MEAS > Spectrum Emission Mask > Ref Channel > Sweep Time**

Set the Meas Type

```
:MEASure:SEMask:TYPE TPref|PSDRef  
:MEASure:SEMask:TYPE?
```

Displays a menu where you can select a measurement reference type, **Total Pwr Ref** or **PSD Ref**.

***RST:** Total Pwr Ref

Example: :MEAS:SEM:TYPE TPref or SEM:TYPE PSDRef

Key access: **MEAS > Spectrum Emission Mask > Meas Type**

SENSe Subsystem

This subsystem provides the command used to set the instrument state parameters so that you can measure the input signal.

[:SENSe]:AVERage Subsection

Set the Average Count

```
[ :SENSe ]:AVERage:TRACe[1] | 2 | 3 | 4:COUNT <integer>
[ :SENSe ]:AVERage:TRACe[1] | 2 | 3 | 4:COUNT?
```

Specifies the number of measurements that are combined.

***RST:** 1

Range: 1 to 1000

Key access: TRACE > Average

Turn Averaging On/Off

```
[ :SENSe ]:AVERage:TRACe[1] | 2 | 3 | 4 [ :STATE ]
OFF | ON | 0 | 1
[ :SENSe ]:AVERage:TRACe[1] | 2 | 3 | 4 [ :STATE ]?
```

This command toggles averaging off and on. Averaging combines the value of successive measurements to average out measurement variations.

***RST:** Off

Key access: TRACE > Average On Off

Type of Averaging for Measurements

```
[ :SENSe] :AVERAge:TYPE LOGPower | POWer | VOLTage
[ :SENSe] :AVERAge:TYPE?
```

Use this command to select the averaging type for the measurement:

LOG POWER - Averages the data as appropriate for the logarithmic scaled y- axis.

Power - Converts the scale from logarithmic to linear power units, and then averages the power trace data.

Voltage - Averages the data as appropriate for the linearly scaled y- axis scale.

***RST:** log power

Key access: **BW/SWP > Average Type**

[:SENSe]:BANDwidth Subsection

Resolution Bandwidth

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

Specifies the resolution bandwidth.

Example: BAND 1 kHz

Range: 10 Hz to 3 MHz

Default Unit: Hz

Key access: **BW/SWP > RBW Auto Man**

Resolution Bandwidth Automatic

```
[ :SENSe]:BANDwidth|BWIDth[:RESolution]:AUTO
OFF|ON|0|1
[:SENSe]:BANDwidth|BWIDth[:RESolution]:AUTO?
```

Couples the resolution bandwidth to the frequency span.

***RST:** On

Example: BWID:AUTO On

Video Bandwidth

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

Specifies the video bandwidth.

***RST:** 3 MHz

Range: 1 Hz to 3 MHz. This range is dependent upon the setting of
[:SENSe]:BANDwidth|BWIDth[:RESolution].

Default Unit: Hz

Key access: **BW/SWP > VBW Auto Man**

Video Bandwidth Automatic

```
[ :SENSe]:BANDwidth|BWIDth:VIDeo:AUTO OFF|ON|0|1
[:SENSe]:BANDwidth|BWIDth:VIDeo:AUTO?
```

Couples the video bandwidth to the resolution bandwidth.

***RST:** On

Key access: **BW/SWP > VBW Auto Man**

Video to Resolution Bandwidth Ratio

```
[ :SENSE ] :BANDwidth | BWIDth :VIDeo :RATio <number>  
[ :SENSE ] :BANDwidth | BWIDth :VIDeo :RATio ?
```

Specifies the ratio of the video bandwidth to the resolution bandwidth.

***RST:** 1.0

Range: 0.00001 to 3.0e6

Key access: **BW/SWP > VBW/RBW Ratio**

Video to Resolution Bandwidth Ratio Mode Select

```
[ :SENSE ] :BANDwidth | BWIDth :VIDeo :RATio :AUTO  
OFF | ON | 0 | 1  
[ :SENSE ] :BANDwidth | BWIDth :VIDeo :RATio :AUTO ?
```

Selects auto or manual mode for video bandwidth to resolution bandwidth ratio.

***RST:** Auto

Key access: **BW/SWP > VBW/RBW Auto Man**

[:SENSe]:DETECTOR Subsection

Automatic Detection Type Selected

```
[ :SENSe]:DETECTOR:AUTO OFF|ON|0|1
[ :SENSe]:DETECTOR:AUTO?
```

Switches automatically to the optimum detection type for typical measurements using the current instrument settings.

The detector type is average if any of these are on:

- Trace averaging when the Average Type is Power (RMS).

The detector type is sample if any of the following conditions are true:

- Trace averaging is on with average type of video
- Both max and min hold trace modes are on
- Resolution bandwidth is less than 1 kHz, and trace averaging is on

The detector type is negative peak if any trace is in min hold and no traces are in max hold.

The detector type is peak if the above conditions are off.

Manually changing the detector function turns Auto off.

***RST:** On

Key access: Trace > More > Detector

Type of Detection

```
[[:SENSE]:DETECTOR[:FUNCTION]NEGATIVE|POSITIVE|SAMPLE|AVERAGE|RMS|NORMAL
[:SENSE]:DETECTOR[:FUNCTION]?
```

Specifies the detection mode. For each trace interval (bucket), average detection displays the average of all the samples within the interval. The averaging can be done using two methods:

the power method (RMS)

the video method (Y Axis Units)

The method is controlled by **BW/SWP > Avg Type**.

- **Negative peak** detection displays the lowest sample taken during the interval being displayed.
- **Positive peak** detection displays the highest sample taken during the interval being displayed.
- **Sample** detection displays the sample taken during the interval being displayed, and is used primarily to display noise or noise-like signals. In sample mode, the instantaneous signal value at the present display point is placed into memory. This detection should not be used to make the most accurate amplitude measurement of non noise-like signals.
- **Average** detection is used when measuring the average value of the amplitude across each trace interval (bucket). The averaging method used by the average detector is set to either video or power as appropriate when the average type is auto coupled.
- **Normal** detection selects the maximum and minimum video signal values alternately. When selecting **Normal** detection, “Norm” appears in the upper-left corner.

*PST: Positive

Key access: Trace > More > Detector

[:SENSE]:FREQUENCY Subsection

Center Frequency

```
[ :SENSE]:FREQUENCY:CENTER <freq>
[ :SENSE]:FREQUENCY:CENTER UP|DOWN
[ :SENSE]:FREQUENCY:CENTER?
```

Set the center frequency.

***RST:** 1.500 GHz
Range: -80 MHz to 3.08 GHz
Key access: **FREQ > Center Freq**

Center Frequency Step Size Automatic

```
[ :SENSE]:FREQUENCY:CENTER:STEP:AUTO OFF|ON|0|1
[ :SENSE]:FREQUENCY:CENTER:STEP:AUTO?
```

Specifies whether the step size is set automatically based on the span.

***RST:** On
Key access: **FREQ > CF Step Auto Man**

Center Frequency Step Size

```
[ :SENSE]:FREQUENCY:CENTER:STEP[: INCREMENT]
<freq>
[ :SENSE]:FREQUENCY:CENTER:STEP[: INCREMENT]?
```

Specifies the center frequency step size.

***RST:** Span/10
Key access: **FREQ > CF Step Man**

Frequency Span

```
[ :SENSe ] :FREQuency:SPAN <freq>  
[ :SENSe ] :FREQuency:SPAN?
```

Set the frequency span. Setting the span to 0 Hz puts the analyzer into zero span.

***RST:** 3.0 GHz
Default Unit: Hz
Key access: **FREQ > Span | Zero Span**

Full Frequency Span

```
[ :SENSe ] :FREQuency:SPAN:FULL
```

Set the frequency span to full scale.

***RST:** 3.0 GHz
Key access: **FREQ > Full Span**

Last Frequency Span

```
[ :SENSe ] :FREQuency:SPAN:PREVIOUS
```

Set the frequency span to the previous span setting.

Key access: **FREQ > Last Span**

Start Frequency

```
[ :SENSe ] :FREQuency:START <freq>  
[ :SENSe ] :FREQuency:START?
```

Set the start frequency.

***RST:** 0 Hz
Range: -80 MHz - 3.080 GHz
Default Unit: Hz
Key access: **FREQ > Start Freq**

Stop Frequency

```
[[:SENSE]:FREQUENCY:STOP <freq>
[:SENSE]:FREQUENCY:STOP?
```

Set the stop frequency.

***RST:** 3.0 GHz
Default Unit: Hz
Key access: **FREQ > Stop Freq**

[[:SENSE]:POWER Subsection**Input Attenuation**

```
[[:SENSE]:POWER[:RF]:ATTENUATION <rel_amp1>
[:SENSE]:POWER[:RF]:ATTENUATION?
```

Set the input attenuator. This value is set at its auto value if input attenuation is set to auto.

***RST:** 20 dB
Range: 0 to 70 dB
Default Unit: dB
Key access: **AMPTD > Attenuation Auto Man**

Input Port Attenuator Auto

```
[[:SENSE]:POWER[:RF]:ATTENUATION:AUTO OFF|ON|0|1
[:SENSE]:POWER[:RF]:ATTENUATION:AUTO?
```

Select the input port attenuator range to be set either automatically (On) by the Reference Level Setting or manually (Off).

***RST:** On
Key access: **AMPTD > Attenuation**

Input Port Power Gain

```
[ :SENSe] :POWer [ :RF] :GAIN [ :STATe] OFF | ON | 0 | 1
[ :SENSe] :POWer [ :RF] :GAIN [ :STATe] ?
```

Turns the internal preamp on or off.

***RST:** Off

Remarks: This command is only available with Option PA3 installed.

Key access: **AMPTD > Preamp On Off**

[:SENSe] :SWEEp Subsection**Sweep Time**

```
[ :SENSe] :SWEEp :TIME <time>
[ :SENSe] :SWEEp :TIME ?
```

Specifies the time in which the instrument sweeps the display.

***RST:** 100.2 ms

Default Unit: seconds

Remarks: A span value of 0 Hz causes the analyzer to enter zero span mode. In zero span the X-axis represents time rather than frequency.

Key access: **BW/SWP > Sweep Time Auto Man**

Automatic Sweep Time

```
[ :SENSe] :SWEEp :TIME :AUTO OFF | ON | 0 | 1
[ :SENSe] :SWEEp :TIME :AUTO ?
```

Automatically selects the fastest sweep time for the current settings.

***RST:** On

Key access: **BW/SWP > Sweep Time Auto Man**

Sweep Mode

```
[ :SENSe] :SWEep:TIME:AUTO:MODE NORMAl | FAST
[ :SENSe] :SWEep:TIME:AUTO:MODE?
```

Specifies the type of automatic coupling for the fastest sweep time at the current settings.

***RST:** On

Key access: **BW/SWP > Sweep > Sweep Mode Normal/Fast**

TD Mode

```
[ :SENSe] :SWEep:TDMoDe OFF | ON | 0 | 1
[ :SENSe] :SWEep:TDMoDe?
```

This command toggles the TD mode between on and off.

***RST:** On

Key access: **BW/SWP > Sweep > TD Mode**

SYSTEM Subsystem

This subsystem is used to set the controls and parameters associated with the overall system communication. These functions are not related to instrument performance.

Set Time

```
:SYSTEM:TIME <hh>, <mm>, <ss>
:SYSTEM:TIME?
```

Sets the time of the real-time clock of the instrument.

Hour must be an integer 0 to 23.

Minute must be an integer 0 to 59.

Second must be an integer 0 to 59.

Key access: **SYS > Setting > General > Time/Date > Time**

Set Date

```
:SYSTEM:DATE <mm>, <dd>, <yyyy>
:SYSTEM:DATE?
```

Sets the date of the real-time clock of the instrument. Year is a 4-digit integer. Month is an integer 1 to 12. Day is an integer 1 to 31 (depending on the month)

Key access: **SYS > Setting > General > Time/Date > Date**

Error Information Query

```
:SYSTEM:ERROR[:NEXT]?
```

This command queries the earliest entry to the error queue and then deletes that entry. *CLS clears the entire error queue.

Key access: **SYS > More > Show Errors**

Power on Type

```
:SYSTem:CONFigure:PORT REF|TRIGger
:SYSTem:CONFigure:PORT?
```

This command toggles the channel for external input between reference and trigger signal.

Key access: **SYS > Input/Output > Ext Input Trig/Ref**

Restart

```
:SYSTem:POWer:RESet
```

Use this command to restart the instrument.

Power Off

```
:SYSTem:POWer:OFF
```

Use this command to power off the instrument. This command has the same effect as Power hardkey on the front panel.

Low Frequency Channel

```
:SYSTem:CHANnel OFF|ON|0|1
:SYSTem:CHANnel?
```

Use this command to switch the signal channel to low frequency channel.

Screen save

```
:SYSTem:FILE:SAVE SCReen
```

Use this command to capture the instrument screen into the pre-defined saving path.

TGENerator Subsystem

The TGENerator subsystem controls the use of the tracking generator mode of the analyzer. Use the command `:INSTrument[:SElect] TGENerator` to access this subsystem.

Output Amplitdue

```
:TGENerator:AMPLitude <ampt>
:TGENerator:AMPLitude?
```

***RST:** -20 dBm

Range: 0 to -30 dBm

Key access: **Meas > Amplitude**

Amplitude On/Off

```
:TGENerator:AMPLitude:STATE OFF|ON|0|1
:TGENerator:AMPLitude:STATE?
```

This command toggles the state of tracking generator between on and off.

***RST:** Off

Key access: **Meas > Amplitude On Off**

Amplitude Step

```
:TGENerator:AMPLitude:STEP <ampt>
:TGENerator:AMPLitude:STEP?
```

This command sets the amplitude step size of the tracking generator output. This command is valid after tracking generator is enabled.

***RST:** Off

Key access: **Meas > Amptd Step**

Amplitude Offset

```
:TGENERator:AMPLitude:OFFSet <ampt>
```

This command sets the amplitude offset of the tracking generator output. This command is valid after tracking generator is enabled.

***RST:** 0 dB

Key access: Meas > Amptd Offset

Storing as Reference

```
:TGENERator:NORMALize:REF
```

This command stores the current trace to Trace 4 as a reference. This command is valid after tracking generator is enabled.

Key access: Meas > Normalize > Store Ref

Normalization

```
:TGENERator:NORMALize:STATE OFF|ON|0|1
```

```
:TGENERator:NORMALize:STATE?
```

This command toggles the normalization between on and off.

***RST:** Off

Key access: Meas > Normalize > Normalize On/Off

Normalization Reference Level

```
:TGENERator:NORMALize:LEVEL <para>
```

```
:TGENERator:NORMALize:LEVEL?
```

Use this command to set the normalization reference level.

***RST:** 0 dB

Range: -327.6 to 327.6 dB

Key access: Meas > Normalize > Norm Ref Lvl

Normalization Reference Position

:TGENERator:NORMALize:POSN <para>

:TGENERator:NORMALize:POSN?

Use this command to set the normalization reference position.

***RST:** 0 dB

Range: -327.6 to 327.6 dB

Key access: Meas > Normalize > Norm Ref Lvl

Reference Trace

:TGENERator:NORMALize:TRACe VIEW|BLANk

:TGENERator:NORMALize:TRACe?

This command toggles the reference trace display between VIEW and BLANk.

Select VIEW to hold and display the amplitude data of the selected trace. If a trace is deactivated by Blank, the stored trace data can be retrieved by View.

Select BLANk to store the amplitude data for the selected trace and removes it on the screen.

***RST:** BLANk

Key access: Meas > Normalize > Ref Trace

TRACe Subsystem

The TRACe subsystem controls access to the internal trace memory of the analyzer.

Select Trace Display Mode

```
:TRACe1|2|3|4:MODE WRITE|MAXHold|MIN-
Hold|VIEW|BLANk
:TRACe1|2|3|4:MODE?
```

Selects the display mode for the selected trace.

Write puts the trace in the normal mode, updating the data.

Maximum hold displays the highest measured trace value for all the data that has been measured since the function was turned on.

Minimum hold displays the lowest measured trace value for all the data that has been measured since the function was turned on.

View turns on the trace data so that it can be viewed on the display.

Blank turns off the trace data so that it is not viewed on the display.

Key access: TRACE > Clear Write | Max Hold | Min Hold | View | Blank

Trace data

```
:TRACe1|2|3|4[:DATA]?
```

This query command returns the current displayed data.

Trace format

```
:TRACe:FORMAt ASCii|REAL
:TRACe:FORMAt?
```

This command toggles the trace format between ASCii and real.

TRIGger Subsystem

The TRIGger subsystem is used to set the controls and parameters associated with triggering the data acquisitions. This subsystem is only valid when the analyzer is in zero span.

External Trigger Slope

```
:TRIGger[:SEquence]:EXTernal[1]:SLOPe POSi-
tive|NEGative
:TRIGger[:SEquence]:EXTernal[1]:SLOPe?
```

This command activates the trigger condition that allows the next sweep to start when the external voltage (connected to **EXT TRIG IN** connector) passes through approximately 1.5 volts. The external trigger signal must be a 0 V to +5 V TTL signal. This function only controls the trigger polarity (for positive or negative-going signals).

Before you set the trigger slope, The external trigger source must be selected using the command

```
:TRIGger[:SEquence]:SOURce EXTernal.
```

***RST:** Positive

Key access: **SPAN > Trigger > Ext Rise/Fall**

Trigger Source

```
:TRIGger[:SEquence]:SOURce IMMedi-
ate|VIDeo|EXTernal
:TRIGger[:SEquence]:SOURce?
```

Specifies the source (or type) of triggering used to start a measurement.

Immediate is free-run triggering

Video triggers on the video signal level

External allows you to connect an external trigger source

***RST:** Immediate (free-run triggering)

Remarks: Free-run activates the trigger condition that allows the next sweep to start as soon as possible after the last sweep.

Key access: **SPAN > Trigger > Free Run | Video | Ext Rise/Fall**

Video Trigger Level Amplitude

```
:TRIGger[:SEquence]:VIDEo:LEVEl <ampl>
:TRIGger[:SEquence]:VIDEo:LEVEl?
```

Specifies the level at which a video trigger will occur. Video is adjusted using this command, but must also be selected using the command `:TRIGger[:SEquence]:SOURce VIDEo`.

***RST:** 2.5 divisions below reference level

Range: 10 display divisions below reference level to reference level

Default Unit: current amplitude units

Key access: **SPAN > Trigger > Video**

Trigger Delay Time

```
:TRIGger[:SEquence]:DELaytime <time>
:TRIGger[:SEquence]:DELaytime?
```

Specifies trigger delay time for video or external trigger signal.

***RST:** 6 μ s

Key access: **SPAN > Trigger > Video**

UNIT Subsystem

Select Power Units of Measure

```
:UNIT:POWer DBM|DBMV|DBUV|DBUA|V|W|A  
:UNIT:POWer?
```

Specifies amplitude units for the input, output and display.

***RST:** dBm in log amplitude scale
Volts in linear amplitude scale

Key access: **AMPTD > More > Y Axis**

EMF Mode

```
:UNIT:POWer:EMF ON|OFF|1|0  
:UNIT:POWer:EMF?
```

This command toggles the EMF mode between on and off. EMF mode is available when the Y Axis Unit is dBmV, dB μ V or V. This mode is used to measure the port voltage in open circuit.

***RST:** Off

Key access: **AMPTD > More > EMF Mode**