Keysight InfiniiVision 1000 X-Series Oscilloscopes

KEYSIGHT TECHNOLOGIES

Programmer's Guide

Notices

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Safety Notices

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

In This Book

This book is your guide to programming the 1000 X-Series oscilloscopes:

Table 1 1000 X-Series Model Numbers, Bandwidths

Model:	EDUX1002A	EDUX1002G	DSOX1102A	DSOX1102G
Channels:	2			
Bandwidth:	50 MHz		70 MHz, 100 MHz with DSOX1B7T102 upgrade	
Sampling rate:	1 GSa/s		2 GSa/s	
Memory:	100 kpts		1 Mpts	
Segmented memory:	No		Yes	
Waveform generator:	No	Yes (20 MHz)	No	Yes (20 MHz)
Mask/limit test:	No		Yes	

The first few chapters describe how to set up and get started:

- Chapter 1, "What's New," starting on page 25, describes programming command changes in the latest version of oscilloscope software.
- Chapter 2, "Setting Up," starting on page 31, describes the steps you must take before you can program the oscilloscope.
- Chapter 3, "Getting Started," starting on page 37, gives a general overview of oscilloscope program structure and shows how to program the oscilloscope using a few simple examples.
- Chapter 4, "Commands Quick Reference," starting on page 49, is a brief listing of the 1000 X-Series oscilloscope commands and syntax.

The next chapters provide reference information on common commands, root level commands, other subsystem commands, and error messages:

- Chapter 5, "Common (*) Commands," starting on page 105, describes commands defined by the IEEE 488.2 standard that are common to all instruments.
- Chapter 6, "Root (:) Commands," starting on page 131, describes commands that reside at the root level of the command tree and control many of the basic functions of the oscilloscope.
- Chapter 7, ":ABUS Commands," starting on page 163, describes commands that control all oscilloscope functions associated with the analog channels bus display.
- Chapter 8, ":ACQuire Commands," starting on page 173, describes commands for setting the parameters used when acquiring and storing data.
- Chapter 9, ":CALibrate Commands," starting on page 187, describes utility commands for determining the state of the calibration factor protection button.

- Chapter 10, “:CHANnel<n> Commands,” starting on page 197, describes commands that control all oscilloscope functions associated with individual analog channels or groups of channels.
- Chapter 11, “:DEMO Commands,” starting on page 219, describes commands that control the education kit (EDK license) demonstration signals that can be output on the oscilloscope's Demo terminal.
- Chapter 12, “:DISPlay Commands,” starting on page 223, describes commands that control how waveforms, graticule, and text are displayed and written on the screen.
- Chapter 13, “:DVM Commands,” starting on page 237, describes commands that control the optional DSOXDVM digital voltmeter analysis feature.
- Chapter 14, “:EXTernal Trigger Commands,” starting on page 245, describes commands that control the input characteristics of the external trigger input.
- Chapter 15, “:FFT Commands,” starting on page 255, describes commands that control the FFT (Fast Fourier Transform) function for displaying the frequence content of a waveform.
- Chapter 16, “:FRANalysis Commands,” starting on page 269, describes commands that control oscilloscope functions associated with the Frequency Response Analysis (FRA) feature, which is available in G-suffix oscilloscope models (that have a built-in waveform generator).
- Chapter 17, “:FUNCtion Commands,” starting on page 281, describes commands that control math waveforms.
- Chapter 18, “:HARDcopy Commands,” starting on page 303, describes commands that set and query the selection of hardcopy device and formatting options.
- Chapter 19, “:MARKer Commands,” starting on page 315, describes commands that set and query the settings of X-axis markers (X1 and X2 cursors) and the Y-axis markers (Y1 and Y2 cursors).
- Chapter 20, “:MEASure Commands,” starting on page 331, describes commands that select automatic measurements (and control markers).
- Chapter 21, “:MTESt Commands,” starting on page 383, describes commands that control the mask test features provided with Option LMT.
- Chapter 22, “:RECall Commands,” starting on page 417, describes commands that recall previously saved oscilloscope setups, reference waveforms, or masks.
- Chapter 23, “:SAVE Commands,” starting on page 425, describes commands that save oscilloscope setups, screen images, and data.
- Chapter 24, “:SBUS<n> Commands,” starting on page 445, describes commands that control oscilloscope functions associated with the serial decode bus and serial triggering.
- Chapter 25, “:SYSTem Commands,” starting on page 529, describes commands that control basic system functions of the oscilloscope.

- Chapter 26, “:TIMebase Commands,” starting on page 553, describes commands that control all horizontal sweep functions.
- Chapter 27, “:TRIGger Commands,” starting on page 565, describes commands that control the trigger modes and parameters for each trigger type.
- Chapter 28, “:WAVeform Commands,” starting on page 613, describes commands that provide access to waveform data.
- Chapter 29, “:WGEN Commands,” starting on page 649, describes commands that control waveform generator (Option WGN) functions and parameters.
- Chapter 30, “:WMEMory<r> Commands,” starting on page 681, describes commands that control reference waveforms.
- Chapter 31, “Obsolete and Discontinued Commands,” starting on page 691, describes obsolete commands which still work but have been replaced by newer commands and discontinued commands which are no longer supported.
- Chapter 32, “Error Messages,” starting on page 737, lists the instrument error messages that can occur while programming the oscilloscope.

The command descriptions in this reference show upper and lowercase characters. For example, :AUToscale indicates that the entire command name is :AUTOSCALE. The short form, :AUT, is also accepted by the oscilloscope.

Then, there are chapters that describe programming topics and conceptual information in more detail:

- Chapter 33, “Status Reporting,” starting on page 745, describes the oscilloscope's status registers and how to check the status of the instrument.
- Chapter 34, “Synchronizing Acquisitions,” starting on page 765, describes how to wait for acquisitions to complete before querying measurement results or performing other operations with the captured data.
- Chapter 35, “More About Oscilloscope Commands,” starting on page 775, contains additional information about oscilloscope programming commands.

Finally, there is a chapter that contains programming examples:

- Chapter 36, “Programming Examples,” starting on page 785.

See Also

- For more information on using the SICL, VISA, and VISA COM libraries in general, see the documentation that comes with the Keysight IO Libraries Suite.
- For information on controller PC interface configuration, see the documentation for the interface card used (for example, the Keysight 82350A GPIB interface).
- For information on oscilloscope front-panel operation, see the *User's Guide*.
- For detailed connectivity information, refer to the *Keysight Technologies USB/LAN/GPIB Connectivity Guide*. For a printable electronic copy of the *Connectivity Guide*, direct your Web browser to www.keysight.com and search for "Connectivity Guide".

- For the latest versions of this and other manuals, see:
  http://www.keysight.com/find/1000X-Series-manual

Contents

1 What's New

KEYSIGHT TECHNOLOGIES

Version 1.00 at Introduction

The Keysight InfiniiVision 1000 X-Series oscilloscopes were introduced with version 1.00 of oscilloscope operating software.

The command set is most closely related to the InfiniiVision 2000 X-Series oscilloscopes (and the 7000 Series, 6000 Series, and 54620/54640 Series oscilloscopes before them). For more information, see "Command Differences From 2000 X-Series Oscilloscopes" on page 27.

Command Differences From 2000 X-Series Oscilloscopes

The Keysight InfiniiVision 1000 X-Series oscilloscopes command set is most closely related to the InfiniiVision 2000 X-Series oscilloscopes (and the 7000 Series, 6000 Series, and 54620/54640 Series oscilloscopes before them).

The main differences between the version 2.50 programming command set for the InfiniiVision 1000 X-Series oscilloscopes and the 2.40 programming command set for the InfiniiVision 2000 X-Series oscilloscopes are related to:

- You can define a bus made up of analog channels. (There are no digital channels in the 1000 X-Series oscilloscopes from which to display buses.)
- Dedicated FFT function (and selectable math function).
- Frequency Response Analysis feature on models with a built-in waveform generator.
- I2C and UART/RS232 serial decode and triggering is supported on all models. Additionally, CAN, LIN, and SPI serial decode and triggering is supported on the DSOX1000-Series oscilloscopes.
- The Ext Trig input can be displayed as a digital waveform whose high and low values are determined by the threshold voltage setting.
- Waveform event search is not supported.
- There is no LAN interface (only USB is supported).
- The EDUX1000-Series oscilloscopes do not have the PATTern trigger mode.
- The DSOX1000-Series oscilloscopes add the SHOLd (setup and hold) and TRANsition trigger modes (that were in the 3000 X-Series oscilloscopes).

More detailed descriptions of the new, changed, obsolete, and discontinued commands appear below.

New Commands

Command	Description
:ABUS Commands (see page 163)	Commands for using buses made up of analog channels.
:DISPlay:MENU:TIMeout (see page 234)	Sets the softkey menu timeout period.
:EXTernal:DISPlay (see page 248)	Turns the external trigger input display on or off.
:EXTernal:LABel (see page 249)	Sets the external trigger input's digital waveform label.
:EXTernal:LEVel (see page 250)	Sets the external trigger input threshold (trigger) voltage level.
:EXTernal:POSition (see page 251)	Sets the external trigger input waveform's vertical position.

Command	Description
:FFT Commands (see page 255)	Commands for using the FFT function feature.
:FRANalysis Commands (see page 269)	Commands for using the Frequency Response Analysis feature.
:FUNCtion[:FFT]:PHASe:REFerence (see page 286)	Sets the reference point for calculating the FFT Phase function to either the trigger point or beginning of the displayed waveform.
:FUNCtion:FREQuency:LOWPass (see page 290)	Sets the low-pass filter's -3 dB cutoff frequency.
:MEASure:BRATe (see page 342)	Bit rate measurement.
:MEASure:COUNter (see page 344)	Hardware frequency counter measurement.
:MEASure:NDUTy (see page 353)	Negative duty cycle measurement.
:MEASure:SDEViation (see page 362)	Std deviation measurement.
:MEASure:XMAX (see page 380)	X-at-Max-Y measurement.
:MEASure:XMIN (see page 381)	X-at-Min-Y measurement.
:SYSTem:RLOGger (see page 542)	Enables or disables remote command logging, optionally specifying the log file name and write mode.
:SYSTem:RLOGger:DESTination (see page 543)	Specifies whether remote commands are logged to a text file (on a connected USB storage device), logged to the screen, or both.
:SYSTem:RLOGger:DISPlay (see page 544)	Enables or disables the screen display of logged remote commands and their return values (if applicable).
:SYSTem:RLOGger:FNAMe (see page 545)	Specifies the remote command log file name.
:SYSTem:RLOGger:STATe (see page 546)	Enables or disables remote command logging.
:SYSTem:RLOGger:TRANsparent (see page 547)	Specifies whether the screen display background for remote command logging is transparent or solid.
:SYSTem:RLOGger:WMODe (see page 548)	Specifies the remote command logging write mode (either CREate or APPend).
:TRIGger:SHOLd Commands (see page 596)	For setting up setup and hold triggers (previously in 3000 X-Series oscilloscopes).

Command	Description
:TRIGger:TRANsition Commands (see page 602)	For setting up transition triggers (previously in 3000 X-Series oscilloscopes).
:WGEN:OUTPut:POLarity (see page 673)	Lets you invert the waveform generator output.

Changed Commands

Command	Differences From InfiniiVision 2000 X-Series Oscilloscopes
:BLANk (see page 140)	FFT, ABUS, and EXT sources are available.
:CALibrate:OUTPut (see page 191)	This command controls the Gen Out output signal (instead of TRIG OUT). There is no waveform generator sync output signal.
:DIGitize (see page 141)	FFT, ABUS, and EXT sources are available.
:FUNCtion[:FFT]:VTYPe (see page 288)	With the FFTPhase operation, you can select vertical units in DEGRees or RADians.
:MARKer:X1Y1source (see page 320)	FFT and EXTernal sources are available.
:MEASure:DEFine (see page 345)	FFT source is available.
:MEASure:DUTYcycle (see page 350)	EXTernal source is available.
:MEASure:FREQuency (see page 352)	EXTernal source is available.
:MEASure:NWIDth (see page 354)	EXTernal source is available.
:MEASure:PERiod (see page 357)	EXTernal source is available.
:MEASure:PWIDth (see page 360)	EXTernal source is available.
:MEASure:TEDGe (see page 366)	EXTernal source is available.
:MEASure:VAVerage (see page 371)	FFT source is available.
:MEASure:VMAX (see page 373)	FFT source is available.
:MEASure:VMIN (see page 371)	FFT source is available.
:MEASure:VPP (see page 375)	FFT source is available.
:MEASure:VTIMe (see page 377)	EXTernal source is available.

Command	Differences From InfiniiVision 2000 X-Series Oscilloscopes
:STATus (see page 159)	FFT and ABUS sources are available.
:TRIGger:LEVel:HIGH (see page 572)	EXTernal source is available.
:TRIGger:LEVel:LOW (see page 573)	EXTernal source is available.
:TRIGger:MODE (see page 574)	SHOLd and TRANsition modes, as well as the PATTern mode, are available for DSOX1000-Series oscilloscopes.
:TRIGger:PATTern (see page 592)	EXTernal can be used as an edge source.
:VIEW (see page 162)	FFT, ABUS, and EXT sources are available.
:WAVeform:SOURce (see page 634)	FFT, ABUS, and EXT sources are available.

Obsolete Commands

Obsolete Command	Current Command Equivalent	Behavior Differences

Discontinued Commands

Command	Description
:BUS Commands	There are no digital channels.
:DIGital Commands	
:HARDcopy:NETWork:ADDRess	There is no LAN interface on the 1000 X-Series oscilloscopes.
:HARDcopy:NETWork:APPLy	
:HARDcopy:NETWork:DOMain	
:HARDcopy:NETWork:PASSword	
:HARDcopy:NETWork:SLOT	
:HARDcopy:NETWork:USERname	
:LISTer Commands	Lister for serial decode is not supported.
:POD Commands	There are no digital channels.
:SEARch Commands	Searching serial decode is not supported.

2 Setting Up

This chapter explains how to install the Keysight IO Libraries Suite software, connect the oscilloscope to the controller PC, set up the oscilloscope, and verify the oscilloscope connection.

Step 1. Install Keysight IO Libraries Suite software

1 Download the Keysight IO Libraries Suite software from the Keysight web site at:
   - http://www.keysight.com/find/iolib
2 Run the setup file, and follow its installation instructions.

Step 2. Connect and set up the oscilloscope

The 1000 X-Series oscilloscope has one interface you can use for programming:

- USB (device port).

This interface is always active.

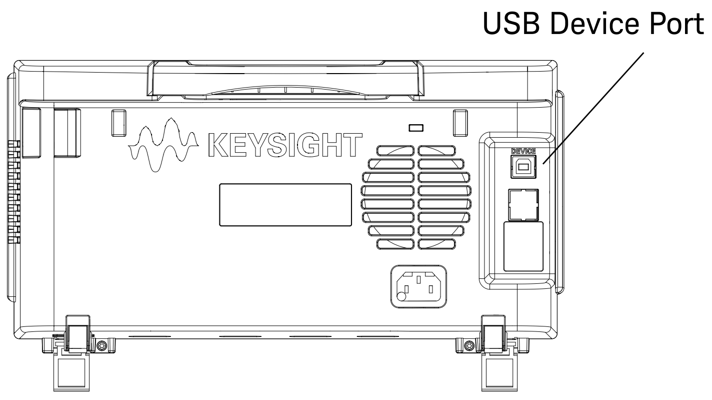


Figure 1 Control Connector on Rear Panel

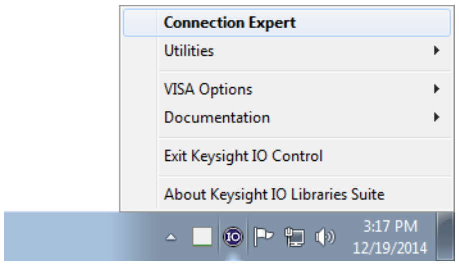
Using the USB (Device) Interface

1 Connect a USB cable from the controller PC's USB port to the "USB DEVICE" port on the back of the oscilloscope.

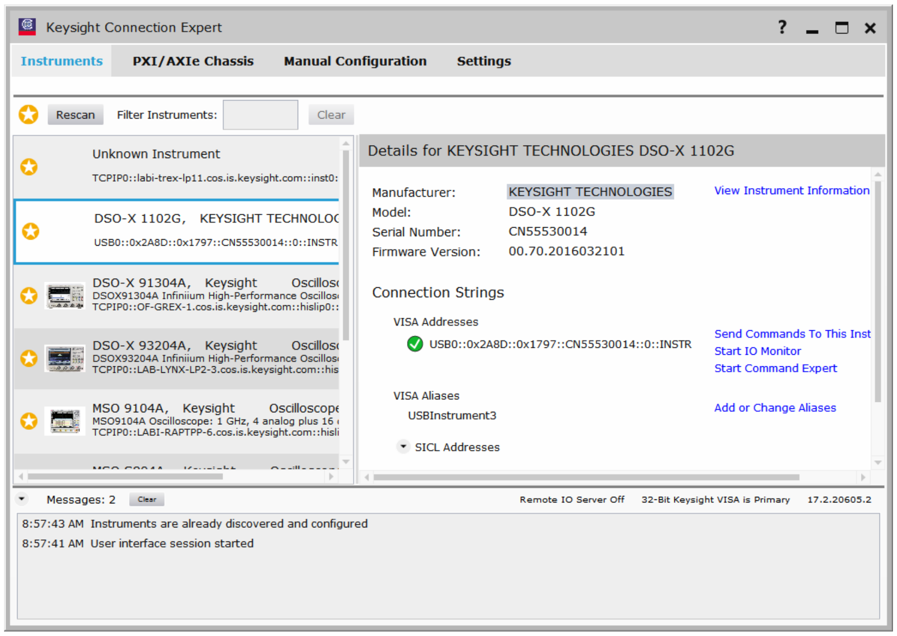
This is a USB 2.0 high-speed port.

Step 3. Verify the oscilloscope connection

1. On the controller PC, click on the Keysight IO Control icon in the taskbar and choose **Connection Expert** from the popup menu.



2. In the Keysight Connection Expert application, instruments connected to the controller's USB interface should automatically appear in the Instruments tab.



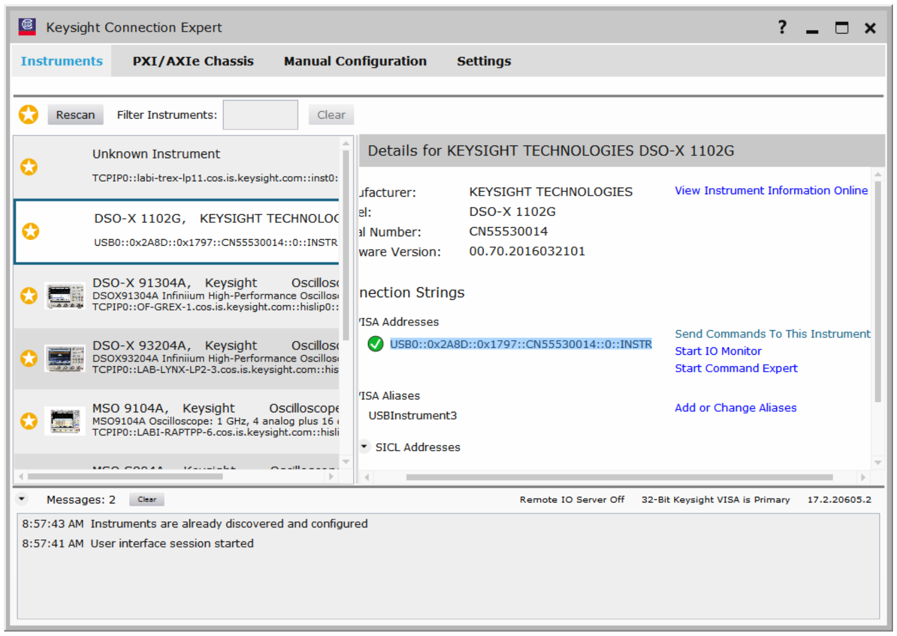
```
Unknown Instrument
TCPIP0::labi-trex-lp11.cos.is.keysight.com::inst0:

DSO-X 1102G,   KEYSIGHT TECHNOLOG
USB0::0x2A8D::0x1797::CN55530014::0::INSTR

DSO-X 91304A,   Keysight      Oscillos
DSOX91304A Infiniium High-Performance Oscillos
TCPIP0::OF-GREX-1.cos.is.keysight.com::hislip0::

DSO-X 93204A,   Keysight      Oscillos
DSOX93204A Infiniium High-Performance Oscillos
TCPIP0::LAB-LYNX-LP2-3.cos.is.keysight.com::his

MSO 9104A,   Keysight      Oscilloscope
MSO9104A Oscilloscope: 1 GHz, 4 analog plus 16
TCPIP0::LABI-RAPTPP-6.cos.is.keysight.com::hisli
```

```
Details for KEYSIGHT TECHNOLOGIES DSO-X 1102G

Manufacturer:       KEYSIGHT TECHNOLOGIES        View Instrument Information
Model:              DSO-X 1102G
Serial Number:      CN55530014
Firmware Version:   00.70.2016032101

Connection Strings
  VISA Addresses
    USB0::0x2A8D::0x1797::CN55530014::0::INSTR   Send Commands To This Inst
                                                 Start IO Monitor
                                                 Start Command Expert
  VISA Aliases
    USBInstrument3                               Add or Change Aliases

  SICL Addresses
```

```
Messages: 2   Clear        Remote IO Server Off   32-Bit Keysight VISA is Primary   17.2.20605.2
8:57:43 AM  Instruments are already discovered and configured
8:57:41 AM  User interface session started
```

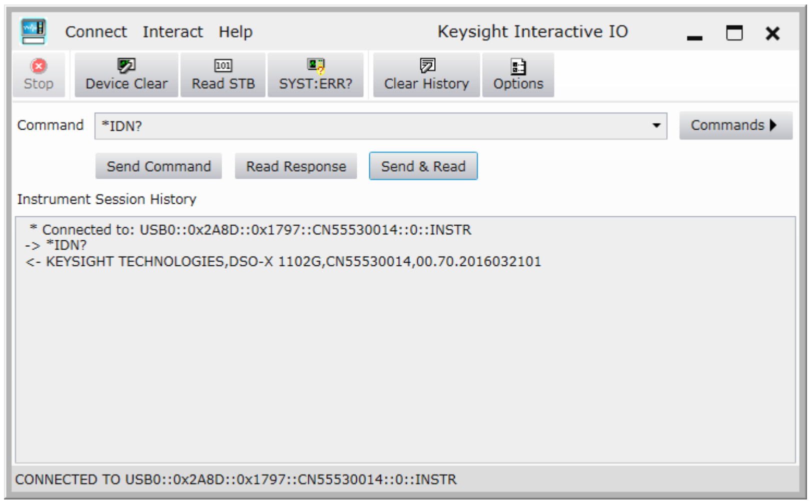
3 Test some commands on the instrument:

a In the Details for the selected instrument, click **Send Commands To This Instrument**.



```
Unknown Instrument
TCPIP0::labi-trex-lp11.cos.is.keysight.com::inst0:
DSO-X 1102G,   KEYSIGHT TECHNOLOG
USB0::0x2A8D::0x1797::CN55530014::0::INSTR
DSO-X 91304A,   Keysight   Oscillosc
DSOX91304A Infiniium High-Performance Oscillos
TCPIP0::OF-GREX-1.cos.is.keysight.com::hislip0::
DSO-X 93204A,   Keysight   Oscillosc
DSOX93204A Infiniium High-Performance Oscillos
TCPIP0::LAB-LYNX-LP2-3.cos.is.keysight.com::his
MSO 9104A,   Keysight   Oscilloscope
MSO9104A Oscilloscope: 1 GHz, 4 analog plus 16
TCPIP0::LABI-RAPTPP-6.cos.is.keysight.com::hisli

Details for KEYSIGHT TECHNOLOGIES DSO-X 1102G
ufacturer:        KEYSIGHT TECHNOLOGIES
el:               DSO-X 1102G
l Number:         CN55530014
ware Version:     00.70.2016032101

nection Strings
ISA Addresses
 USB0::0x2A8D::0x1797::CN55530014::0::INSTR
ISA Aliases
 USBInstrument3
 SICL Addresses

Remote IO Server Off   32-Bit Keysight VISA is Primary   17.2.20605.2
8:57:43 AM  Instruments are already discovered and configured
8:57:41 AM  User interface session started
```

b In the Keysight Interactive IO application, enter commands in the **Command** field and press **Send Command**, **Read Response**, or **Send & Read**.



```
Command  *IDN?

Instrument Session History
 * Connected to: USB0::0x2A8D::0x1797::CN55530014::0::INSTR
-> *IDN?
<- KEYSIGHT TECHNOLOGIES,DSO-X 1102G,CN55530014,00.70.2016032101

CONNECTED TO USB0::0x2A8D::0x1797::CN55530014::0::INSTR
```

c Choose **Connect > Exit** from the menu to exit the Keysight Interactive IO application.

4 In the Keysight Connection Expert application, choose **File > Exit** from the menu to exit the application.

3 Getting Started

This chapter gives you an overview of programming the 1000 X-Series oscilloscopes. It describes basic oscilloscope program structure and shows how to program the oscilloscope using a few simple examples.

The getting started examples show how to send oscilloscope setup, data capture, and query commands, and they show how to read query results.

NOTE

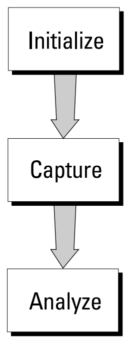
Language for Program Examples

The programming examples in this guide are written in Visual Basic using the Keysight VISA COM library.

KEYSIGHT TECHNOLOGIES

Basic Oscilloscope Program Structure

The following figure shows the basic structure of every program you will write for the oscilloscope.



Initializing

To ensure consistent, repeatable performance, you need to start the program, controller, and oscilloscope in a known state. Without correct initialization, your program may run correctly in one instance and not in another. This might be due to changes made in configuration by previous program runs or from the front panel of the oscilloscope.

- Program initialization defines and initializes variables, allocates memory, or tests system configuration.
- Controller initialization ensures that the interface to the oscilloscope is properly set up and ready for data transfer.
- Oscilloscope initialization sets the channel configuration, channel labels, threshold voltages, trigger specification, trigger mode, timebase, and acquisition type.

Capturing Data

Once you initialize the oscilloscope, you can begin capturing data for analysis. Remember that while the oscilloscope is responding to commands from the controller, it is not performing acquisitions. Also, when you change the oscilloscope configuration, any data already captured will most likely be rendered.

To collect data, you use the :DIGitize command. This command clears the waveform buffers and starts the acquisition process. Acquisition continues until acquisition memory is full, then stops. The acquired data is displayed by the oscilloscope, and the captured data can be measured, stored in acquisition memory in the oscilloscope, or transferred to the controller for further analysis. Any additional commands sent while :DIGitize is working are buffered until :DIGitize is complete.

You could also put the oscilloscope into run mode, then use a wait loop in your program to ensure that the oscilloscope has completed at least one acquisition before you make a measurement. Keysight does not recommend this because the needed length of the wait loop may vary, causing your program to fail. :DIGitize, on the other hand, ensures that data capture is complete. Also, :DIGitize, when complete, stops the acquisition process so that all measurements are on displayed data, not on a constantly changing data set.

Analyzing Captured Data

After the oscilloscope has completed an acquisition, you can find out more about the data, either by using the oscilloscope measurements or by transferring the data to the controller for manipulation by your program. Built-in measurements include: frequency, duty cycle, period, positive pulse width, and negative pulse width.

Using the :WAVeform commands, you can transfer the data to your controller. You may want to display the data, compare it to a known good measurement, or simply check logic patterns at various time intervals in the acquisition.

Programming the Oscilloscope

Referencing the IO Library

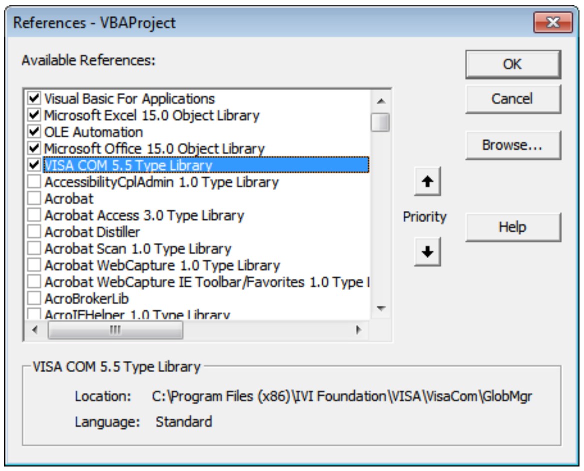
No matter which instrument programming library you use (SICL, VISA, or VISA COM), you must reference the library from your program.

In C/C++, you must tell the compiler where to find the include and library files (see the Keysight IO Libraries Suite documentation for more information).

To reference the Keysight VISA COM library in Visual Basic for Applications (VBA, which comes with Microsoft Office products like Excel):

1 Choose **Tools > References...** from the main menu.

2 In the References dialog, check the "VISA COM 5.5 Type Library".



Available References:

- ☑ Visual Basic For Applications
- ☑ Microsoft Excel 15.0 Object Library
- ☑ OLE Automation
- ☑ Microsoft Office 15.0 Object Library
- ☑ VISA COM 5.5 Type Library
- ☐ AccessibilityCplAdmin 1.0 Type Library
- ☐ Acrobat
- ☐ Acrobat Access 3.0 Type Library
- ☐ Acrobat Distiller
- ☐ Acrobat Scan 1.0 Type Library
- ☐ Acrobat WebCapture 1.0 Type Library
- ☐ Acrobat WebCapture IE Toolbar/Favorites 1.0 Type l
- ☐ AcroBrokerLib
- ☐ AcroIEHelper 1.0 Type Library

VISA COM 5.5 Type Library

Location: C:\Program Files (x86)\IVI Foundation\VISA\VisaCom\GlobMgr

Language: Standard

3 Click **OK**.

To reference the Keysight VISA COM library in Microsoft Visual Basic 6.0:

1. Choose **Project > References...** from the main menu.
2. In the References dialog, check the "VISA COM 5.5 Type Library".
3. Click **OK**.

Opening the Oscilloscope Connection via the IO Library

PC controllers communicate with the oscilloscope by sending and receiving messages over a remote interface. Once you have opened a connection to the oscilloscope over the remote interface, programming instructions normally appear as ASCII character strings embedded inside write statements of the programing language. Read statements are used to read query responses from the oscilloscope.

For example, when using the Keysight VISA COM library in Visual Basic (after opening the connection to the instrument using the ResourceManager object's Open method), the FormattedIO488 object's WriteString, WriteNumber, WriteList, or WriteIEEEBlock methods are used for sending commands and queries. After a query is sent, the response is read using the ReadString, ReadNumber, ReadList, or ReadIEEEBlock methods.

The following Visual Basic statements open the connection and send a command that turns on the oscilloscope's label display.

```
Dim myMgr As VisaComLib.ResourceManager
Dim myScope As VisaComLib.FormattedIO488

Set myMgr = New VisaComLib.ResourceManager
Set myScope = New VisaComLib.FormattedIO488

' Open the connection to the oscilloscope. Get the VISA Address from the
' Keysight Connection Expert (installed with Keysight IO Libraries Suite
).
Set myScope.IO = myMgr.Open("<VISA Address>")

' Send a command.
myScope.WriteString ":DISPlay:LABel ON"
```

The ":DISPLAY:LABEL ON" in the above example is called a *program message*. Program messages are explained in more detail in "Program Message Syntax" on page 777.

Initializing the Interface and the Oscilloscope

To make sure the bus and all appropriate interfaces are in a known state, begin every program with an initialization statement. When using the Keysight VISA COM library, you can use the resource session object's Clear method to clears the interface buffer:

```
Dim myMgr As VisaComLib.ResourceManager
Dim myScope As VisaComLib.FormattedIO488

Set myMgr = New VisaComLib.ResourceManager
Set myScope = New VisaComLib.FormattedIO488

' Open the connection to the oscilloscope. Get the VISA Address from the
' Keysight Connection Expert (installed with Keysight IO Libraries Suite
).
Set myScope.IO = myMgr.Open("<VISA Address>")

' Clear the interface buffer and set the interface timeout to 10 seconds
.
myScope.IO.Clear
myScope.IO.Timeout = 10000
```

When you are using GPIB, CLEAR also resets the oscilloscope's parser. The parser is the program which reads in the instructions which you send it.

After clearing the interface, initialize the instrument to a preset state:

```
myScope.WriteString "*RST"
```

NOTE

Information for Initializing the Instrument

The actual commands and syntax for initializing the instrument are discussed in Chapter 5, “Common (*) Commands,” starting on page 105.

Refer to the Keysight IO Libraries Suite documentation for information on initializing the interface.

Using :AUToscale to Automate Oscilloscope Setup

The :AUToscale command performs a very useful function for unknown waveforms by setting up the vertical channel, time base, and trigger level of the instrument.

The syntax for the autoscale command is:

```
myScope.WriteString ":AUToscale"
```

Using Other Oscilloscope Setup Commands

A typical oscilloscope setup would set the vertical range and offset voltage, the horizontal range, delay time, delay reference, trigger mode, trigger level, and slope. An example of the commands that might be sent to the oscilloscope are:

```
myScope.WriteString ":CHANnel1:PROBe 10"
myScope.WriteString ":CHANnel1:RANGe 16"
myScope.WriteString ":CHANnel1:OFFSet 1.00"
myScope.WriteString ":TIMebase:MODE MAIN"
myScope.WriteString ":TIMebase:RANGe 1E-3"
myScope.WriteString ":TIMebase:DELay 100E-6"
```

Vertical is set to 16 V full-scale (2 V/div) with center of screen at 1 V and probe attenuation set to 10. This example sets the time base at 1 ms full-scale (100 ms/div) with a delay of 100 µs.

Example Oscilloscope Setup Code

This program demonstrates the basic command structure used to program the oscilloscope.

```
' Initialize the instrument interface to a known state.
myScope.IO.Clear
myScope.IO.Timeout = 10000   ' Set interface timeout to 10 seconds.

' Initialize the instrument to a preset state.
myScope.WriteString "*RST"

' Set the time base mode to normal with the horizontal time at
' 50 ms/div with 0 s of delay referenced at the center of the
' graticule.
myScope.WriteString ":TIMebase:RANGe 5E-4"   ' Time base to 50 us/div.
myScope.WriteString ":TIMebase:DELay 0"      ' Delay to zero.
myScope.WriteString ":TIMebase:REFerence CENTer"   ' Display ref. at
                                                   ' center.

' Set the vertical range to 1.6 volts full scale with center screen
' at -0.4 volts with 10:1 probe attenuation and DC coupling.
myScope.WriteString ":CHANnel1:PROBe 10"     ' Probe attenuation
                                             ' to 10:1.
myScope.WriteString ":CHANnel1:RANGe 1.6"    ' Vertical range
                                             ' 1.6 V full scale.
myScope.WriteString ":CHANnel1:OFFSet -0.4"  ' Offset to -0.4.
myScope.WriteString ":CHANnel1:COUPling DC"  ' Coupling to DC.

' Configure the instrument to trigger at -0.4 volts with normal
' triggering.
myScope.WriteString ":TRIGger:SWEep NORMal"   ' Normal triggering.
myScope.WriteString ":TRIGger:LEVel -0.4"     ' Trigger level to -0.4.
myScope.WriteString ":TRIGger:SLOPe POSitive" ' Trigger on pos. slope.

' Configure the instrument for normal acquisition.
myScope.WriteString ":ACQuire:TYPE NORMal"   ' Normal acquisition.
```

Capturing Data with the :DIGitize Command

The :DIGitize command captures data that meets the specifications set up by the :ACQuire subsystem. When the digitize process is complete, the acquisition is stopped. The captured data can then be measured by the instrument or transferred to the controller for further analysis. The captured data consists of two parts: the waveform data record, and the preamble.

NOTE

Ensure New Data is Collected

When you change the oscilloscope configuration, the waveform buffers are cleared. Before doing a measurement, send the :DIGitize command to the oscilloscope to ensure new data has been collected.

When you send the :DIGitize command to the oscilloscope, the specified channel signal is digitized with the current :ACQuire parameters. To obtain waveform data, you must specify the :WAVeform parameters for the SOURce channel, the FORMat type, and the number of POINts prior to sending the :WAVeform:DATA? query.

NOTE

Set :TIMebase:MODE to MAIN when using :DIGitize

:TIMebase:MODE must be set to MAIN to perform a :DIGitize command or to perform any :WAVeform subsystem query. A "Settings conflict" error message will be returned if these commands are executed when MODE is set to ROLL, XY, or WINDow (zoomed). Sending the *RST (reset) command will also set the time base mode to normal.

The number of data points comprising a waveform varies according to the number requested in the :ACQuire subsystem. The :ACQuire subsystem determines the number of data points, type of acquisition, and number of averages used by the :DIGitize command. This allows you to specify exactly what the digitized information contains.

The following program example shows a typical setup:

```
myScope.WriteString ":ACQuire:TYPE AVERage"
myScope.WriteString ":ACQuire:COMPlete 100"
myScope.WriteString ":ACQuire:COUNt 8"
myScope.WriteString ":DIGitize CHANnel1"
myScope.WriteString ":WAVeform:SOURce CHANnel1"
myScope.WriteString ":WAVeform:FORMat BYTE"
myScope.WriteString ":WAVeform:POINts 500"
myScope.WriteString ":WAVeform:DATA?"
```

This setup places the instrument into the averaged mode with eight averages. This means that when the :DIGitize command is received, the command will execute until the signal has been averaged at least eight times.

After receiving the :WAVeform:DATA? query, the instrument will start passing the waveform information.

Digitized waveforms are passed from the instrument to the controller by sending a numerical representation of each digitized point. The format of the numerical representation is controlled with the :WAVeform:FORMat command and may be selected as BYTE, WORD, or ASCii.

The easiest method of transferring a digitized waveform depends on data structures, formatting available and I/O capabilities. You must scale the integers to determine the voltage value of each point. These integers are passed starting with the left most point on the instrument's display.

For more information, see the waveform subsystem commands and corresponding program code examples in Chapter 28, “:WAVeform Commands,” starting on page 613.

NOTE

Aborting a Digitize Operation Over the Programming Interface

When using the programming interface, you can abort a digitize operation by sending a Device Clear over the bus (for example, myScope.IO.Clear).

Reading Query Responses from the Oscilloscope

After receiving a query (command header followed by a question mark), the instrument interrogates the requested function and places the answer in its output queue. The answer remains in the output queue until it is read or another command is issued. When read, the answer is transmitted across the interface to the designated listener (typically a controller).

The statement for reading a query response message from an instrument's output queue typically has a format specification for handling the response message.

When using the VISA COM library in Visual Basic, you use different read methods (ReadString, ReadNumber, ReadList, or ReadIEEEBlock) for the various query response formats. For example, to read the result of the query command :CHANnel1:COUPling? you would execute the statements:

```
myScope.WriteString ":CHANnel1:COUPling?"
Dim strQueryResult As String
strQueryResult = myScope.ReadString
```

This reads the current setting for the channel one coupling into the string variable strQueryResult.

All results for queries (sent in one program message) must be read before another program message is sent.

Sending another command before reading the result of the query clears the output buffer and the current response. This also causes an error to be placed in the error queue.

Executing a read statement before sending a query causes the controller to wait indefinitely.

The format specification for handling response messages depends on the programming language.

Reading Query Results into String Variables

The output of the instrument may be numeric or character data depending on what is queried. Refer to the specific command descriptions for the formats and types of data returned from queries.

NOTE **Express String Variables Using Exact Syntax**

In Visual Basic, string variables are case sensitive and must be expressed exactly the same each time they are used.

The following example shows numeric data being returned to a string variable:

```
myScope.WriteString ":CHANnel1:RANGe?"
Dim strQueryResult As String
strQueryResult = myScope.ReadString
MsgBox "Range (string):" + strQueryResult
```

After running this program, the controller displays:

Range (string): +40.0E+00

Reading Query Results into Numeric Variables

The following example shows numeric data being returned to a numeric variable:

```
myScope.WriteString ":CHANnel1:RANGe?"
Dim varQueryResult As Variant
varQueryResult = myScope.ReadNumber
MsgBox "Range (variant):" + CStr(varQueryResult)
```

After running this program, the controller displays:

Range (variant): 40

Reading Definite-Length Block Query Response Data

Definite-length block query response data allows any type of device-dependent data to be transmitted over the system interface as a series of 8-bit binary data bytes. This is particularly useful for sending large quantities of data or 8-bit extended ASCII codes. The syntax is a pound sign (#) followed by a non-zero digit representing the number of digits in the decimal integer. After the non-zero digit is the decimal integer that states the number of 8-bit data bytes being sent. This is followed by the actual data.

For example, for transmitting 1000 bytes of data, the syntax would be:

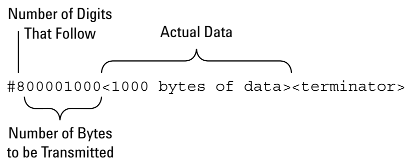


Figure 2 Definite-length block response data

The "8" states the number of digits that follow, and "00001000" states the number of bytes to be transmitted.

The VISA COM library's ReadIEEEBlock and WriteIEEEBlock methods understand the definite-length block syntax, so you can simply use variables that contain the data:

```
' Read oscilloscope setup using ":SYSTem:SETup?" query.
myScope.WriteString ":SYSTem:SETup?"
Dim varQueryResult As Variant
varQueryResult = myScope.ReadIEEEBlock(BinaryType_UI1)

' Write learn string back to oscilloscope using ":SYSTem:SETup" command:
myScope.WriteIEEEBlock ":SYSTem:SETup ", varQueryResult
```

Sending Multiple Queries and Reading Results

You can send multiple queries to the instrument within a single command string, but you must also read them back as a single query result. This can be accomplished by reading them back into a single string variable, multiple string variables, or multiple numeric variables.

For example, to read the :TIMebase:RANGe?;DELay? query result into a single string variable, you could use the commands:

```
myScope.WriteString ":TIMebase:RANGe?;DELay?"
Dim strQueryResult As String
strQueryResult = myScope.ReadString
MsgBox "Timebase range; delay:" + strQueryResult
```

When you read the result of multiple queries into a single string variable, each response is separated by a semicolon. For example, the output of the previous example would be:

```
Timebase range; delay: <range_value>;<delay_value>
```

To read the :TIMebase:RANGe?;DELay? query result into multiple string variables, you could use the ReadList method to read the query results into a string array variable using the commands:

```
myScope.WriteString ":TIMebase:RANGe?;DELay?"
Dim strResults() As String
strResults() = myScope.ReadList(ASCIIType_BSTR)
MsgBox "Timebase range: " + strResults(0) + ", delay: " + strResults(1)
```

To read the :TIMebase:RANGe?;DELay? query result into multiple numeric variables, you could use the ReadList method to read the query results into a variant array variable using the commands:

```
myScope.WriteString ":TIMebase:RANGe?;DELay?"
Dim varResults() As Variant
varResults() = myScope.ReadList
MsgBox "Timebase range: " + FormatNumber(varResults(0) * 1000, 4) + _
       " ms, delay: " + FormatNumber(varResults(1) * 1000000, 4) + " us"
```

Checking Instrument Status

Status registers track the current status of the instrument. By checking the instrument status, you can find out whether an operation has been completed, whether the instrument is receiving triggers, and more.

For more information, see Chapter 33, “Status Reporting,” starting on page 745 which explains how to check the status of the instrument.

4 Commands Quick Reference

Command Summary

- :WGEN Commands Summary (see page 97)
- :WMEMory<r> Commands Summary (see page 99)

Table 2 Common (*) Commands Summary

Command	Query	Options and Query Returns
`*CLS` (see page 109)	n/a	n/a

`*ESE <mask>` (see page 110)	`*ESE?` (see page 110)	`<mask> ::= 0 to 255; an integer in NR1 format:`
		
		`Bit Weight Name Enables`
		`--- ------ ---- ----------`
		`7 128 PON Power On`
		`6 64 URQ User Request`
		`5 32 CME Command Error`
		`4 16 EXE Execution Error`
		`3 8 DDE Dev. Dependent Error`
		`2 4 QYE Query Error`
		`1 2 RQL Request Control`
		`0 1 OPC Operation Complete`

n/a	`*ESR?` (see page 112)	`<status> ::= 0 to 255; an integer in NR1 format`

n/a	`*IDN?` (see page 112)	`AGILENT TECHNOLOGIES,<model>,<serial number>,X.XX.XX`
		`<model> ::= the model number of the instrument`
		`<serial number> ::= the serial number of the instrument`
		`<X.XX.XX> ::= the software revision of the instrument`

n/a	`*LRN?` (see page 115)	`<learn_string> ::= current instrument setup as a block of data in IEEE 488.2 # format`
`*OPC` (see page 116)	`*OPC?` (see page 116)	`ASCII "1" is placed in the output queue when all pending device operations have completed.`

Table 2 Common (*) Commands Summary (continued)

Command	Query	Options and Query Returns

n/a	*OPT? (see page 117)	<return_value> ::= 0,0,<license info>
		<license info> ::= <All field>, <reserved>, <reserved>, <reserved>, <Memory>, <reserved>, <reserved>, <reserved>, <reserved>, <reserved>, <reserved>, <Segmented Memory>, <Mask Test>, <reserved>, <Bandwidth>, <reserved>, <reserved>, <reserved>, <reserved>, <reserved>, <Educator's Kit>, <Waveform Generator>, <reserved>, <reserved>, <reserved>, <reserved>, <reserved>, <reserved>, <reserved>, <reserved>, <Digital Voltmeter>, <reserved>, <reserved>, <reserved>, <Remote Command Logging>, <reserved>, <reserved>, <reserved>
		<All field> ::= {0 | All}
		<reserved> ::= 0
		<Memory> ::= {0 | MEMUP}
		<Segmented Memory> ::= {0 | SGM}
		<Mask Test> ::= {0 | MASK}
		<Bandwidth> ::= {0 | BW10 | BW20}
		<Educator's Kit> ::= {0 | EDK}
		<Waveform Generator> ::= {0 | WAVEGEN}
		<Digital Voltmeter> ::= {0 | DVM}
		<Remote Command Logging> ::= {0 | RML}

*RCL <value> (see page 118)	n/a	<value> ::= {0 | 1 | 4 | 5 | 6 | 7 | 8 | 9}
*RST (see page 119)	n/a	See *RST (Reset) (see page 119)
*SAV <value> (see page 122)	n/a	<value> ::= {0 | 1 | 4 | 5 | 6 | 7 | 8 | 9}

Table 2 Common (*) Commands Summary (continued)

Command	Query	Options and Query Returns

`*SRE <mask>` (see page 123)	`*SRE?` (see page 124)	`<mask> ::= sum of all bits that are set, 0 to 255; an integer in NR1 format. <mask> ::= following values:`
		
		`Bit Weight Name Enables`
		`--- ------ ---- ----------`
		`7 128 OPER Operation Status Reg`
		`6 64 ---- (Not used.)`
		`5 32 ESB Event Status Bit`
		`4 16 MAV Message Available`
		`3 8 ---- (Not used.)`
		`2 4 MSG Message`
		`1 2 USR User`
		`0 1 TRG Trigger`

n/a	`*STB?` (see page 125)	`<value> ::= 0 to 255; an integer in NR1 format, as shown in the following:`
		
		`Bit Weight Name "1" Indicates`
		`--- ------ ---- ---------------`
		`7 128 OPER Operation status condition occurred.`
		`6 64 RQS/MSS Instrument is requesting service.`
		`5 32 ESB Enabled event status condition occurred.`
		`4 16 MAV Message available.`
		`3 8 ---- (Not used.)`
		`2 4 MSG Message displayed.`
		`1 2 USR User event condition occurred.`
		`0 1 TRG A trigger occurred.`

`*TRG` (see page 127)	n/a	n/a
n/a	`*TST?` (see page 128)	`<result> ::= 0 or non-zero value; an integer in NR1 format`
`*WAI` (see page 129)	n/a	n/a

Table 3 Root (:) Commands Summary

Command	Query	Options and Query Returns
n/a	:AER? (see page 134)	{0 | 1}; an integer in NR1 format
:AUToscale [<source>[,..,<source>]] (see page 135)	n/a	<source> ::= CHANnel<n> <source> can be repeated up to 5 times <n> ::= 1 to (# analog channels) in NR1 format
:AUToscale:AMODE <value> (see page 137)	:AUToscale:AMODE? (see page 137)	<value> ::= {NORMal | CURRent}}
:AUToscale:CHANnels <value> (see page 138)	:AUToscale:CHANnels? (see page 138)	<value> ::= {ALL | DISPlayed}}
:AUToscale:FDEBug {{0 | OFF} | {1 | ON}} (see page 139)	:AUToscale:FDEBug? (see page 139)	{0 | 1}
:BLANk [<source>] (see page 140)	n/a	<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r> | ABUS} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1 to (# ref waveforms) in NR1 format
:DIGitize [<source>[,..,<source>]] (see page 141)	n/a	<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | ABUS} <source> can be repeated up to 5 times <n> ::= 1 to (# analog channels) in NR1 format
:MTEenable <n> (see page 142)	:MTEenable? (see page 142)	<n> ::= 16-bit integer in NR1 format
n/a	:MTERegister[:EVENt]? (see page 144)	<n> ::= 16-bit integer in NR1 format
:OPEE <n> (see page 146)	:OPEE? (see page 146)	<n> ::= 15-bit integer in NR1 format
n/a	:OPERregister:CONDition? (see page 148)	<n> ::= 15-bit integer in NR1 format
n/a	:OPERegister[:EVENt]? (see page 150)	<n> ::= 15-bit integer in NR1 format

Table 3 Root (:) Commands Summary (continued)

Command	Query	Options and Query Returns

:OVLenable <mask> (see page 152)	:OVLenable? (see page 152)	<mask> ::= 16-bit integer in NR1 format as shown:
		`Bit Weight Input`
		`--- ------ ----------`
		`10   1024  Ext Trigger Fault`
		` 9    512  Channel 4 Fault`
		` 8    256  Channel 3 Fault`
		` 7    128  Channel 2 Fault`
		` 6     64  Channel 1 Fault`
		` 4     16  Ext Trigger OVL`
		` 3      8  Channel 4 OVL`
		` 2      4  Channel 3 OVL`
		` 1      2  Channel 2 OVL`
		` 0      1  Channel 1 OVL`

n/a	:OVLRegister? (see page 154)	<value> ::= integer in NR1 format. See OVLenable for <value>
:PRINt [<options>] (see page 155)	n/a	<options> ::= [<print option>][,..,<print option>] <print option> ::= {COLor | GRAYscale | PRINter0 | PRINter1 | BMP8bit | BMP | PNG | NOFactors | FACTors} <print option> can be repeated up to 5 times.
:RUN (see page 156)	n/a	n/a
n/a	:SERial (see page 157)	<return value> ::= unquoted string containing serial number
:SINGle (see page 158)	n/a	n/a

n/a	:STATus? <display> (see page 159)	{0 | 1}
		<display> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r> | ABUS}
		<n> ::= 1 to (# analog channels) in NR1 format
		<r> ::= 1 to (# ref waveforms) in NR1 format

:STOP (see page 160)	n/a	n/a

Table 3 Root (:) Commands Summary (continued)

Command	Query	Options and Query Returns
n/a	:TER? (see page 161)	{0 | 1}
:VIEW <source> (see page 162)	n/a	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1 to (# ref waveforms) in NR1 format

Table 4 :ABUS Commands Summary

Command	Query	Options and Query Returns
:ABUS:BIT<m> {{0 | OFF} | {1 | ON}} (see page 165)	:ABUS:BIT<m>? (see page 165)	{0 | 1} <m> ::= 0-2; an integer in NR1 format
:ABUS:BITS <channel_list>, {{0 | OFF} | {1 | ON}} (see page 166)	:ABUS:BITS? (see page 166)	<channel_list>, {0 | 1} <channel_list> ::= (@<m>,<m>:<m> ...) where "," is separator and ":" is range <m> ::= 0-2; an integer in NR1 format
:ABUS:CLEar (see page 168)	n/a	n/a
:ABUS:DISPlay {{0 | OFF} | {1 | ON}} (see page 169)	:ABUS:DISPlay? (see page 169)	{0 | 1}
:ABUS:LABel <string> (see page 170)	:ABUS:LABel? (see page 170)	<string> ::= quoted ASCII string up to 10 characters
:ABUS:MASK <mask> (see page 171)	:ABUS:MASK? (see page 171)	<mask> ::= 32-bit integer in decimal, <nondecimal>, or <string> <nondecimal> ::= #Hnn...n where n ::= {0,..,9 | A,..,F} for hexadecimal <nondecimal> ::= #Bnn...n where n ::= {0 | 1} for binary <string> ::= "0xnn...n" where n ::= {0,..,9 | A,..,F} for hexadecimal

Table 5 :ACQuire Commands Summary

Command	Query	Options and Query Returns
:ACQuire:COMPlete <complete> (see page 175)	:ACQuire:COMPlete? (see page 175)	<complete> ::= 100; an integer in NR1 format
:ACQuire:COUNt <count> (see page 176)	:ACQuire:COUNt? (see page 176)	<count> ::= an integer from 2 to 65536 in NR1 format
:ACQuire:MODE <mode> (see page 177)	:ACQuire:MODE? (see page 177)	<mode> ::= {RTIMe | SEGMented}
n/a	:ACQuire:POINts? (see page 178)	<# points> ::= an integer in NR1 format
:ACQuire:SEGMented:ANALyze (see page 179)	n/a	n/a (with SGM license)
:ACQuire:SEGMented:COUNt <count> (see page 180)	:ACQuire:SEGMented:COUNt? (see page 180)	<count> ::= an integer from 2 to 50 in NR1 format (with SGM license)
:ACQuire:SEGMented:INDex <index> (see page 181)	:ACQuire:SEGMented:INDex? (see page 181)	<index> ::= an integer from 1 to 50 in NR1 format (with SGM license)
n/a	:ACQuire:SRATe? (see page 184)	<sample_rate> ::= sample rate (samples/s) in NR3 format
:ACQuire:TYPE <type> (see page 185)	:ACQuire:TYPE? (see page 185)	<type> ::= {NORMal | AVERage | HRESolution | PEAK}

Table 6 :CALibrate Commands Summary

Command	Query	Options and Query Returns
n/a	:CALibrate:DATE? (see page 189)	<return value> ::= <year>,<month>,<day>; all in NR1 format
:CALibrate:LABel <string> (see page 190)	:CALibrate:LABel? (see page 190)	<string> ::= quoted ASCII string up to 32 characters
:CALibrate:OUTPut <signal> (see page 191)	:CALibrate:OUTPut? (see page 191)	<signal> ::= {TRIGgers | MASK | WAVEgen}
n/a	:CALibrate:PROTected? (see page 192)	{"PROTected" | "UNPRotected"}
:CALibrate:STARt (see page 193)	n/a	n/a

Table 6 :CALibrate Commands Summary (continued)

Command	Query	Options and Query Returns
n/a	:CALibrate:STATus? (see page 194)	<return value> ::= <status_code>,<status_string> <status_code> ::= an integer status code <status_string> ::= an ASCII status string
n/a	:CALibrate:TEMPerature? (see page 195)	<return value> ::= degrees C delta since last cal in NR3 format
n/a	:CALibrate:TIME? (see page 196)	<return value> ::= <hours>,<minutes>,<seconds>; all in NR1 format

Table 7 :CHANnel<n> Commands Summary

Command	Query	Options and Query Returns
:CHANnel<n>:BANDwidth <limit> (see page 200)	:CHANnel<n>:BANDwidth? [MAXimum] (see page 200)	<limit> ::= 25E6 in NR3 format <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:BWLimit {{0 | OFF} | {1 | ON}} (see page 201)	:CHANnel<n>:BWLimit? (see page 201)	{0 | 1} <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:COUPling <coupling> (see page 202)	:CHANnel<n>:COUPling? (see page 202)	<coupling> ::= {AC | DC} <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:DISPlay {{0 | OFF} | {1 | ON}} (see page 203)	:CHANnel<n>:DISPlay? (see page 203)	{0 | 1} <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:IMPedance <impedance> (see page 204)	:CHANnel<n>:IMPedance? (see page 204)	<impedance> ::= ONEMeg <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:INVert {{0 | OFF} | {1 | ON}} (see page 205)	:CHANnel<n>:INVert? (see page 205)	{0 | 1} <n> ::= 1 to (# analog channels) in NR1 format

Table 7 :CHANnel<n> Commands Summary (continued)

Command	Query	Options and Query Returns
:CHANnel<n>:LABel <string> (see page 206)	:CHANnel<n>:LABel? (see page 206)	<string> ::= any series of 10 or less ASCII characters enclosed in quotation marks <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:OFFSet <offset>[suffix] (see page 207)	:CHANnel<n>:OFFSet? (see page 207)	<offset> ::= Vertical offset value in NR3 format [suffix] ::= {V | mV} <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:PROBe <attenuation> (see page 208)	:CHANnel<n>:PROBe? (see page 208)	<attenuation> ::= Probe attenuation ratio in NR3 format <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:PROBe:HEAD[:TYPE] <head_param> (see page 209)	:CHANnel<n>:PROBe:HEAD[:TYPE]? (see page 209)	<head_param> ::= {SEND0 | SEND6 | SEND12 | SEND20 | DIFF0 | DIFF6 | DIFF12 | DIFF20 | NONE} <n> ::= 1 to (# analog channels) in NR1 format
n/a	:CHANnel<n>:PROBe:ID? (see page 210)	<probe id> ::= unquoted ASCII string up to 11 characters <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:PROBe:SKEW <skew_value> (see page 211)	:CHANnel<n>:PROBe:SKEW? (see page 211)	<skew_value> ::= -100 ns to +100 ns in NR3 format <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:PROBe:STYPe <signal type> (see page 212)	:CHANnel<n>:PROBe:STYPe? (see page 212)	<signal type> ::= {DIFFerential | SINGle} <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:PROTection (see page 213)	:CHANnel<n>:PROTection? (see page 213)	NORM <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:RANGe <range>[suffix] (see page 214)	:CHANnel<n>:RANGe? (see page 214)	<range> ::= Vertical full-scale range value in NR3 format [suffix] ::= {V | mV} <n> ::= 1 to (# analog channels) in NR1 format

Table 7 :CHANnel<n> Commands Summary (continued)

Command	Query	Options and Query Returns
:CHANnel<n>:SCALe <scale>[suffix] (see page 215)	:CHANnel<n>:SCALe? (see page 215)	<scale> ::= Vertical units per division value in NR3 format [suffix] ::= {V | mV} <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:UNITs <units> (see page 216)	:CHANnel<n>:UNITs? (see page 216)	<units> ::= {VOLT | AMPere} <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:VERNier {{0 | OFF} | {1 | ON}} (see page 217)	:CHANnel<n>:VERNier? (see page 217)	{0 | 1} <n> ::= 1 to (# analog channels) in NR1 format

Table 8 :DEMO Commands Summary

Command	Query	Options and Query Returns
:DEMO:FUNCtion <signal> (see page 220)	:DEMO:FUNCtion? (see page 221)	<signal> ::= {SINusoid | NOISy | LFSine | AM | RFBurst | FMBurst | HARMonics | COUPling | RINGing | SINGle | CLK | TRANsition | BURSt | GLITch | UART | CAN | LIN}
:DEMO:OUTPut {{0 | OFF} | {1 | ON}} (see page 222)	:DEMO:OUTPut? (see page 222)	{0 | 1}

Table 9 :DISPlay Commands Summary

Command	Query	Options and Query Returns
:DISPlay:ANNotation {{0 | OFF} | {1 | ON}} (see page 225)	:DISPlay:ANNotation? (see page 225)	{0 | 1}
:DISPlay:ANNotation:BACKground <mode> (see page 226)	:DISPlay:ANNotation:BACKground? (see page 226)	<mode> ::= {OPAQue | INVerted | TRANsparent}
:DISPlay:ANNotation:COLor <color> (see page 227)	:DISPlay:ANNotation:COLor? (see page 227)	<color> ::= {CH1 | CH2 | CH3 | CH4 | DIG | MATH | REF | MARKer | WHITe | RED}
:DISPlay:ANNotation:TEXT <string> (see page 228)	:DISPlay:ANNotation:TEXT? (see page 228)	<string> ::= quoted ASCII string (up to 254 characters)

Table 9 :DISPlay Commands Summary (continued)

Command	Query	Options and Query Returns
:DISPlay:CLEar (see page 229)	n/a	n/a

n/a	:DISPlay:DATA? [<format>][,][<palette>] (see page 230)	<format> ::= {BMP | BMP8bit | PNG}
		<palette> ::= {COLor | GRAYscale}
		<display data> ::= data in IEEE 488.2 # format

:DISPlay:INTensity:WAVeform <value> (see page 231)	:DISPlay:INTensity:WAVeform? (see page 231)	<value> ::= an integer from 0 to 100 in NR1 format.
:DISPlay:LABel {{0 | OFF} | {1 | ON}} (see page 232)	:DISPlay:LABel? (see page 232)	{0 | 1}
:DISPlay:LABList <binary block> (see page 233)	:DISPlay:LABList? (see page 233)	<binary block> ::= an ordered list of up to 75 labels, each 10 characters maximum, separated by newline characters
:DISPlay:PERSistence <value> (see page 235)	:DISPlay:PERSistence? (see page 235)	<value> ::= {MINimum | INFinite | <time>} <time> ::= seconds in in NR3 format from 100E-3 to 60E0
:DISPlay:VECTors {1 | ON} (see page 236)	:DISPlay:VECTors? (see page 236)	1

Table 10 :DVM Commands Summary

Command	Query	Options and Query Returns
:DVM:ARANge {{0 | OFF} | {1 | ON}} (see page 238)	:DVM:ARANge? (see page 238)	{0 | 1}
n/a	:DVM:CURRent? (see page 239)	<dvm_value> ::= floating-point number in NR3 format
:DVM:ENABle {{0 | OFF} | {1 | ON}} (see page 240)	:DVM:ENABle? (see page 240)	{0 | 1}
n/a	:DVM:FREQuency? (see page 239)	<freq_value> ::= floating-point number in NR3 format

Table 10 :DVM Commands Summary (continued)

Command	Query	Options and Query Returns
:DVM:MODE <mode> (see page 242)	:DVM:MODE? (see page 242)	<dvm_mode> ::= {ACRMs | DC | DCRMs | FREQuency}
:DVM:SOURce <source> (see page 243)	:DVM:SOURce? (see page 243)	<source> ::= {CHANnel<n>} <n> ::= 1 to (# analog channels) in NR1 format

Table 11 :EXTernal Trigger Commands Summary

Command	Query	Options and Query Returns
:EXTernal:BWLimit <bwlimit> (see page 247)	:EXTernal:BWLimit? (see page 247)	<bwlimit> ::= {0 | OFF}
:EXTernal:DISPlay {{0 | OFF} | {1 | ON}} (see page 248)	:EXTernal:DISPlay? (see page 248)	<setting> ::= {0 | 1}
:EXTernal:LABel <string> (see page 249)	:EXTernal:LABel? (see page 249)	<string> ::= quoted ASCII string.
:EXTernal:LEVel <level>[<suffix>] (see page 250)	:EXTernal:LEVel? (see page 250)	<value> ::= external trigger level value in NR3 format. <suffix> ::= {V | mV}
:EXTernal:POSition <value> (see page 251)	:EXTernal:POSition? (see page 251)	<value> ::= Ext Trig waveform vertical position in divisions in NR3 format.
:EXTernal:PROBe <attenuation> (see page 252)	:EXTernal:PROBe? (see page 252)	<attenuation> ::= probe attenuation ratio in NR3 format
:EXTernal:RANGe <range>[<suffix>] (see page 253)	:EXTernal:RANGe? (see page 253)	<range> ::= vertical full-scale range value in NR3 format <suffix> ::= {V | mV}
:EXTernal:UNITs <units> (see page 254)	:EXTernal:UNITs? (see page 254)	<units> ::= {VOLT | AMPere}

Table 12 :FFT Commands Summary

Command	Query	Options and Query Returns
:FFT:CENTer <frequency> (see page 257)	:FFT:CENTer? (see page 257)	<frequency> ::= the current center frequency in NR3 format. The range of legal values is from -25 GHz to 25 GHz.
:FFT:DISPlay {{0 | OFF} | {1 | ON}} (see page 258)	:FFT:DISPlay? (see page 258)	<s> ::= 1-6, in NR1 format. {0 | 1}
:FFT:OFFSet <offset> (see page 259)	:FFT:OFFSet? (see page 259)	<offset> ::= the value at center screen in NR3 format.
:FFT:RANGe <range> (see page 260)	:FFT:RANGe? (see page 260)	<range> ::= the full-scale vertical axis value in NR3 format.
:FFT:REFerence <level> (see page 261)	:FFT:REFerence? (see page 261)	<level> ::= the current reference level in NR3 format.
:FFT:SCALe <scale value>[<suffix>] (see page 262)	:FFT:SCALe? (see page 262)	<scale_value> ::= integer in NR1 format. <suffix> ::= dB

:FFT:SOURce1 <source> (see page 263)	:FFT:SOURce1? (see page 263)	<source> ::= {CHANnel<n> | FUNCtion<c> | MATH<c>}
		<n> ::= 1 to (# analog channels) in NR1 format.
		<c> ::= {1 | 2}

:FFT:SPAN <span> (see page 264)	:FFT:SPAN? (see page 264)	<span> ::= the current frequency span in NR3 format. Legal values are 1 Hz to 100 GHz.
:FFT:VTYPe <units> (see page 265)	:FFT:VTYPe? (see page 265)	<units> ::= {DECibel | VRMS}
:FFT:WINDow <window> (see page 266)	:FFT:WINDow? (see page 266)	<window> ::= {RECTangular | HANNing | FLATtop | BHARris}

Table 13 :FFT Commands Summary

Command	Query	Options and Query Returns
n/a	:FRANalysis:DATA? (see page 271)	<binary_block> ::= comma-separated data with newlines at the end of each row
:FRANalysis:ENABle {{0 | OFF} | {1 | ON}} (see page 272)	:FRANalysis:ENABle? (see page 272)	{0 | 1}

Table 13 :FFT Commands Summary (continued)

Command	Query	Options and Query Returns

:FRANalysis:FREQuency:STARt <value>[suffix] (see page 273)	:FRANalysis:FREQuency:STARt? (see page 273)	<value> ::= {20 | 100 | 1000 | 10000 | 100000 | 1000000 | 10000000}
		[suffix] ::= {Hz | kHz| MHz}

:FRANalysis:FREQuency:STOP <value>[suffix] (see page 274)	:FRANalysis:FREQuency:STOP? (see page 274)	<value> ::= {100 | 1000 | 10000 | 100000 | 1000000 | 10000000 | 20000000}
		[suffix] ::= {Hz | kHz| MHz}

:FRANalysis:RUN (see page 275)	n/a	n/a
:FRANalysis:SOURce:INPut <source> (see page 276)	:FRANalysis:SOURce:INPut? (see page 276)	<source> ::= CHANnel<n> <n> ::= 1 to (# analog channels) in NR1 format
:FRANalysis:SOURce:OUTPut <source> (see page 277)	:FRANalysis:SOURce:OUTPut? (see page 277)	<source> ::= CHANnel<n> <n> ::= 1 to (# analog channels) in NR1 format
:FRANalysis:WGEN:LOAD <impedance> (see page 278)	:FRANalysis:WGEN:LOAD? (see page 278)	<impedance> ::= {ONEMeg | FIFTy}
:FRANalysis:WGEN:VOLTage <amplitude> (see page 279)	:FRANalysis:WGEN:VOLTage? (see page 279)	<amplitude> ::= amplitude in volts in NR3 format

Table 14 :FUNCtion Commands Summary

Command	Query	Options and Query Returns
:FUNCtion:DISPlay {{0 | OFF} | {1 | ON}} (see page 284)	:FUNCtion:DISPlay? (see page 284)	{0 | 1}
:FUNCtion[:FFT]:CENTer <frequency> (see page 285)	:FUNCtion[:FFT]:CENTer? (see page 285)	<frequency> ::= the current center frequency in NR3 format. The range of legal values is from 0 Hz to 25 GHz.
:FUNCtion[:FFT]:PHASe:REFerence <ref_point> (see page 286)	:FUNCtion[:FFT]:PHASe:REFerence? (see page 286)	<ref_point> ::= {TRIGger | DISPlay}

Table 14 :FUNCtion Commands Summary (continued)

Command	Query	Options and Query Returns
:FUNCtion[:FFT]:SPAN <span> (see page 287)	:FUNCtion[:FFT]:SPAN? (see page 287)	<span> ::= the current frequency span in NR3 format. Legal values are 1 Hz to 100 GHz.
:FUNCtion[:FFT]:VTYPe <units> (see page 288)	:FUNCtion[:FFT]:VTYPe? (see page 288)	<units> ::= {DECibel | VRMS} for the FFT (magnitude) operation <units> ::= {DEGRees | RADians} for the FFTPhase operation
:FUNCtion[:FFT]:WINDow <window> (see page 289)	:FUNCtion[:FFT]:WINDow? (see page 289)	<window> ::= {RECTangular | HANNing | FLATtop | BHARris}
:FUNCtion:FREQuency:LOWPass <3dB_freq> (see page 290)	:FUNCtion:FREQuency:LOWPass? (see page 290)	<3dB_freq> ::= 3dB cutoff frequency value in NR3 format
:FUNCtion:GOFT:OPERation <operation> (see page 291)	:FUNCtion:GOFT:OPERation? (see page 291)	<operation> ::= {ADD | SUBTract | MULTiply}
:FUNCtion:GOFT:SOURce1 <source> (see page 292)	:FUNCtion:GOFT:SOURce1? (see page 292)	<source> ::= CHANnel<n> <n> ::= 1 to (# analog channels) in NR1 format
:FUNCtion:GOFT:SOURce2 <source> (see page 293)	:FUNCtion:GOFT:SOURce2? (see page 293)	<source> ::= CHANnel<n> <n> ::= 1 to (# analog channels) in NR1 format
:FUNCtion:OFFSet <offset> (see page 294)	:FUNCtion:OFFSet? (see page 294)	<offset> ::= the value at center screen in NR3 format. The range of legal values is +/-10 times the current sensitivity of the selected function.
:FUNCtion:OPERation <operation> (see page 295)	:FUNCtion:OPERation? (see page 295)	<operation> ::= {ADD | SUBTract | MULTiply | DIVide | FFT | FFTPhase | LOWPass}
:FUNCtion:RANGe <range> (see page 297)	:FUNCtion:RANGe? (see page 297)	<range> ::= the full-scale vertical axis value in NR3 format. The range for ADD, SUBT, MULT is 8E-6 to 800E+3. The range for the FFT function is 8 to 800 dBV.

Table 14 :FUNCtion Commands Summary (continued)

Command	Query	Options and Query Returns
:FUNCtion:REFerence <level> (see page 298)	:FUNCtion:REFerence? (see page 298)	<level> ::= the value at center screen in NR3 format. The range of legal values is +/-10 times the current sensitivity of the selected function.
:FUNCtion:SCALe <scale value>[<suffix>] (see page 299)	:FUNCtion:SCALe? (see page 299)	<scale value> ::= integer in NR1 format <suffix> ::= {V | dB}
:FUNCtion:SOURce1 <source> (see page 300)	:FUNCtion:SOURce1? (see page 300)	<source> ::= {CHANnel<n> | GOFT} <n> ::= 1 to (# analog channels) in NR1 format GOFT is only for FFT operation.
:FUNCtion:SOURce2 <source> (see page 301)	:FUNCtion:SOURce2? (see page 301)	<source> ::= {CHANnel<n> | NONE} <n> ::= 1 to (# analog channels) in NR1 format, depending on SOURce1 selection

Table 15 :HARDcopy Commands Summary

Command	Query	Options and Query Returns
:HARDcopy:AREA <area> (see page 305)	:HARDcopy:AREA? (see page 305)	<area> ::= SCReen
:HARDcopy:APRinter <active_printer> (see page 306)	:HARDcopy:APRinter? (see page 306)	<active_printer> ::= {<index> | <name>} <index> ::= integer index of printer in list <name> ::= name of printer in list
:HARDcopy:FACTors {{0 | OFF} | {1 | ON}} (see page 307)	:HARDcopy:FACTors? (see page 307)	{0 | 1}
:HARDcopy:FFEed {{0 | OFF} | {1 | ON}} (see page 308)	:HARDcopy:FFEed? (see page 308)	{0 | 1}
:HARDcopy:INKSaver {{0 | OFF} | {1 | ON}} (see page 309)	:HARDcopy:INKSaver? (see page 309)	{0 | 1}

Table 15 :HARDcopy Commands Summary (continued)

Command	Query	Options and Query Returns
:HARDcopy:LAYout <layout> (see page 310)	:HARDcopy:LAYout? (see page 310)	<layout> ::= {LANDscape | PORTrait}
:HARDcopy:PALette <palette> (see page 311)	:HARDcopy:PALette? (see page 311)	<palette> ::= {COLor | GRAYscale | NONE}
n/a	:HARDcopy:PRINter:LIST? (see page 312)	<list> ::= [<printer_spec>] ... [printer_spec>] <printer_spec> ::= "<index>,<active>,<name>;" <index> ::= integer index of printer <active> ::= {Y | N} <name> ::= name of printer
:HARDcopy:STARt (see page 313)	n/a	n/a

Table 16 :MARKer Commands Summary

Command	Query	Options and Query Returns
:MARKer:MODE <mode> (see page 318)	:MARKer:MODE? (see page 318)	<mode> ::= {OFF | MEASurement | MANual | WAVeform}
:MARKer:X1Position <position>[suffix] (see page 319)	:MARKer:X1Position? (see page 319)	<position> ::= X1 cursor position value in NR3 format [suffix] ::= {s | ms | us | ns | ps | Hz | kHz | MHz} <return_value> ::= X1 cursor position value in NR3 format
:MARKer:X1Y1source <source> (see page 320)	:MARKer:X1Y1source? (see page 320)	<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format EXTernal available for MANUAL mode only <return_value> ::= <source>

Table 16 :MARKer Commands Summary (continued)

Command	Query	Options and Query Returns
:MARKer:X2Position <position>[suffix] (see page 321)	:MARKer:X2Position? (see page 321)	<position> ::= X2 cursor position value in NR3 format [suffix] ::= {s | ms | us | ns | ps | Hz | kHz | MHz} <return_value> ::= X2 cursor position value in NR3 format
:MARKer:X2Y2source <source> (see page 322)	:MARKer:X2Y2source? (see page 322)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= <source>
n/a	:MARKer:XDELta? (see page 323)	<return_value> ::= X cursors delta value in NR3 format
:MARKer:XUNits <mode> (see page 324)	:MARKer:XUNits? (see page 324)	<units> ::= {SEConds | HERTz | DEGRees | PERCent}
:MARKer:XUNits:USE (see page 325)	n/a	n/a
:MARKer:Y1Position <position>[suffix] (see page 326)	:MARKer:Y1Position? (see page 326)	<position> ::= Y1 cursor position value in NR3 format [suffix] ::= {V | mV | dB} <return_value> ::= Y1 cursor position value in NR3 format
:MARKer:Y2Position <position>[suffix] (see page 327)	:MARKer:Y2Position? (see page 327)	<position> ::= Y2 cursor position value in NR3 format [suffix] ::= {V | mV | dB} <return_value> ::= Y2 cursor position value in NR3 format
n/a	:MARKer:YDELta? (see page 328)	<return_value> ::= Y cursors delta value in NR3 format
:MARKer:YUNits <mode> (see page 329)	:MARKer:YUNits? (see page 329)	<units> ::= {BASE | PERCent}
:MARKer:YUNits:USE (see page 330)	n/a	n/a

Table 17 :MEASure Commands Summary

Command	Query	Options and Query Returns
:MEASure:ALL (see page 341)	n/a	n/a
:MEASure:BRATe [<source>] (see page 342)	:MEASure:BRATe? [<source>] (see page 342)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal} <n> ::= 1 to (# of analog channels) in NR1 format <r> ::= 1 to (# ref waveforms) in NR1 format <return_value> ::= bit rate in Hz, NR3 format
:MEASure:CLEar (see page 343)	n/a	n/a
:MEASure:COUNter [<source>] (see page 344)	:MEASure:COUNter? [<source>] (see page 344)	<source> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format <return_value> ::= counter frequency in Hertz in NR3 format
:MEASure:DEFine DELay, <delay spec>[,<source>] (see page 345)	:MEASure:DEFine? DELay[,<source>]?(see page 346)	<delay spec> ::= <edge_spec1>,<edge_spec2> edge_spec1 ::= [<slope>]<occurrence> edge_spec2 ::= [<slope>]<occurrence> <slope> ::= {+ | -} <occurrence> ::= integer <source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}

:MEASure:DEFine THResholds, <threshold spec>[,<source>] (see page 345)	:MEASure:DEFine? THResholds[,<source>] (see page 346)	<threshold spec> ::= {STANdard} | {<threshold mode>,<upper>, <middle>,<lower>}
		<threshold mode> ::= {PERCent | ABSolute}
		<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r>}

Table 17 :MEASure Commands Summary (continued)

Command	Query	Options and Query Returns
:MEASure:DELay [<source1>] [,<source2>] (see page 348)	:MEASure:DELay? [<source1>] [,<source2>] (see page 348)	<source1,2> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= floating-point number delay time in seconds in NR3 format
:MEASure:DUTYcycle [<source>] (see page 350)	:MEASure:DUTYcycle? [<source>] (see page 350)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= ratio of positive pulse width to period in NR3 format
:MEASure:FALLtime [<source>] (see page 351)	:MEASure:FALLtime? [<source>] (see page 351)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= time in seconds between the lower and upper thresholds in NR3 format
:MEASure:FREQuency [<source>] (see page 352)	:MEASure:FREQuency? [<source>] (see page 352)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= frequency in Hertz in NR3 format

Table 17 :MEASure Commands Summary (continued)

Command	Query	Options and Query Returns
:MEASure:NDUTy [<source>] (see page 353)	:MEASure:NDUTy? [<source>] (see page 353)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1 to (# ref waveforms) in NR1 format <return_value> ::= ratio of negative pulse width to period in NR3 format
:MEASure:NWIDth [<source>] (see page 354)	:MEASure:NWIDth? [<source>] (see page 354)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= negative pulse width in seconds-NR3 format
:MEASure:OVERshoot [<source>] (see page 355)	:MEASure:OVERshoot? [<source>] (see page 355)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= the percent of the overshoot of the selected waveform in NR3 format
:MEASure:PERiod [<source>] (see page 357)	:MEASure:PERiod? [<source>] (see page 357)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= waveform period in seconds in NR3 format

Table 17 :MEASure Commands Summary (continued)

Command	Query	Options and Query Returns
:MEASure:PHASe [<source1>] [,<source2>] (see page 358)	:MEASure:PHASe? [<source1>] [,<source2>] (see page 358)	<source1,2> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= the phase angle value in degrees in NR3 format
:MEASure:PREShoot [<source>] (see page 359)	:MEASure:PREShoot? [<source>] (see page 359)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= the percent of preshoot of the selected waveform in NR3 format
:MEASure:PWIDth [<source>] (see page 360)	:MEASure:PWIDth? [<source>] (see page 360)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= width of positive pulse in seconds in NR3 format
:MEASure:RISetime [<source>] (see page 361)	:MEASure:RISetime? [<source>] (see page 361)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= rise time in seconds in NR3 format
:MEASure:SDEViation [<source>] (see page 362)	:MEASure:SDEViation? [<source>] (see page 362)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1 to (# ref waveforms) in NR1 format <return_value> ::= calculated std deviation in NR3 format

Table 17 :MEASure Commands Summary (continued)

Command	Query	Options and Query Returns
:MEASure:SHOW {1 | ON} (see page 363)	:MEASure:SHOW? (see page 363)	{1}

:MEASure:SOURce <source1> [,<source2>] (see page 364)	:MEASure:SOURce? (see page 364)	<source1,2> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal}
		<n> ::= 1 to (# analog channels) in NR1 format
		<r> ::= 1-2 in NR1 format
		<return_value> ::= {<source> | NONE}

n/a	:MEASure:TEDGe? <slope><occurrence>[, <source>] (see page 366)	<slope> ::= direction of the waveform <occurrence> ::= the transition to be reported <source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= time in seconds of the specified transition
n/a	:MEASure:TVALue? <value>, [<slope>]<occurrence> [,<source>] (see page 368)	<value> ::= voltage level that the waveform must cross. <slope> ::= direction of the waveform when <value> is crossed. <occurrence> ::= transitions reported. <source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= time in seconds of specified voltage crossing in NR3 format

Table 17 :MEASure Commands Summary (continued)

Command	Query	Options and Query Returns
:MEASure:VAMPlitude [<source>] (see page 370)	:MEASure:VAMPlitude? [<source>] (see page 370)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= the amplitude of the selected waveform in volts in NR3 format
:MEASure:VAVerage [<interval>][,][<source>] (see page 371)	:MEASure:VAVerage? [<interval>][,][<source>] (see page 371)	<interval> ::= {CYCLe | DISPlay} <source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= calculated average voltage in NR3 format
:MEASure:VBASe [<source>] (see page 372)	:MEASure:VBASe? [<source>] (see page 372)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <base_voltage> ::= voltage at the base of the selected waveform in NR3 format
:MEASure:VMAX [<source>] (see page 373)	:MEASure:VMAX? [<source>] (see page 373)	<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= maximum voltage of the selected waveform in NR3 format

Table 17 :MEASure Commands Summary (continued)

Command	Query	Options and Query Returns
:MEASure:VMIN [<source>] (see page 374)	:MEASure:VMIN? [<source>] (see page 374)	<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= minimum voltage of the selected waveform in NR3 format
:MEASure:VPP [<source>] (see page 375)	:MEASure:VPP? [<source>] (see page 375)	<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= voltage peak-to-peak of the selected waveform in NR3 format

:MEASure:VRMS [<interval>][,] [<type>][,] [<source>] (see page 376)	:MEASure:VRMS? [<interval>][,] [<type>][,] [<source>] (see page 376)	<interval> ::= {CYCLe | DISPlay}
		<type> ::= {AC | DC}
		<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}
		<n> ::= 1 to (# analog channels) in NR1 format
		<r> ::= 1-2 in NR1 format
		<return_value> ::= calculated dc RMS voltage in NR3 format

n/a	:MEASure:VTIMe? <vtime>[,<source>] (see page 377)	<vtime> ::= displayed time from trigger in seconds in NR3 format <source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= voltage at the specified time in NR3 format

Table 17 :MEASure Commands Summary (continued)

Command	Query	Options and Query Returns
:MEASure:VTOP [<source>] (see page 378)	:MEASure:VTOP? [<source>] (see page 378)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= voltage at the top of the waveform in NR3 format
:MEASure:WINDow <type> (see page 379)	:MEASure:WINDow? (see page 379)	<type> ::= {MAIN | ZOOM | AUTO}
:MEASure:XMAX [<source>] (see page 380)	:MEASure:XMAX? [<source>] (see page 380)	<source> ::= {CHANnel<n> | FUNCtion | FFT | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1 to (# ref waveforms) in NR1 format <return_value> ::= horizontal value of the maximum in NR3 format
:MEASure:XMIN [<source>] (see page 381)	:MEASure:XMIN? [<source>] (see page 381)	<source> ::= {CHANnel<n> | FUNCtion | FFT | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1 to (# ref waveforms) in NR1 format <return_value> ::= horizontal value of the maximum in NR3 format

Table 18 :MTESt Commands Summary

Command	Query	Options and Query Returns
:MTESt:ALL {{0 | OFF} | {1 | ON}} (see page 388)	:MTESt:ALL? (see page 388)	{0 | 1}
:MTESt:AMASk:CREate (see page 389)	n/a	n/a

Table 18 :MTESt Commands Summary (continued)

Command	Query	Options and Query Returns
:MTESt:AMASk:SOURce <source> (see page 390)	:MTESt:AMASk:SOURce? (see page 390)	<source> ::= CHANnel<n> <n> ::= {1 | 2 | 3 | 4} for 4ch models <n> ::= {1 | 2} for 2ch models
:MTESt:AMASk:UNITs <units> (see page 391)	:MTESt:AMASk:UNITs? (see page 391)	<units> ::= {CURRent | DIVisions}
:MTESt:AMASk:XDELta <value> (see page 392)	:MTESt:AMASk:XDELta? (see page 392)	<value> ::= X delta value in NR3 format
:MTESt:AMASk:YDELta <value> (see page 393)	:MTESt:AMASk:YDELta? (see page 393)	<value> ::= Y delta value in NR3 format
n/a	:MTESt:COUNt:FWAVeforms? [CHANnel<n>] (see page 394)	<failed> ::= number of failed waveforms in NR1 format
:MTESt:COUNt:RESet (see page 395)	n/a	n/a
n/a	:MTESt:COUNt:TIME? (see page 396)	<time> ::= elapsed seconds in NR3 format
n/a	:MTESt:COUNt:WAVeforms? (see page 397)	<count> ::= number of waveforms in NR1 format
:MTESt:DATA <mask> (see page 398)	:MTESt:DATA? (see page 398)	<mask> ::= data in IEEE 488.2 # format.
:MTESt:DELete (see page 399)	n/a	n/a
:MTESt:ENABle {{0 | OFF} | {1 | ON}} (see page 400)	:MTESt:ENABle? (see page 400)	{0 | 1}
:MTESt:LOCK {{0 | OFF} | {1 | ON}} (see page 401)	:MTESt:LOCK? (see page 401)	{0 | 1}
:MTESt:RMODe <rmode> (see page 402)	:MTESt:RMODe? (see page 402)	<rmode> ::= {FORever | TIME | SIGMa | WAVeforms}
:MTESt:RMODe:FACTion:MEASure {{0 | OFF} | {1 | ON}} (see page 403)	:MTESt:RMODe:FACTion:MEASure? (see page 403)	{0 | 1}
:MTESt:RMODe:FACTion:PRINt {{0 | OFF} | {1 | ON}} (see page 404)	:MTESt:RMODe:FACTion:PRINt? (see page 404)	{0 | 1}

Table 18 :MTESt Commands Summary (continued)

Command	Query	Options and Query Returns
:MTESt:RMODe:FACTion:SAVE {{0 | OFF} | {1 | ON}} (see page 405)	:MTESt:RMODe:FACTion:SAVE? (see page 405)	{0 | 1}
:MTESt:RMODe:FACTion:STOP {{0 | OFF} | {1 | ON}} (see page 406)	:MTESt:RMODe:FACTion:STOP? (see page 406)	{0 | 1}
:MTESt:RMODe:SIGMa <level> (see page 407)	:MTESt:RMODe:SIGMa? (see page 407)	<level> ::= from 0.1 to 9.3 in NR3 format
:MTESt:RMODe:TIME <seconds> (see page 408)	:MTESt:RMODe:TIME? (see page 408)	<seconds> ::= from 1 to 86400 in NR3 format
:MTESt:RMODe:WAVeforms <count> (see page 409)	:MTESt:RMODe:WAVeforms? (see page 409)	<count> ::= number of waveforms in NR1 format
:MTESt:SCALe:BIND {{0 | OFF} | {1 | ON}} (see page 410)	:MTESt:SCALe:BIND? (see page 410)	{0 | 1}
:MTESt:SCALe:X1 <x1_value> (see page 411)	:MTESt:SCALe:X1? (see page 411)	<x1_value> ::= X1 value in NR3 format
:MTESt:SCALe:XDELta <xdelta_value> (see page 412)	:MTESt:SCALe:XDELta? (see page 412)	<xdelta_value> ::= X delta value in NR3 format
:MTESt:SCALe:Y1 <y1_value> (see page 413)	:MTESt:SCALe:Y1? (see page 413)	<y1_value> ::= Y1 value in NR3 format
:MTESt:SCALe:Y2 <y2_value> (see page 414)	:MTESt:SCALe:Y2? (see page 414)	<y2_value> ::= Y2 value in NR3 format
:MTESt:SOURce <source> (see page 415)	:MTESt:SOURce? (see page 415)	<source> ::= {CHANnel<n> | NONE} <n> ::= {1 | 2 | 3 | 4} for 4ch models <n> ::= {1 | 2} for 2ch models
n/a	:MTESt:TITLe? (see page 416)	<title> ::= a string of up to 128 ASCII characters

Table 19 :RECall Commands Summary

Command	Query	Options and Query Returns
:RECall:FILename <base_name> (see page 419)	:RECall:FILename? (see page 419)	<base_name> ::= quoted ASCII string
:RECall:MASK[:STARt] [<file_spec>] (see page 420)	n/a	<file_spec> ::= {<internal_loc> | <file_name>} <internal_loc> ::= 0-3; an integer in NR1 format <file_name> ::= quoted ASCII string
:RECall:PWD <path_name> (see page 421)	:RECall:PWD? (see page 421)	<path_name> ::= quoted ASCII string
:RECall:SETup[:STARt] [<file_spec>] (see page 422)	n/a	<file_spec> ::= {<internal_loc> | <file_name>} <internal_loc> ::= 0-9; an integer in NR1 format <file_name> ::= quoted ASCII string
:RECall:WMEMory<r>[:STARt] [<file_name>] (see page 423)	n/a	<r> ::= 1-2 in NR1 format <file_name> ::= quoted ASCII string If extension included in file name, it must be ".h5".

Table 20 :SAVE Commands Summary

Command	Query	Options and Query Returns
:SAVE:FILename <base_name> (see page 428)	:SAVE:FILename? (see page 428)	<base_name> ::= quoted ASCII string
:SAVE:IMAGe[:STARt] [<file_name>] (see page 429)	n/a	<file_name> ::= quoted ASCII string
:SAVE:IMAGe:FACTors {{0 | OFF} | {1 | ON}} (see page 430)	:SAVE:IMAGe:FACTors? (see page 430)	{0 | 1}
:SAVE:IMAGe:FORMat <format> (see page 431)	:SAVE:IMAGe:FORMat? (see page 431)	<format> ::= {TIFF | {BMP | BMP24bit} | BMP8bit | PNG | NONE}

Table 20 :SAVE Commands Summary (continued)

Command	Query	Options and Query Returns
:SAVE:IMAGe:INKSaver {{0 | OFF} | {1 | ON}} (see page 432)	:SAVE:IMAGe:INKSaver? (see page 432)	{0 | 1}
:SAVE:IMAGe:PALette <palette> (see page 433)	:SAVE:IMAGe:PALette? (see page 433)	<palette> ::= {COLor | GRAYscale | MONochrome}
:SAVE:MASK[:STARt] [<file_spec>] (see page 434)	n/a	<file_spec> ::= {<internal_loc> | <file_name>} <internal_loc> ::= 0-3; an integer in NR1 format <file_name> ::= quoted ASCII string
:SAVE:MULTi[:STARt] [<file_name>] (see page 435)	n/a	<file_name> ::= quoted ASCII string
:SAVE:PWD <path_name> (see page 436)	:SAVE:PWD? (see page 436)	<path_name> ::= quoted ASCII string
:SAVE:SETup[:STARt] [<file_spec>] (see page 437)	n/a	<file_spec> ::= {<internal_loc> | <file_name>} <internal_loc> ::= 0-9; an integer in NR1 format <file_name> ::= quoted ASCII string
:SAVE:WAVeform[:STARt] [<file_name>] (see page 438)	n/a	<file_name> ::= quoted ASCII string
:SAVE:WAVeform:FORMat <format> (see page 439)	:SAVE:WAVeform:FORMat? (see page 439)	<format> ::= {ASCiixy | CSV | BINary | NONE}
:SAVE:WAVeform:LENGth <length> (see page 440)	:SAVE:WAVeform:LENGth? (see page 440)	<length> ::= 100 to max. length; an integer in NR1 format
:SAVE:WAVeform:LENGth:MAX {{0 | OFF} | {1 | ON}} (see page 441)	:SAVE:WAVeform:LENGth:MAX? (see page 441)	{0 | 1}
:SAVE:WAVeform:SEGMented <option> (see page 442)	:SAVE:WAVeform:SEGMented? (see page 442)	<option> ::= {ALL | CURRent}

Table 20 :SAVE Commands Summary (continued)

Command	Query	Options and Query Returns
:SAVE:WMEMory:SOURce <source> (see page 443)	:SAVE:WMEMory:SOURce? (see page 443)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format NOTE: Only ADD or SUBtract math operations can be saved as reference waveforms. <return_value> ::= <source>
:SAVE:WMEMory[:STARt] [<file_name>] (see page 444)	n/a	<file_name> ::= quoted ASCII string If extension included in file name, it must be ".h5".

Table 21 General :SBUS<n> Commands Summary

Command	Query	Options and Query Returns
:SBUS<n>:DISPlay {{0 | OFF} | {1 | ON}} (see page 448)	:SBUS<n>:DISPlay? (see page 448)	{0 | 1}
:SBUS<n>:MODE <mode> (see page 449)	:SBUS<n>:MODE? (see page 449)	<mode> ::= {CAN | IIC | LIN | SPI | UART}

Table 22 :SBUS<n>:CAN Commands Summary

Command	Query	Options and Query Returns
n/a	:SBUS<n>:CAN:COUNt:ERRor? (see page 452)	<frame_count> ::= integer in NR1 format
n/a	:SBUS<n>:CAN:COUNt:OVERload? (see page 453)	<frame_count> ::= integer in NR1 format
:SBUS<n>:CAN:COUNt:RESet (see page 454)	n/a	n/a
n/a	:SBUS<n>:CAN:COUNt:TOTal? (see page 455)	<frame_count> ::= integer in NR1 format
n/a	:SBUS<n>:CAN:COUNt:UTILization? (see page 456)	<percent> ::= floating-point in NR3 format

Table 22 :SBUS<n>:CAN Commands Summary (continued)

Command	Query	Options and Query Returns
:SBUS<n>:CAN:SAMPlepoint <value> (see page 457)	:SBUS<n>:CAN:SAMPlepoint? (see page 457)	<value> ::= {60 | 62.5 | 68 | 70 | 75 | 80 | 87.5} in NR3 format
:SBUS<n>:CAN:SIGNal:BAUDrate <baudrate> (see page 458)	:SBUS<n>:CAN:SIGNal:BAUDrate? (see page 458)	<baudrate> ::= integer from 10000 to 4000000 in 100 b/s increments, or 5000000
:SBUS<n>:CAN:SIGNal:DEFinition <value> (see page 459)	:SBUS<n>:CAN:SIGNal:DEFinition? (see page 459)	<value> ::= {CANH | CANL | RX | TX | DIFFerential | DIFL | DIFH}
:SBUS<n>:CAN:SOURce <source> (see page 460)	:SBUS<n>:CAN:SOURce? (see page 460)	<source> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:SBUS<n>:CAN:TRIGger <condition> (see page 461)	:SBUS<n>:CAN:TRIGger? (see page 462)	<condition> ::= {SOF | DATA | ERRor | IDData | IDEither | IDRemote | ALLerrors | OVERload | ACKerror}

:SBUS<n>:CAN:TRIGger:PATTern:DATA <string> (see page 463)	:SBUS<n>:CAN:TRIGger:PATTern:DATA? (see page 463)	<string> ::= "nn...n" where n ::= {0 | 1 | X | $}
		<string ::= "0xnn...n" where n ::= {0,..,9 | A,..,F | X | $}

:SBUS<n>:CAN:TRIGger:PATTern:DATA:LENGth <length> (see page 464)	:SBUS<n>:CAN:TRIGger:PATTern:DATA:LENGth? (see page 464)	<length> ::= integer from 1 to 8 in NR1 format

:SBUS<n>:CAN:TRIGger:PATTern:ID <string> (see page 465)	:SBUS<n>:CAN:TRIGger:PATTern:ID? (see page 465)	<string> ::= "nn...n" where n ::= {0 | 1 | X | $}
		<string ::= "0xnn...n" where n ::= {0,..,9 | A,..,F | X | $}

:SBUS<n>:CAN:TRIGger:PATTern:ID:MODE <value> (see page 466)	:SBUS<n>:CAN:TRIGger:PATTern:ID:MODE? (see page 466)	<value> ::= {STANdard | EXTended}

Table 23 :SBUS<n>:IIC Commands Summary

Command	Query	Options and Query Returns
:SBUS<n>:IIC:ASIZe <size> (see page 468)	:SBUS<n>:IIC:ASIZe? (see page 468)	<size> ::= {BIT7 | BIT8}
:SBUS<n>:IIC[:SOURce]:CLOCk <source> (see page 469)	:SBUS<n>:IIC[:SOURce]:CLOCk? (see page 469)	<source> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:SBUS<n>:IIC[:SOURce]:DATA <source> (see page 470)	:SBUS<n>:IIC[:SOURce]:DATA? (see page 470)	<source> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:SBUS<n>:IIC:TRIGger:PATTern:ADDRess <value> (see page 471)	:SBUS<n>:IIC:TRIGger:PATTern:ADDRess? (see page 471)	<value> ::= integer or <string> <string> ::= "0xnn" n ::= {0,..,9 | A,..,F}
:SBUS<n>:IIC:TRIGger:PATTern:DATA <value> (see page 472)	:SBUS<n>:IIC:TRIGger:PATTern:DATA? (see page 472)	<value> ::= integer or <string> <string> ::= "0xnn" n ::= {0,..,9 | A,..,F}
:SBUS<n>:IIC:TRIGger:PATTern:DATa2 <value> (see page 473)	:SBUS<n>:IIC:TRIGger:PATTern:DATa2? (see page 473)	<value> ::= integer or <string> <string> ::= "0xnn" n ::= {0,..,9 | A,..,F}
:SBUS<n>:IIC:TRIGger:QUALifier <value> (see page 474)	:SBUS<n>:IIC:TRIGger:QUALifier? (see page 474)	<value> ::= {EQUal | NOTequal | LESSthan | GREaterthan}
:SBUS<n>:IIC:TRIGger[:TYPE] <type> (see page 475)	:SBUS<n>:IIC:TRIGger[:TYPE]? (see page 475)	<type> ::= {STARt | STOP | READ7 | READEprom | WRITe7 | WRITe10 | NACKnowledge | ANACk | R7Data2 | W7Data2 | RESTart}

Table 24 :SBUS<n>:LIN Commands Summary

Command	Query	Options and Query Returns
:SBUS<n>:LIN:PARity {{0 | OFF} | {1 | ON}} (see page 479)	:SBUS<n>:LIN:PARity? (see page 479)	{0 | 1}
:SBUS<n>:LIN:SAMPlepoint <value> (see page 480)	:SBUS<n>:LIN:SAMPlepoint? (see page 480)	<value> ::= {60 | 62.5 | 68 | 70 | 75 | 80 | 87.5} in NR3 format
:SBUS<n>:LIN:SIGNal:BAUDrate <baudrate> (see page 481)	:SBUS<n>:LIN:SIGNal:BAUDrate? (see page 481)	<baudrate> ::= integer from 2400 to 625000 in 100 b/s increments

Table 24 :SBUS<n>:LIN Commands Summary (continued)

Command	Query	Options and Query Returns
:SBUS<n>:LIN:SOURce <source> (see page 482)	:SBUS<n>:LIN:SOURce? (see page 482)	<source> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:SBUS<n>:LIN:STANdard <std> (see page 483)	:SBUS<n>:LIN:STANdard? (see page 483)	<std> ::= {LIN13 | LIN20}
:SBUS<n>:LIN:SYNCbreak <value> (see page 484)	:SBUS<n>:LIN:SYNCbreak? (see page 484)	<value> ::= integer = {11 | 12 | 13}
:SBUS<n>:LIN:TRIGger <condition> (see page 485)	:SBUS<n>:LIN:TRIGger? (see page 485)	<condition> ::= {SYNCbreak | ID | DATA}
:SBUS<n>:LIN:TRIGger:ID <value> (see page 486)	:SBUS<n>:LIN:TRIGger:ID? (see page 486)	<value> ::= 7-bit integer in decimal, <nondecimal>, or <string> from 0-63 or 0x00-0x3f <nondecimal> ::= #Hnn where n ::= {0,..,9 | A,..,F} for hexadecimal <nondecimal> ::= #Bnn...n where n ::= {0 | 1} for binary <string> ::= "0xnn" where n ::= {0,..,9 | A,..,F} for hexadecimal
:SBUS<n>:LIN:TRIGger:PATTern:DATA <string> (see page 487)	:SBUS<n>:LIN:TRIGger:PATTern:DATA? (see page 487)	<string> ::= "n" where n ::= 32-bit integer in unsigned decimal when <base> = DECimal <string> ::= "nn...n" where n ::= {0 | 1 | X | $} when <base> = BINary <string> ::= "0xnn...n" where n ::= {0,..,9 | A,..,F | X | $} when <base> = HEX
:SBUS<n>:LIN:TRIGger:PATTern:DATA:LENGth <length> (see page 489)	:SBUS<n>:LIN:TRIGger:PATTern:DATA:LENGth? (see page 489)	<length> ::= integer from 1 to 8 in NR1 format
:SBUS<n>:LIN:TRIGger:PATTern:FORMat <base> (see page 490)	:SBUS<n>:LIN:TRIGger:PATTern:FORMat? (see page 490)	<base> ::= {BINary | HEX | DECimal}

Table 25 :SBUS<n>:SPI Commands Summary

Command	Query	Options and Query Returns
:SBUS<n>:SPI:BITorder <order> (see page 493)	:SBUS<n>:SPI:BITorder? (see page 493)	<order> ::= {LSBFirst | MSBFirst}
:SBUS<n>:SPI:CLOCk:SLOPe <slope> (see page 494)	:SBUS<n>:SPI:CLOCk:SLOPe? (see page 494)	<slope> ::= {NEGative | POSitive}
:SBUS<n>:SPI:CLOCk:TIMeout <time_value> (see page 495)	:SBUS<n>:SPI:CLOCk:TIMeout? (see page 495)	<time_value> ::= time in seconds in NR3 format
:SBUS<n>:SPI:FRAMing <value> (see page 496)	:SBUS<n>:SPI:FRAMing? (see page 496)	<value> ::= {CHIPselect | {NCHipselect | NOTC} | TIMeout}
:SBUS<n>:SPI:SOURce:CLOCk <source> (see page 497)	:SBUS<n>:SPI:SOURce:CLOCk? (see page 497)	<value> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:SBUS<n>:SPI:SOURce:FRAMe <source> (see page 498)	:SBUS<n>:SPI:SOURce:FRAMe? (see page 498)	<value> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:SBUS<n>:SPI:SOURce:MISO <source> (see page 499)	:SBUS<n>:SPI:SOURce:MISO? (see page 499)	<value> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:SBUS<n>:SPI:SOURce:MOSI <source> (see page 500)	:SBUS<n>:SPI:SOURce:MOSI? (see page 500)	<value> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format

:SBUS<n>:SPI:TRIGger:PATTern:MISO:DATA <string> (see page 501)	:SBUS<n>:SPI:TRIGger:PATTern:MISO:DATA? (see page 501)	<string> ::= "nn...n" where n ::= {0 | 1 | X | $}
		
		<string ::= "0xnn...n" where n ::= {0,..,9 | A,..,F | X | $}

:SBUS<n>:SPI:TRIGger:PATTern:MISO:WIDTh <width> (see page 502)	:SBUS<n>:SPI:TRIGger:PATTern:MISO:WIDTh? (see page 502)	<width> ::= integer from 4 to 64 in NR1 format

:SBUS<n>:SPI:TRIGger:PATTern:MOSI:DATA <string> (see page 503)	:SBUS<n>:SPI:TRIGger:PATTern:MOSI:DATA? (see page 503)	<string> ::= "nn...n" where n ::= {0 | 1 | X | $}
		
		<string ::= "0xnn...n" where n ::= {0,..,9 | A,..,F | X | $}

Table 25 :SBUS<n>:SPI Commands Summary (continued)

Command	Query	Options and Query Returns
:SBUS<n>:SPI:TRIGger:PATTern:MOSI:WIDTh <width> (see page 504)	:SBUS<n>:SPI:TRIGger:PATTern:MOSI:WIDTh? (see page 504)	<width> ::= integer from 4 to 64 in NR1 format
:SBUS<n>:SPI:TRIGger:TYPE <value> (see page 505)	:SBUS<n>:SPI:TRIGger:TYPE? (see page 505)	<value> ::= {MOSI | MISO}
:SBUS<n>:SPI:WIDTh <word_width> (see page 506)	:SBUS<n>:SPI:WIDTh? (see page 506)	<word_width> ::= integer 4-16 in NR1 format

Table 26 :SBUS<n>:UART Commands Summary

Command	Query	Options and Query Returns
:SBUS<n>:UART:BASE <base> (see page 509)	:SBUS<n>:UART:BASE? (see page 509)	<base> ::= {ASCii | BINary | HEX}
:SBUS<n>:UART:BAUDrate <baudrate> (see page 510)	:SBUS<n>:UART:BAUDrate? (see page 510)	<baudrate> ::= integer from 100 to 8000000
:SBUS<n>:UART:BITorder <bitorder> (see page 511)	:SBUS<n>:UART:BITorder? (see page 511)	<bitorder> ::= {LSBFirst | MSBFirst}
n/a	:SBUS<n>:UART:COUNt:ERRor? (see page 512)	<frame_count> ::= integer in NR1 format
:SBUS<n>:UART:COUNt:RESet (see page 513)	n/a	n/a
n/a	:SBUS<n>:UART:COUNt:RXFRames? (see page 514)	<frame_count> ::= integer in NR1 format
n/a	:SBUS<n>:UART:COUNt:TXFRames? (see page 515)	<frame_count> ::= integer in NR1 format
:SBUS<n>:UART:FRAMing <value> (see page 516)	:SBUS<n>:UART:FRAMing? (see page 516)	<value> ::= {OFF | <decimal> | <nondecimal>} <decimal> ::= 8-bit integer from 0-255 (0x00-0xff) <nondecimal> ::= #Hnn where n ::= {0,..,9 | A,..,F} for hexadecimal <nondecimal> ::= #Bnn...n where n ::= {0 | 1} for binary

Table 26 :SBUS<n>:UART Commands Summary (continued)

Command	Query	Options and Query Returns
:SBUS<n>:UART:PARity <parity> (see page 517)	:SBUS<n>:UART:PARity? (see page 517)	<parity> ::= {EVEN | ODD | NONE}
:SBUS<n>:UART:POLarity <polarity> (see page 518)	:SBUS<n>:UART:POLarity? (see page 518)	<polarity> ::= {HIGH | LOW}
:SBUS<n>:UART:SOURce:RX <source> (see page 519)	:SBUS<n>:UART:SOURce:RX? (see page 519)	<source> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:SBUS<n>:UART:SOURce:TX <source> (see page 520)	:SBUS<n>:UART:SOURce:TX? (see page 520)	<source> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:SBUS<n>:UART:TRIGger:BASE <base> (see page 521)	:SBUS<n>:UART:TRIGger:BASE? (see page 521)	<base> ::= {ASCii | HEX}
:SBUS<n>:UART:TRIGger:BURSt <value> (see page 522)	:SBUS<n>:UART:TRIGger:BURSt? (see page 522)	<value> ::= {OFF | 1 to 4096 in NR1 format}
:SBUS<n>:UART:TRIGger:DATA <value> (see page 523)	:SBUS<n>:UART:TRIGger:DATA? (see page 523)	<value> ::= 8-bit integer from 0-255 (0x00-0xff) in decimal, <hexadecimal>, <binary>, or <quoted_string> format <hexadecimal> ::= #Hnn where n ::= {0,..,9 | A,..,F} for hexadecimal <binary> ::= #Bnn...n where n ::= {0 | 1} for binary <quoted_string> ::= any of the 128 valid 7-bit ASCII characters (or standard abbreviations)
:SBUS<n>:UART:TRIGger:IDLE <time_value> (see page 524)	:SBUS<n>:UART:TRIGger:IDLE? (see page 524)	<time_value> ::= time from 1 us to 10 s in NR3 format
:SBUS<n>:UART:TRIGger:QUALifier <value> (see page 525)	:SBUS<n>:UART:TRIGger:QUALifier? (see page 525)	<value> ::= {EQUal | NOTequal | GREaterthan | LESSthan}

Table 26 :SBUS<n>:UART Commands Summary (continued)

Command	Query	Options and Query Returns
:SBUS<n>:UART:TRIGger :TYPE <value> (see page 526)	:SBUS<n>:UART:TRIGger :TYPE? (see page 526)	<value> ::= {RSTArt | RSTOp | RDATa | RD1 | RD0 | RDX | PARityerror | TSTArt | TSTOp | TDATa | TD1 | TD0 | TDX}
:SBUS<n>:UART:WIDTh <width> (see page 527)	:SBUS<n>:UART:WIDTh? (see page 527)	<width> ::= {5 | 6 | 7 | 8 | 9}

Table 27 :SYSTem Commands Summary

Command	Query	Options and Query Returns

:SYSTem:DATE <date> (see page 531)	:SYSTem:DATE? (see page 531)	<date> ::= <year>,<month>,<day>
		<year> ::= 4-digit year in NR1 format
		<month> ::= {1,..,12 | JANuary | FEBruary | MARch | APRil | MAY | JUNe | JULy | AUGust | SEPtember | OCTober | NOVember | DECember}
		<day> ::= {1,..31}

:SYSTem:DSP <string> (see page 532)	n/a	<string> ::= up to 75 characters as a quoted ASCII string
n/a	:SYSTem:ERRor? (see page 533)	<error> ::= an integer error code <error string> ::= quoted ASCII string. See Error Messages (see page 737).
:SYSTem:LOCK <value> (see page 534)	:SYSTem:LOCK? (see page 534)	<value> ::= {{1 | ON} | {0 | OFF}}
:SYSTem:MENU <menu> (see page 535)	n/a	<menu> ::= {MASK | MEASure | SEGMented | LISTer}
:SYSTem:PERSona[:MANufacturer] <manufacturer_string> (see page 536)	:SYSTem:PERSona[:MANufacturer]? (see page 536)	<manufacturer_string> ::= quoted ASCII string, up to 63 characters
:SYSTem:PERSona[:MANufacturer]:DEFault (see page 537)	n/a	Sets manufacturer string to "KEYSIGHT TECHNOLOGIES"
:SYSTem:PRESet (see page 538)	n/a	See :SYSTem:PRESet (see page 538)

Table 27 :SYSTem Commands Summary (continued)

Command	Query	Options and Query Returns
:SYSTem:PROTection:LOCK <value> (see page 541)	:SYSTem:PROTection:LOCK? (see page 541)	<value> ::= {{1 | ON} | {0 | OFF}}

:SYSTem:RLOGger <setting>[,<file_name>[,<write_mode>]] (see page 542)	n/a	<setting> ::= {{0 | OFF} | {1 | ON}}
		<file_name> ::= quoted ASCII string
		<write_mode> ::= {CREate | APPend}

:SYSTem:RLOGger:DESTination <dest> (see page 543)	:SYSTem:RLOGger:DESTination? (see page 543)	<dest> ::= {FILE | SCReen | BOTH}
:SYSTem:RLOGger:DISPlay {{0 | OFF} | {1 | ON}} (see page 544)	:SYSTem:RLOGger:DISPlay? (see page 544)	<setting> ::= {0 | 1}
:SYSTem:RLOGger:FNAMe <file_name> (see page 545)	:SYSTem:RLOGger:FNAMe? (see page 545)	<file_name> ::= quoted ASCII string
:SYSTem:RLOGger:STATe {{0 | OFF} | {1 | ON}} (see page 546)	:SYSTem:RLOGger:STATe? (see page 546)	<setting> ::= {0 | 1}
:SYSTem:RLOGger:TRANsparent {{0 | OFF} | {1 | ON}} (see page 547)	:SYSTem:RLOGger:TRANsparent? (see page 547)	<setting> ::= {0 | 1}
:SYSTem:RLOGger:WMODe <write_mode> (see page 548)	:SYSTem:RLOGger:WMODe? (see page 548)	<write_mode> ::= {CREate | APPend}
:SYSTem:SETup <setup_data> (see page 549)	:SYSTem:SETup? (see page 549)	<setup_data> ::= data in IEEE 488.2 # format.
:SYSTem:TIME <time> (see page 551)	:SYSTem:TIME? (see page 551)	<time> ::= hours,minutes,seconds in NR1 format

Table 28 :TIMebase Commands Summary

Command	Query	Options and Query Returns
:TIMebase:MODE <value> (see page 555)	:TIMebase:MODE? (see page 555)	<value> ::= {MAIN | WINDow | XY | ROLL}
:TIMebase:POSition <pos> (see page 556)	:TIMebase:POSition? (see page 556)	<pos> ::= time from the trigger event to the display reference point in NR3 format
:TIMebase:RANGe <range_value> (see page 557)	:TIMebase:RANGe? (see page 557)	<range_value> ::= time for 10 div in seconds in NR3 format
:TIMebase:REFerence {LEFT | CENTer | RIGHt} (see page 558)	:TIMebase:REFerence? (see page 558)	<return_value> ::= {LEFT | CENTer | RIGHt}
:TIMebase:SCALe <scale_value> (see page 559)	:TIMebase:SCALe? (see page 559)	<scale_value> ::= time/div in seconds in NR3 format
:TIMebase:VERNier {{0 | OFF} | {1 | ON}} (see page 560)	:TIMebase:VERNier? (see page 560)	{0 | 1}
:TIMebase:WINDow:POSition <pos> (see page 561)	:TIMebase:WINDow:POSition? (see page 561)	<pos> ::= time from the trigger event to the zoomed view reference point in NR3 format
:TIMebase:WINDow:RANGe <range_value> (see page 562)	:TIMebase:WINDow:RANGe? (see page 562)	<range value> ::= range value in seconds in NR3 format for the zoomed window
:TIMebase:WINDow:SCALe <scale_value> (see page 563)	:TIMebase:WINDow:SCALe? (see page 563)	<scale_value> ::= scale value in seconds in NR3 format for the zoomed window

Table 29 General :TRIGger Commands Summary

Command	Query	Options and Query Returns
:TRIGger:FORCe (see page 568)	n/a	n/a
:TRIGger:HFReject {{0 | OFF} | {1 | ON}} (see page 569)	:TRIGger:HFReject? (see page 569)	{0 | 1}
:TRIGger:HOLDoff <holdoff_time> (see page 570)	:TRIGger:HOLDoff? (see page 570)	<holdoff_time> ::= 60 ns to 10 s in NR3 format
:TRIGger:LEVel:ASETup (see page 571)	n/a	n/a

Table 29 General :TRIGger Commands Summary (continued)

Command	Query	Options and Query Returns
:TRIGger:LEVel:HIGH <level>, <source> (see page 572)	:TRIGger:LEVel:HIGH? <source> (see page 572)	<level> ::= .75 x full-scale voltage from center screen in NR3 format. <source> ::= CHANnel<n> <n> ::= 1 to (# analog channels) in NR1 format
:TRIGger:LEVel:LOW <level>, <source> (see page 573)	:TRIGger:LEVel:LOW? <source> (see page 573)	<level> ::= .75 x full-scale voltage from center screen in NR3 format. <source> ::= CHANnel<n> <n> ::= 1 to (# analog channels) in NR1 format

:TRIGger:MODE <mode> (see page 574)	:TRIGger:MODE? (see page 574)	<mode> ::= {EDGE | GLITch | PATTern | SHOLd | TRANsition | TV | SBUS1}
		<return_value> ::= {<mode> | <none>}
		<none> ::= query returns "NONE" if the :TIMebase:MODE is ROLL or XY

:TRIGger:NREJect {{0 | OFF} | {1 | ON}} (see page 575)	:TRIGger:NREJect? (see page 575)	{0 | 1}
:TRIGger:SWEep <sweep> (see page 576)	:TRIGger:SWEep? (see page 576)	<sweep> ::= {AUTO | NORMal}

Table 30 :TRIGger[:EDGE] Commands Summary

Command	Query	Options and Query Returns
:TRIGger[:EDGE]:COUPling {AC | DC | LFReject} (see page 578)	:TRIGger[:EDGE]:COUPling? (see page 578)	{AC | DC | LFReject}
:TRIGger[:EDGE]:LEVel <level> [,<source>] (see page 579)	:TRIGger[:EDGE]:LEVel? [<source>] (see page 579)	For internal triggers, <level> ::= .75 x full-scale voltage from center screen in NR3 format. For external triggers, <level> ::= ±(external range setting) in NR3 format. <source> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:TRIGger[:EDGE]:REJect {OFF | LFReject | HFReject} (see page 580)	:TRIGger[:EDGE]:REJect? (see page 580)	{OFF | LFReject | HFReject}
:TRIGger[:EDGE]:SLOPe <polarity> (see page 581)	:TRIGger[:EDGE]:SLOPe? (see page 581)	<polarity> ::= {POSitive | NEGative | EITHer | ALTernate}
:TRIGger[:EDGE]:SOURce <source> (see page 582)	:TRIGger[:EDGE]:SOURce? (see page 582)	<source> ::= {CHANnel<n> | EXTernal | LINE | WGEN} <n> ::= 1 to (# analog channels) in NR1 format

Table 31 :TRIGger:GLITch Commands Summary

Command	Query	Options and Query Returns
:TRIGger:GLITch:GREaterthan <greater_than_time>[suffix] (see page 584)	:TRIGger:GLITch:GREaterthan? (see page 584)	<greater_than_time> ::= floating-point number in NR3 format [suffix] ::= {s | ms | us | ns | ps}
:TRIGger:GLITch:LESSthan <less_than_time>[suffix] (see page 585)	:TRIGger:GLITch:LESSthan? (see page 585)	<less_than_time> ::= floating-point number in NR3 format [suffix] ::= {s | ms | us | ns | ps}

Table 31 :TRIGger:GLITch Commands Summary (continued)

Command	Query	Options and Query Returns
:TRIGger:GLITch:LEVel <level> [<source>] (see page 586)	:TRIGger:GLITch:LEVel? (see page 586)	For internal triggers, <level> ::= .75 x full-scale voltage from center screen in NR3 format. For external triggers, <level> ::= ±(external range setting) in NR3 format. <source> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:TRIGger:GLITch:POLarity <polarity> (see page 587)	:TRIGger:GLITch:POLarity? (see page 587)	<polarity> ::= {POSitive | NEGative}
:TRIGger:GLITch:QUALifier <qualifier> (see page 588)	:TRIGger:GLITch:QUALifier? (see page 588)	<qualifier> ::= {GREaterthan | LESSthan | RANGe}
:TRIGger:GLITch:RANGe <less_than_time>[suffix], <greater_than_time>[suffix] (see page 589)	:TRIGger:GLITch:RANGe? (see page 589)	<less_than_time> ::= 15 ns to 10 seconds in NR3 format <greater_than_time> ::= 10 ns to 9.99 seconds in NR3 format [suffix] ::= {s | ms | us | ns | ps}
:TRIGger:GLITch:SOURce <source> (see page 590)	:TRIGger:GLITch:SOURce? (see page 590)	<source> ::= {CHANnel<n>} <n> ::= 1 to (# analog channels) in NR1 format

Table 32 :TRIGger:PATTern Commands Summary

Command	Query	Options and Query Returns
:TRIGger:PATTern <string>[,<edge_source>,<edge>] (see page 592)	:TRIGger:PATTern? (see page 592)	<string> ::= "nn...n" where n ::= {0 | 1 | X | R | F} when <base> = ASCii <string> ::= "0xnn...n" where n ::= {0,..,9 | A,..,F | X | $} when <base> = HEX <edge_source> ::= {CHANnel<n> | EXTernal | NONE} <n> ::= 1 to (# analog channels) in NR1 format <edge> ::= {POSitive | NEGative}
:TRIGger:PATTern:FORMat <base> (see page 594)	:TRIGger:PATTern:FORMat? (see page 594)	<base> ::= {ASCii | HEX}
:TRIGger:PATTern:QUALifier <qualifier> (see page 595)	:TRIGger:PATTern:QUALifier? (see page 595)	<qualifier> ::= ENTered

Table 33 :TRIGger:TV Commands Summary

Command	Query	Options and Query Returns
:TRIGger:TV:LINE <line number> (see page 608)	:TRIGger:TV:LINE? (see page 608)	<line number> ::= integer in NR1 format
:TRIGger:TV:MODE <tv mode> (see page 609)	:TRIGger:TV:MODE? (see page 609)	<tv mode> ::= {FIEld1 | FIEld2 | AFIelds | ALINes | LFIeld1 | LFIeld2 | LALTernate}
:TRIGger:TV:POLarity <polarity> (see page 610)	:TRIGger:TV:POLarity? (see page 610)	<polarity> ::= {POSitive | NEGative}
:TRIGger:TV:SOURce <source> (see page 611)	:TRIGger:TV:SOURce? (see page 611)	<source> ::= {CHANnel<n>} <n> ::= 1 to (# analog channels) in NR1 format
:TRIGger:TV:STANdard <standard> (see page 612)	:TRIGger:TV:STANdard? (see page 612)	<standard> ::= {NTSC | PAL | PALM | SECam}

Table 34 :WAVeform Commands Summary

Command	Query	Options and Query Returns
:WAVeform:BYTeorder <value> (see page 620)	:WAVeform:BYTeorder? (see page 620)	<value> ::= {LSBFirst | MSBFirst}
n/a	:WAVeform:COUNt? (see page 621)	<count> ::= an integer from 1 to 65536 in NR1 format
n/a	:WAVeform:DATA? (see page 622)	<binary block length bytes>, <binary data> For example, to transmit 1000 bytes of data, the syntax would be: #800001000<1000 bytes of data><NL> 8 is the number of digits that follow 00001000 is the number of bytes to be transmitted <1000 bytes of data> is the actual data
:WAVeform:FORMat <value> (see page 624)	:WAVeform:FORMat? (see page 624)	<value> ::= {WORD | BYTE | ASCII}
:WAVeform:POINts <# points> (see page 625)	:WAVeform:POINts? (see page 625)	<# points> ::= {100 | 250 | 500 | 1000 | <points_mode>} if waveform points mode is NORMal <# points> ::= {100 | 250 | 500 | 1000 | 2000 ... 8000000 in 1-2-5 sequence | <points_mode>} if waveform points mode is MAXimum or RAW <points_mode> ::= {NORMal | MAXimum | RAW}
:WAVeform:POINts:MODE <points_mode> (see page 627)	:WAVeform:POINts:MODE? (see page 627)	<points_mode> ::= {NORMal | MAXimum | RAW}

Table 34 :WAVeform Commands Summary (continued)

Command	Query	Options and Query Returns
n/a	:WAVeform:PREamble? (see page 629)	<preamble_block> ::= <format NR1>, <type NR1>,<points NR1>,<count NR1>, <xincrement NR3>, <xorigin NR3>, <xreference NR1>,<yincrement NR3>, <yorigin NR3>, <yreference NR1> <format> ::= an integer in NR1 format: • 0 for BYTE format • 1 for WORD format • 2 for ASCii format <type> ::= an integer in NR1 format: • 0 for NORMal type • 1 for PEAK detect type • 3 for AVERage type • 4 for HRESolution type <count> ::= Average count, or 1 if PEAK detect type or NORMal; an integer in NR1 format
n/a	:WAVeform:SEGMented:COUNt? (see page 632)	<count> ::= an integer from 2 to 1000 in NR1 format (with SGM license)
n/a	:WAVeform:SEGMented:TTAG? (see page 633)	<time_tag> ::= in NR3 format (with SGM license)
:WAVeform:SOURce <source> (see page 634)	:WAVeform:SOURce? (see page 634)	<source> ::= {CHANnel<n> | FUNCtion | MATH} <n> ::= 1 to (# analog channels) in NR1 format
:WAVeform:SOURce:SUBSource <subsource> (see page 638)	:WAVeform:SOURce:SUBSource? (see page 638)	<subsource> ::= {{SUB0 | RX | MOSI} | {SUB1 | TX | MISO}}
n/a	:WAVeform:TYPE? (see page 639)	<return_mode> ::= {NORM | PEAK | AVER | HRES}
:WAVeform:UNSigned {{0 | OFF} | {1 | ON}} (see page 640)	:WAVeform:UNSigned? (see page 640)	{0 | 1}
:WAVeform:VIEW <view> (see page 641)	:WAVeform:VIEW? (see page 641)	<view> ::= {MAIN}

Table 34 :WAVeform Commands Summary (continued)

Command	Query	Options and Query Returns
n/a	:WAVeform:XINCrement? (see page 642)	<return_value> ::= x-increment in the current preamble in NR3 format
n/a	:WAVeform:XORigin? (see page 643)	<return_value> ::= x-origin value in the current preamble in NR3 format
n/a	:WAVeform:XREFerence? (see page 644)	<return_value> ::= 0 (x-reference value in the current preamble in NR1 format)
n/a	:WAVeform:YINCrement? (see page 645)	<return_value> ::= y-increment value in the current preamble in NR3 format
n/a	:WAVeform:YORigin? (see page 646)	<return_value> ::= y-origin in the current preamble in NR3 format
n/a	:WAVeform:YREFerence? (see page 647)	<return_value> ::= y-reference value in the current preamble in NR1 format

Table 35 :WGEN Commands Summary

Command	Query	Options and Query Returns
:WGEN:FREQuency <frequency> (see page 652)	:WGEN:FREQuency? (see page 652)	<frequency> ::= frequency in Hz in NR3 format
:WGEN:FUNCtion <signal> (see page 653)	:WGEN:FUNCtion? (see page 654)	<signal> ::= {SINusoid | SQUare | RAMP | PULSe | NOISe | DC}
:WGEN:FUNCtion:PULSe:WIDTh <width> (see page 656)	:WGEN:FUNCtion:PULSe:WIDTh? (see page 656)	<width> ::= pulse width in seconds in NR3 format
:WGEN:FUNCtion:RAMP:SYMMetry <percent> (see page 657)	:WGEN:FUNCtion:RAMP:SYMMetry? (see page 657)	<percent> ::= symmetry percentage from 0% to 100% in NR1 format
:WGEN:FUNCtion:SQUare:DCYCle <percent? (see page 658)	:WGEN:FUNCtion:SQUare:DCYCle? (see page 658)	<percent> ::= duty cycle percentage from 20% to 80% in NR1 format
:WGEN:MODulation:AM:DEPTh <percent> (see page 659)	:WGEN:MODulation:AM:DEPTh? (see page 659)	<percent> ::= AM depth percentage from 0% to 100% in NR1 format

Table 35 :WGEN Commands Summary (continued)

Command	Query	Options and Query Returns
:WGEN:MODulation:AM:FREQuency <frequency> (see page 660)	:WGEN:MODulation:AM:FREQuency? (see page 660)	<frequency> ::= modulating waveform frequency in Hz in NR3 format
:WGEN:MODulation:FM:DEViation <frequency> (see page 661)	:WGEN:MODulation:FM:DEViation? (see page 661)	<frequency> ::= frequency deviation in Hz in NR3 format
:WGEN:MODulation:FM:FREQuency <frequency> (see page 662)	:WGEN:MODulation:FM:FREQuency? (see page 662)	<frequency> ::= modulating waveform frequency in Hz in NR3 format
:WGEN:MODulation:FSKey:FREQuency <percent> (see page 663)	:WGEN:MODulation:FSKey:FREQuency? (see page 663)	<frequency> ::= hop frequency in Hz in NR3 format
:WGEN:MODulation:FSKey:RATE <rate> (see page 664)	:WGEN:MODulation:FSKey:RATE? (see page 664)	<rate> ::= FSK modulation rate in Hz in NR3 format
:WGEN:MODulation:FUNCtion <shape> (see page 665)	:WGEN:MODulation:FUNCtion? (see page 665)	<shape> ::= {SINusoid | SQUare| RAMP}
:WGEN:MODulation:FUNCtion:RAMP:SYMMetry <percent> (see page 666)	:WGEN:MODulation:FUNCtion:RAMP:SYMMetry? (see page 666)	<percent> ::= symmetry percentage from 0% to 100% in NR1 format
:WGEN:MODulation:NOISe <percent> (see page 667)	:WGEN:MODulation:NOISe? (see page 667)	<percent> ::= 0 to 100
:WGEN:MODulation:STATe {{0 | OFF} | {1 | ON}} (see page 668)	:WGEN:MODulation:STATe? (see page 668)	{0 | 1}
:WGEN:MODulation:TYPE <type> (see page 669)	:WGEN:MODulation:TYPE? (see page 669)	<type> ::= {AM | FM | FSK}
:WGEN:OUTPut {{0 | OFF} | {1 | ON}} (see page 671)	:WGEN:OUTPut? (see page 671)	{0 | 1}
:WGEN:OUTPut:LOAD <impedance> (see page 672)	:WGEN:OUTPut:LOAD? (see page 672)	<impedance> ::= {ONEMeg | FIFTy}
:WGEN:OUTPut:POLarity <polarity> (see page 673)	:WGEN:OUTPut:POLarity? (see page 673)	<polarity> ::= {NORMal | INVerted}

Table 35 :WGEN Commands Summary (continued)

Command	Query	Options and Query Returns
:WGEN:PERiod <period> (see page 674)	:WGEN:PERiod? (see page 674)	<period> ::= period in seconds in NR3 format
:WGEN:RST (see page 675)	n/a	n/a
:WGEN:VOLTage <amplitude> (see page 676)	:WGEN:VOLTage? (see page 676)	<amplitude> ::= amplitude in volts in NR3 format
:WGEN:VOLTage:HIGH <high> (see page 677)	:WGEN:VOLTage:HIGH? (see page 677)	<high> ::= high-level voltage in volts, in NR3 format
:WGEN:VOLTage:LOW <low> (see page 678)	:WGEN:VOLTage:LOW? (see page 678)	<low> ::= low-level voltage in volts, in NR3 format
:WGEN:VOLTage:OFFSet <offset> (see page 679)	:WGEN:VOLTage:OFFSet? (see page 679)	<offset> ::= offset in volts in NR3 format

Table 36 :WMEMory<r> Commands Summary

Command	Query	Options and Query Returns
:WMEMory<r>:CLEar (see page 683)	n/a	<r> ::= 1-2 in NR1 format
:WMEMory<r>:DISPlay {{0 | OFF} | {1 | ON}} (see page 684)	:WMEMory<r>:DISPlay? (see page 684)	<r> ::= 1-2 in NR1 format {0 | 1}
:WMEMory<r>:LABel <string> (see page 685)	:WMEMory<r>:LABel? (see page 685)	<r> ::= 1-2 in NR1 format <string> ::= any series of 10 or less ASCII characters enclosed in quotation marks
:WMEMory<r>:SAVE <source> (see page 686)	n/a	<r> ::= 1-2 in NR1 format <source> ::= {CHANnel<n> | FUNCtion | MATH} <n> ::= 1 to (# analog channels) in NR1 format NOTE: Only ADD or SUBtract math operations can be saved as reference waveforms.
:WMEMory<r>:SKEW <skew> (see page 687)	:WMEMory<r>:SKEW? (see page 687)	<r> ::= 1-2 in NR1 format <skew> ::= time in seconds in NR3 format

Table 36 :WMEMory<r> Commands Summary (continued)

Command	Query	Options and Query Returns
:WMEMory<r>:YOFFset <offset>[suffix] (see page 688)	:WMEMory<r>:YOFFset? (see page 688)	<r> ::= 1-2 in NR1 format <offset> ::= vertical offset value in NR3 format [suffix] ::= {V | mV}
:WMEMory<r>:YRANge <range>[suffix] (see page 689)	:WMEMory<r>:YRANge? (see page 689)	<r> ::= 1-2 in NR1 format <range> ::= vertical full-scale range value in NR3 format [suffix] ::= {V | mV}
:WMEMory<r>:YSCale <scale>[suffix] (see page 690)	:WMEMory<r>:YSCale? (see page 690)	<r> ::= 1-2 in NR1 format <scale> ::= vertical units per division value in NR3 format [suffix] ::= {V | mV}

Syntax Elements

Number Format

NR1 specifies integer data.

NR3 specifies exponential data in floating point format (for example, -1.0E-3).

<NL> (Line Terminator)

<NL> = new line or linefeed (ASCII decimal 10).

The line terminator, or a leading colon, will send the parser to the "root" of the command tree.

[ ] (Optional Syntax Terms)

Items enclosed in square brackets, [ ], are optional.

{ } (Braces)

When several items are enclosed by braces, { }, only one of these elements may be selected. Vertical line (|) indicates "or". For example, {ON | OFF} indicates that only ON or OFF may be selected, not both.

::= (Defined As)

::= means "defined as".

For example, <A> ::= <B> indicates that <A> can be replaced by <B> in any statement containing <A>.

< > (Angle Brackets)

< > Angle brackets enclose words or characters that symbolize a program code parameter or an interface command.

... (Ellipsis)

... An ellipsis (trailing dots) indicates that the preceding element may be repeated one or more times.

n,..,p (Value Ranges)

n,..,p ::= all integers between n and p inclusive.

d (Digits)

d ::= A single ASCII numeric character 0 - 9.

Quoted ASCII String

A quoted ASCII string is a string delimited by either double quotes (") or single quotes ('). Some command parameters require a quoted ASCII string. For example, when using the Keysight VISA COM library in Visual Basic, the command:

```
myScope.WriteString ":CHANNEL1:LABEL 'One'"
```

has a quoted ASCII string of:

```
'One'
```

In order to read quoted ASCII strings from query return values, some programming languages require special handling or syntax.

Definite-Length Block Response Data

Definite-length block response data allows any type of device-dependent data to be transmitted over the system interface as a series of 8-bit binary data bytes. This is particularly useful for sending large quantities of data or 8-bit extended ASCII codes. This syntax is a pound sign (#) followed by a non-zero digit representing the number of digits in the decimal integer. After the non-zero digit is the decimal integer that states the number of 8-bit data bytes being sent. This is followed by the actual data.

For example, for transmitting 1000 bytes of data, the syntax would be

```
#800001000<1000 bytes of data> <NL>
```

8 is the number of digits that follow

00001000 is the number of bytes to be transmitted

<1000 bytes of data> is the actual data

5 Common (*) Commands

Commands defined by IEEE 488.2 standard that are common to all instruments. See "Introduction to Common (*) Commands" on page 107.

Table 37 Common (*) Commands Summary

Command	Query	Options and Query Returns
`*CLS` (see page 109)	n/a	n/a

`*ESE <mask>` (see page 110)	`*ESE?` (see page 110)	`<mask> ::= 0 to 255; an integer in NR1 format:`
		`Bit Weight Name Enables`
		`--- ------ ---- ----------`
		` 7    128  PON  Power On`
		` 6     64  URQ  User Request`
		` 5     32  CME  Command Error`
		` 4     16  EXE  Execution Error`
		` 3      8  DDE  Dev. Dependent Error`
		` 2      4  QYE  Query Error`
		` 1      2  RQL  Request Control`
		` 0      1  OPC  Operation Complete`

n/a	`*ESR?` (see page 112)	`<status> ::= 0 to 255; an integer in NR1 format`

n/a	`*IDN?` (see page 112)	`AGILENT TECHNOLOGIES,<model>,<serial number>,X.XX.XX`
		`<model> ::= the model number of the instrument`
		`<serial number> ::= the serial number of the instrument`
		`<X.XX.XX> ::= the software revision of the instrument`

n/a	`*LRN?` (see page 115)	`<learn_string> ::= current instrument setup as a block of data in IEEE 488.2 # format`

Table 37 Common (*) Commands Summary (continued)

Command	Query	Options and Query Returns
*OPC (see page 116)	*OPC? (see page 116)	ASCII "1" is placed in the output queue when all pending device operations have completed.

n/a	*OPT? (see page 117)	<return_value> ::= 0,0,<license info>
		<license info> ::= <All field>, <reserved>, <reserved>, <reserved>, <Memory>, <reserved>, <reserved>, <reserved>, <reserved>, <reserved>, <reserved>, <Segmented Memory>, <Mask Test>, <reserved>, <Bandwidth>, <reserved>, <reserved>, <reserved>, <reserved>, <reserved>, <Educator's Kit>, <Waveform Generator>, <reserved>, <reserved>, <reserved>, <reserved>, <reserved>, <reserved>, <reserved>, <reserved>, <Digital Voltmeter>, <reserved>, <reserved>, <reserved>, <Remote Command Logging>, <reserved>, <reserved>, <reserved>
		<All field> ::= {0 | All}
		<reserved> ::= 0
		<Memory> ::= {0 | MEMUP}
		<Segmented Memory> ::= {0 | SGM}
		<Mask Test> ::= {0 | MASK}
		<Bandwidth> ::= {0 | BW10 | BW20}
		<Educator's Kit> ::= {0 | EDK}
		<Waveform Generator> ::= {0 | WAVEGEN}
		<Digital Voltmeter> ::= {0 | DVM}
		<Remote Command Logging> ::= {0 | RML}

*RCL <value> (see page 118)	n/a	<value> ::= {0 | 1 | 4 | 5 | 6 | 7 | 8 | 9}
*RST (see page 119)	n/a	See *RST (Reset) (see page 119)
*SAV <value> (see page 122)	n/a	<value> ::= {0 | 1 | 4 | 5 | 6 | 7 | 8 | 9}

Table 37 Common (*) Commands Summary (continued)

Command	Query	Options and Query Returns
*SRE <mask> (see page 123)	*SRE? (see page 124)	<mask> ::= sum of all bits that are set, 0 to 255; an integer in NR1 format. <mask> ::= following values: Bit Weight Name Enables --- ------ ---- ---------- 7 128 OPER Operation Status Reg 6 64 ---- (Not used.) 5 32 ESB Event Status Bit 4 16 MAV Message Available 3 8 ---- (Not used.) 2 4 MSG Message 1 2 USR User 0 1 TRG Trigger
n/a	*STB? (see page 125)	<value> ::= 0 to 255; an integer in NR1 format, as shown in the following: Bit Weight Name "1" Indicates --- ------ ---- --------------- 7 128 OPER Operation status condition occurred. 6 64 RQS/MSS Instrument is requesting service. 5 32 ESB Enabled event status condition occurred. 4 16 MAV Message available. 3 8 ---- (Not used.) 2 4 MSG Message displayed. 1 2 USR User event condition occurred. 0 1 TRG A trigger occurred.
*TRG (see page 127)	n/a	n/a
n/a	*TST? (see page 128)	<result> ::= 0 or non-zero value; an integer in NR1 format
*WAI (see page 129)	n/a	n/a

Introduction to Common (*) Commands

The common commands are defined by the IEEE 488.2 standard. They are implemented by all instruments that comply with the IEEE 488.2 standard. They provide some of the basic instrument functions, such as instrument identification and reset, reading the instrument setup, and determining how status is read and cleared.

Common commands can be received and processed by the instrument whether they are sent over the interface as separate program messages or within other program messages. If an instrument subsystem has been selected and a common command is received by the instrument, the instrument remains in the selected subsystem. For example, if the program message ":ACQuire:TYPE AVERage; *CLS; COUNt 256" is received by the instrument, the instrument sets the acquire type, then clears the status information and sets the average count.

In contrast, if a root level command or some other subsystem command is within the program message, you must re-enter the original subsystem after the command. For example, the program message ":ACQuire:TYPE AVERage; :AUToscale; :ACQuire:COUNt 256" sets the acquire type, completes the autoscale, then sets the acquire count. In this example, :ACQuire must be sent again after the :AUToscale command in order to re-enter the ACQuire subsystem and set the count.

NOTE **Each of the status registers has an enable (mask) register. By setting the bits in the enable register, you can select the status information you want to use.**

*CLS (Clear Status)

C (see page 776)

Command Syntax

```
*CLS
```

The *CLS common command clears the status data structures, the device-defined error queue, and the Request-for-OPC flag.

NOTE If the *CLS command immediately follows a program message terminator, the output queue and the MAV (message available) bit are cleared.

See Also

- "Introduction to Common (*) Commands" on page 107
- "*STB (Read Status Byte)" on page 125
- "*ESE (Standard Event Status Enable)" on page 110
- "*ESR (Standard Event Status Register)" on page 112
- "*SRE (Service Request Enable)" on page 123
- ":SYSTem:ERRor" on page 533

*ESE (Standard Event Status Enable)

C (see page 776)

Command Syntax

```
*ESE <mask_argument>

<mask_argument> ::= integer from 0 to 255
```

The *ESE common command sets the bits in the Standard Event Status Enable Register. The Standard Event Status Enable Register contains a mask value for the bits to be enabled in the Standard Event Status Register. A "1" in the Standard Event Status Enable Register enables the corresponding bit in the Standard Event Status Register. A zero disables the bit.

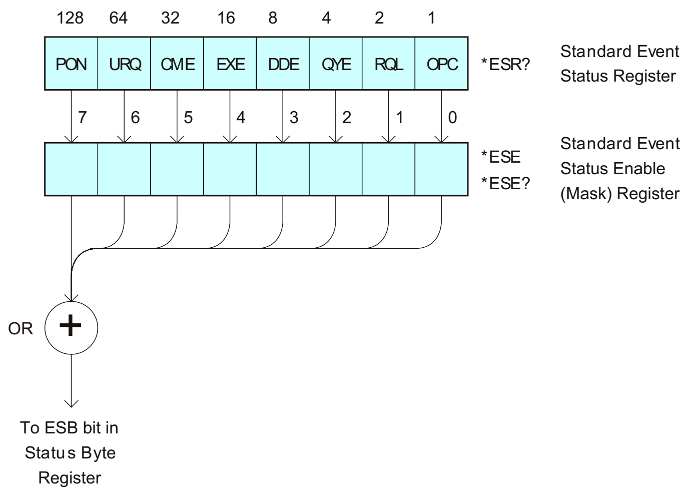

128
64
32
16
8
4
2
1
PON
URQ
CME
EXE
DDE
QYE
RQL
OPC
*ESR?
Standard Event Status Register
7
6
5
4
3
2
1
0
*ESE
*ESE?
Standard Event Status Enable (Mask) Register
OR
To ESB bit in Status Byte Register

Table 38 Standard Event Status Enable (ESE)

Bit	Name	Description	When Set (1 = High = True), Enables:
7	PON	Power On	Event when an OFF to ON transition occurs.
6	URQ	User Request	Event when a front-panel key is pressed.
5	CME	Command Error	Event when a command error is detected.
4	EXE	Execution Error	Event when an execution error is detected.
3	DDE	Device Dependent Error	Event when a device-dependent error is detected.
2	QYE	Query Error	Event when a query error is detected.
1	RQL	Request Control	Event when the device is requesting control. (Not used.)
0	OPC	Operation Complete	Event when an operation is complete.

Query Syntax

```
*ESE?
```

The *ESE? query returns the current contents of the Standard Event Status Enable Register.

Return Format

```
<mask_argument><NL>
```

```
<mask_argument> ::= 0,..,255; an integer in NR1 format.
```

See Also

- "Introduction to Common (*) Commands" on page 107
- "*ESR (Standard Event Status Register)" on page 112
- "*OPC (Operation Complete)" on page 116
- "*CLS (Clear Status)" on page 109

*ESR (Standard Event Status Register)

C (see page 776)

Query Syntax `*ESR?`

The *ESR? query returns the contents of the Standard Event Status Register. When you read the Event Status Register, the value returned is the total bit weights of all of the bits that are high at the time you read the byte. Reading the register clears the Event Status Register.

The following table shows bit weight, name, and condition for each bit.

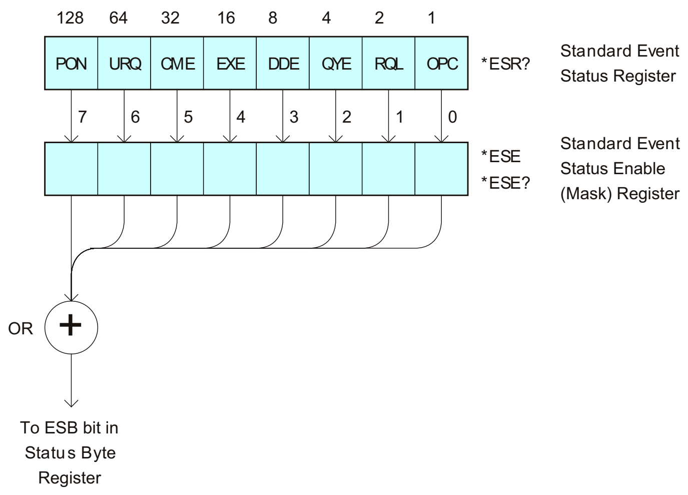

128
64
32
16
8
4
2
1
PON
URQ
CME
EXE
DDE
QYE
RQL
OPC
*ESR?
Standard Event Status Register
7
6
5
4
3
2
1
0
*ESE
*ESE?
Standard Event Status Enable (Mask) Register
OR
To ESB bit in Status Byte Register

Table 39 Standard Event Status Register (ESR)

Bit	Name	Description	When Set (1 = High = True), Indicates:
7	PON	Power On	An OFF to ON transition has occurred.
6	URQ	User Request	A front-panel key has been pressed.
5	CME	Command Error	A command error has been detected.
4	EXE	Execution Error	An execution error has been detected.
3	DDE	Device Dependent Error	A device-dependent error has been detected.
2	QYE	Query Error	A query error has been detected.
1	RQL	Request Control	The device is requesting control. (Not used.)
0	OPC	Operation Complete	Operation is complete.

Return Format `<status><NL>`

```
<status> ::= 0,..,255; an integer in NR1 format.
```

NOTE

Reading the Standard Event Status Register clears it. High or 1 indicates the bit is true.

See Also

- "Introduction to Common (*) Commands" on page 107
- "*ESE (Standard Event Status Enable)" on page 110
- "*OPC (Operation Complete)" on page 116
- "*CLS (Clear Status)" on page 109
- ":SYSTem:ERRor" on page 533

*IDN (Identification Number)

C (see page 776)

Query Syntax

```
*IDN?
```

The *IDN? query identifies the instrument type and software version.

Return Format

```
<manufacturer_string>,<model>,<serial_number>,X.XX.XX <NL>

<manufacturer_string> ::= KEYSIGHT TECHNOLOGIES

<model> ::= the model number of the instrument

<serial_number> ::= the serial number of the instrument

X.XX.XX ::= the software revision of the instrument
```

See Also

- "Introduction to Common (*) Commands" on page 107
- "*OPT (Option Identification)" on page 117
- ":SYSTem:PERSona[:MANufacturer]" on page 536
- ":SYSTem:PERSona[:MANufacturer]:DEFault" on page 537

*LRN (Learn Device Setup)

C (see page 776)

Query Syntax

```
*LRN?
```

The *LRN? query result contains the current state of the instrument. This query is similar to the :SYSTem:SETup? (see page 549) query, except that it contains ":SYST:SET " before the binary block data. The query result is a valid command that can be used to restore instrument settings at a later time.

Return Format

```
<learn_string><NL>

<learn_string> ::= :SYST:SET <setup_data>

<setup_data> ::= binary block data in IEEE 488.2 # format
```

<learn string> specifies the current instrument setup. The block size is subject to change with different firmware revisions.

NOTE The *LRN? query return format has changed from previous Keysight oscilloscopes to match the IEEE 488.2 specification which says that the query result must contain ":SYST:SET " before the binary block data.

See Also

- "Introduction to Common (*) Commands" on page 107
- "*RCL (Recall)" on page 118
- "*SAV (Save)" on page 122
- ":SYSTem:SETup" on page 549

*OPC (Operation Complete)

C (see page 776)

Command Syntax

```
*OPC
```

The *OPC command sets the operation complete bit in the Standard Event Status Register when all pending device operations have finished.

Query Syntax

```
*OPC?
```

The *OPC? query places an ASCII "1" in the output queue when all pending device operations have completed. The interface hangs until this query returns.

Return Format

```
<complete><NL>
```

```
<complete> ::= 1
```

See Also

- "Introduction to Common (*) Commands" on page 107
- "*ESE (Standard Event Status Enable)" on page 110
- "*ESR (Standard Event Status Register)" on page 112
- "*CLS (Clear Status)" on page 109

*OPT (Option Identification)

🟩C (see page 776)

Query Syntax

```
*OPT?
```

The *OPT? query reports the options installed in the instrument. This query returns a string that identifies the module and its software revision level.

Return Format

```
0,0,<license info>

<license info> ::= <All field>, <reserved>, <reserved>, <reserved>,
   <Memory>, <Low Speed Serial>, <Automotive Serial>, <reserved>,
   <reserved>, <reserved>, <Segmented Memory>, <Mask Test>, <reserved>,
   <Bandwidth>, <reserved>, <reserved>, <reserved>, <reserved>,
   <reserved>, <reserved>, <Educator's Kit>, <Waveform Generator>,
   <reserved>, <reserved>, <reserved>, <reserved>, <reserved>,
   <reserved>, <reserved>, <Digital Voltmeter>, <reserved>, <reserved>,
   <reserved>, <Remote Command Logging>, <reserved>, <reserved>,
   <reserved>

<All field> ::= {0 | All}

<reserved> ::= 0

<Memory> ::= {0 | MEMUP}

<Low Speed Serial> ::= {0 | EMBD}

<Automotive Serial> ::= {0 | AUTO}

<Segmented Memory> ::= {0 | SGM}

<Mask Test> ::= {0 | MASK}

<Bandwidth> ::= {0 | BW10}

<Educator's Kit> ::= {0 | EDK}

<Waveform Generator> ::= {0 | WAVEGEN}

<Digital Voltmeter> ::= {0 | DVM}

<Remote Command Logging> ::= {0 | RML}
```

The *OPT? query returns the following:

Module	Module Id
No modules attached	0,0,0,0,0,0,0,0,0,0,0,0,0,SGM,MASK,0,0,0,0,0,0,0,0,0,EDK,WAVEGEN,0,0,0, 0,0,0,0,0,0,0,0,RML,0,0,0

See Also

- "Introduction to Common (*) Commands" on page 107
- "*IDN (Identification Number)" on page 114

*RCL (Recall)

C (see page 776)

Command Syntax

```
*RCL <value>
```

```
<value> ::= {0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9}
```

The *RCL command restores the state of the instrument from the specified save/recall register.

See Also

- "Introduction to Common (*) Commands" on page 107
- "*SAV (Save)" on page 122

*RST (Reset)

C (see page 776)

Command Syntax

```
*RST
```

The *RST command places the instrument in a known state. This is the same as pressing **[Save/Recall] > Default/Erase > Factory Default** on the front panel.

When you perform a factory default setup, there are no user settings that remain unchanged. To perform the equivalent of the front panel's **[Default Setup]** key, where some user settings (like preferences) remain unchanged, use the :SYSTem:PRESet command.

Reset conditions are:

Acquire Menu	
Mode	Normal
Averaging	Off
# Averages	8

Analog Channel Menu	
Channel 1	On
Channel 2	Off
Volts/division	5.00 V
Offset	0.00
Coupling	DC
Probe attenuation	10:1
Vernier	Off
Invert	Off
BW limit	Off
Impedance	1 M Ohm (cannot be changed)
Units	Volts
Skew	0

Cursor Menu	
Source	Channel 1

Display Menu	
Persistence	Off
Grid	20%

Quick Meas Menu	
Source	Channel 1

Run Control	
	Scope is running

Time Base Menu	
Main time/division	100 us
Main time base delay	0.00 s
Delay time/division	500 ns
Delay time base delay	0.00 s
Reference	center
Mode	main
Vernier	Off

Trigger Menu	
Type	Edge
Mode	Auto
Coupling	dc
Source	Channel 1
Level	0.0 V
Slope	Positive
HF Reject and noise reject	Off
Holdoff	60 ns
External probe attenuation	10:1
External Units	Volts
External Impedance	1 M Ohm (cannot be changed)

See Also

- "Introduction to Common (*) Commands" on page 107
- ":SYSTem:PRESet" on page 538

Example Code

```
' RESET - This command puts the oscilloscope into a known state.
' This statement is very important for programs to work as expected.
' Most of the following initialization commands are initialized by
' *RST.  It is not necessary to reinitialize them unless the default
' setting is not suitable for your application.
myScope.WriteString "*RST"  ' Reset the oscilloscope to the defaults.
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

*SAV (Save)

C (see page 776)

Command Syntax

```
*SAV <value>

<value> ::= {0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9}
```

The *SAV command stores the current state of the instrument in a save register. The data parameter specifies the register where the data will be saved.

See Also

- "Introduction to Common (*) Commands" on page 107
- "*RCL (Recall)" on page 118

*SRE (Service Request Enable)

C (see page 776)

Command Syntax

```
*SRE <mask>

<mask> ::= integer with values defined in the following table.
```

The *SRE command sets the bits in the Service Request Enable Register. The Service Request Enable Register contains a mask value for the bits to be enabled in the Status Byte Register. A one in the Service Request Enable Register enables the corresponding bit in the Status Byte Register. A zero disables the bit.

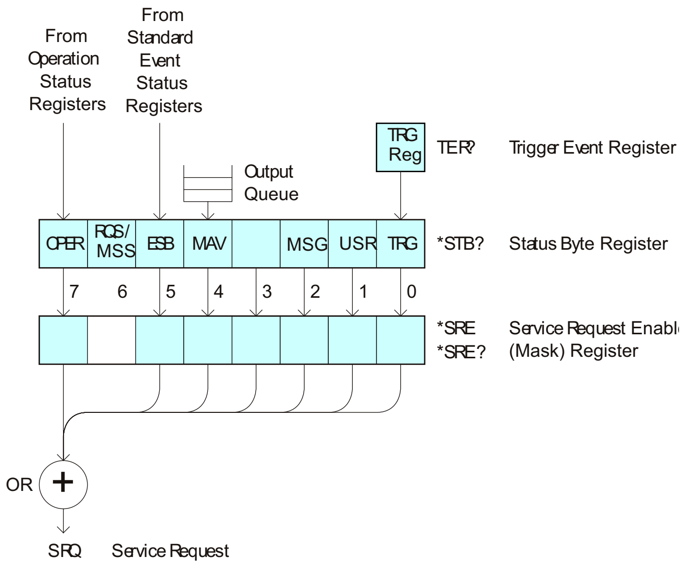


Table 40 Service Request Enable Register (SRE)

Bit	Name	Description	When Set (1 = High = True), Enables:
7	OPER	Operation Status Register	Interrupts when enabled conditions in the Operation Status Register (OPER) occur.
6	---	---	(Not used.)
5	ESB	Event Status Bit	Interrupts when enabled conditions in the Standard Event Status Register (ESR) occur.
4	MAV	Message Available	Interrupts when messages are in the Output Queue.
3	---	---	(Not used.)
2	MSG	Message	Interrupts when an advisory has been displayed on the oscilloscope.
1	USR	User Event	Interrupts when enabled user event conditions occur.
0	TRG	Trigger	Interrupts when a trigger occurs.

Query Syntax

```
*SRE?
```

The *SRE? query returns the current value of the Service Request Enable Register.

Return Format

```
<mask><NL>

<mask> ::= sum of all bits that are set, 0,..,255;
           an integer in NR1 format
```

See Also

- "Introduction to Common (*) Commands" on page 107
- "*STB (Read Status Byte)" on page 125
- "*CLS (Clear Status)" on page 109

*STB (Read Status Byte)

C (see page 776)

Query Syntax

```
*STB?
```

The *STB? query returns the current value of the instrument's status byte. The MSS (Master Summary Status) bit is reported on bit 6 instead of the RQS (request service) bit. The MSS indicates whether or not the device has at least one reason for requesting service.

Return Format

```
<value><NL>

<value> ::= 0,..,255; an integer in NR1 format
```

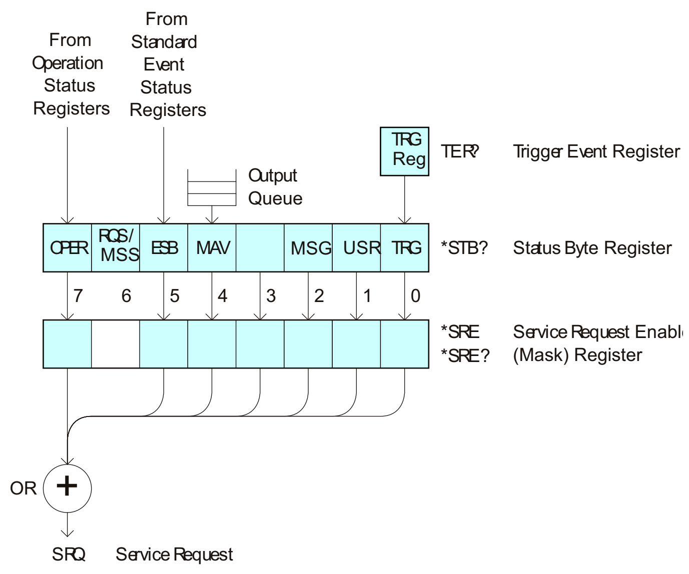


Table 41 Status Byte Register (STB)

Bit	Name	Description	When Set (1 = High = True), Indicates:
7	OPER	Operation Status Register	An enabled condition in the Operation Status Register (OPER) has occurred.
6	RQS	Request Service	When polled, that the device is requesting service.
	MSS	Master Summary Status	When read (by *STB?), whether the device has a reason for requesting service.
5	ESB	Event Status Bit	An enabled condition in the Standard Event Status Register (ESR) has occurred.
4	MAV	Message Available	There are messages in the Output Queue.
3	---	---	(Not used, always 0.)
2	MSG	Message	An advisory has been displayed on the oscilloscope.
1	USR	User Event	An enabled user event condition has occurred.
0	TRG	Trigger	A trigger has occurred.

NOTE To read the instrument's status byte with RQS reported on bit 6, use the interface Serial Poll.

See Also

- "Introduction to Common (*) Commands" on page 107
- "*SRE (Service Request Enable)" on page 123

*TRG (Trigger)

C (see page 776)

Command Syntax

```
*TRG
```

The *TRG command has the same effect as the :DIGitize command with no parameters.

See Also

- "Introduction to Common (*) Commands" on page 107
- ":DIGitize" on page 141
- ":RUN" on page 156
- ":STOP" on page 160

*TST (Self Test)

C (see page 776)

Query Syntax

```
*TST?
```

The *TST? query performs a self-test on the instrument. The result of the test is placed in the output queue. A zero indicates the test passed and a non-zero indicates the test failed. If the test fails, refer to the troubleshooting section of the *Service Guide*.

Return Format

```
<result><NL>

<result> ::= 0 or non-zero value; an integer in NR1 format
```

See Also

- "Introduction to Common (*) Commands" on page 107

*WAI (Wait To Continue)

C (see page 776)

Command Syntax `*WAI`

The *WAI command has no function in the oscilloscope, but is parsed for compatibility with other instruments.

See Also

- "Introduction to Common (*) Commands" on page 107

6 Root (:) Commands

Control many of the basic functions of the oscilloscope and reside at the root level of the command tree. See "Introduction to Root (:) Commands" on page 133.

Table 42 Root (:) Commands Summary

Command	Query	Options and Query Returns
n/a	:AER? (see page 134)	{0 | 1}; an integer in NR1 format
:AUToscale [<source>[,..,<source>]] (see page 135)	n/a	<source> ::= CHANnel<n> <source> can be repeated up to 5 times <n> ::= 1 to (# analog channels) in NR1 format
:AUToscale:AMODE <value> (see page 137)	:AUToscale:AMODE? (see page 137)	<value> ::= {NORMal | CURRent}}
:AUToscale:CHANnels <value> (see page 138)	:AUToscale:CHANnels? (see page 138)	<value> ::= {ALL | DISPlayed}}
:AUToscale:FDEBug {{0 | OFF} | {1 | ON}} (see page 139)	:AUToscale:FDEBug? (see page 139)	{0 | 1}
:BLANk [<source>] (see page 140)	n/a	<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r> | ABUS} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1 to (# ref waveforms) in NR1 format
:DIGitize [<source>[,..,<source>]] (see page 141)	n/a	<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | ABUS} <source> can be repeated up to 5 times <n> ::= 1 to (# analog channels) in NR1 format

Table 42 Root (:) Commands Summary (continued)

Command	Query	Options and Query Returns
:MTEenable <n> (see page 142)	:MTEenable? (see page 142)	<n> ::= 16-bit integer in NR1 format
n/a	:MTERegister[:EVENt]? (see page 144)	<n> ::= 16-bit integer in NR1 format
:OPEE <n> (see page 146)	:OPEE? (see page 146)	<n> ::= 15-bit integer in NR1 format
n/a	:OPERregister:CONDition? (see page 148)	<n> ::= 15-bit integer in NR1 format
n/a	:OPERegister[:EVENt]? (see page 150)	<n> ::= 15-bit integer in NR1 format

:OVLenable <mask> (see page 152)	:OVLenable? (see page 152)	<mask> ::= 16-bit integer in NR1 format as shown:
		`Bit Weight Input`
		`--- ------ ----------`
		`10   1024  Ext Trigger Fault`
		` 9    512  Channel 4 Fault`
		` 8    256  Channel 3 Fault`
		` 7    128  Channel 2 Fault`
		` 6     64  Channel 1 Fault`
		` 4     16  Ext Trigger OVL`
		` 3      8  Channel 4 OVL`
		` 2      4  Channel 3 OVL`
		` 1      2  Channel 2 OVL`
		` 0      1  Channel 1 OVL`

n/a	:OVLRegister? (see page 154)	<value> ::= integer in NR1 format. See OVLenable for <value>
:PRINt [<options>] (see page 155)	n/a	<options> ::= [<print option>][,..,<print option>] <print option> ::= {COLor | GRAYscale | PRINter0 | PRINter1 | BMP8bit | BMP | PNG | NOFactors | FACTors} <print option> can be repeated up to 5 times.
:RUN (see page 156)	n/a	n/a
n/a	:SERial (see page 157)	<return value> ::= unquoted string containing serial number
:SINGle (see page 158)	n/a	n/a

Table 42 Root (:) Commands Summary (continued)

Command	Query	Options and Query Returns

n/a	:STATus? <display> (see page 159)	{0 | 1}
		<display> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r> | ABUS}
		<n> ::= 1 to (# analog channels) in NR1 format
		<r> ::= 1 to (# ref waveforms) in NR1 format

:STOP (see page 160)	n/a	n/a
n/a	:TER? (see page 161)	{0 | 1}
:VIEW <source> (see page 162)	n/a	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1 to (# ref waveforms) in NR1 format

Introduction to Root (:) Commands

Root level commands control many of the basic operations of the instrument. These commands are always recognized by the parser if they are prefixed with a colon, regardless of current command tree position. After executing a root-level command, the parser is positioned at the root of the command tree.

:AER (Arm Event Register)

C (see page 776)

Query Syntax

```
:AER?
```

The AER query reads the Arm Event Register. After the Arm Event Register is read, it is cleared. A "1" indicates the trigger system is in the armed state, ready to accept a trigger.

The Armed Event Register is summarized in the Wait Trig bit of the Operation Status Event Register. A Service Request can be generated when the Wait Trig bit transitions and the appropriate enable bits have been set in the Operation Status Enable Register (OPEE) and the Service Request Enable Register (SRE).

Return Format

```
<value><NL>

<value> ::= {0 | 1}; an integer in NR1 format.
```

See Also

- "Introduction to Root (:) Commands" on page 133
- ":OPEE (Operation Status Enable Register)" on page 146
- ":OPERegister:CONDition (Operation Status Condition Register)" on page 148
- ":OPERegister[:EVENt] (Operation Status Event Register)" on page 150
- "*STB (Read Status Byte)" on page 125
- "*SRE (Service Request Enable)" on page 123

:AUToscale

C (see page 776)

Command Syntax

```
:AUToscale

:AUToscale [<source>[,..,<source>]]

<source> ::= CHANnel<n>

<n> ::= 1 to (# analog channels) in NR1 format

The <source> parameter may be repeated up to 5 times.
```

The :AUToscale command evaluates all input signals and sets the correct conditions to display the signals. This is the same as pressing the **[Auto Scale]** key on the front panel.

If one or more sources are specified, those specified sources will be enabled and all others blanked. The autoscale channels mode (see ":AUToscale:CHANnels" on page 138) is set to DISPlayed channels. Then, the autoscale is performed.

When the :AUToscale command is sent, the following conditions are affected and actions are taken:

- Thresholds.
- Channels with activity around the trigger point are turned on, others are turned off.
- Channels are reordered on screen; analog channel 1 first, followed by the remaining analog channels.
- Delay is set to 0 seconds.
- Time/Div.

The :AUToscale command does not affect the following conditions:

- Label names.
- Trigger conditioning.

The :AUToscale command turns off the following items:

- Cursors.
- Measurements.
- Math waveforms.
- Reference waveforms.
- Zoomed (delayed) time base mode.

For further information on :AUToscale, see the *User's Guide*.

See Also

- "Introduction to Root (:) Commands" on page 133
- ":AUToscale:CHANnels" on page 138

- ":AUToscale:AMODE" on page 137

Example Code

```
' AUTOSCALE - This command evaluates all the input signals and sets
' the correct conditions to display all of the active signals.
myScope.WriteString ":AUToscale"   ' Same as pressing Auto Scale key.
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:AUToscale:AMODE

N (see page 776)

Command Syntax

```
:AUToscale:AMODE <value>

<value> ::= {NORMal | CURRent}
```

The :AUTOscale:AMODE command specifies the acquisition mode that is set by subsequent :AUToscales.

- When NORMal is selected, an :AUToscale command sets the NORMal acquisition type and the RTIMe (real-time) acquisition mode.
- When CURRent is selected, the current acquisition type and mode are kept on subsequent :AUToscales.

Use the :ACQuire:TYPE and :ACQuire:MODE commands to set the acquisition type and mode.

Query Syntax

```
:AUToscale:AMODE?
```

The :AUToscale:AMODE? query returns the autoscale acquire mode setting.

Return Format

```
<value><NL>

<value> ::= {NORM | CURR}
```

See Also

- "Introduction to Root (:) Commands" on page 133
- ":AUToscale" on page 135
- ":AUToscale:CHANnels" on page 138
- ":ACQuire:TYPE" on page 185
- ":ACQuire:MODE" on page 177

:AUToscale:CHANnels

N (see page 776)

Command Syntax

```
:AUToscale:CHANnels <value>

<value> ::= {ALL | DISPlayed}
```

The :AUTOscale:CHANnels command specifies which channels will be displayed on subsequent :AUToscales.

- When ALL is selected, all channels that meet the requirements of :AUToscale will be displayed.
- When DISPlayed is selected, only the channels that are turned on are autoscaled.

Use the :VIEW or :BLANk root commands to turn channels on or off.

Query Syntax

```
:AUToscale:CHANnels?
```

The :AUToscale:CHANnels? query returns the autoscale channels setting.

Return Format

```
<value><NL>

<value> ::= {ALL | DISP}
```

See Also

- "Introduction to Root (:) Commands" on page 133
- ":AUToscale" on page 135
- ":AUToscale:AMODE" on page 137
- ":VIEW" on page 162
- ":BLANk" on page 140

:AUToscale:FDEBug

N (see page 776)

Command Syntax

```
:AUToscale:FDEBug <on_off>
```

```
<on_off> ::= {{1 | ON} | {0 | OFF}}
```

The :AUToscale:FDEBug command turns fast debug auto scaling on or off.

The Fast Debug option changes the behavior of :AUToscale to let you make quick visual comparisons to determine whether the signal being probed is a DC voltage, ground, or an active AC signal.

Channel coupling is maintained for easy viewing of oscillating signals.

Query Syntax

```
:AUToscale:FDEBug?
```

The :AUToscale:FDEBug? query returns the current autoscale fast debug setting.

Return Format

```
<on_off><NL>
```

```
<on_off> ::= {1 | 0}
```

See Also

- "Introduction to Root (:) Commands" on page 133
- ":AUToscale" on page 135

:BLANk

N (see page 776)

Command Syntax

```
:BLANk [<source>]

<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r> | ABUS
    | EXT}

<n> ::= 1 to (# analog channels) in NR1 format

<r> ::= 1 to (# ref waveforms) in NR1 format
```

The :BLANk command turns off (stops displaying) the specified channel, math function, or serial decode bus. The :BLANk command with no parameter turns off all sources.

NOTE To turn on (start displaying) a channel, etc., use the :VIEW command. The DISPlay commands, :CHANnel<n>:DISPlay, :FUNCtion:DISPlay, or :WMEMory<r>:DISPlay, are the preferred method to turn on/off a channel, etc.

NOTE MATH is an alias for FUNCtion.

See Also

- "Introduction to Root (:) Commands" on page 133
- ":DISPlay:CLEar" on page 229
- ":CHANnel<n>:DISPlay" on page 203
- ":FUNCtion:DISPlay" on page 284
- ":WMEMory<r>:DISPlay" on page 684
- ":STATus" on page 159
- ":VIEW" on page 162

Example Code

- "Example Code" on page 162

:DIGitize

C (see page 776)

Command Syntax

```
:DIGitize [<source>[,..,<source>]]

<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | ABUS | EXT}

<n> ::= 1 to (# analog channels) in NR1 format

The <source> parameter may be repeated up to 5 times.
```

The :DIGitize command is a specialized RUN command. It causes the instrument to acquire waveforms according to the settings of the :ACQuire commands subsystem. When the acquisition is complete, the instrument is stopped.

If no argument is given, :DIGitize acquires the channels currently displayed. If no channels are displayed, all channels are acquired.

NOTE The :DIGitize command is only executed when the :TIMebase:MODE is MAIN or WINDow.

NOTE To halt a :DIGitize in progress, use the device clear command.

NOTE MATH is an alias for FUNCtion.

See Also

- "Introduction to Root (:) Commands" on page 133
- ":RUN" on page 156
- ":SINGle" on page 158
- ":STOP" on page 160
- ":TIMebase:MODE" on page 555
- Chapter 8, “:ACQuire Commands,” starting on page 173
- Chapter 28, “:WAVeform Commands,” starting on page 613

Example Code

```
  ' Capture an acquisition using :DIGitize.
  ' -----------------------------------------------------------------
  myScope.WriteString ":DIGitize CHANnel1"
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:MTEenable (Mask Test Event Enable Register)

N (see page 776)

Command Syntax

```
:MTEenable <mask>

<mask> ::= 16-bit integer
```

The :MTEenable command sets a mask in the Mask Test Event Enable register. Set any of the following bits to "1" to enable bit 9 in the Operation Status Condition Register and potentially cause an SRQ (Service Request interrupt to be generated.

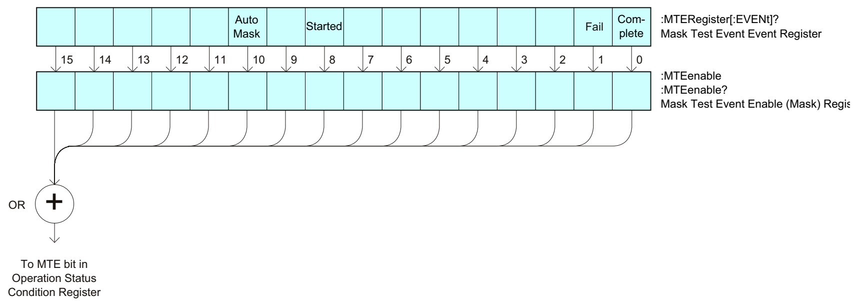

Auto Mask
Started
Fail
Com-plete
:MTERegister[:EVENt]?
Mask Test Event Event Register
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
:MTEenable
:MTEenable?
Mask Test Event Enable (Mask) Regis
OR
To MTE bit in Operation Status Condition Register

Table 43 Mask Test Event Enable Register (MTEenable)

Bit	Name	Description	When Set (1 = High = True), Enables:
15-11	---	---	(Not used.)
10	Auto Mask	Auto Mask Created	Auto mask creation completed.
9	---	---	(Not used.)
8	Started	Mask Testing Started	Mask testing started.
7-2	---	---	(Not used.)
1	Fail	Mask Test Fail	Mask test failed.
0	Complet e	Mask Test Complete	Mask test is complete.

Query Syntax

```
:MTEenable?
```

The :MTEenable? query returns the current value contained in the Mask Test Event Enable register as an integer number.

Return Format

```
<value><NL>

<value> ::= integer in NR1 format.
```

See Also

- "Introduction to Root (:) Commands" on page 133

- ":AER (Arm Event Register)" on page 134
- ":CHANnel<n>:PROTection" on page 213
- ":OPERegister[:EVENt] (Operation Status Event Register)" on page 150
- ":OVLenable (Overload Event Enable Register)" on page 152
- ":OVLRegister (Overload Event Register)" on page 154
- "*STB (Read Status Byte)" on page 125
- "*SRE (Service Request Enable)" on page 123

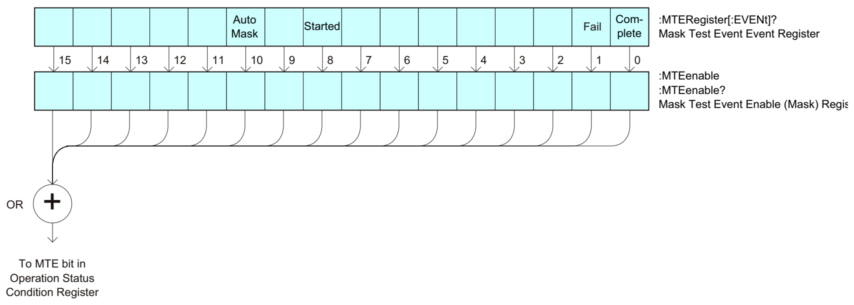
:MTERegister[:EVENt] (Mask Test Event Event Register)

N (see page 776)

Query Syntax

```
:MTERegister[:EVENt]?
```

The :MTERegister[:EVENt]? query returns the integer value contained in the Mask Test Event Event Register and clears the register.



Auto Mask
Started
Fail
Com-plete
:MTERegister[:EVENt]?
Mask Test Event Event Register
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
:MTEenable
:MTEenable?
Mask Test Event Enable (Mask) Regis
OR
+
To MTE bit in Operation Status Condition Register

Table 44 Mask Test Event Event Register

Bit	Name	Description	When Set (1 = High = True), Indicates:
15-11	---	---	(Not used.)
10	Auto Mask	Auto Mask Created	Auto mask creation completed.
9	---	---	(Not used.)
8	Started	Mask Testing Started	Mask testing started.
7-2	---	---	(Not used.)
1	Fail	Mask Test Fail	The mask test failed.
0	Complete	Mask Test Complete	The mask test is complete.

Return Format

```
<value><NL>

<value> ::= integer in NR1 format.
```

See Also

- "Introduction to Root (:) Commands" on page 133
- ":CHANnel<n>:PROTection" on page 213
- ":OPEE (Operation Status Enable Register)" on page 146
- ":OPERegister:CONDition (Operation Status Condition Register)" on page 148
- ":OVLenable (Overload Event Enable Register)" on page 152
- ":OVLRegister (Overload Event Register)" on page 154

- "*STB (Read Status Byte)" on page 125
- "*SRE (Service Request Enable)" on page 123

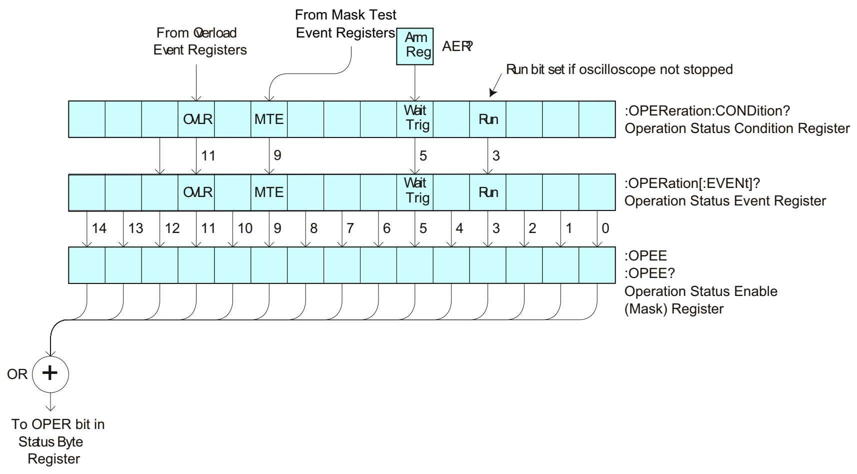
:OPEE (Operation Status Enable Register)

C (see page 776)

Command Syntax

```
:OPEE <mask>

<mask> ::= 15-bit integer
```

The :OPEE command sets a mask in the Operation Status Enable register. Set any of the following bits to "1" to enable bit 7 in the Status Byte Register and potentially cause an SRQ (Service Request interrupt to be generated.



From Overload Event Registers
From Mask Test Event Registers
Arm Reg
AER?
Run bit set if oscilloscope not stopped
OVLR
MTE
Wait Trig
Run
:OPERation:CONDition?
Operation Status Condition Register
11
9
5
3
:OPERation[:EVENt]?
Operation Status Event Register
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
:OPEE
:OPEE?
Operation Status Enable (Mask) Register
OR
To OPER bit in Status Byte Register

Table 45 Operation Status Enable Register (OPEE)

Bit	Name	Description	When Set (1 = High = True), Enables:
14-12	---	---	(Not used.)
11	OVLR	Overload	Event when 50Ω input overload occurs.
10	---	---	(Not used.)
9	MTE	Mask Test Event	Event when mask test event occurs.
8-6	---	---	(Not used.)
5	Wait Trig	Wait Trig	Event when the trigger is armed.
4	---	---	(Not used.)
3	Run	Running	Event when the oscilloscope is running (not stopped).
2-0	---	---	(Not used.)

Query Syntax

```
:OPEE?
```

The :OPEE? query returns the current value contained in the Operation Status Enable register as an integer number.

Return Format

```
<value><NL>

<value> ::= integer in NR1 format.
```

See Also

- "Introduction to Root (:) Commands" on page 133
- ":AER (Arm Event Register)" on page 134
- ":CHANnel<n>:PROTection" on page 213
- ":OPERegister[:EVENt] (Operation Status Event Register)" on page 150
- ":OVLenable (Overload Event Enable Register)" on page 152
- ":OVLRegister (Overload Event Register)" on page 154
- "*STB (Read Status Byte)" on page 125
- "*SRE (Service Request Enable)" on page 123

:OPERegister:CONDition (Operation Status Condition Register)

C (see page 776)

Query Syntax

```
:OPERegister:CONDition?
```

The :OPERegister:CONDition? query returns the integer value contained in the Operation Status Condition Register.

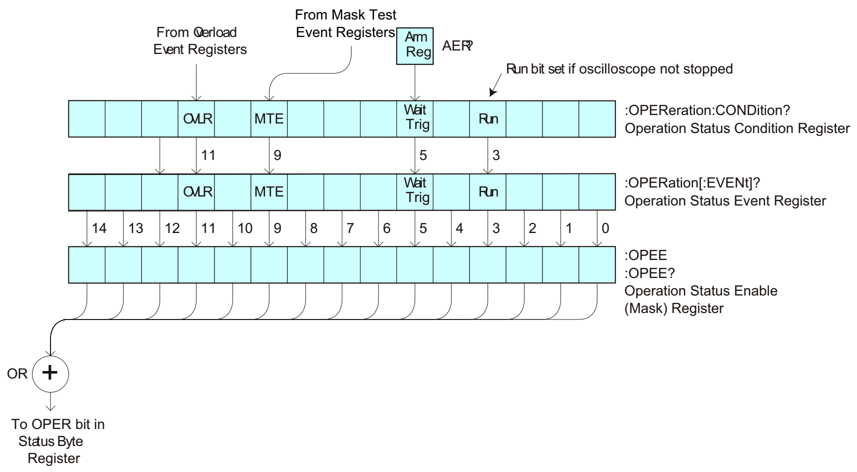

From Overload Event Registers
From Mask Test Event Registers
Arm Reg
AER?
Run bit set if oscilloscope not stopped
OVLR
MTE
Wait Trig
Run
:OPERation:CONDition?
Operation Status Condition Register
:OPERation[:EVENt]?
Operation Status Event Register
14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
:OPEE
:OPEE?
Operation Status Enable (Mask) Register
OR
To OPER bit in Status Byte Register

Table 46 Operation Status Condition Register

Bit	Name	Description	When Set (1 = High = True), Indicates:
14-12	---	---	(Not used.)
11	OVLR	Overload	A 50Ω input overload has occurred.
10	---	---	(Not used.)
9	MTE	Mask Test Event	A mask test event has occurred.
8-6	---	---	(Not used.)
5	Wait Trig	Wait Trig	The trigger is armed (set by the Trigger Armed Event Register (TER)).
4	---	---	(Not used.)
3	Run	Running	The oscilloscope is running (not stopped).
2-0	---	---	(Not used.)

Return Format

```
<value><NL>

<value> ::= integer in NR1 format.
```

See Also

- "Introduction to Root (:) Commands" on page 133

- ":CHANnel<n>:PROTection" on page 213
- ":OPEE (Operation Status Enable Register)" on page 146
- ":OPERegister[:EVENt] (Operation Status Event Register)" on page 150
- ":OVLenable (Overload Event Enable Register)" on page 152
- ":OVLRegister (Overload Event Register)" on page 154
- "*STB (Read Status Byte)" on page 125
- "*SRE (Service Request Enable)" on page 123
- ":MTERegister[:EVENt] (Mask Test Event Event Register)" on page 144
- ":MTEenable (Mask Test Event Enable Register)" on page 142

:OPERegister[:EVENt] (Operation Status Event Register)

C (see page 776)

Query Syntax

```
:OPERegister[:EVENt]?
```

The :OPERegister[:EVENt]? query returns the integer value contained in the Operation Status Event Register.

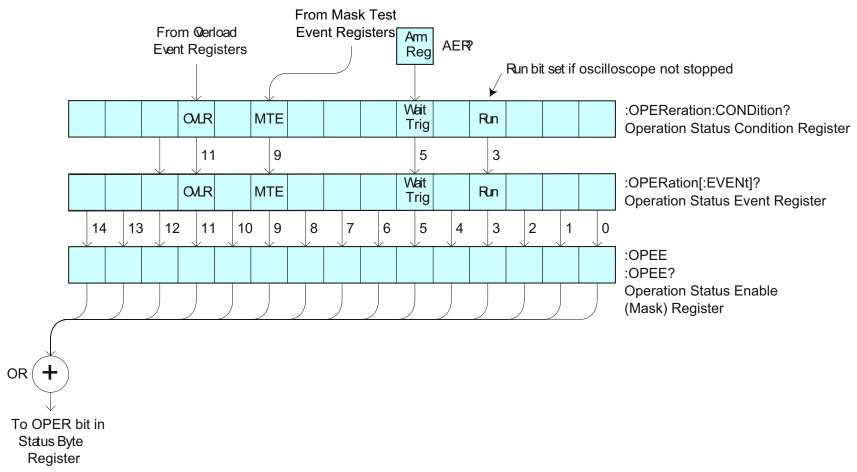


Table 47 Operation Status Event Register

Bit	Name	Description	When Set (1 = High = True), Indicates:
14-12	---	---	(Not used.)
11	OVLR	Overload	A 50Ω input overload has occurred.
10	---	---	(Not used.)
9	MTE	Mask Test Event	A mask test event has occurred.
8-6	---	---	(Not used.)
5	Wait Trig	Wait Trig	The trigger is armed (set by the Trigger Armed Event Register (TER)).
4	---	---	(Not used.)
3	Run	Running	The oscilloscope has gone from a stop state to a single or running state.
2-0	---	---	(Not used.)

Return Format

```
<value><NL>

<value> ::= integer in NR1 format.
```

See Also

- "Introduction to Root (:) Commands" on page 133
- ":CHANnel<n>:PROTection" on page 213
- ":OPEE (Operation Status Enable Register)" on page 146
- ":OPERegister:CONDition (Operation Status Condition Register)" on page 148
- ":OVLenable (Overload Event Enable Register)" on page 152
- ":OVLRegister (Overload Event Register)" on page 154
- "*STB (Read Status Byte)" on page 125
- "*SRE (Service Request Enable)" on page 123
- ":MTERegister[:EVENt] (Mask Test Event Event Register)" on page 144
- ":MTEenable (Mask Test Event Enable Register)" on page 142

:OVLenable (Overload Event Enable Register)

C (see page 776)

Command Syntax

```
:OVLenable <enable_mask>
```

```
<enable_mask> ::= 16-bit integer
```

The overload enable mask is an integer representing an input as described in the following table.

The :OVLenable command sets the mask in the Overload Event Enable Register and enables the reporting of the Overload Event Register. If enabled, such an event will set bit 11 in the Operation Status Register.

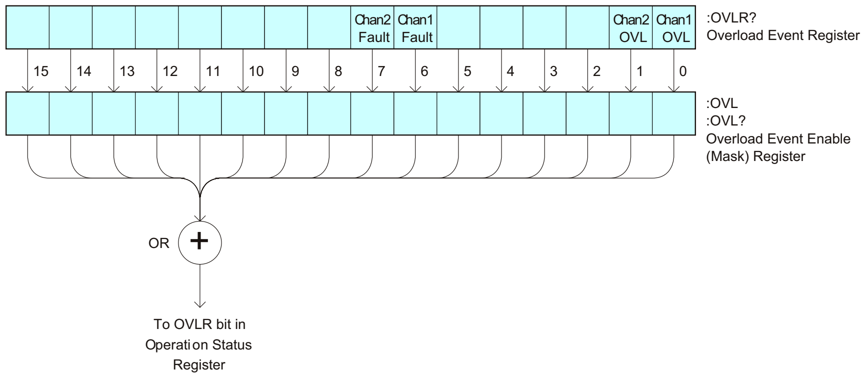


Table 48 Overload Event Enable Register (OVL)

Bit	Description	When Set (1 = High = True), Enables:
15-8	---	(Not used.)
7	Channel 2 Fault	Event when fault occurs on Channel 2 input.
6	Channel 1 Fault	Event when fault occurs on Channel 1 input.
5-2	---	(Not used.)
1	Channel 2 OVL	Event when overload occurs on Channel 2 input.
0	Channel 1 OVL	Event when overload occurs on Channel 1 input.

Query Syntax

```
:OVLenable?
```

The :OVLenable query returns the current enable mask value contained in the Overload Event Enable Register.

Return Format

```
<enable_mask><NL>
```

```
<enable_mask> ::= integer in NR1 format.
```

See Also

- "Introduction to Root (:) Commands" on page 133
- ":CHANnel<n>:PROTection" on page 213
- ":OPEE (Operation Status Enable Register)" on page 146
- ":OPERegister:CONDition (Operation Status Condition Register)" on page 148
- ":OPERegister[:EVENt] (Operation Status Event Register)" on page 150
- ":OVLRegister (Overload Event Register)" on page 154
- "*STB (Read Status Byte)" on page 125
- "*SRE (Service Request Enable)" on page 123

:OVLRegister (Overload Event Register)

C (see page 776)

Query Syntax

```
:OVLRegister?
```

The :OVLRegister query returns the overload protection value stored in the Overload Event Register (OVLR). A "1" indicates an overload has occurred.

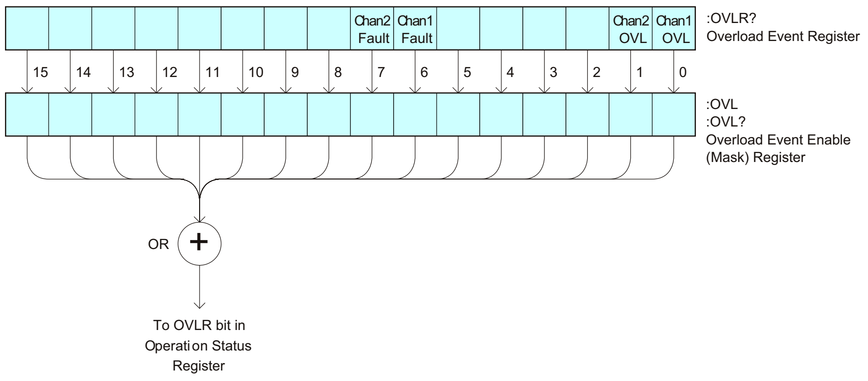


Table 49 Overload Event Register (OVLR)

Bit	Description	When Set (1 = High = True), Indicates:
15-8	---	(Not used.)
7	Channel 2 Fault	Fault has occurred on Channel 2 input.
6	Channel 1 Fault	Fault has occurred on Channel 1 input.
5-2	---	(Not used.)
1	Channel 2 OVL	Overload has occurred on Channel 2 input.
0	Channel 1 OVL	Overload has occurred on Channel 1 input.

Return Format

```
<value><NL>

<value> ::= integer in NR1 format.
```

See Also

- "Introduction to Root (:) Commands" on page 133
- ":CHANnel<n>:PROTection" on page 213
- ":OPEE (Operation Status Enable Register)" on page 146
- ":OVLenable (Overload Event Enable Register)" on page 152
- "*STB (Read Status Byte)" on page 125
- "*SRE (Service Request Enable)" on page 123

:PRINt

C (see page 776)

Command Syntax

```
:PRINt [<options>]

<options> ::= [<print option>][,..,<print option>]

<print option> ::= {COLor | GRAYscale | PRINter0 | PRINter1 | BMP8bit
                   | BMP | PNG | NOFactors | FACTors}

The <print option> parameter may be repeated up to 5 times.
```

The PRINt command formats the output according to the currently selected format (device). If an option is not specified, the value selected in the Print Config menu is used.

See Also

- "Introduction to Root (:) Commands" on page 133
- "Introduction to :HARDcopy Commands" on page 304
- ":HARDcopy:FACTors" on page 307
- ":HARDcopy:GRAYscale" on page 707
- ":DISPlay:DATA" on page 230

:RUN

C (see page 776)

Command Syntax

```
:RUN
```

The :RUN command starts repetitive acquisitions. This is the same as pressing the Run key on the front panel.

See Also

- ["Introduction to Root (:) Commands"](#) on page 133
- [":SINGle"](#) on page 158
- [":STOP"](#) on page 160

Example Code

```
' RUN_STOP - (not executed in this example)
'  - RUN starts the data acquisition for the active waveform display.
'  - STOP stops the data acquisition and turns off AUTOSTORE.
' myScope.WriteString ":RUN"   ' Start data acquisition.
' myScope.WriteString ":STOP"   ' Stop the data acquisition.
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:SERial

N (see page 776)

Query Syntax `:SERial?`

The :SERial? query returns the serial number of the instrument.

Return Format: `Unquoted string<NL>`

See Also
- "Introduction to Root (:) Commands" on page 133

:SINGle

C (see page 776)

Command Syntax

```
:SINGle
```

The :SINGle command causes the instrument to acquire a single trigger of data. This is the same as pressing the Single key on the front panel.

See Also

- "Introduction to Root (:) Commands" on page 133
- ":RUN" on page 156
- ":STOP" on page 160

:STATus

N (see page 776)

Query Syntax

```
:STATus? <source>

<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r> | ABUS
    | EXT}

<n> ::= 1 to (# analog channels) in NR1 format

<r> ::= 1 to (# ref waveforms) in NR1 format
```

The :STATus? query reports whether the channel, function, or serial decode bus specified by <source> is displayed.

NOTE MATH is an alias for FUNCtion.

Return Format

```
<value><NL>

<value> ::= {1 | 0}
```

See Also

- "Introduction to Root (:) Commands" on page 133
- ":BLANk" on page 140
- ":CHANnel<n>:DISPlay" on page 203
- ":FUNCtion:DISPlay" on page 284
- ":WMEMory<r>:DISPlay" on page 684
- ":VIEW" on page 162

:STOP

C (see page 776)

Command Syntax

```
:STOP
```

The :STOP command stops the acquisition. This is the same as pressing the Stop key on the front panel.

See Also

- "Introduction to Root (:) Commands" on page 133
- ":RUN" on page 156
- ":SINGle" on page 158

Example Code

- "Example Code" on page 156

:TER (Trigger Event Register)

C (see page 776)

Query Syntax

```
:TER?
```

The :TER? query reads the Trigger Event Register. After the Trigger Event Register is read, it is cleared. A one indicates a trigger has occurred. A zero indicates a trigger has not occurred.

The Trigger Event Register is summarized in the TRG bit of the Status Byte Register (STB). A Service Request (SRQ) can be generated when the TRG bit of the Status Byte transitions, and the TRG bit is set in the Service Request Enable register. The Trigger Event Register must be cleared each time you want a new service request to be generated.

Return Format

```
<value><NL>

<value> ::= {1 | 0}; a 16-bit integer in NR1 format.
```

See Also

- "Introduction to Root (:) Commands" on page 133
- "*SRE (Service Request Enable)" on page 123
- "*STB (Read Status Byte)" on page 125

:VIEW

N (see page 776)

Command Syntax

```
:VIEW <source>

<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r> | ABUS
    | EXT}

<n> ::= 1 to (# analog channels) in NR1 format

<r> ::= 1 to (# ref waveforms) in NR1 format
```

The :VIEW command turns on the specified channel, function, or serial decode bus.

NOTE MATH is an alias for FUNCtion.

See Also

- "Introduction to Root (:) Commands" on page 133
- ":BLANk" on page 140
- ":CHANnel<n>:DISPlay" on page 203
- ":FUNCtion:DISPlay" on page 284
- ":WMEMory<r>:DISPlay" on page 684
- ":STATus" on page 159

Example Code

```
' VIEW_BLANK - (not executed in this example)
'  - VIEW turns on (starts displaying) a channel.
'  - BLANK turns off (stops displaying) a channel.
' myScope.WriteString ":BLANk CHANnel1"    ' Turn channel 1 off.
' myScope.WriteString ":VIEW CHANnel1"    ' Turn channel 1 on.
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

7 :ABUS Commands

Control all oscilloscope functions associated with a bus made up of analog channels. See "Introduction to :ABUS Commands" on page 164.

Table 50 :ABUS Commands Summary

Command	Query	Options and Query Returns

`:ABUS:BIT<m> {{0 | OFF} | {1 | ON}}` (see page 165)	`:ABUS:BIT<m>?` (see page 165)	`{0 | 1}`
		`<m> ::= 0-2; an integer in NR1 format`

`:ABUS:BITS <channel_list>, {{0 | OFF} | {1 | ON}}` (see page 166)	`:ABUS:BITS?` (see page 166)	`<channel_list>, {0 | 1}`
		`<channel_list> ::= (@<m>,<m>:<m> ...) where "," is separator and ":" is range`
		`<m> ::= 0-2; an integer in NR1 format`

`:ABUS:CLEar` (see page 168)	n/a	n/a
`:ABUS:DISPlay {{0 | OFF} | {1 | ON}}` (see page 169)	`:ABUS:DISPlay?` (see page 169)	`{0 | 1}`
`:ABUS:LABel <string>` (see page 170)	`:ABUS:LABel?` (see page 170)	`<string> ::= quoted ASCII string up to 10 characters`

`:ABUS:MASK <mask>` (see page 171)	`:ABUS:MASK?` (see page 171)	`<mask> ::= 32-bit integer in decimal, <nondecimal>, or <string>`
		`<nondecimal> ::= #Hnn...n where n ::= {0,..,9 | A,..,F} for hexadecimal`
		`<nondecimal> ::= #Bnn...n where n ::= {0 | 1} for binary`
		`<string> ::= "0xnn...n" where n ::= {0,..,9 | A,..,F} for hexadecimal`

Introduction to :ABUS Commands

The ABUS subsystem commands control the viewing, labeling, and analog channel bus makeup.

Reporting the Setup

Use :ABUS? to query setup information for the ABUS subsystem.

Return Format

The following is a sample response from the :ABUS? query. In this case, the query was issued following a *RST command.

```
:ABUS:DISP 0;LAB "ABUS1";MASK +0
```

:ABUS:BIT<m>

N (see page 776)

Command Syntax

```
:ABUS:BIT<m> <display>
```

```
<display> ::= {{1 | ON} | {0 | OFF}}
```

```
<m> ::= An integer, 0,..,2, is attached as a suffix to BIT
and defines the analog channel that is affected by the command.
```

The :ABUS:BIT<m> command includes or excludes the selected bit as part of the definition for the selected bus. If the parameter is a 1 (ON), the bit is included in the definition. If the parameter is a 0 (OFF), the bit is excluded from the definition.

Bit	Channel
0	channel 1
1	channel 2
2	Ext Trig input

Query Syntax

```
:ABUS:BIT<m>?
```

The :ABUS:BIT<m>? query returns the value indicating whether the specified bit is included or excluded from the specified bus definition.

Return Format

```
<display><NL>
```

```
<display> ::= {0 | 1}
```

See Also

- "Introduction to :ABUS Commands" on page 164
- ":ABUS:BITS" on page 166
- ":ABUS:CLEar" on page 168
- ":ABUS:DISPlay" on page 169
- ":ABUS:LABel" on page 170
- ":ABUS:MASK" on page 171

Example Code

```
' Include analog channel 2 in the bus:
myScope.WriteString ":ABUS:BIT1 ON"
```

:ABUS:BITS

N (see page 776)

Command Syntax

```
:ABUS:BITS <channel_list>, <display>
```

```
<channel_list> ::= (@<m>,<m>:<m>, ...) where commas separate bits and
colons define bit ranges.
```

```
<m> ::= An integer, 0,..,2, defines an analog channel affected by the
command.
```

```
<display> ::= {{1 | ON} | {0 | OFF}}
```

The :ABUS:BITS command includes or excludes the selected bits in the channel list in the definition of the analog bus. If the parameter is a 1 (ON), then the bits in the channel list are included as part of the analog bus definition. If the parameter is a 0 (OFF), then the bits in the channel list are excluded from the definition of the analog bus.

The threshold voltage level for each channel is set using the trigger-level commands of the source. For analog channels, the trigger-level command to use depends on the current Trigger Mode. For the External Trigger channel, use :EXTernal:LEVel command.

Bit	Channel
0	channel 1
1	channel 2
2	Ext Trig input

Query Syntax

```
:ABUS:BITS?
```

The :ABUS:BITS? query returns the definition for the specified bus.

Return Format

```
<channel_list>, <display><NL>
```

```
<channel_list> ::= (@<m>,<m>:<m>, ...) where commas separate bits and
colons define bit ranges.
```

```
<display> ::= {0 | 1}
```

See Also

- "Introduction to :ABUS Commands" on page 164
- ":ABUS:BIT<m>" on page 165
- ":ABUS:CLEar" on page 168
- ":ABUS:DISPlay" on page 169
- ":ABUS:LABel" on page 170
- ":ABUS:MASK" on page 171

Example Code

```
' Include analog channels 1, Ext Trig input in the bus:
myScope.WriteString ":ABUS:BITS (@0,2), ON"

' Include all analog channels in the bus:
myScope.WriteString ":ABUS:BITS (@0:2), ON"
```

:ABUS:CLEar

N (see page 776)

Command Syntax

```
:ABUS:CLEar
```

The :ABUS:CLEar command excludes all of the analog channels from the selected bus definition.

See Also

- "Introduction to :ABUS Commands" on page 164
- ":ABUS:BIT<m>" on page 165
- ":ABUS:BITS" on page 166
- ":ABUS:DISPlay" on page 169
- ":ABUS:LABel" on page 170
- ":ABUS:MASK" on page 171

:ABUS:DISPlay

N (see page 776)

Command Syntax

```
:ABUS:DISPlay <value>
```

```
<value> ::= {{1 | ON} | {0 | OFF}}
```

The :ABUS:DISPlay command enables or disables the view of the selected bus.

Query Syntax

```
:ABUS:DISPlay?
```

The :ABUS:DISPlay? query returns the display value of the selected bus.

Return Format

```
<value><NL>
```

```
<value> ::= {0 | 1}
```

See Also

- "Introduction to :ABUS Commands" on page 164
- ":ABUS:BIT<m>" on page 165
- ":ABUS:BITS" on page 166
- ":ABUS:CLEar" on page 168
- ":ABUS:LABel" on page 170
- ":ABUS:MASK" on page 171

:ABUS:LABel

N (see page 776)

Command Syntax

```
:ABUS:LABel <quoted_string>
```

```
<quoted_string> ::= any series of 10 or less characters as a
quoted ASCII string.
```

The :ABUS:LABel command sets the bus label to the quoted string. Setting a label for a bus will also result in the name being added to the label list.

NOTE Label strings are 10 characters or less, and may contain any commonly used ASCII characters. Labels with more than 10 characters are truncated to 10 characters.

Query Syntax

```
:ABUS:LABel?
```

The :ABUS:LABel? query returns the name of the specified bus.

Return Format

```
<quoted_string><NL>
```

```
<quoted_string> ::= any series of 10 or less characters as a
quoted ASCII string.
```

See Also

- "Introduction to :ABUS Commands" on page 164
- ":ABUS:BIT<m>" on page 165
- ":ABUS:BITS" on page 166
- ":ABUS:CLEar" on page 168
- ":ABUS:DISPlay" on page 169
- ":ABUS:MASK" on page 171
- ":CHANnel:LABel" on page 696
- ":DISPlay:LABList" on page 233

Example Code

```
' Set the analog channel bus label to "DATA":
myScope.WriteString ":ABUS:LABel 'Data'"
```

:ABUS:MASK

N (see page 776)

Command Syntax

```
:ABUS:MASK <mask>

<mask> ::= 32-bit integer in decimal, <nondecimal>, or <string>

<nondecimal> ::= #Hnn...n where n ::= {0,..,9 | A,..,F} for hexadecimal

<nondecimal> ::= #Bnn...n where n ::= {0 | 1} for binary

<string> ::= "0xnn...n" where n ::= {0,..,9 | A,..,F} for hexadecimal
```

The :ABUS:MASK command defines the bits included and excluded in the selected bus according to the mask. Set a mask bit to a "1" to include that bit in the selected bus, and set a mask bit to a "0" to exclude it.

Query Syntax

```
:ABUS:MASK?
```

The :ABUS:MASK? query returns the mask value for the specified bus.

Return Format

```
<mask><NL> in decimal format
```

See Also

- "Introduction to :ABUS Commands" on page 164
- ":ABUS:BIT<m>" on page 165
- ":ABUS:BITS" on page 166
- ":ABUS:CLEar" on page 168
- ":ABUS:DISPlay" on page 169
- ":ABUS:LABel" on page 170

8 :ACQuire Commands

Set the parameters for acquiring and storing data. See "Introduction to :ACQuire Commands" on page 173.

Table 51 :ACQuire Commands Summary

Command	Query	Options and Query Returns
`:ACQuire:COMPlete <complete>` (see page 175)	`:ACQuire:COMPlete?` (see page 175)	`<complete> ::= 100; an integer in NR1 format`
`:ACQuire:COUNt <count>` (see page 176)	`:ACQuire:COUNt?` (see page 176)	`<count> ::= an integer from 2 to 65536 in NR1 format`
`:ACQuire:MODE <mode>` (see page 177)	`:ACQuire:MODE?` (see page 177)	`<mode> ::= {RTIMe | SEGMented}`
n/a	`:ACQuire:POINts?` (see page 178)	`<# points> ::= an integer in NR1 format`
`:ACQuire:SEGMented:ANALyze` (see page 179)	n/a	n/a (with SGM license)
`:ACQuire:SEGMented:COUNt <count>` (see page 180)	`:ACQuire:SEGMented:COUNt?` (see page 180)	`<count> ::= an integer from 2 to 50 in NR1 format (with SGM license)`
`:ACQuire:SEGMented:INDex <index>` (see page 181)	`:ACQuire:SEGMented:INDex?` (see page 181)	`<index> ::= an integer from 1 to 50 in NR1 format (with SGM license)`
n/a	`:ACQuire:SRATe?` (see page 184)	`<sample_rate> ::= sample rate (samples/s) in NR3 format`
`:ACQuire:TYPE <type>` (see page 185)	`:ACQuire:TYPE?` (see page 185)	`<type> ::= {NORMal | AVERage | HRESolution | PEAK}`

Introduction to :ACQuire Commands

The ACQuire subsystem controls the way in which waveforms are acquired. These acquisition types are available: normal, averaging, peak detect, and high resolution.

Normal

The :ACQuire:TYPE NORMal command sets the oscilloscope in the normal acquisition mode. For the majority of user models and signals, NORMal mode yields the best oscilloscope picture of the waveform.

Averaging

The :ACQuire:TYPE AVERage command sets the oscilloscope in the averaging mode. You can set the count by sending the :ACQuire:COUNt command followed by the number of averages. In this mode, the value for averages is an integer from 2 to 65536. The COUNt value determines the number of averages that must be acquired.

High-Resolution

The :ACQuire:TYPE HRESolution command sets the oscilloscope in the high-resolution mode (also known as *smoothing*). This mode is used to reduce noise at slower sweep speeds where the digitizer samples faster than needed to fill memory for the displayed time range. Instead of decimating samples, they are averaged together to provide the value for one display point. The slower the sweep speed, the greater the number of samples that are averaged together for each display point.

Peak Detect

The :ACQuire:TYPE PEAK command sets the oscilloscope in the peak detect mode. In this mode, :ACQuire:COUNt has no meaning.

Reporting the Setup

Use :ACQuire? to query setup information for the ACQuire subsystem.

Return Format

The following is a sample response from the :ACQuire? query. In this case, the query was issued following a *RST command.

```
:ACQ:MODE RTIM;TYPE NORM;COMP 100;COUNT 8;SEGM:COUN 2
```

:ACQuire:COMPlete

C (see page 776)

Command Syntax

```
:ACQuire:COMPlete <complete>
```

```
<complete> ::= 100; an integer in NR1 format
```

The :ACQuire:COMPlete command affects the operation of the :DIGitize command. It specifies the minimum completion criteria for an acquisition. The parameter determines the percentage of the time buckets that must be "full" before an acquisition is considered complete. If :ACQuire:TYPE is NORMal, it needs only one sample per time bucket for that time bucket to be considered full.

The only legal value for the :COMPlete command is 100. All time buckets must contain data for the acquisition to be considered complete.

Query Syntax

```
:ACQuire:COMPlete?
```

The :ACQuire:COMPlete? query returns the completion criteria (100) for the currently selected mode.

Return Format

```
<completion_criteria><NL>
```

```
<completion_criteria> ::= 100; an integer in NR1 format
```

See Also

- "Introduction to :ACQuire Commands" on page 173
- ":ACQuire:TYPE" on page 185
- ":DIGitize" on page 141
- ":WAVeform:POINts" on page 625

Example Code

```
' AQUIRE_COMPLETE - Specifies the minimum completion criteria for
' an acquisition.  The parameter determines the percentage of time
' buckets needed to be "full" before an acquisition is considered
' to be complete.
myScope.WriteString ":ACQuire:COMPlete 100"
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:ACQuire:COUNt

C (see page 776)

Command Syntax

```
:ACQuire:COUNt <count>
```

```
<count> ::= integer in NR1 format
```

In averaging mode, the :ACQuire:COUNt command specifies the number of values to be averaged for each time bucket before the acquisition is considered to be complete for that time bucket. When :ACQuire:TYPE is set to AVERage, the count can be set to any value from 2 to 65536.

NOTE The :ACQuire:COUNt 1 command has been deprecated. The AVERage acquisition type with a count of 1 is functionally equivalent to the HRESolution acquisition type; however, you should select the high-resolution acquisition mode with the :ACQuire:TYPE HRESolution command instead.

Query Syntax

```
:ACQuire:COUNT?
```

The :ACQuire:COUNT? query returns the currently selected count value for averaging mode.

Return Format

```
<count_argument><NL>
```

```
<count_argument> ::= an integer from 2 to 65536 in NR1 format
```

See Also

- "Introduction to :ACQuire Commands" on page 173
- ":ACQuire:TYPE" on page 185
- ":DIGitize" on page 141
- ":WAVeform:COUNt" on page 621

:ACQuire:MODE

C (see page 776)

Command Syntax

```
:ACQuire:MODE <mode>

<mode> ::= {RTIMe | SEGMented}
```

The :ACQuire:MODE command sets the acquisition mode of the oscilloscope.

- The :ACQuire:MODE RTIMe command sets the oscilloscope in real time mode.

NOTE The obsolete command ACQuire:TYPE:REALtime is functionally equivalent to sending ACQuire:MODE RTIMe; TYPE NORMal.

- The :ACQuire:MODE SEGMented command sets the oscilloscope in segmented memory mode.

  Segmented memory is available on the DSOX1000-Series oscilloscope models.

Query Syntax

```
:ACQuire:MODE?
```

The :ACQuire:MODE? query returns the acquisition mode of the oscilloscope.

Return Format

```
<mode_argument><NL>

<mode_argument> ::= {RTIM | SEGM}
```

See Also

- "Introduction to :ACQuire Commands" on page 173
- ":ACQuire:TYPE" on page 185

:ACQuire:POINts

C (see page 776)

Query Syntax

```
:ACQuire:POINts?
```

The :ACQuire:POINts? query returns the number of data points that the hardware will acquire from the input signal. The number of points acquired is not directly controllable. To set the number of points to be transferred from the oscilloscope, use the command :WAVeform:POINts. The :WAVeform:POINts? query will return the number of points available to be transferred from the oscilloscope.

Return Format

```
<points_argument><NL>

<points_argument> ::= an integer in NR1 format
```

See Also

- "Introduction to :ACQuire Commands" on page 173
- ":DIGitize" on page 141
- ":WAVeform:POINts" on page 625

:ACQuire:SEGMented:ANALyze

N (see page 776)

Command Syntax

```
:ACQuire:SEGMented:ANALyze
```

NOTE

Segmented memory is available on the DSOX1000-Series oscilloscope models that have the SGM license.

This command calculates measurement statistics and/or infinite persistence over all segments that have been acquired. It corresponds to the front panel **Analyze Segments** softkey which appears in the Segmented Memory menu.

In order to use this command, the oscilloscope must be stopped and in segmented acquisition mode, with either quick measurements or infinite persistence on.

See Also

- ":ACQuire:MODE" on page 177
- ":ACQuire:SEGMented:COUNt" on page 180
- "Introduction to :ACQuire Commands" on page 173

:ACQuire:SEGMented:COUNt

N (see page 776)

Command Syntax

```
:ACQuire:SEGMented:COUNt <count>

<count> ::= an integer from 2 to 50 (w/100K memory) in NR1 format
```

NOTE Segmented memory is available on the DSOX1000-Series oscilloscope models that have the SGM license.

The :ACQuire:SEGMented:COUNt command sets the number of memory segments to acquire.

The segmented memory acquisition mode is enabled with the :ACQuire:MODE command, and data is acquired using the :DIGitize, :SINGle, or :RUN commands. The number of memory segments in the current acquisition is returned by the :WAVeform:SEGMented:COUNt? query.

The maximum number of segments may be limited by the memory depth of your oscilloscope. For example, an oscilloscope with 100K memory allows a maximum of 50 segments.

Query Syntax

```
:ACQuire:SEGMented:COUNt?
```

The :ACQuire:SEGMented:COUNt? query returns the current count setting.

Return Format

```
<count><NL>

<count> ::= an integer from 2 to 50 (w/100K memory) in NR1 format
```

See Also

- ":ACQuire:MODE" on page 177
- ":DIGitize" on page 141
- ":SINGle" on page 158
- ":RUN" on page 156
- ":WAVeform:SEGMented:COUNt" on page 632
- ":ACQuire:SEGMented:ANALyze" on page 179
- "Introduction to :ACQuire Commands" on page 173

Example Code

- "Example Code" on page 181

:ACQuire:SEGMented:INDex

N (see page 776)

Command Syntax

```
:ACQuire:SEGMented:INDex <index>
```

```
<index> ::= an integer from 1 to 50 (w/100K memory) in NR1 format
```

NOTE Segmented memory is available on the DSOX1000-Series oscilloscope models that have the SGM license.

The :ACQuire:SEGMented:INDex command sets the index into the memory segments that have been acquired.

The segmented memory acquisition mode is enabled with the :ACQuire:MODE command. The number of segments to acquire is set using the :ACQuire:SEGMented:COUNt command, and data is acquired using the :DIGitize, :SINGle, or :RUN commands. The number of memory segments that have been acquired is returned by the :WAVeform:SEGMented:COUNt? query. The time tag of the currently indexed memory segment is returned by the :WAVeform:SEGMented:TTAG? query.

The maximum number of segments may be limited by the memory depth of your oscilloscope. For example, an oscilloscope with 100K memory allows a maximum of 50 segments.

Query Syntax

```
:ACQuire:SEGMented:INDex?
```

The :ACQuire:SEGMented:INDex? query returns the current segmented memory index setting.

Return Format

```
<index><NL>
```

```
<index> ::= an integer from 1 to 50 (w/100K memory) in NR1 format
```

See Also

- ":ACQuire:MODE" on page 177
- ":ACQuire:SEGMented:COUNt" on page 180
- ":DIGitize" on page 141
- ":SINGle" on page 158
- ":RUN" on page 156
- ":WAVeform:SEGMented:COUNt" on page 632
- ":WAVeform:SEGMented:TTAG" on page 633
- ":ACQuire:SEGMented:ANALyze" on page 179
- "Introduction to :ACQuire Commands" on page 173

Example Code

```
' Segmented memory commands example.
' -------------------------------------------------------------------
```

```
Option Explicit

Public myMgr As VisaComLib.ResourceManager
Public myScope As VisaComLib.FormattedIO488
Public varQueryResult As Variant
Public strQueryResult As String

Private Declare Sub Sleep Lib "kernel32" (ByVal dwMilliseconds As Long)

Sub Main()

  On Error GoTo VisaComError

  ' Create the VISA COM I/O resource.
  Set myMgr = New VisaComLib.ResourceManager
  Set myScope = New VisaComLib.FormattedIO488
  Set myScope.IO = _
        myMgr.Open("USB0::0x0957::0x17A6::US50210029::0::INSTR")
  myScope.IO.Clear   ' Clear the interface.

  ' Turn on segmented memory acquisition mode.
  myScope.WriteString ":ACQuire:MODE SEGMented"
  myScope.WriteString ":ACQuire:MODE?"
  strQueryResult = myScope.ReadString
  Debug.Print "Acquisition mode: " + strQueryResult

  ' Set the number of segments to 25.
  myScope.WriteString ":ACQuire:SEGMented:COUNt 25"
  myScope.WriteString ":ACQuire:SEGMented:COUNt?"
  strQueryResult = myScope.ReadString
  Debug.Print "Acquisition memory segments: " + strQueryResult

  ' If data will be acquired within the IO timeout:
  'myScope.IO.Timeout = 10000
  'myScope.WriteString ":DIGitize"
  'Debug.Print ":DIGitize blocks until all segments acquired."
  'myScope.WriteString ":WAVeform:SEGMented:COUNt?"
  'varQueryResult = myScope.ReadNumber

  ' Or, to poll until the desired number of segments acquired:
  myScope.WriteString ":SINGle"
  Debug.Print ":SINGle does not block until all segments acquired."
  Do
    Sleep 100   ' Small wait to prevent excessive queries.
    myScope.WriteString ":WAVeform:SEGMented:COUNt?"
    varQueryResult = myScope.ReadNumber
  Loop Until varQueryResult = 25

  Debug.Print "Number of segments in acquired data: " _
      + FormatNumber(varQueryResult)

  Dim lngSegments As Long
  lngSegments = varQueryResult

  ' For each segment:
  Dim dblTimeTag As Double
  Dim lngI As Long

  For lngI = lngSegments To 1 Step -1

    ' Set the segmented memory index.
    myScope.WriteString ":ACQuire:SEGMented:INDex " + CStr(lngI)
    myScope.WriteString ":ACQuire:SEGMented:INDex?"
    strQueryResult = myScope.ReadString
    Debug.Print "Acquisition memory segment index: " + strQueryResult

    ' Display the segment time tag.
    myScope.WriteString ":WAVeform:SEGMented:TTAG?"
    dblTimeTag = myScope.ReadNumber
    Debug.Print "Segment " + CStr(lngI) + " time tag: " _
        + FormatNumber(dblTimeTag, 12)

  Next lngI

  Exit Sub

VisaComError:
  MsgBox "VISA COM Error:" + vbCrLf + Err.Description

End Sub
```

:ACQuire:SRATe

N (see page 776)

Query Syntax

```
:ACQuire:SRATe?
```

The :ACQuire:SRATe? query returns the current oscilloscope acquisition sample rate. The sample rate is not directly controllable.

Return Format

```
<sample_rate><NL>

<sample_rate> ::= sample rate in NR3 format
```

See Also

- "Introduction to :ACQuire Commands" on page 173
- ":ACQuire:POINts" on page 178

:ACQuire:TYPE

C (see page 776)

Command Syntax

```
:ACQuire:TYPE <type>

<type> ::= {NORMal | AVERage | HRESolution | PEAK}
```

The :ACQuire:TYPE command selects the type of data acquisition that is to take place. The acquisition types are:

- NORMal — sets the oscilloscope in the normal mode.
- AVERage — sets the oscilloscope in the averaging mode. You can set the count by sending the :ACQuire:COUNt command followed by the number of averages. In this mode, the value for averages is an integer from 1 to 65536. The COUNt value determines the number of averages that must be acquired.

  The AVERage type is not available when in segmented memory mode (:ACQuire:MODE SEGMented).
- HRESolution — sets the oscilloscope in the high-resolution mode (also known as *smoothing*). This mode is used to reduce noise at slower sweep speeds where the digitizer samples faster than needed to fill memory for the displayed time range.

  For example, if the digitizer samples at 200 MSa/s, but the effective sample rate is 1 MSa/s (because of a slower sweep speed), only 1 out of every 200 samples needs to be stored. Instead of storing one sample (and throwing others away), the 200 samples are averaged together to provide the value for one display point. The slower the sweep speed, the greater the number of samples that are averaged together for each display point.
- PEAK — sets the oscilloscope in the peak detect mode. In this mode, :ACQuire:COUNt has no meaning.

The AVERage and HRESolution types can give you extra bits of vertical resolution. See the *User's Guide* for an explanation. When getting waveform data acquired using the AVERage and HRESolution types, be sure to use the WORD or ASCii waveform data formats to get the extra bits of vertical resolution.

NOTE **The obsolete command ACQuire:TYPE:REALtime is functionally equivalent to sending ACQuire:MODE RTIME; TYPE NORMal.**

Query Syntax

```
:ACQuire:TYPE?
```

The :ACQuire:TYPE? query returns the current acquisition type.

Return Format

```
<acq_type><NL>

<acq_type> ::= {NORM | AVER | HRES | PEAK}
```

See Also

- "Introduction to :ACQuire Commands" on page 173
- ":ACQuire:COUNt" on page 176
- ":ACQuire:MODE" on page 177
- ":DIGitize" on page 141
- ":WAVeform:FORMat" on page 624
- ":WAVeform:TYPE" on page 639
- ":WAVeform:PREamble" on page 629

Example Code

```
' AQUIRE_TYPE - Sets the acquisition mode, which can be NORMAL,
' PEAK, or AVERAGE.
myScope.WriteString ":ACQuire:TYPE NORMal"
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

9 :CALibrate Commands

Utility commands for viewing calibration status and for starting the user calibration procedure. See "Introduction to :CALibrate Commands" on page 188.

Table 52 :CALibrate Commands Summary

Command	Query	Options and Query Returns
n/a	:CALibrate:DATE? (see page 189)	<return value> ::= <year>,<month>,<day>; all in NR1 format
:CALibrate:LABel <string> (see page 190)	:CALibrate:LABel? (see page 190)	<string> ::= quoted ASCII string up to 32 characters
:CALibrate:OUTPut <signal> (see page 191)	:CALibrate:OUTPut? (see page 191)	<signal> ::= {TRIGgers | MASK | WAVEgen}
n/a	:CALibrate:PROTected? (see page 192)	{"PROTected" | "UNPRotected"}
:CALibrate:STARt (see page 193)	n/a	n/a
n/a	:CALibrate:STATus? (see page 194)	<return value> ::= <status_code>,<status_string> <status_code> ::= an integer status code <status_string> ::= an ASCII status string
n/a	:CALibrate:TEMPerature? (see page 195)	<return value> ::= degrees C delta since last cal in NR3 format
n/a	:CALibrate:TIME? (see page 196)	<return value> ::= <hours>,<minutes>,<seconds>; all in NR1 format

Introduction to :CALibrate Commands

The CALibrate subsystem provides utility commands for:

- Determining the state of the calibration factor protection switch (CAL PROTECT).
- Saving and querying the calibration label string.
- Reporting the calibration time and date.
- Reporting changes in the temperature since the last calibration.
- Starting the user calibration procedure.

:CALibrate:DATE

N (see page 776)

Query Syntax

```
:CALibrate:DATE?
```

The :CALibrate:DATE? query returns the date of the last calibration.

Return Format

```
<date><NL>

<date> ::= year,month,day in NR1 format<NL>
```

See Also

- "Introduction to :CALibrate Commands" on page 188

:CALibrate:LABel

N (see page 776)

Command Syntax

```
:CALibrate:LABel <string>
```

```
<string> ::= quoted ASCII string of up to 32 characters in length,
not including the quotes
```

The CALibrate:LABel command saves a string that is up to 32 characters in length into the instrument's non-volatile memory. The string may be used to record calibration dates or other information as needed.

Query Syntax

```
:CALibrate:LABel?
```

The :CALibrate:LABel? query returns the contents of the calibration label string.

Return Format

```
<string><NL>
```

```
<string>::= unquoted ASCII string of up to 32 characters in length
```

See Also

- "Introduction to :CALibrate Commands" on page 188

:CALibrate:OUTPut

N (see page 776)

Command Syntax

```
:CALibrate:OUTPut <signal>
```

```
<signal> ::= {TRIGgers | MASK | OFF}
```

The CALibrate:OUTPut command sets the signal that is available on the Gen Out BNC:

- TRIGgers — pulse when a trigger event occurs.
- MASK — signal from mask test indicating a failure.
- OFF — either no signal or the waveform generator output signal when :WGEN:OUTPut is ON.

Query Syntax

```
:CALibrate:OUTPut?
```

The :CALibrate:OUTPut query returns the Gen Out BNC signal selection.

Return Format

```
<signal><NL>
```

```
<signal> ::= {TRIG | MASK | OFF}
```

See Also

- "Introduction to :CALibrate Commands" on page 188
- ":WGEN:OUTPut" on page 671

:CALibrate:PROTected

N (see page 776)

Query Syntax

```
:CALibrate:PROTected?
```

The :CALibrate:PROTected? query returns the rear-panel calibration protect (CAL PROTECT) button state. The value "PROTected" indicates calibration is disabled, and "UNPRotected" indicates calibration is enabled.

Return Format

```
<switch><NL>

<switch> ::= {"PROTected" | "UNPRotected"}
```

See Also

- "Introduction to :CALibrate Commands" on page 188

:CALibrate:STARt

N (see page 776)

Command Syntax

```
:CALibrate:STARt
```

The CALibrate:STARt command starts the user calibration procedure.

NOTE Before starting the user calibration procedure, you must set the rear panel CALIBRATION switch to UNPROTECTED, and you must connect BNC cables from the TRIG OUT connector to the analog channel inputs. See the *User's Guide* for details.

See Also

- "Introduction to :CALibrate Commands" on page 188
- ":CALibrate:PROTected" on page 192

:CALibrate:STATus

N (see page 776)

Query Syntax

```
:CALibrate:STATus?
```

The :CALibrate:STATus? query returns the summary results of the last user calibration procedure.

Return Format

```
<return value><NL>

<return value> ::= <status_code>,<status_string>

<status_code> ::= an integer status code

<status_string> ::= an ASCII status string
```

See Also

- "Introduction to :CALibrate Commands" on page 188

:CALibrate:TEMPerature

(see page 776)

Query Syntax

```
:CALibrate:TEMPerature?
```

The :CALibrate:TEMPerature? query returns the change in temperature since the last user calibration procedure.

Return Format

```
<return value><NL>

<return value> ::= degrees C delta since last cal in NR3 format
```

See Also

- "Introduction to :CALibrate Commands" on page 188

:CALibrate:TIME

N (see page 776)

Query Syntax

```
:CALibrate:TIME?
```

The :CALibrate:TIME? query returns the time of the last calibration.

Return Format

```
<date><NL>
```

```
<date> ::= hour,minutes,seconds in NR1 format
```

See Also

- "Introduction to :CALibrate Commands" on page 188

10 :CHANnel<n> Commands

Control all oscilloscope functions associated with individual analog channels or groups of channels. See "Introduction to :CHANnel<n> Commands" on page 199.

Table 53 :CHANnel<n> Commands Summary

Command	Query	Options and Query Returns
:CHANnel<n>:BANDwidth <limit> (see page 200)	:CHANnel<n>:BANDwidth? [MAXimum] (see page 200)	<limit> ::= 25E6 in NR3 format <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:BWLimit {{0 | OFF} | {1 | ON}} (see page 201)	:CHANnel<n>:BWLimit? (see page 201)	{0 | 1} <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:COUPling <coupling> (see page 202)	:CHANnel<n>:COUPling? (see page 202)	<coupling> ::= {AC | DC} <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:DISPlay {{0 | OFF} | {1 | ON}} (see page 203)	:CHANnel<n>:DISPlay? (see page 203)	{0 | 1} <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:IMPedance <impedance> (see page 204)	:CHANnel<n>:IMPedance? (see page 204)	<impedance> ::= ONEMeg <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:INVert {{0 | OFF} | {1 | ON}} (see page 205)	:CHANnel<n>:INVert? (see page 205)	{0 | 1} <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:LABel <string> (see page 206)	:CHANnel<n>:LABel? (see page 206)	<string> ::= any series of 10 or less ASCII characters enclosed in quotation marks <n> ::= 1 to (# analog channels) in NR1 format

Table 53 :CHANnel<n> Commands Summary (continued)

Command	Query	Options and Query Returns
:CHANnel<n>:OFFSet <offset>[suffix] (see page 207)	:CHANnel<n>:OFFSet? (see page 207)	<offset> ::= Vertical offset value in NR3 format [suffix] ::= {V | mV} <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:PROBe <attenuation> (see page 208)	:CHANnel<n>:PROBe? (see page 208)	<attenuation> ::= Probe attenuation ratio in NR3 format <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:PROBe:HEAD[:TYPE] <head_param> (see page 209)	:CHANnel<n>:PROBe:HEAD[:TYPE]? (see page 209)	<head_param> ::= {SEND0 | SEND6 | SEND12 | SEND20 | DIFF0 | DIFF6 | DIFF12 | DIFF20 | NONE} <n> ::= 1 to (# analog channels) in NR1 format
n/a	:CHANnel<n>:PROBe:ID? (see page 210)	<probe id> ::= unquoted ASCII string up to 11 characters <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:PROBe:SKEW <skew_value> (see page 211)	:CHANnel<n>:PROBe:SKEW? (see page 211)	<skew_value> ::= -100 ns to +100 ns in NR3 format <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:PROBe:STYPe <signal type> (see page 212)	:CHANnel<n>:PROBe:STYPe? (see page 212)	<signal type> ::= {DIFFerential | SINGle} <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:PROTection (see page 213)	:CHANnel<n>:PROTection? (see page 213)	NORM <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:RANGe <range>[suffix] (see page 214)	:CHANnel<n>:RANGe? (see page 214)	<range> ::= Vertical full-scale range value in NR3 format [suffix] ::= {V | mV} <n> ::= 1 to (# analog channels) in NR1 format
:CHANnel<n>:SCALe <scale>[suffix] (see page 215)	:CHANnel<n>:SCALe? (see page 215)	<scale> ::= Vertical units per division value in NR3 format [suffix] ::= {V | mV} <n> ::= 1 to (# analog channels) in NR1 format

Table 53 :CHANnel<n> Commands Summary (continued)

Command	Query	Options and Query Returns

`:CHANnel<n>:UNITs <units>` (see page 216)	`:CHANnel<n>:UNITs?` (see page 216)	`<units> ::= {VOLT | AMPere}`
		`<n> ::= 1 to (# analog channels) in NR1 format`

`:CHANnel<n>:VERNier {{0 | OFF} | {1 | ON}}` (see page 217)	`:CHANnel<n>:VERNier?` (see page 217)	`{0 | 1}`
		`<n> ::= 1 to (# analog channels) in NR1 format`

Introduction to :CHANnel<n> Commands

`<n> ::= 1 to (# analog channels) in NR1 format`

The CHANnel<n> subsystem commands control an analog channel (vertical or Y-axis of the oscilloscope). Channels are independently programmable for all offset, probe, coupling, bandwidth limit, inversion, vernier, and range (scale) functions. The channel number (1 or 2) specified in the command selects the analog channel that is affected by the command.

A label command provides identifying annotations of up to 10 characters.

You can toggle the channel displays on and off with the :CHANnel<n>:DISPlay command as well as with the root level commands :VIEW and :BLANk.

NOTE The obsolete CHANnel subsystem is supported.

Reporting the Setup

Use :CHANnel1? or :CHANnel2? to query setup information for the CHANnel<n> subsystem.

Return Format

The following are sample responses from the :CHANnel<n>? query. In this case, the query was issued following a *RST command.

```
:CHAN1:RANG +40.0E+00;OFFS +0.00000E+00;COUP DC;IMP ONEM;DISP 1;BWL 0;
INV 0;LAB "1";UNIT VOLT;PROB +10E+00;PROB:SKEW +0.00E+00;STYP SING
```

:CHANnel<n>:BANDwidth

N (see page 776)

Command Syntax

```
:CHANnel<n>:BANDwidth <limit>
```

```
<limit> ::= 25E6 in NR3 format
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :CHANnel<n>:BANDwidth command sets the bandwidth limit value and turns on bandwidth limiting (see the :CHANnel<n>:BWLimit command).

For waveforms with frequencies below the bandwidth limit, turning the bandwidth limit on removes unwanted high frequency noise from the waveform.

Bandwidth limit also limits the trigger signal path of the channel.

While you can request any limit; the oscilloscope will choose the only bandwidth limit available, 25 MHz.

Query Syntax

```
:CHANnel<n>:BANDwidth? [MAXimum]
```

The :CHANnel<n>:BANDwidth? query returns the current setting of the low-pass filter.

If the bandwidth limit is off, the query returns the full bandwidth of the oscilloscope.

When the MAXimum parameter is used, the oscilloscope's maximum possible bandwidth is returned.

Return Format

```
<limit><NL>
```

```
<limit> ::= 25E6 or full bandwidth in NR3 format
```

See Also

- ":CHANnel<n>:BWLimit" on page 201

:CHANnel<n>:BWLimit

C (see page 776)

Command Syntax

```
:CHANnel<n>:BWLimit <bwlimit>
```

```
<bwlimit> ::= {{1 | ON} | {0 | OFF}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :CHANnel<n>:BWLimit command controls an internal low-pass filter. When the filter is on, the bandwidth of the specified channel is limited to approximately 25 MHz.

Query Syntax

```
:CHANnel<n>:BWLimit?
```

The :CHANnel<n>:BWLimit? query returns the current setting of the low-pass filter.

Return Format

```
<bwlimit><NL>
```

```
<bwlimit> ::= {1 | 0}
```

See Also

- "Introduction to :CHANnel<n> Commands" on page 199

:CHANnel<n>:COUPling

C (see page 776)

Command Syntax

```
:CHANnel<n>:COUPling <coupling>
```

```
<coupling> ::= {AC | DC}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :CHANnel<n>:COUPling command selects the input coupling for the specified channel. The coupling for each analog channel can be set to AC or DC.

Query Syntax

```
:CHANnel<n>:COUPling?
```

The :CHANnel<n>:COUPling? query returns the current coupling for the specified channel.

Return Format

```
<coupling value><NL>
```

```
<coupling value> ::= {AC | DC}
```

See Also

- "Introduction to :CHANnel<n> Commands" on page 199

:CHANnel<n>:DISPlay

C (see page 776)

Command Syntax

```
:CHANnel<n>:DISPlay <display value>
```

```
<display value> ::= {{1 | ON} | {0 | OFF}}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :CHANnel<n>:DISPlay command turns the display of the specified channel on or off.

Query Syntax

```
:CHANnel<n>:DISPlay?
```

The :CHANnel<n>:DISPlay? query returns the current display setting for the specified channel.

Return Format

```
<display value><NL>
```

```
<display value> ::= {1 | 0}
```

See Also

- "Introduction to :CHANnel<n> Commands" on page 199
- ":VIEW" on page 162
- ":BLANk" on page 140
- ":STATus" on page 159

:CHANnel<n>:IMPedance

C (see page 776)

Command Syntax

```
:CHANnel<n>:IMPedance <impedance>
```

```
<impedance> ::= ONEMeg
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :CHANnel<n>:IMPedance command selects the input impedance setting for the specified analog channel. The only legal value for this command is ONEMeg (1 MΩ).

Query Syntax

```
:CHANnel<n>:IMPedance?
```

The :CHANnel<n>:IMPedance? query returns the current input impedance setting for the specified channel.

Return Format

```
<impedance value><NL>
```

```
<impedance value> ::= ONEM
```

See Also

- "Introduction to :CHANnel<n> Commands" on page 199

:CHANnel<n>:INVert

N (see page 776)

Command Syntax

```
:CHANnel<n>:INVert <invert value>
```

```
<invert value> ::= {{1 | ON} | {0 | OFF}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :CHANnel<n>:INVert command selects whether or not to invert the input signal for the specified channel. The inversion may be 1 (ON/inverted) or 0 (OFF/not inverted).

Query Syntax

```
:CHANnel<n>:INVert?
```

The :CHANnel<n>:INVert? query returns the current state of the channel inversion.

Return Format

```
<invert value><NL>
```

```
<invert value> ::= {0 | 1}
```

See Also

- "Introduction to :CHANnel<n> Commands" on page 199

:CHANnel<n>:LABel

N (see page 776)

Command Syntax

```
:CHANnel<n>:LABel <string>

<string> ::= quoted ASCII string

<n> ::= 1 to (# analog channels) in NR1 format
```

NOTE Label strings are 10 characters or less, and may contain any commonly used ASCII characters. Labels with more than 10 characters are truncated to 10 characters. Lower case characters are converted to upper case.

The :CHANnel<n>:LABel command sets the analog channel label to the string that follows. Setting a label for a channel also adds the name to the label list in non-volatile memory (replacing the oldest label in the list).

Query Syntax

```
:CHANnel<n>:LABel?
```

The :CHANnel<n>:LABel? query returns the label associated with a particular analog channel.

Return Format

```
<string><NL>

<string> ::= quoted ASCII string
```

See Also

- "Introduction to :CHANnel<n> Commands" on page 199
- ":DISPlay:LABel" on page 232
- ":DISPlay:LABList" on page 233

Example Code

```
' LABEL - This command allows you to write a name (10 characters
' maximum) next to the channel number.  It is not necessary, but
' can be useful for organizing the display.
myScope.WriteString ":CHANnel1:LABel ""CAL 1"""   ' Label ch1 "CAL 1".
myScope.WriteString ":CHANnel2:LABel ""CAL2"""    ' Label ch1 "CAL2".
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:CHANnel<n>:OFFSet

C (see page 776)

Command Syntax

```
:CHANnel<n>:OFFSet <offset> [<suffix>]
```

```
<offset> ::= Vertical offset value in NR3 format
```

```
<suffix> ::= {V | mV}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :CHANnel<n>:OFFSet command sets the value that is represented at center screen for the selected channel. The range of legal values varies with the value set by the :CHANnel<n>:RANGe and :CHANnel<n>:SCALe commands. If you set the offset to a value outside of the legal range, the offset value is automatically set to the nearest legal value. Legal values are affected by the probe attenuation setting.

Query Syntax

```
:CHANnel<n>:OFFSet?
```

The :CHANnel<n>:OFFSet? query returns the current offset value for the selected channel.

Return Format

```
<offset><NL>
```

```
<offset> ::= Vertical offset value in NR3 format
```

See Also

- "Introduction to :CHANnel<n> Commands" on page 199
- ":CHANnel<n>:RANGe" on page 214
- ":CHANnel<n>:SCALe" on page 215
- ":CHANnel<n>:PROBe" on page 208

:CHANnel<n>:PROBe

🟩C (see page 776)

Command Syntax

```
:CHANnel<n>:PROBe <attenuation>

<attenuation> ::= probe attenuation ratio in NR3 format

<n> ::= 1 to (# analog channels) in NR1 format

The obsolete attenuation values X1, X10, X20, X100 are also supported.
```

The :CHANnel<n>:PROBe command specifies the probe attenuation factor for the selected channel. The probe attenuation factor may be 0.1 to 10000. This command does not change the actual input sensitivity of the oscilloscope. It changes the reference constants for scaling the display factors, for making automatic measurements, and for setting trigger levels.

Query Syntax

```
:CHANnel<n>:PROBe?
```

The :CHANnel<n>:PROBe? query returns the current probe attenuation factor for the selected channel.

Return Format

```
<attenuation><NL>

<attenuation> ::= probe attenuation ratio in NR3 format
```

See Also

- "Introduction to :CHANnel<n> Commands" on page 199
- ":CHANnel<n>:RANGe" on page 214
- ":CHANnel<n>:SCALe" on page 215
- ":CHANnel<n>:OFFSet" on page 207

Example Code

```
   ' CHANNEL_PROBE - Sets the probe attenuation factor for the selected
   ' channel.  The probe attenuation factor may be set from 0.1 to 10000
.
   myScope.WriteString ":CHANnel1:PROBe 10"   ' Set Probe to 10:1.
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:CHANnel<n>:PROBe:HEAD[:TYPE]

C (see page 776)

Command Syntax

NOTE This command is valid only for the 113xA Series probes.

```
:CHANnel<n>:PROBe:HEAD[:TYPE] <head_param>

<head_param> ::= {SEND0 | SEND6 | SEND12 | SEND20 | DIFF0 | DIFF6
                 | DIFF12 | DIFF20 | NONE}

<n> ::= {1 | 2 | 3 | 4}
```

The :CHANnel<n>:PROBe:HEAD[:TYPE] command sets an analog channel probe head type and dB value. You can choose from:

- SEND0 — Single-ended, 0dB.
- SEND6 — Single-ended, 6dB.
- SEND12 — Single-ended, 12dB.
- SEND20 — Single-ended, 20dB.
- DIFF0 — Differential, 0dB.
- DIFF6 — Differential, 6dB.
- DIFF12 — Differential, 12dB.
- DIFF20 — Differential, 20dB.

Query Syntax

```
:CHANnel<n>:PROBe:HEAD[:TYPE]?
```

The :CHANnel<n>:PROBe:HEAD[:TYPE]? query returns the current probe head type setting for the selected channel.

Return Format

```
<head_param><NL>

<head_param> ::= {SEND0 | SEND6 | SEND12 | SEND20 | DIFF0 | DIFF6
                 | DIFF12 | DIFF20 | NONE}
```

See Also

- "Introduction to :CHANnel<n> Commands" on page 199
- ":CHANnel<n>:PROBe" on page 208
- ":CHANnel<n>:PROBe:ID" on page 210
- ":CHANnel<n>:PROBe:SKEW" on page 211
- ":CHANnel<n>:PROBe:STYPe" on page 212

:CHANnel<n>:PROBe:ID

C (see page 776)

Query Syntax

```
:CHANnel<n>:PROBe:ID?
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :CHANnel<n>:PROBe:ID? query returns the type of probe attached to the specified oscilloscope channel.

Return Format

```
<probe id><NL>
```

```
<probe id> ::= unquoted ASCII string up to 11 characters
```

Some of the possible returned values are:

- 1131A
- 1132A
- 1134A
- 1147A
- 1153A
- 1154A
- 1156A
- 1157A
- 1158A
- 1159A
- AutoProbe
- E2621A
- E2622A
- E2695A
- E2697A
- HP1152A
- HP1153A
- NONE
- Probe
- Unknown
- Unsupported

See Also

- "Introduction to :CHANnel<n> Commands" on page 199

:CHANnel<n>:PROBe:SKEW

C (see page 776)

Command Syntax

```
:CHANnel<n>:PROBe:SKEW <skew value>

<skew value> ::= skew time in NR3 format

<skew value> ::= -100 ns to +100 ns

<n> ::= 1 to (# analog channels) in NR1 format
```

The :CHANnel<n>:PROBe:SKEW command sets the channel-to-channel skew factor for the specified channel. Each analog channel can be adjusted + or -100 ns for a total of 200 ns difference between channels. You can use the oscilloscope's probe skew control to remove cable-delay errors between channels.

Query Syntax

```
:CHANnel<n>:PROBe:SKEW?
```

The :CHANnel<n>:PROBe:SKEW? query returns the current probe skew setting for the selected channel.

Return Format

```
<skew value><NL>

<skew value> ::= skew value in NR3 format
```

See Also

- "Introduction to :CHANnel<n> Commands" on page 199

:CHANnel<n>:PROBe:STYPe

C (see page 776)

Command Syntax

NOTE

This command is valid only for the 113xA Series probes.

```
:CHANnel<n>:PROBe:STYPe <signal type>
```

```
<signal type> ::= {DIFFerential | SINGle}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :CHANnel<n>:PROBe:STYPe command sets the channel probe signal type (STYPe) to differential or single-ended when using the 113xA Series probes and determines how offset is applied.

When single-ended is selected, the :CHANnel<n>:OFFset command changes the offset value of the probe amplifier. When differential is selected, the :CHANnel<n>:OFFset command changes the offset value of the channel amplifier.

Query Syntax

```
:CHANnel<n>:PROBe:STYPe?
```

The :CHANnel<n>:PROBe:STYPe? query returns the current probe signal type setting for the selected channel.

Return Format

```
<signal type><NL>
```

```
<signal type> ::= {DIFF | SING}
```

See Also

- "Introduction to :CHANnel<n> Commands" on page 199
- ":CHANnel<n>:OFFSet" on page 207

:CHANnel<n>:PROTection

N (see page 776)

Command Syntax

```
:CHANnel<n>:PROTection[:CLEar]
```

```
<n> ::= 1 to (# analog channels) in NR1 format| 4}
```

With the 1000 X-Series oscilloscopes, the analog channel input impedance is always 1 MΩ, so automatic overvoltage protection is not necessary (as it is for channels with 50Ω input impedance). There are no protection settings to clear, so the :CHANnel<n>:PROTection[:CLEar] command does nothing.

Query Syntax

```
:CHANnel<n>:PROTection?
```

The :CHANnel<n>:PROTection query always returns NORM (normal).

Return Format

```
NORM<NL>
```

See Also

- "Introduction to :CHANnel<n> Commands" on page 199
- ":CHANnel<n>:COUPling" on page 202
- ":CHANnel<n>:PROBe" on page 208

:CHANnel<n>:RANGe

C (see page 776)

Command Syntax

```
:CHANnel<n>:RANGe <range>[<suffix>]
```

```
<range> ::= vertical full-scale range value in NR3 format
```

```
<suffix> ::= {V | mV}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :CHANnel<n>:RANGe command defines the full-scale vertical axis of the selected channel. When using 1:1 probe attenuation, legal values for the range are from 8 mV to 40 V.

If the probe attenuation is changed, the range value is multiplied by the probe attenuation factor.

Query Syntax

```
:CHANnel<n>:RANGe?
```

The :CHANnel<n>:RANGe? query returns the current full-scale range setting for the specified channel.

Return Format

```
<range_argument><NL>
```

```
<range_argument> ::= vertical full-scale range value in NR3 format
```

See Also

- "Introduction to :CHANnel<n> Commands" on page 199
- ":CHANnel<n>:SCALe" on page 215
- ":CHANnel<n>:PROBe" on page 208

Example Code

```
   ' CHANNEL_RANGE - Sets the full scale vertical range in volts.  The
   ' range value is 8 times the volts per division.
   myScope.WriteString ":CHANnel1:RANGe 8"   ' Set the vertical range to
 8 volts.
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:CHANnel<n>:SCALe

N (see page 776)

Command Syntax

```
:CHANnel<n>:SCALe <scale>[<suffix>]
```

```
<scale> ::= vertical units per division in NR3 format
```

```
<suffix> ::= {V | mV}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :CHANnel<n>:SCALe command sets the vertical scale, or units per division, of the selected channel.

If the probe attenuation is changed, the scale value is multiplied by the probe's attenuation factor.

Query Syntax

```
:CHANnel<n>:SCALe?
```

The :CHANnel<n>:SCALe? query returns the current scale setting for the specified channel.

Return Format

```
<scale value><NL>
```

```
<scale value> ::= vertical units per division in NR3 format
```

See Also

- "Introduction to :CHANnel<n> Commands" on page 199
- ":CHANnel<n>:RANGe" on page 214
- ":CHANnel<n>:PROBe" on page 208

:CHANnel<n>:UNITs

N (see page 776)

Command Syntax

```
:CHANnel<n>:UNITs <units>

<units> ::= {VOLT | AMPere}

<n> ::= 1 to (# analog channels) in NR1 format
```

The :CHANnel<n>:UNITs command sets the measurement units for the connected probe. Select VOLT for a voltage probe and select AMPere for a current probe. Measurement results, channel sensitivity, and trigger level will reflect the measurement units you select.

Query Syntax

```
:CHANnel<n>:UNITs?
```

The :CHANnel<n>:UNITs? query returns the current units setting for the specified channel.

Return Format

```
<units><NL>

<units> ::= {VOLT | AMP}
```

See Also

- "Introduction to :CHANnel<n> Commands" on page 199
- ":CHANnel<n>:RANGe" on page 214
- ":CHANnel<n>:PROBe" on page 208
- ":EXTernal:UNITs" on page 254

:CHANnel<n>:VERNier

N (see page 776)

Command Syntax

```
:CHANnel<n>:VERNier <vernier value>

<vernier value> ::= {{1 | ON} | {0 | OFF}

<n> ::= 1 to (# analog channels) in NR1 format
```

The :CHANnel<n>:VERNier command specifies whether the channel's vernier (fine vertical adjustment) setting is ON (1) or OFF (0).

Query Syntax

```
:CHANnel<n>:VERNier?
```

The :CHANnel<n>:VERNier? query returns the current state of the channel's vernier setting.

Return Format

```
<vernier value><NL>

<vernier value> ::= {0 | 1}
```

See Also

- "Introduction to :CHANnel<n> Commands" on page 199

11 :DEMO Commands

When the education kit is licensed (Option EDK), you can output demonstration signals on the oscilloscope's Demo terminal. See "Introduction to :DEMO Commands" on page 219.

Table 54 :DEMO Commands Summary

Command	Query	Options and Query Returns
`:DEMO:FUNCtion <signal>` (see page 220)	`:DEMO:FUNCtion?` (see page 221)	`<signal> ::= {SINusoid | NOISy | LFSine | AM | RFBurst | FMBurst | HARMonics | COUPling | RINGing | SINGle | CLK | TRANsition | BURSt | GLITch | UART | CAN | LIN}`
`:DEMO:OUTPut {{0 | OFF} | {1 | ON}}` (see page 222)	`:DEMO:OUTPut?` (see page 222)	`{0 | 1}`

Introduction to :DEMO Commands

The :DEMO subsystem provides commands to output demonstration signals on the oscillosope's Demo terminal.

Reporting the Setup

Use :DEMO? to query setup information for the DEMO subsystem.

Return Format

The following is a sample response from the :DEMO? query. In this case, the query was issued following the *RST command.

```
:DEMO:FUNC SIN;OUTP 0
```

:DEMO:FUNCtion

N (see page 776)

Command Syntax

```
:DEMO:FUNCtion <signal>

<signal> ::= {SINusoid | NOISy | LFSine | AM | RFBurst | FMBurst
    | HARMonics | COUPling | RINGing | SINGle | CLK | TRANsition
    | BURSt | GLITch | UART | CAN | LIN}
```

The :DEMO:FUNCtion command selects the type of demo signal:

Demo Signal Function	Demo Terminal
SINusoid	250 kHz sine wave @ ~ 6 Vpp, 0 V offset
NOISy	1 kHz sine wave @ ~ 2.4 Vpp, 0.0 V offset, with ~ 0.5 Vpp of random noise added
LFSine	30 Hz sine wave @ ~2.7 Vpp, 0 V offset, with very narrow glitch near each positive peak
AM	Amplitude modulated signal, ~ 3 Vpp, 0 V offset, with ~260 kHz carrier and sine envelope
RFBurst	5-cycle burst of a 10 MHz amplitude modulated sine wave @ ~ 2.6 Vpp, 0 V offset occurring once every 4 ms
FMBurst	FM burst, modulated from ~100 kHz to ~1 MHz, ~5.0 Vpp, ~600 mV offset.
HARMonics	1 kHz sine wave @ ~3.5 Vpp, 0.0 V offset, with a ~2 kHz sine wave coupled in
COUPling	1 kHz square wave @ ~1 Vpp, 0.0 V offset, with a ~90 kHz sine wave with ~180 mVpp riding on top
RINGing	10 kHz digital pulse @ ~ 3 Vpp, 1.5 V offset, and ~24 µs pulse width with ringing
SINGle	~24 µs wide digital pulse with ringing @ ~ 3 Vpp, 1.5 V offset Press the front panel **Set Off Single-Shot** softkey to cause the selected single-shot signal to be output.
CLK	50 kHz clock @ ~2 Vpp, 1 V offset, with infrequent glitch (1 glitch per 50,000 clocks)
TRANsition	Digital pulse train with two different edge speeds @ ~ 3.5 Vpp, 1.75 V offset
BURSt	Burst of digital pulses that occur every 50 µs @ ~ 3.6 Vpp, ~1.5 V offset
GLITch	Burst of 6 digital pulses (plus infrequent glitch) that occurs once every 80 µs @ ~3.6 Vpp, ~1.8 V offset

Demo Signal Function	Demo Terminal
UART	Receive data (RX) with odd parity, 19.2 kbps, 8-bit words, LSB out 1st, low idle @ ~2.8 Vpp, 1.4 V offset
CAN	CAN_L, 125 kbps dominant-low, ~2.8 Vpp, ~1.4 V offset, available in DSOX1000-Series oscilloscope models only
LIN	LIN, 19.2 kbs, ~2.8 Vpp, ~1.4 V offset, available in DSOX1000-Series oscilloscope models only

Query Syntax

```
:DEMO:FUNCtion?
```

The :DEMO:FUNCtion? query returns the currently selected demo signal type.

Return Format

```
<signal><NL>

<signal> ::= {SIN | NOIS | LFS | AM | RFB | FMB | HARM | COUP | RING
    | SING | CLK | TRAN | BURS | GLIT | UART | CAN | LIN}
```

See Also

- "Introduction to :DEMO Commands" on page 219

:DEMO:OUTPut

N (see page 776)

Command Syntax

```
:DEMO:OUTPut <on_off>
```

```
<on_off> ::= {{1 | ON} | {0 | OFF}
```

The :DEMO:OUTPut command specifies whether the demo signal output is ON (1) or OFF (0).

Query Syntax

```
:DEMO:OUTPut?
```

The :DEMO:OUTPut? query returns the current state of the demo signal output setting.

Return Format

```
<on_off><NL>
```

```
<on_off> ::= {1 | 0}
```

See Also

- "Introduction to :DEMO Commands" on page 219
- ":DEMO:FUNCtion" on page 220

12 :DISPlay Commands

Control how waveforms, graticule, and text are displayed and written on the screen. See "Introduction to :DISPlay Commands" on page 224.

Table 55 :DISPlay Commands Summary

Command	Query	Options and Query Returns
:DISPlay:ANNotation {{0 | OFF} | {1 | ON}} (see page 225)	:DISPlay:ANNotation? (see page 225)	{0 | 1}
:DISPlay:ANNotation:BACKground <mode> (see page 226)	:DISPlay:ANNotation:BACKground? (see page 226)	<mode> ::= {OPAQue | INVerted | TRANsparent}
:DISPlay:ANNotation:COLor <color> (see page 227)	:DISPlay:ANNotation:COLor? (see page 227)	<color> ::= {CH1 | CH2 | MATH | REF | MARKer | WHITe | RED}
:DISPlay:ANNotation:TEXT <string> (see page 228)	:DISPlay:ANNotation:TEXT? (see page 228)	<string> ::= quoted ASCII string (up to 254 characters)
:DISPlay:CLEar (see page 229)	n/a	n/a

n/a	:DISPlay:DATA? [<format>][,][<palette>] (see page 230)	<format> ::= {BMP | BMP8bit | PNG}
		<palette> ::= {COLor | GRAYscale}
		<display data> ::= data in IEEE 488.2 # format

:DISPlay:INTensity:WAVeform <value> (see page 231)	:DISPlay:INTensity:WAVeform? (see page 231)	<value> ::= an integer from 0 to 100 in NR1 format.
:DISPlay:LABel {{0 | OFF} | {1 | ON}} (see page 232)	:DISPlay:LABel? (see page 232)	{0 | 1}

Table 55 :DISPlay Commands Summary (continued)

Command	Query	Options and Query Returns
`:DISPlay:LABList <binary block>` (see page 233)	`:DISPlay:LABList?` (see page 233)	`<binary block> ::= an ordered list of up to 75 labels, each 10 characters maximum, separated by newline characters`
`:DISPlay:MENU:TIMeout {<value> | {OFF | MAX}}` (see page 234)	`:DISPlay:MENU:TIMeout?` (see page 234)	`<value> ::= an integer from 5 to 60 in NR1 format.`

`:DISPlay:PERSistence <value>` (see page 235)	`:DISPlay:PERSistence?` (see page 235)	`<value> ::= {MINimum | INFinite | <time>}`
		`<time> ::= seconds in in NR3 format from 100E-3 to 60E0`

`:DISPlay:VECTors {1 | ON}` (see page 236)	`:DISPlay:VECTors?` (see page 236)	`1`

Introduction to :DISPlay Commands

The DISPlay subsystem is used to control the display storage and retrieval of waveform data, labels, and text. This subsystem allows the following actions:

- Clear the waveform area on the display.
- Turn vectors on or off.
- Set waveform persistence.
- Specify labels.
- Save and Recall display data.

Reporting the Setup

Use :DISPlay? to query the setup information for the DISPlay subsystem.

Return Format

The following is a sample response from the :DISPlay? query. In this case, the query was issued following a *RST command.

```
:DISP:LAB 0;VECT 1;PERS MIN
```

:DISPlay:ANNotation

N (see page 776)

Command Syntax

```
:DISPlay:ANNotation <setting>

<setting> ::= {{1 | ON} | {0 | OFF}}
```

The :DISPlay:ANNotation command turns the annotation on and off. When on, the annotation appears in the upper left corner of the oscilloscope's display.

The annotation is useful for documentation purposes, to add notes before capturing screens.

Query Syntax

```
:DISPlay:ANNotation?
```

The :DISPlay:ANNotation? query returns the annotation setting.

Return Format

```
<value><NL>

<value> ::= {0 | 1}
```

See Also

- ":DISPlay:ANNotation:TEXT" on page 228
- ":DISPlay:ANNotation:COLor" on page 227
- ":DISPlay:ANNotation:BACKground" on page 226
- "Introduction to :DISPlay Commands" on page 224

:DISPlay:ANNotation:BACKground

N (see page 776)

Command Syntax

```
:DISPlay:ANNotation:BACKground <mode>
```

```
<mode> ::= {OPAQue | INVerted | TRANsparent}
```

The :DISPlay:ANNotation:BACKground command specifies the background of the annotation:

- OPAQue — the annotation has a solid background.
- INVerted — the annotation's foreground and background colors are switched.
- TRANsparent — the annotation has a transparent background.

Query Syntax

```
:DISPlay:ANNotation:BACKground?
```

The :DISPlay:ANNotation:BACKground? query returns the specified annotation background mode.

Return Format

```
<mode><NL>
```

```
<mode> ::= {OPAQ | INV | TRAN}
```

See Also

- ":DISPlay:ANNotation" on page 225
- ":DISPlay:ANNotation:TEXT" on page 228
- ":DISPlay:ANNotation:COLor" on page 227
- "Introduction to :DISPlay Commands" on page 224

:DISPlay:ANNotation:COLor

N (see page 776)

Command Syntax

```
:DISPlay:ANNotation:COLor <color>
```

```
<color> ::= {CH1 | CH2 | MATH | REF | MARKer | WHITe | RED}
```

The :DISPlay:ANNotation:COLor command specifies the annotation color. You can choose white, red, or colors that match analog channels, math waveforms, reference waveforms, or markers.

Query Syntax

```
:DISPlay:ANNotation:COLor?
```

The :DISPlay:ANNotation:COLor? query returns the specified annotation color.

Return Format

```
<color><NL>
```

```
<color> ::= {CH1 | CH2 | MATH | REF | MARK | WHIT | RED}
```

See Also

- ":DISPlay:ANNotation" on page 225
- ":DISPlay:ANNotation:TEXT" on page 228
- ":DISPlay:ANNotation:BACKground" on page 226
- "Introduction to :DISPlay Commands" on page 224

:DISPlay:ANNotation:TEXT

N (see page 776)

Command Syntax

```
:DISPlay:ANNotation:TEXT <string>
```

```
<string> ::= quoted ASCII string (up to 254 characters)
```

The :DISPlay:ANNotation:TEXT command specifies the annotation string. The annotation string can contain as many characters as will fit in the Edit Annotation box on the oscilloscope's screen, up to 254 characters.

You can include a carriage return in the annotation string using the characters "\n". Note that this is not a new line character but the actual "\" (backslash) and "n" characters in the string. Carriage returns lessen the number of characters available for the annotation string.

Use :DISPlay:ANNotation:TEXT "" to remotely clear the annotation text. (Two sets of quote marks without a space between them creates a NULL string.)

Query Syntax

```
:DISPlay:ANNotation:TEXT?
```

The :DISPlay:ANNotation:TEXT? query returns the specified annotation text.

When carriage returns are present in the annotation text, they are returned as the actual carriage return character (ASCII 0x0D).

Return Format

```
<string><NL>
```

```
<string> ::= quoted ASCII string
```

See Also

- ":DISPlay:ANNotation" on page 225
- ":DISPlay:ANNotation:COLor" on page 227
- ":DISPlay:ANNotation:BACKground" on page 226
- "Introduction to :DISPlay Commands" on page 224

:DISPlay:CLEar

N (see page 776)

Command Syntax `:DISPlay:CLEar`

The :DISPlay:CLEar command clears the display and resets all associated measurements. If the oscilloscope is stopped, all currently displayed data is erased. If the oscilloscope is running, all of the data for active channels and functions is erased; however, new data is displayed on the next acquisition.

See Also

- "Introduction to :DISPlay Commands" on page 224

:DISPlay:DATA

N (see page 776)

Query Syntax

```
:DISPlay:DATA? [<format>][,][<palette>]
```

```
<format> ::= {BMP | BMP8bit | PNG}
```

```
<palette> ::= {COLor | GRAYscale}
```

The :DISPlay:DATA? query reads screen image data. You can choose 24-bit BMP, 8-bit BMP8bit, or 24-bit PNG formats in color or grayscale.

If no format or palette option is specified, the screen image is returned in BMP, COLor format.

Screen image data is returned in the IEEE-488.2 # binary block data format.

Return Format

```
<display data><NL>
```

```
<display data> ::= binary block data in IEEE-488.2 # format.
```

See Also

- "Introduction to :DISPlay Commands" on page 224
- ":HARDcopy:INKSaver" on page 309
- ":PRINt" on page 155
- "*RCL (Recall)" on page 118
- "*SAV (Save)" on page 122
- ":VIEW" on page 162

Example Code

```
   ' IMAGE_TRANSFER - In this example, we will query for the image data
   ' with ":DISPlay:DATA?", read the data, and then save it to a file.
   Dim byteData() As Byte
   myScope.IO.Timeout = 15000
   myScope.WriteString ":DISPlay:DATA? BMP, COLOR"
   byteData = myScope.ReadIEEEBlock(BinaryType_UI1)
   ' Output display data to a file:
   strPath = "c:\scope\data\screen.bmp"
   ' Remove file if it exists.
   If Len(Dir(strPath)) Then
     Kill strPath
   End If
   Close #1   ' If #1 is open, close it.
   Open strPath For Binary Access Write Lock Write As #1   ' Open file f
or output.
   Put #1, , byteData   ' Write data.
   Close #1   ' Close file.
   myScope.IO.Timeout = 5000
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:DISPlay:INTensity:WAVeform

N (see page 776)

Command Syntax

```
:DISPlay:INTensity:WAVeform <value>
```

```
<value> ::= an integer from 0 to 100 in NR1 format.
```

The :DISPlay:INTensity:WAVeform command sets the waveform intensity.

This is the same as adjusting the front panel **[Intensity]** knob.

Query Syntax

```
:DISPlay:INTensity:WAVeform?
```

The :DISPlay:INTensity:WAVeform? query returns the waveform intensity setting.

Return Format

```
<value><NL>
```

```
<value> ::= an integer from 0 to 100 in NR1 format.
```

See Also

- "Introduction to :DISPlay Commands" on page 224

:DISPlay:LABel

N (see page 776)

Command Syntax

```
:DISPlay:LABel <value>
```

```
<value> ::= {{1 | ON} | {0 | OFF}}
```

The :DISPlay:LABel command turns the analog channel labels on and off.

Query Syntax

```
:DISPlay:LABel?
```

The :DISPlay:LABel? query returns the display mode of the analog channel labels.

Return Format

```
<value><NL>
```

```
<value> ::= {0 | 1}
```

See Also

- "Introduction to :DISPlay Commands" on page 224
- ":CHANnel<n>:LABel" on page 206

Example Code

```
   ' DISP_LABEL
   '  - Turns label names ON or OFF on the analyzer display.
   myScope.WriteString ":DISPlay:LABel ON"   ' Turn on labels.
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:DISPlay:LABList

N (see page 776)

Command Syntax

```
:DISPlay:LABList <binary block data>

<binary block> ::= an ordered list of up to 75 labels, a maximum of 10
                   characters each, separated by newline characters.
```

The :DISPlay:LABList command adds labels to the label list. Labels are added in alphabetical order.

NOTE Labels that begin with the same alphabetic base string followed by decimal digits are considered duplicate labels. Duplicate labels are not added to the label list. For example, if label "A0" is in the list and you try to add a new label called "A123456789", the new label is not added.

Query Syntax

```
:DISPlay:LABList?
```

The :DISPlay:LABList? query returns the label list.

Return Format

```
<binary block><NL>

<binary block> ::= an ordered list of up to 75 labels, a maximum of 10
                   characters each, separated by newline characters.
```

See Also

- "Introduction to :DISPlay Commands" on page 224
- ":DISPlay:LABel" on page 232
- ":CHANnel<n>:LABel" on page 206

:DISPlay:MENU:TIMeout

N (see page 776)

Command Syntax

```
:DISPlay:MENU:TIMeout {<value> | {OFF | MAX}}
```

```
<value> ::= an integer from 5 to 60 in NR1 format.
```

The :DISPlay:MENU:TIMeout command sets the softkey menu timeout period. OFF and MAX are equivalent.

Query Syntax

```
:DISPlay:MENU:TIMeout?
```

The :DISPlay:MENU:TIMeout? query returns the softkey menu timeout period setting.

Return Format

```
<value><NL>
```

```
<value> ::= an integer from 5 to 60 in NR1 format or OFF.
```

:DISPlay:PERSistence

N (see page 776)

Command Syntax

```
:DISPlay:PERSistence <value>

<value> ::= {MINimum | INFinite | <time>}

<time> ::= seconds in in NR3 format from 100E-3 to 60E0
```

The :DISPlay:PERSistence command specifies the persistence setting:

- MINimum — indicates zero persistence.
- INFinite — indicates infinite persistence.
- <time> — for variable persistence, that is, you can specify how long acquisitions remain on the screen.

Use the :DISPlay:CLEar command to erase points stored by persistence.

Query Syntax

```
:DISPlay:PERSistence?
```

The :DISPlay:PERSistence? query returns the specified persistence value.

Return Format

```
<value><NL>

<value> ::= {MIN | INF | <time>}
```

See Also

- "Introduction to :DISPlay Commands" on page 224
- ":DISPlay:CLEar" on page 229

:DISPlay:VECTors

N (see page 776)

Command Syntax

```
:DISPlay:VECTors <vectors>
```

```
<vectors> ::= {1 | ON}
```

The only legal value for the :DISPlay:VECTors command is ON (or 1). This specifies that lines are drawn between acquired data points on the screen.

Query Syntax

```
:DISPlay:VECTors?
```

The :DISPlay:VECTors? query returns the vectors setting.

Return Format

```
<vectors><NL>
```

```
<vectors> ::= 1
```

See Also

- "Introduction to :DISPlay Commands" on page 224

13 :DVM Commands

When the optional DSOXDVM digital voltmeter analysis feature is licensed, these commands control the digital voltmeter (DVM) feature.

Table 56 :DVM Commands Summary

Command	Query	Options and Query Returns
`:DVM:ARANge {{0 | OFF} | {1 | ON}}` (see page 238)	`:DVM:ARANge?` (see page 238)	`{0 | 1}`
n/a	`:DVM:CURRent?` (see page 239)	`<dvm_value> ::= floating-point number in NR3 format`
`:DVM:ENABle {{0 | OFF} | {1 | ON}}` (see page 240)	`:DVM:ENABle?` (see page 240)	`{0 | 1}`
n/a	`:DVM:FREQuency?` (see page 239)	`<freq_value> ::= floating-point number in NR3 format`
`:DVM:MODE <mode>` (see page 242)	`:DVM:MODE?` (see page 242)	`<dvm_mode> ::= {ACRMs | DC | DCRMs | FREQuency}`

`:DVM:SOURce <source>` (see page 243)	`:DVM:SOURce?` (see page 243)	`<source> ::= {CHANnel<n>}`
		`<n> ::= 1 to (# analog channels) in NR1 format`

:DVM:ARANge

N (see page 776)

Command Syntax

```
:DVM:ARANge <setting>
```

```
<setting> ::= {{OFF | 0} | {ON | 1}}
```

If the selected digital voltmeter (DVM) source channel is not used in oscilloscope triggering, the :DVM:ARANge command turns the digital voltmeter's Auto Range capability on or off.

- When on, the DVM channel's vertical scale, vertical (ground level) position, and trigger (threshold voltage) level (used for the counter frequency measurement) are automatically adjusted.

  The Auto Range capability overrides attempted adjustments of the channel's vertical scale and position.
- When off, you can adjust the channel's vertical scale and position normally.

Query Syntax

```
:DVM:ARANge?
```

The :DVM:ARANge? query returns a flag indicating whether the digital voltmeter's Auto Range capability is on or off.

Return Format

```
<setting><NL>
```

```
<setting> ::= {0 | 1}
```

See Also

- ":DVM:SOURce" on page 243
- ":DVM:ENABle" on page 240
- ":DVM:MODE" on page 242

:DVM:CURRent

N (see page 776)

Query Syntax `:DVM:CURRent?`

The :DVM:CURRent? query returns the displayed 3-digit DVM value based on the current mode.

Return Format `<dvm_value><NL>`

```
<dvm_value> ::= floating-point number in NR3 format
```

See Also

- ":DVM:SOURce" on page 243
- ":DVM:ENABle" on page 240
- ":DVM:MODE" on page 242
- ":DVM:FREQuency" on page 241

:DVM:ENABle

N (see page 776)

Command Syntax

```
:DVM:ENABle <setting>
```

```
<setting> ::= {{OFF | 0} | {ON | 1}}
```

The :DVM:ENABle command turns the digital voltmeter (DVM) analysis feature on or off.

Query Syntax

```
:DVM:ENABle?
```

The :DVM:ENABle? query returns a flag indicating whether the digital voltmeter (DVM) analysis feature is on or off.

Return Format

```
<setting><NL>
```

```
<setting> ::= {0 | 1}
```

See Also

- ":DVM:SOURce" on page 243
- ":DVM:MODE" on page 242
- ":DVM:ARANge" on page 238

:DVM:FREQuency

N (see page 776)

Query Syntax

```
:DVM:FREQuency?
```

The :DVM:FREQuency? query returns the displayed 5-digit frequency value that is displayed below the main DVM value.

If the requirements for the DVM FREQuency mode are not met (see ":DVM:MODE" on page 242), this query will return 9.9E+37.

Return Format

```
<freq_value><NL>

<freq_value> ::= floating-point number in NR3 format
```

See Also

- ":DVM:SOURce" on page 243
- ":DVM:ENABle" on page 240
- ":DVM:MODE" on page 242
- ":DVM:CURRent" on page 239

:DVM:MODE

N (see page 776)

Command Syntax

```
:DVM:MODE <dvm_mode>

<dvm_mode> ::= {ACRMs | DC | DCRMs | FREQuency}
```

The :DVM:MODE command sets the digital voltmenter (DVM) mode:

- ACRMs — displays the root-mean-square value of the acquired data, with the DC component removed.
- DC — displays the DC value of the acquired data.
- DCRMs — displays the root-mean-square value of the acquired data.
- FREQuency — displays the frequency counter measurement. Requires the EDGE or GLITch trigger mode, and the DVM source and the trigger source must be the same analog channel.

Query Syntax

```
:DVM:MODE?
```

The :DVM:MODE? query returns the selected DVM mode.

Return Format

```
<dvm_mode><NL>

<dvm_mode> ::= {ACRM | DC | DCRM | FREQ}
```

See Also

- ":DVM:ENABle" on page 240
- ":DVM:SOURce" on page 243
- ":DVM:ARANge" on page 238
- ":DVM:CURRent" on page 239
- ":DVM:FREQuency" on page 241
- ":TRIGger:MODE" on page 574

:DVM:SOURce

N (see page 776)

Command Syntax

```
:DVM:SOURce <source>

<source> ::= {CHANnel<n>}

<n> ::= 1 to (# analog channels) in NR1 format
```

The :DVM:SOURce command sets the select the analog channel on which digital voltmeter (DVM) measurements are made.

The selected channel does not have to be on (displaying a waveform) in order for DVM measurements to be made.

Query Syntax

```
:DVM:SOURce?
```

The :DVM:SOURce? query returns the selected DVM input source.

Return Format

```
<source><NL>

<source> ::= {CHAN<n>}

<n> ::= 1 to (# analog channels) in NR1 format
```

See Also

- ":DVM:ENABle" on page 240
- ":DVM:MODE" on page 242
- ":DVM:ARANge" on page 238
- ":DVM:CURRent" on page 239
- ":DVM:FREQuency" on page 241

14 :EXTernal Trigger Commands

Control the input characteristics of the external trigger input. See "Introduction to :EXTernal Trigger Commands" on page 246.

Table 57 :EXTernal Trigger Commands Summary

Command	Query	Options and Query Returns
:EXTernal:BWLimit <bwlimit> (see page 247)	:EXTernal:BWLimit? (see page 247)	<bwlimit> ::= {0 | OFF}
:EXTernal:DISPlay {{0 | OFF} | {1 | ON}} (see page 248)	:EXTernal:DISPlay? (see page 248)	<setting> ::= {0 | 1}
:EXTernal:LABel <string> (see page 249)	:EXTernal:LABel? (see page 249)	<string> ::= quoted ASCII string.
:EXTernal:LEVel <level>[<suffix>] (see page 250)	:EXTernal:LEVel? (see page 250)	<value> ::= external trigger level value in NR3 format. <suffix> ::= {V | mV}
:EXTernal:POSition <value> (see page 251)	:EXTernal:POSition? (see page 251)	<value> ::= Ext Trig waveform vertical position in divisions in NR3 format.
:EXTernal:PROBe <attenuation> (see page 252)	:EXTernal:PROBe? (see page 252)	<attenuation> ::= probe attenuation ratio in NR3 format
:EXTernal:RANGe <range>[<suffix>] (see page 253)	:EXTernal:RANGe? (see page 253)	<range> ::= vertical full-scale range value in NR3 format <suffix> ::= {V | mV}
:EXTernal:UNITs <units> (see page 254)	:EXTernal:UNITs? (see page 254)	<units> ::= {VOLT | AMPere}

Introduction to :EXTernal Trigger Commands

The EXTernal trigger subsystem commands control the input characteristics of the external trigger input. The probe factor, impedance, input range, input protection state, units, and bandwidth limit settings may all be queried. Depending on the instrument type, some settings may be changeable.

Reporting the Setup

Use :EXTernal? to query setup information for the EXTernal subsystem.

Return Format

The following is a sample response from the :EXTernal query. In this case, the query was issued following a *RST command.

```
:EXT:BWL 0;RANG +8E+00;UNIT VOLT;PROB +1.000E+00
```

:EXTernal:BWLimit

C (see page 776)

Command Syntax

```
:EXTernal:BWLimit <bwlimit>
```

```
<bwlimit> ::= {0 | OFF}
```

The :EXTernal:BWLimit command is provided for product compatibility. The only legal value is 0 or OFF. Use the :TRIGger:HFReject command to limit bandwidth on the external trigger input.

Query Syntax

```
:EXTernal:BWLimit?
```

The :EXTernal:BWLimit? query returns the current setting of the low-pass filter (always 0).

Return Format

```
<bwlimit><NL>
```

```
<bwlimit> ::= 0
```

See Also

- "Introduction to :EXTernal Trigger Commands" on page 246
- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:HFReject" on page 569

:EXTernal:DISPlay

N (see page 776)

Command Syntax

```
:EXTernal:DISPlay {{0 | OFF} | {1 | ON}}
```

The :EXTernal:DISPlay command turns the external trigger input display on or off.

Query Syntax

```
:EXTernal:DISPlay?
```

The :EXTernal:DISPlay? query returns the external trigger input display setting.

Return Format

```
<setting><NL>

<setting> ::= {0 | 1}
```

See Also

- ":EXTernal:LEVel" on page 250

:EXTernal:LABel

N (see page 776)

Command Syntax

```
:EXTernal:LABel <string>

<string> ::= quoted ASCII string.
```

NOTE Label strings are 10 characters or less, and may contain any commonly used ASCII characters. Labels with more than 10 characters are truncated to 10 characters. Lower case characters are converted to upper case.

The :EXTernal:LABel command sets the external trigger input's digital waveform label to the string that follows. Setting a label for the external waveform also adds the name to the label list in non-volatile memory (replacing the oldest label in the list).

Query Syntax

```
:EXTernal:LABel?
```

The :EXTernal:LABel? query returns the label associated with the external trigger input's digital waveform.

Return Format

```
<string><NL>

<string> ::= quoted ASCII string.
```

See Also

- ":EXTernal:DISPlay" on page 248
- ":DISPlay:LABel" on page 232

:EXTernal:LEVel

N (see page 776)

Command Syntax

```
:EXTernal:LEVel <level>[<suffix>]
```

```
<value> ::= external trigger level value in NR3 format.
```

```
<suffix> ::= {V | mV}
```

The :EXTernal:LEVel command sets the external trigger input threshold (trigger) voltage level.

Query Syntax

```
:EXTernal:LEVel?
```

The :EXTernal:LEVel? query returns the external trigger input threshold voltage setting.

Return Format

```
<value><NL>
```

See Also

- ":EXTernal:DISPlay" on page 248

:EXTernal:POSition

N (see page 776)

Command Syntax

```
:EXTernal:POSition <value>
```

```
<value> ::= Ext Trig waveform vertical position in divisions in NR3 form
at.
```

The :EXTernal:POSition command sets the external trigger input waveform's veritical position on the oscilloscope display.

When the external trigger input's waveform is displayed (see :EXTernal:DISPlay), a cyan digital waveform, based on the :EXTernal:LEVel threshold voltage, appears on the oscilloscope display. This waveform is one division tall, and the base of the waveform can be positioned from -3.5 divisions to 2.5 divisions.

Query Syntax

```
:EXTernal:POSition?
```

The :EXTernal:POSition? query returns, in vertical divisions, the position of the external trigger input waveform.

Return Format

```
<value><NL>
```

See Also

- ":EXTernal:DISPlay" on page 248
- ":EXTernal:LEVel" on page 250

:EXTernal:PROBe

C (see page 776)

Command Syntax

```
:EXTernal:PROBe <attenuation>
```

```
<attenuation> ::= probe attenuation ratio in NR3 format
```

The :EXTernal:PROBe command specifies the probe attenuation factor for the external trigger. The probe attenuation factor may be 0.1 to 10000. This command does not change the actual input sensitivity of the oscilloscope. It changes the reference constants for scaling the display factors and for setting trigger levels.

If an AutoProbe probe is connected to the oscilloscope, the attenuation value cannot be changed from the sensed value. Attempting to set the oscilloscope to an attenuation value other than the sensed value produces an error.

Query Syntax

```
:EXTernal:PROBe?
```

The :EXTernal:PROBe? query returns the current probe attenuation factor for the external trigger.

Return Format

```
<attenuation><NL>
```

```
<attenuation> ::= probe attenuation ratio in NR3 format
```

See Also

- "Introduction to :EXTernal Trigger Commands" on page 246
- ":EXTernal:RANGe" on page 253
- "Introduction to :TRIGger Commands" on page 565
- ":CHANnel<n>:PROBe" on page 208

:EXTernal:RANGe

C (see page 776)

Command Syntax

```
:EXTernal:RANGe <range>[<suffix>]
```

```
<range> ::= vertical full-scale range value in NR3 format
```

```
<suffix> ::= {V | mV}
```

The :EXTernal:RANGe command sets the external trigger input signal range.

When using DSOX1000-Series oscilloscopes, this range is either 1.6 V or 8 V when you are using a 1:1 probe.

When using EDUX1000-Series oscilloscopes, this range is 8 V when you are using a 1:1 probe and cannot be changed.

If the probe attenuation is changed, the range value is multiplied by the probe attenuation factor.

Query Syntax

```
:EXTernal:RANGe?
```

The :EXTernal:RANGe? query returns the current full-scale range setting for the external trigger.

Return Format

```
<range_argument><NL>
```

```
<range_argument> ::= external trigger range value in NR3 format
```

See Also

- "Introduction to :EXTernal Trigger Commands" on page 246
- ":EXTernal:PROBe" on page 252
- "Introduction to :TRIGger Commands" on page 565

:EXTernal:UNITs

N (see page 776)

Command Syntax

```
:EXTernal:UNITs <units>
```

```
<units> ::= {VOLT | AMPere}
```

The :EXTernal:UNITs command sets the measurement units for the probe connected to the external trigger input. Select VOLT for a voltage probe and select AMPere for a current probe. Measurement results, channel sensitivity, and trigger level will reflect the measurement units you select.

Query Syntax

```
:EXTernal:UNITs?
```

The :CHANnel<n>:UNITs? query returns the current units setting for the external trigger.

Return Format

```
<units><NL>
```

```
<units> ::= {VOLT | AMP}
```

See Also

- "Introduction to :EXTernal Trigger Commands" on page 246
- "Introduction to :TRIGger Commands" on page 565
- ":EXTernal:RANGe" on page 253
- ":EXTernal:PROBe" on page 252
- ":CHANnel<n>:UNITs" on page 216

15 :FFT Commands

Control functions in the measurement/storage module. See "Introduction to :FFT Commands" on page 256.

Table 58 :FFT Commands Summary

Command	Query	Options and Query Returns
:FFT:CENTer <frequency> (see page 257)	:FFT:CENTer? (see page 257)	<frequency> ::= the current center frequency in NR3 format. The range of legal values is from -25 GHz to 25 GHz.
:FFT:DISPlay {{0 | OFF} | {1 | ON}} (see page 258)	:FFT:DISPlay? (see page 258)	<s> ::= 1-6, in NR1 format. {0 | 1}
:FFT:OFFSet <offset> (see page 259)	:FFT:OFFSet? (see page 259)	<offset> ::= the value at center screen in NR3 format.
:FFT:RANGe <range> (see page 260)	:FFT:RANGe? (see page 260)	<range> ::= the full-scale vertical axis value in NR3 format.
:FFT:REFerence <level> (see page 261)	:FFT:REFerence? (see page 261)	<level> ::= the current reference level in NR3 format.
:FFT:SCALe <scale value>[<suffix>] (see page 262)	:FFT:SCALe? (see page 262)	<scale_value> ::= integer in NR1 format. <suffix> ::= dB

:FFT:SOURce1 <source> (see page 263)	:FFT:SOURce1? (see page 263)	<source> ::= {CHANnel<n> | FUNCtion<c> | MATH<c>}
		<n> ::= 1 to (# analog channels) in NR1 format.
		<c> ::= {1 | 2}

:FFT:SPAN <span> (see page 264)	:FFT:SPAN? (see page 264)	<span> ::= the current frequency span in NR3 format. Legal values are 1 Hz to 100 GHz.

Table 58 :FFT Commands Summary (continued)

Command	Query	Options and Query Returns
`:FFT:VTYPe <units>` (see page 265)	`:FFT:VTYPe?` (see page 265)	`<units> ::= {DECibel | VRMS}`
`:FFT:WINDow <window>` (see page 266)	`:FFT:WINDow?` (see page 266)	`<window> ::= {RECTangular | HANNing | FLATtop | BHARris}`

Introduction to :FFT Commands

The FFT subsystem controls the FFT function in the oscilloscope.

Reporting the Setup

Use :FFT? to query setup information for the FFT subsystem.

Return Format

The following is a sample response from the :FFT? query. In this case, the query was issued following a *RST command.

```
:FFT:DISP 0;SOUR1 CHAN1;RANG +160E+00;OFFS -60.0000E+00;SPAN
+100.0000E+03;CENT +50.000000E+03;WIND HANN;VTYP DEC;DMODE
NORM;AVER:COUN 8
```

:FFT:CENTer

N (see page 776)

Command Syntax

```
:FFT:CENTer <frequency>

<frequency> ::= the current center frequency in NR3 format. The range
                of legal values is from -25 GHz to 25 GHz.
```

The :FFT:CENTer command sets the center frequency when FFT (Fast Fourier Transform) is selected.

Query Syntax

```
:FFT:CENTer?
```

The :FFT:CENTer? query returns the current center frequency in Hertz.

Return Format

```
<frequency><NL>

<frequency> ::= the current center frequency in NR3 format. The range
                of legal values is from -25 GHz to 25 GHz.
```

NOTE After a *RST (Reset) or :AUToscale command, the values returned by the :FFT:CENTer? and :FFT:SPAN? queries depend on the current :TIMebase:RANGe value. Once you change either the :FFT:CENTer or :FFT:SPAN value, they no longer track the :TIMebase:RANGe value.

See Also

- ":FFT:DISPlay" on page 258
- ":FFT:OFFSet" on page 259
- ":FFT:RANGe" on page 260
- ":FFT:REFerence" on page 261
- ":FFT:SCALe" on page 262
- ":FFT:SOURce1" on page 263
- ":FFT:SPAN" on page 264
- ":FFT:VTYPe" on page 265
- ":FFT:WINDow" on page 266

:FFT:DISPlay

N (see page 776)

Command Syntax

```
:FFT:DISPlay {{0 | OFF} | {1 | ON}}
```

The :FFT:DISPlay command turns the display of the FFT function on or off.

When ON is selected, the FFT function is calculated and displayed.

When OFF is selected, the FFT function is neither calculated nor displayed.

Query Syntax

```
:FFT:DISPlay?
```

The :FFT:DISPlay? query returns whether the function display is on or off.

Return Format

```
<display><NL>

<display> ::= {0 | 1}
```

See Also

- ":FFT:CENTer" on page 257
- ":FFT:OFFSet" on page 259
- ":FFT:RANGe" on page 260
- ":FFT:REFerence" on page 261
- ":FFT:SCALe" on page 262
- ":FFT:SOURce1" on page 263
- ":FFT:SPAN" on page 264
- ":FFT:VTYPe" on page 265
- ":FFT:WINDow" on page 266

:FFT:OFFSet

N (see page 776)

Command Syntax

```
:FFT:OFFSet <offset>
```

```
<offset> ::= the value at center screen in NR3 format.
```

The :FFT:OFFSet command specifies the FFT vertical value represented at center screen.

If you set the offset to a value outside of the legal range, the offset value is automatically set to the nearest legal value.

NOTE **The :FFT:OFFSet command is equivalent to the :FFT:REFerence command.**

Query Syntax

```
:FFT:OFFSet?
```

The :FFT:OFFSet? query returns the current offset value for the FFT function.

Return Format

```
<offset><NL>
```

```
<offset> ::= the value at center screen in NR3 format.
```

See Also

- ":FFT:CENTer" on page 257
- ":FFT:DISPlay" on page 258
- ":FFT:RANGe" on page 260
- ":FFT:REFerence" on page 261
- ":FFT:SCALe" on page 262
- ":FFT:SOURce1" on page 263
- ":FFT:SPAN" on page 264
- ":FFT:VTYPe" on page 265
- ":FFT:WINDow" on page 266

:FFT:RANGe

N (see page 776)

Command Syntax

```
:FFT:RANGe <range>
```

```
<range> ::= the full-scale vertical axis value in NR3 format.
```

The :FFT:RANGe command defines the full-scale vertical axis for the FFT function.

Query Syntax

```
:FFT:RANGe?
```

The :FFT:RANGe? query returns the current full-scale range value for the FFT function.

Return Format

```
<range><NL>
```

```
<range> ::= the full-scale vertical axis value in NR3 format.
```

See Also

- ":FFT:CENTer" on page 257
- ":FFT:DISPlay" on page 258
- ":FFT:OFFSet" on page 259
- ":FFT:REFerence" on page 261
- ":FFT:SCALe" on page 262
- ":FFT:SOURce1" on page 263
- ":FFT:SPAN" on page 264
- ":FFT:VTYPe" on page 265
- ":FFT:WINDow" on page 266

:FFT:REFerence

N (see page 776)

Command Syntax

```
:FFT:REFerence <level>
```

```
<level> ::= the current reference level in NR3 format.
```

The :FFT:REFerence command specifies the FFT vertical value represented at center screen.

If you set the reference level to a value outside of the legal range, the level is automatically set to the nearest legal value.

NOTE **The :FFT:REFerence command is equivalent to the :FFT:OFFSet command.**

Query Syntax

```
:FFT:REFerence?
```

The :FFT:REFerence? query returns the current reference level value for the FFT function.

Return Format

```
<level><NL>
```

```
<level> ::= the current reference level in NR3 format.
```

See Also

- ":FFT:CENTer" on page 257
- ":FFT:DISPlay" on page 258
- ":FFT:OFFSet" on page 259
- ":FFT:RANGe" on page 260
- ":FFT:SCALe" on page 262
- ":FFT:SOURce1" on page 263
- ":FFT:SPAN" on page 264
- ":FFT:VTYPe" on page 265
- ":FFT:WINDow" on page 266

:FFT:SCALe

N (see page 776)

Command Syntax

```
:FFT:SCALe <scale_value>[<suffix>]
```

```
<scale_value> ::= floating-point value in NR3 format.
```

```
<suffix> ::= dB
```

The :FFT:SCALe command sets the vertical scale, or units per division, of the FFT function. Legal values for the scale depend on the selected function.

Query Syntax

```
:FFT:SCALe?
```

The :FFT:SCALe? query returns the current scale value for the FFT function.

Return Format

```
<scale_value><NL>
```

```
<scale_value> ::= floating-point value in NR3 format.
```

See Also

- ":FFT:CENTer" on page 257
- ":FFT:DISPlay" on page 258
- ":FFT:OFFSet" on page 259
- ":FFT:RANGe" on page 260
- ":FFT:REFerence" on page 261
- ":FFT:SOURce1" on page 263
- ":FFT:SPAN" on page 264
- ":FFT:VTYPe" on page 265
- ":FFT:WINDow" on page 266

:FFT:SOURce1

N (see page 776)

Command Syntax

```
:FFT:SOURce1 <offset>

<source> ::= {CHANnel<n>}

<n> ::= 1 to (# analog channels) in NR1 format.
```

The :FFT:SOURce1 command selects the source for the FFT function.

NOTE **Another shorthand notation for SOURce1 in this command/query (besides SOUR1) is SOUR.**

Query Syntax

```
:FFT:SOURce1?
```

The :FFT:SOURce1? query returns the current source1 for the FFT function.

Return Format

```
<source><NL>

<source> ::= {CHAN<n>}
```

See Also

- ":FFT:CENTer" on page 257
- ":FFT:DISPlay" on page 258
- ":FFT:OFFSet" on page 259
- ":FFT:RANGe" on page 260
- ":FFT:REFerence" on page 261
- ":FFT:SCALe" on page 262
- ":FFT:SPAN" on page 264
- ":FFT:VTYPe" on page 265
- ":FFT:WINDow" on page 266

:FFT:SPAN

N (see page 776)

Command Syntax

```
:FFT:SPAN <span>
```

```
<span> ::= the current frequency span in NR3 format. Legal values are
           1 Hz to 100 GHz.
```

```
If you set the frequency span to a value outside of the legal range, the
step size is automatically set to the nearest legal value.
```

The :FFT:SPAN command sets the frequency span of the display (left graticule to right graticule) when FFT (Fast Fourier Transform) is selected.

Query Syntax

```
:FFT:SPAN?
```

The :FFT:SPAN? query returns the current frequency span in Hertz.

NOTE After a *RST (Reset) or :AUToscale command, the values returned by the :FFT:CENTer? and :FFT:SPAN? queries depend on the current :TIMebase:RANGe value. Once you change either the :FFT:CENTer or :FFT:SPAN value, they no longer track the :TIMebase:RANGe value.

Return Format

```
<span><NL>
```

```
<span> ::= the current frequency span in NR3 format. Legal values are 1
Hz to 100 GHz.
```

See Also

- ":FFT:CENTer" on page 257
- ":FFT:DISPlay" on page 258
- ":FFT:OFFSet" on page 259
- ":FFT:RANGe" on page 260
- ":FFT:REFerence" on page 261
- ":FFT:SCALe" on page 262
- ":FFT:SOURce1" on page 263
- ":FFT:VTYPe" on page 265
- ":FFT:WINDow" on page 266

:FFT:VTYPe

N (see page 776)

Command Syntax

```
:FFT:VTYPe <units>
```

```
<units> ::= {DECibel | VRMS}
```

The :FFT:VTYPe command specifies FFT vertical units as DECibel or VRMS.

Query Syntax

```
:FFT:VTYPe?
```

The :FFT:VTYPe? query returns the current FFT vertical units.

Return Format

```
<units><NL>
```

```
<units> ::= {DEC | VRMS}
```

See Also

- ":FFT:CENTer" on page 257
- ":FFT:DISPlay" on page 258
- ":FFT:OFFSet" on page 259
- ":FFT:RANGe" on page 260
- ":FFT:REFerence" on page 261
- ":FFT:SCALe" on page 262
- ":FFT:SOURce1" on page 263
- ":FFT:SPAN" on page 264
- ":FFT:WINDow" on page 266

:FFT:WINDow

N (see page 776)

Command Syntax

```
:FFT:WINDow <window>
```

```
<window> ::= {RECTangular | HANNing | FLATtop | BHARris}
```

The :FFT:WINDow command allows the selection of four different windowing transforms or operations for the FFT (Fast Fourier Transform) function.

The FFT operation assumes that the time record repeats. Unless an integral number of sampled waveform cycles exist in the record, a discontinuity is created between the end of one record and the beginning of the next. This discontinuity introduces additional frequency components about the peaks into the spectrum. This is referred to as leakage. To minimize leakage, windows that approach zero smoothly at the start and end of the record are employed as filters to the FFTs. Each window is useful for certain classes of input signals.

- RECTangular — useful for transient signals, and signals where there are an integral number of cycles in the time record.
- HANNing — useful for frequency resolution and general purpose use. It is good for resolving two frequencies that are close together, or for making frequency measurements. This is the default window.
- FLATtop — best for making accurate amplitude measurements of frequency peaks.
- BHARris (Blackman-Harris) — reduces time resolution compared to the rectangular window, but it improves the capacity to detect smaller impulses due to lower secondary lobes (provides minimal spectral leakage).

Query Syntax

```
:FFT:WINDow?
```

The :FFT:WINDow? query returns the value of the window selected for the FFT function.

Return Format

```
<window><NL>
```

```
<window> ::= {RECT | HANN | FLAT | BHAR}
```

See Also

- ":FFT:CENTer" on page 257
- ":FFT:DISPlay" on page 258
- ":FFT:OFFSet" on page 259
- ":FFT:RANGe" on page 260
- ":FFT:REFerence" on page 261
- ":FFT:SCALe" on page 262
- ":FFT:SOURce1" on page 263
- ":FFT:SPAN" on page 264

- ":FFT:VTYPe" on page 265

16 :FRANalysis Commands

Control oscilloscope functions associated with the Frequency Response Analysis (FRA) feature, which is available in G-suffix oscilloscope models (that have a built-in waveform generator). See "Introduction to :FRANalysis Commands" on page 270.

Table 59 :FFT Commands Summary

Command	Query	Options and Query Returns
n/a	:FRANalysis:DATA? (see page 271)	<binary_block> ::= comma-separated data with newlines at the end of each row
:FRANalysis:ENABle {{0 | OFF} | {1 | ON}} (see page 272)	:FRANalysis:ENABle? (see page 272)	{0 | 1}

:FRANalysis:FREQuency:STARt <value>[suffix] (see page 273)	:FRANalysis:FREQuency:STARt? (see page 273)	<value> ::= {20 | 100 | 1000 | 10000 | 100000 | 1000000 | 10000000}
		[suffix] ::= {Hz | kHz| MHz}

:FRANalysis:FREQuency:STOP <value>[suffix] (see page 274)	:FRANalysis:FREQuency:STOP? (see page 274)	<value> ::= {100 | 1000 | 10000 | 100000 | 1000000 | 10000000 | 20000000}
		[suffix] ::= {Hz | kHz| MHz}

:FRANalysis:RUN (see page 275)	n/a	n/a
:FRANalysis:SOURce:INPut <source> (see page 276)	:FRANalysis:SOURce:INPut? (see page 276)	<source> ::= CHANnel<n> <n> ::= 1 to (# analog channels) in NR1 format
:FRANalysis:SOURce:OUTPut <source> (see page 277)	:FRANalysis:SOURce:OUTPut? (see page 277)	<source> ::= CHANnel<n> <n> ::= 1 to (# analog channels) in NR1 format

Table 59 :FFT Commands Summary (continued)

Command	Query	Options and Query Returns
:FRANalysis:WGEN:LOAD <impedance> (see page 278)	:FRANalysis:WGEN:LOAD? (see page 278)	<impedance> ::= {ONEMeg | FIFTy}
:FRANalysis:WGEN:VOLTage <amplitude> (see page 279)	:FRANalysis:WGEN:VOLTage? (see page 279)	<amplitude> ::= amplitude in volts in NR3 format

Introduction to :FRANalysis Commands

The FRANalysis subsystem controls the Frequency Response Analysis feature in the oscilloscope.

The Frequency Response Analysis (FRA) feature controls the built-in waveform generator to sweep a sine wave across a range of frequencies while measuring the input to and output from a device under test (DUT). At each frequency, gain (A) and phase are measured and plotted on a frequency response chart.

Reporting the Setup

Use :FRANalysis? to query setup information for the FRANalysis subsystem.

Return Format

The following is a sample response from the :FRANalysis? query. In this case, the query was issued following a *RST command.

```
:FRAN:SOUR:INP CHAN1;OUTP CHAN2;:FRAN:FREQ:STAR +100E+00;
STOP +20.000000E+06;:FRAN:WGEN:VOLT +200.0E-03;LOAD FIFT
```

:FRANalysis:DATA

N (see page 776)

Query Syntax

```
:FRANalysis:DATA?
```

The :FRANalysis:DATA? query returns the frequency response analysis data.

The data is returned in four comma-separated columns of data for each step in the sweep: Frequency (Hz), Amplitude (Vpp), Gain (dB), and Phase (°).

Return Format

```
<binary_block><NL>

<binary_block> ::= comma-separated data with newlines at the end of each
 row
```

See Also

- ":FRANalysis:ENABle" on page 272
- ":FRANalysis:FREQuency:STARt" on page 273
- ":FRANalysis:FREQuency:STOP" on page 274
- ":FRANalysis:RUN" on page 275
- ":FRANalysis:SOURce:INPut" on page 276
- ":FRANalysis:SOURce:OUTPut" on page 277
- ":FRANalysis:WGEN:LOAD" on page 278
- ":FRANalysis:WGEN:VOLTage" on page 279

:FRANalysis:ENABle

N (see page 776)

Command Syntax

```
:FRANalysis:ENABle <setting>
```

```
<setting> ::= {{0 | OFF} | {1 | ON}}
```

The :FRANalysis:ENABle command turns the Frequency Response Analysis (FRA) feature on or off.

Query Syntax

```
:FRANalysis:ENABle?
```

The :FRANalysis:ENABle? query returns a flag indicating whether the Frequency Response Analysis (FRA) feature is on or off.

Return Format

```
<setting><NL>
```

```
<setting> ::= {0 | 1}
```

See Also

- ":FRANalysis:DATA" on page 271
- ":FRANalysis:FREQuency:STARt" on page 273
- ":FRANalysis:FREQuency:STOP" on page 274
- ":FRANalysis:RUN" on page 275
- ":FRANalysis:SOURce:INPut" on page 276
- ":FRANalysis:SOURce:OUTPut" on page 277
- ":FRANalysis:WGEN:LOAD" on page 278
- ":FRANalysis:WGEN:VOLTage" on page 279

:FRANalysis:FREQuency:STARt

N (see page 776)

Command Syntax

```
:FRANalysis:FREQuency:STARt <value>[suffix]
```

```
<value> ::= {20 | 100 | 1000 | 10000 | 100000 | 1000000 | 10000000}
```

```
[suffix] ::= {Hz | kHz| MHz}
```

The :FRANalysis:FREQuency:STARt command command sets the frequency sweep start value. The frequency response analysis is displayed on a log scale Bode plot, so you can select from decade values in addition to the minimum frequency of 20 Hz.

Query Syntax

```
:FRANalysis:FREQuency:STARt?
```

The :FRANalysis:FREQuency:STARt? query returns the frequency sweep start setting.

Return Format

```
<value><NL>
```

```
<value> ::= {20 | 100 | 1000 | 10000 | 100000 | 1000000 | 10000000}
```

See Also

- ":FRANalysis:DATA" on page 271
- ":FRANalysis:ENABle" on page 272
- ":FRANalysis:FREQuency:STOP" on page 274
- ":FRANalysis:RUN" on page 275
- ":FRANalysis:SOURce:INPut" on page 276
- ":FRANalysis:SOURce:OUTPut" on page 277
- ":FRANalysis:WGEN:LOAD" on page 278
- ":FRANalysis:WGEN:VOLTage" on page 279

:FRANalysis:FREQuency:STOP

N (see page 776)

Command Syntax

```
:FRANalysis:FREQuency:STOP <value>[suffix]
```

```
<value> ::= {100 | 1000 | 10000 | 100000 | 1000000 | 10000000 | 20000000
}
```

```
[suffix] ::= {Hz | kHz| MHz}
```

The :FRANalysis:FREQuency:STOP command sets the frequency sweep stop value. The frequency response analysis is displayed on a log scale Bode plot, so you can select from decade values in addition to the maximum frequency of 20 MHz.

Query Syntax

```
:FRANalysis:FREQuency:STOP?
```

The :FRANalysis:FREQuency:STOP? query returns the frequency sweep stop setting.

Return Format

```
<value><NL>
```

```
<value> ::= {100 | 1000 | 10000 | 100000 | 1000000 | 10000000 | 20000000
}
```

See Also

- ":FRANalysis:DATA" on page 271
- ":FRANalysis:ENABle" on page 272
- ":FRANalysis:FREQuency:STARt" on page 273
- ":FRANalysis:RUN" on page 275
- ":FRANalysis:SOURce:INPut" on page 276
- ":FRANalysis:SOURce:OUTPut" on page 277
- ":FRANalysis:WGEN:LOAD" on page 278
- ":FRANalysis:WGEN:VOLTage" on page 279

:FRANalysis:RUN

N (see page 776)

Command Syntax

```
:FRANalysis:RUN
```

The :FRANalysis:RUN command performs the Frequency Response Analysis. This analysis controls the built-in waveform generator to sweep a sine wave across a range of frequencies while measuring the input to and output from a device under test (DUT). At each frequency, gain (A) and phase are measured and plotted on a Bode frequency response chart.

The :FRANalysis:APPLy command is a valid compatible alias for the :FRANalysis:RUN command.

When the frequency response analysis completes, you can use the :FRANalysis:DATA? query to get four comma-separated columns of data for each step in the sweep: Frequency (Hz), Amplitude (Vpp), Gain (dB), and Phase (°).

It takes some time for the frequency sweep analysis to complete. You can query bit 0 of the Standard Event Status Register (*ESR?) to find out when the analysis is complete.

See Also

- ":FRANalysis:DATA" on page 271
- ":FRANalysis:ENABle" on page 272
- ":FRANalysis:FREQuency:STARt" on page 273
- ":FRANalysis:FREQuency:STOP" on page 274
- ":FRANalysis:SOURce:INPut" on page 276
- ":FRANalysis:SOURce:OUTPut" on page 277
- ":FRANalysis:WGEN:LOAD" on page 278
- ":FRANalysis:WGEN:VOLTage" on page 279
- "*ESR (Standard Event Status Register)" on page 112

:FRANalysis:SOURce:INPut

N (see page 776)

Command Syntax

```
:FRANalysis:SOURce:INPut <source>
```

```
<source> ::= CHANnel<n>
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :FRANalysis:SOURce:INPut command specifies the analog input channel that is probing the input voltage to the device under test (DUT) in the frequency response analysis.

Query Syntax

```
:FRANalysis:SOURce:INPut?
```

The :FRANalysis:SOURce:INPut? query returns the currently selected channel probing the input voltage.

Return Format

```
<source><NL>
```

```
<source> ::= CHAN<n>
```

See Also

- ":FRANalysis:DATA" on page 271
- ":FRANalysis:ENABle" on page 272
- ":FRANalysis:FREQuency:STARt" on page 273
- ":FRANalysis:FREQuency:STOP" on page 274
- ":FRANalysis:RUN" on page 275
- ":FRANalysis:SOURce:OUTPut" on page 277
- ":FRANalysis:WGEN:LOAD" on page 278
- ":FRANalysis:WGEN:VOLTage" on page 279

:FRANalysis:SOURce:OUTPut

N (see page 776)

Command Syntax

```
:FRANalysis:SOURce:OUTPut <source>

<source> ::= CHANnel<n>

<n> ::= 1 to (# analog channels) in NR1 format
```

The :FRANalysis:SOURce:OUTPut command specifies the analog input channel that is probing the output voltage from the device under test (DUT) in the frequency response analysis.

Query Syntax

```
:FRANalysis:SOURce:OUTPut?
```

The :FRANalysis:SOURce:OUTPut? query returns the currently selected channel probing the output voltage.

Return Format

```
<source><NL>

<source> ::= CHAN<n>
```

See Also

- ":FRANalysis:DATA" on page 271
- ":FRANalysis:ENABle" on page 272
- ":FRANalysis:FREQuency:STARt" on page 273
- ":FRANalysis:FREQuency:STOP" on page 274
- ":FRANalysis:RUN" on page 275
- ":FRANalysis:SOURce:INPut" on page 276
- ":FRANalysis:WGEN:LOAD" on page 278
- ":FRANalysis:WGEN:VOLTage" on page 279

:FRANalysis:WGEN:LOAD

N (see page 776)

Command Syntax

```
:FRANalysis:WGEN:LOAD <impedance>
```

```
<impedance> ::= {ONEMeg | FIFTy}
```

The :FRANalysis:WGEN:LOAD command selects the expected output load impedance.

The output impedance of the Gen Out BNC is fixed at 50 ohms. However, the output load selection lets the waveform generator display the correct amplitude and offset levels for the expected output load.

If the actual load impedance is different than the selected value, the displayed amplitude and offset levels will be incorrect.

Query Syntax

```
:FRANalysis:WGEN:LOAD?
```

The :FRANalysis:WGEN:LOAD? query returns the current expected output load impedance.

Return Format

```
<impedance><NL>
```

```
<impedance> ::= {ONEM | FIFT}
```

See Also

- ":FRANalysis:DATA" on page 271
- ":FRANalysis:ENABle" on page 272
- ":FRANalysis:FREQuency:STARt" on page 273
- ":FRANalysis:FREQuency:STOP" on page 274
- ":FRANalysis:RUN" on page 275
- ":FRANalysis:SOURce:INPut" on page 276
- ":FRANalysis:SOURce:OUTPut" on page 277
- ":FRANalysis:WGEN:VOLTage" on page 279

:FRANalysis:WGEN:VOLTage

N (see page 776)

Command Syntax

```
:FRANalysis:WGEN:VOLTage <amplitude>
```

```
<amplitude> ::= amplitude in volts in NR3 format
```

The :FRANalysis:WGEN:VOLTage command specifies the waveform generator's output sine wave amplitude.

Use the :WGEN:VOLTage:OFFSet command to specify the offset voltage or DC level.

You can also specify the amplitude and offset indirectly using the :WGEN:VOLTage:HIGH and :WGEN:VOLTage:LOW commands. For example, an amplitude of 5 V and an offset of 1 V is the same as a high-level voltage of 4 V and a low-level voltage of -1 V.

Query Syntax

```
:FRANalysis:WGEN:VOLTage?
```

The :FRANalysis:WGEN:VOLTage? query returns the currently specified waveform generator amplitude.

Return Format

```
<amplitude><NL>
```

```
<amplitude> ::= amplitude in volts in NR3 format
```

See Also

- ":FRANalysis:DATA" on page 271
- ":FRANalysis:ENABle" on page 272
- ":FRANalysis:FREQuency:STARt" on page 273
- ":FRANalysis:FREQuency:STOP" on page 274
- ":FRANalysis:RUN" on page 275
- ":FRANalysis:SOURce:INPut" on page 276
- ":FRANalysis:SOURce:OUTPut" on page 277
- ":FRANalysis:WGEN:LOAD" on page 278

17 :FUNCtion Commands

Control functions in the measurement/storage module. See "Introduction to :FUNCtion Commands" on page 283.

Table 60 :FUNCtion Commands Summary

Command	Query	Options and Query Returns
`:FUNCtion:DISPlay {{0 | OFF} | {1 | ON}}` (see page 284)	`:FUNCtion:DISPlay?` (see page 284)	`{0 | 1}`
`:FUNCtion[:FFT]:CENTer <frequency>` (see page 285)	`:FUNCtion[:FFT]:CENTer?` (see page 285)	`<frequency> ::= the current center frequency in NR3 format. The range of legal values is from 0 Hz to 25 GHz.`
`:FUNCtion[:FFT]:PHASe:REFerence <ref_point>` (see page 286)	`:FUNCtion[:FFT]:PHASe:REFerence?` (see page 286)	`<ref_point> ::= {TRIGger | DISPlay}`
`:FUNCtion[:FFT]:SPAN <span>` (see page 287)	`:FUNCtion[:FFT]:SPAN?` (see page 287)	`<span> ::= the current frequency span in NR3 format.` `Legal values are 1 Hz to 100 GHz.`
`:FUNCtion[:FFT]:VTYPe <units>` (see page 288)	`:FUNCtion[:FFT]:VTYPe?` (see page 288)	`<units> ::= {DECibel | VRMS} for the FFT (magnitude) operation` `<units> ::= {DEGRees | RADians} for the FFTPhase operation`
`:FUNCtion[:FFT]:WINDow <window>` (see page 289)	`:FUNCtion[:FFT]:WINDow?` (see page 289)	`<window> ::= {RECTangular | HANNing | FLATtop | BHARris}`
`:FUNCtion:FREQuency:LOWPass <3dB_freq>` (see page 290)	`:FUNCtion:FREQuency:LOWPass?` (see page 290)	`<3dB_freq> ::= 3dB cutoff frequency value in NR3 format`
`:FUNCtion:GOFT:OPERation <operation>` (see page 291)	`:FUNCtion:GOFT:OPERation?` (see page 291)	`<operation> ::= {ADD | SUBTract | MULTiply}`

Table 60 :FUNCtion Commands Summary (continued)

Command	Query	Options and Query Returns
:FUNCtion:GOFT:SOURce1 <source> (see page 292)	:FUNCtion:GOFT:SOURce1? (see page 292)	<source> ::= CHANnel<n> <n> ::= 1 to (# analog channels) in NR1 format
:FUNCtion:GOFT:SOURce2 <source> (see page 293)	:FUNCtion:GOFT:SOURce2? (see page 293)	<source> ::= CHANnel<n> <n> ::= 1 to (# analog channels) in NR1 format
:FUNCtion:OFFSet <offset> (see page 294)	:FUNCtion:OFFSet? (see page 294)	<offset> ::= the value at center screen in NR3 format. The range of legal values is +/-10 times the current sensitivity of the selected function.
:FUNCtion:OPERation <operation> (see page 295)	:FUNCtion:OPERation? (see page 295)	<operation> ::= {ADD | SUBTract | MULTiply | DIVide | FFT | FFTPhase | LOWPass}
:FUNCtion:RANGe <range> (see page 297)	:FUNCtion:RANGe? (see page 297)	<range> ::= the full-scale vertical axis value in NR3 format. The range for ADD, SUBT, MULT is 8E-6 to 800E+3. The range for the FFT function is 8 to 800 dBV.
:FUNCtion:REFerence <level> (see page 298)	:FUNCtion:REFerence? (see page 298)	<level> ::= the value at center screen in NR3 format. The range of legal values is +/-10 times the current sensitivity of the selected function.
:FUNCtion:SCALe <scale value>[<suffix>] (see page 299)	:FUNCtion:SCALe? (see page 299)	<scale value> ::= integer in NR1 format <suffix> ::= {V | dB}
:FUNCtion:SOURce1 <source> (see page 300)	:FUNCtion:SOURce1? (see page 300)	<source> ::= {CHANnel<n> | GOFT} <n> ::= 1 to (# analog channels) in NR1 format GOFT is only for FFT operation.
:FUNCtion:SOURce2 <source> (see page 301)	:FUNCtion:SOURce2? (see page 301)	<source> ::= {CHANnel<n> | NONE} <n> ::= 1 to (# analog channels) in NR1 format, depending on SOURce1 selection

Introduction to :FUNCtion Commands

The FUNCtion subsystem controls the math functions in the oscilloscope. Add, subtract, multiply, and FFT (Fast Fourier Transform) operations are available. These math operations only use the analog (vertical) channels.

The SOURce1, DISPlay, RANGe, and OFFSet commands apply to any function.

The SPAN, CENTer, VTYPe, and WINDow commands are only useful for FFT functions. When FFT is selected, the horizontal cursors change from time to frequency (Hz), and the vertical cursors change from volts to decibel (dB).

Reporting the Setup

Use :FUNCtion? to query setup information for the FUNCtion subsystem.

Return Format

The following is a sample response from the :FUNCtion? queries. In this case, the query was issued following a *RST command.

```
:FUNC:OPER ADD;DISP 0;SOUR1 CHAN1;SOUR2 CHAN2;RANG +8.00E+00;OFFS
+0.0E+00;:FUNC:GOFT:OPER ADD;SOUR1 CHAN1;SOUR2 CHAN2
```

:FUNCtion:DISPlay

N (see page 776)

Command Syntax

```
:FUNCtion:DISPlay <display>
```

```
<display> ::= {{1 | ON} | {0 | OFF}}
```

The :FUNCtion:DISPlay command turns the display of the function on or off. When ON is selected, the function performs as specified using the other FUNCtion commands. When OFF is selected, function is neither calculated nor displayed.

Query Syntax

```
:FUNCtion:DISPlay?
```

The :FUNCtion:DISPlay? query returns whether the function display is on or off.

Return Format

```
<display><NL>
```

```
<display> ::= {1 | 0}
```

See Also

- "Introduction to :FUNCtion Commands" on page 283
- ":VIEW" on page 162
- ":BLANk" on page 140
- ":STATus" on page 159

:FUNCtion[:FFT]:CENTer

N (see page 776)

Command Syntax

```
:FUNCtion[:FFT]:CENTer <frequency>

<frequency> ::= the current center frequency in NR3 format.  The range
                of legal values is from 0 Hz to 25 GHz.
```

The :FUNCtion[:FFT]:CENTer command sets the center frequency when FFT (Fast Fourier Transform) is selected.

Query Syntax

```
:FUNCtion[:FFT]:CENTer?
```

The :FUNCtion[:FFT]:CENTer? query returns the current center frequency in Hertz.

Return Format

```
<frequency><NL>

<frequency> ::= the current center frequency in NR3 format.  The range
                of legal values is from 0 Hz to 25 GHz.
```

NOTE After a *RST (Reset) or :AUToscale command, the values returned by the :FUNCtion[:FFT]:CENTer? and :FUNCtion:SPAN? queries depend on the current :TIMebase:RANGe value. Once you change either the :FUNCtion[:FFT]:CENTer or :FUNCtion:SPAN value, they no longer track the :TIMebase:RANGe value.

See Also

- "Introduction to :FUNCtion Commands" on page 283
- ":FUNCtion[:FFT]:SPAN" on page 287
- ":TIMebase:RANGe" on page 557
- ":TIMebase:SCALe" on page 559

:FUNCtion[:FFT]:PHASe:REFerence

N (see page 776)

Command Syntax

```
:FUNCtion[:FFT]:PHASe:REFerence <ref_point>
```

```
<ref_point> ::= {TRIGger | DISPlay}
```

The :FUNCtion[:FFT]:PHASe:REFerence command sets the reference point for calculating the FFT Phase function to either the trigger point or beginning of the displayed waveform.

Query Syntax

```
:FUNCtion[:FFT]:PHASe:REFerence?
```

The :FUNCtion[:FFT]:PHASe:REFerence? query returns the selected reference point.

Return Format

```
<ref_point><NL>
```

```
<ref_point> ::= {TRIGger | DISPlay}
```

See Also

- ":FUNCtion:OPERation" on page 295
- "Introduction to :FUNCtion Commands" on page 283

:FUNCtion[:FFT]:SPAN

N (see page 776)

Command Syntax

```
:FUNCtion[:FFT]:SPAN <span>

<span> ::= the current frequency span in NR3 format. Legal values are
           1 Hz to 100 GHz.

If you set the frequency span to a value outside of the legal range, the
step size is automatically set to the nearest legal value.
```

The :FUNCtion[:FFT]:SPAN command sets the frequency span of the display (left graticule to right graticule) when FFT (Fast Fourier Transform) is selected.

Query Syntax

```
:FUNCtion[:FFT]:SPAN?
```

The :FUNCtion[:FFT]:SPAN? query returns the current frequency span in Hertz.

NOTE After a *RST (Reset) or :AUToscale command, the values returned by the :FUNCtion[:FFT]:CENTer? and :FUNCtion:SPAN? queries depend on the current :TIMebase:RANGe value. Once you change either the :FUNCtion[:FFT]:CENTer or :FUNCtion:SPAN value, they no longer track the :TIMebase:RANGe value.

Return Format

```
<span><NL>

<span> ::= the current frequency span in NR3 format. Legal values are 1
Hz to 100 GHz.
```

See Also

- "Introduction to :FUNCtion Commands" on page 283
- ":FUNCtion[:FFT]:CENTer" on page 285
- ":TIMebase:RANGe" on page 557
- ":TIMebase:SCALe" on page 559

:FUNCtion[:FFT]:VTYPe

N (see page 776)

Command Syntax

```
:FUNCtion[:FFT]:VTYPe <units>

<units> ::= {DECibel | VRMS} for the FFT (magnitude) operation

<units> ::= {DEGRees | RADians} for the FFTPhase operation
```

The :FUNCtion[:FFT]:VTYPe command specifies FFT vertical units.

Query Syntax

```
:FUNCtion[:FFT]:VTYPe?
```

The :FUNCtion[:FFT]:VTYPe? query returns the current FFT vertical units.

Return Format

```
<units><NL>

<units> ::= {DEC | VRMS} for the FFT (magnitude) operation

<units> ::= {DEGR | RAD} for the FFTPhase operation
```

See Also

- "Introduction to :FUNCtion Commands" on page 283
- ":FUNCtion:OPERation" on page 295

:FUNCtion[:FFT]:WINDow

N (see page 776)

Command Syntax

```
:FUNCtion[:FFT]:WINDow <window>
```

```
<window> ::= {RECTangular | HANNing | FLATtop | BHARris}
```

The :FUNCtion[:FFT]:WINDow command allows the selection of four different windowing transforms or operations for the FFT (Fast Fourier Transform) function.

The FFT operation assumes that the time record repeats. Unless an integral number of sampled waveform cycles exist in the record, a discontinuity is created between the end of one record and the beginning of the next. This discontinuity introduces additional frequency components about the peaks into the spectrum. This is referred to as leakage. To minimize leakage, windows that approach zero smoothly at the start and end of the record are employed as filters to the FFTs. Each window is useful for certain classes of input signals.

- RECTangular — useful for transient signals, and signals where there are an integral number of cycles in the time record.
- HANNing — useful for frequency resolution and general purpose use. It is good for resolving two frequencies that are close together, or for making frequency measurements. This is the default window.
- FLATtop — best for making accurate amplitude measurements of frequency peaks.
- BHARris (Blackman-Harris) — reduces time resolution compared to the rectangular window, but it improves the capacity to detect smaller impulses due to lower secondary lobes (provides minimal spectral leakage).

Query Syntax

```
:FUNCtion[:FFT]:WINDow?
```

The :FUNCtion[:FFT]:WINDow? query returns the value of the window selected for the FFT function.

Return Format

```
<window><NL>
```

```
<window> ::= {RECT | HANN | FLAT | BHAR}
```

See Also

- "Introduction to :FUNCtion Commands" on page 283

:FUNCtion:FREQuency:LOWPass

N (see page 776)

Command Syntax

```
:FUNCtion:FREQuency:LOWPass <3dB_freq>
```

```
<3dB_freq> ::= -3dB cutoff frequency value in NR3 format
```

The :FUNCtion:FREQuency:LOWPass command sets the low-pass filter's -3 dB cutoff frequency.

The low-pass filter is a 4th order Bessel-Thompson filter.

Query Syntax

```
:FUNCtion:FREQuency:LOWPass?
```

The :FUNCtion:FREQuency:LOWPass query returns the low-pass filter's cutoff frequency.

Return Format

```
<3dB_freq><NL>
```

```
<3dB_freq> ::= -3dB cutoff frequency value in NR3 format
```

See Also

- ":FUNCtion:OPERation" on page 295

:FUNCtion:GOFT:OPERation

N (see page 776)

Command Syntax

```
:FUNCtion:GOFT:OPERation <operation>
```

```
<operation> ::= {ADD | SUBTract | MULTiply}
```

The :FUNCtion:GOFT:OPERation command sets the math operation for the g(t) source that can be used as the input to the FFT function:

- ADD — Source1 + source2.
- SUBTract — Source1 - source2.
- MULTiply — Source1 * source2.

The :FUNCtion:GOFT:SOURce1 and :FUNCtion:GOFT:SOURce2 commands are used to select source1 and source2.

Query Syntax

```
:FUNCtion:GOFT:OPERation?
```

The :FUNCtion:GOFT:OPERation? query returns the current g(t) source operation setting.

Return Format

```
<operation><NL>
```

```
<operation> ::= {ADD | SUBT | MULT}
```

See Also

- "Introduction to :FUNCtion Commands" on page 283
- ":FUNCtion:GOFT:SOURce1" on page 292
- ":FUNCtion:GOFT:SOURce2" on page 293
- ":FUNCtion:SOURce1" on page 300

:FUNCtion:GOFT:SOURce1

N (see page 776)

Command Syntax

```
:FUNCtion:GOFT:SOURce1 <value>

<value> ::= CHANnel<n>

<n> ::= 1 to (# analog channels) in NR1 format
```

The :FUNCtion:GOFT:SOURce1 command selects the first input channel for the g(t) source that can be used as the input to the FFT function.

Query Syntax

```
:FUNCtion:GOFT:SOURce1?
```

The :FUNCtion:GOFT:SOURce1? query returns the current selection for the first input channel for the g(t) source.

Return Format

```
<value><NL>

<value> ::= CHAN<n>

<n> ::= 1 to (# analog channels) in NR1 format
```

See Also

- "Introduction to :FUNCtion Commands" on page 283
- ":FUNCtion:GOFT:SOURce2" on page 293
- ":FUNCtion:GOFT:OPERation" on page 291

:FUNCtion:GOFT:SOURce2

N (see page 776)

Command Syntax

```
:FUNCtion:GOFT:SOURce2 <value>

<value> ::= CHANnel<n>

<n> ::= 1 to (# analog channels) in NR1 format
```

The :FUNCtion:GOFT:SOURce2 command selects the second input channel for the g(t) source that can be used as the input to the FFT function.

Query Syntax

```
:FUNCtion:GOFT:SOURce2?
```

The :FUNCtion:GOFT:SOURce2? query returns the current selection for the second input channel for the g(t) source.

Return Format

```
<value><NL>

<value> ::= CHAN<n>

<n> ::= 1 to (# analog channels) in NR1 format
```

See Also

- "Introduction to :FUNCtion Commands" on page 283
- ":FUNCtion:GOFT:SOURce1" on page 292
- ":FUNCtion:GOFT:OPERation" on page 291

:FUNCtion:OFFSet

N (see page 776)

Command Syntax

```
:FUNCtion:OFFSet <offset>
```

```
<offset> ::= the value at center screen in NR3 format.
```

The :FUNCtion:OFFSet command sets the voltage or vertical value represented at center screen for the selected function. The range of legal values is generally +/-10 times the current scale of the selected function, but will vary by function. If you set the offset to a value outside of the legal range, the offset value is automatically set to the nearest legal value.

NOTE **The :FUNCtion:OFFset command is equivalent to the :FUNCtion:REFerence command.**

Query Syntax

```
:FUNCtion:OFFSet?
```

The :FUNCtion:OFFSet? query outputs the current offset value for the selected function.

Return Format

```
<offset><NL>
```

```
<offset> ::= the value at center screen in NR3 format.
```

See Also

- "Introduction to :FUNCtion Commands" on page 283
- ":FUNCtion:RANGe" on page 297
- ":FUNCtion:REFerence" on page 298
- ":FUNCtion:SCALe" on page 299

:FUNCtion:OPERation

N (see page 776)

Command Syntax

```
:FUNCtion:OPERation <operation>
```

```
<operation> ::= {ADD | SUBTract | MULTiply | DIVide | FFT
    | FFTPhase | LOWPass}
```

The :FUNCtion:OPERation command sets the desired waveform math operation:

- ADD — Source1 + source2.
- SUBTract — Source1 - source2.
- MULTiply — Source1 * source2.
- DIVide — Source1 / source2.
- FFT (magnitude) — Using the Fast Fourier Transform (FFT), this operation displays the magnitudes of the frequency content that makes up the source waveform. The FFT takes the digitized time record of the specified source and transforms it to the frequency domain.

  The SPAN, CENTer, VTYPe, and WINDow commands are used for FFT functions. When FFT is selected, the horizontal cursors change from time to frequency (Hz), and the vertical cursors change from volts to decibels or V RMS.
- FFTPhase — Using the Fast Fourier Transform (FFT), this operation shows the phase relationships of the frequency content that makes up the source waveform. The FFT takes the digitized time record of the specified source and transforms it to the frequency domain.

  The SPAN, CENTer, VTYPe, and WINDow commands are used for FFT functions. When FFTPhase is selected, the horizontal cursors change from time to frequency (Hz), and the vertical cursors change from volts to degrees or radians.
- LOWPass — Low pass filter — The FREQuency:LOWPass command sets the -3 dB cutoff frequency.

When the operation is ADD, SUBTract, MULTiply, or DIVide, the :FUNCtion:SOURce1 and :FUNCtion:SOURce2 commands are used to select source1 and source2. For FFT, the :FUNCtion:SOURce1 command selects the waveform source.

Query Syntax

```
:FUNCtion:OPERation?
```

The :FUNCtion:OPERation? query returns the current operation for the selected function.

Return Format

```
<operation><NL>
```

```
<operation> ::= {ADD | SUBT | MULT | DIV | FFT | FFTP | LOWP}
```

See Also

- "Introduction to :FUNCtion Commands" on page 283
- ":FUNCtion:SOURce1" on page 300
- ":FUNCtion:SOURce2" on page 301

:FUNCtion:RANGe

N (see page 776)

Command Syntax

```
:FUNCtion:RANGe <range>
```

```
<range> ::= the full-scale vertical axis value in NR3 format.
```

The :FUNCtion:RANGe command defines the full-scale vertical axis for the selected function.

Query Syntax

```
:FUNCtion:RANGe?
```

The :FUNCtion:RANGe? query returns the current full-scale range value for the selected function.

Return Format

```
<range><NL>
```

```
<range> ::= the full-scale vertical axis value in NR3 format.
```

See Also

- "Introduction to :FUNCtion Commands" on page 283
- ":FUNCtion:SCALe" on page 299

:FUNCtion:REFerence

N (see page 776)

Command Syntax

```
:FUNCtion:REFerence <level>
```

```
<level> ::= the current reference level in NR3 format.
```

The :FUNCtion:REFerence command sets the voltage or vertical value represented at center screen for the selected function. The range of legal values is generally +/-10 times the current scale of the selected function, but will vary by function. If you set the reference level to a value outside of the legal range, the level is automatically set to the nearest legal value.

NOTE The FUNCtion:REFerence command is equivalent to the :FUNCtion:OFFSet command.

Query Syntax

```
:FUNCtion:REFerence?
```

The :FUNCtion:REFerence? query outputs the current reference level value for the selected function.

Return Format

```
<level><NL>
```

```
<level> ::= the current reference level in NR3 format.
```

See Also

- "Introduction to :FUNCtion Commands" on page 283
- ":FUNCtion:OFFSet" on page 294
- ":FUNCtion:RANGe" on page 297
- ":FUNCtion:SCALe" on page 299

:FUNCtion:SCALe

N (see page 776)

Command Syntax

```
:FUNCtion:SCALe <scale value>[<suffix>]

<scale value> ::= integer in NR1 format

<suffix> ::= {V | dB}
```

The :FUNCtion:SCALe command sets the vertical scale, or units per division, of the selected function. Legal values for the scale depend on the selected function.

Query Syntax

```
:FUNCtion:SCALe?
```

The :FUNCtion:SCALe? query returns the current scale value for the selected function.

Return Format

```
<scale value><NL>

<scale value> ::= integer in NR1 format
```

See Also

- "Introduction to :FUNCtion Commands" on page 283
- ":FUNCtion:RANGe" on page 297

:FUNCtion:SOURce1

N (see page 776)

Command Syntax

```
:FUNCtion:SOURce1 <value>
```

```
<value> ::= {CHANnel<n> | GOFT}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :FUNCtion:SOURce1 command is used for any :FUNCtion:OPERation selection (including the ADD, SUBTract, or MULTiply channel math operations and the FFT transform). This command selects the first source for channel math operations or the single source for the transforms.

The GOFT parameter is only available for the FFT function. It lets you specify, as the function input source, the addition, subtraction, or multiplication of two channels. When GOFT is used, the g(t) source is specified by the :FUNCtion:GOFT:OPERation, :FUNCtion:GOFT:SOURce1, and :FUNCtion:GOFT:SOURce2 commands.

NOTE **Another shorthand notation for SOURce1 in this command/query (besides SOUR1) is SOUR.**

Query Syntax

```
:FUNCtion:SOURce1?
```

The :FUNCtion:SOURce1? query returns the current source1 for function operations.

Return Format

```
<value><NL>
```

```
<value> ::= {CHAN<n> | GOFT}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

See Also

- "Introduction to :FUNCtion Commands" on page 283
- ":FUNCtion:OPERation" on page 295
- ":FUNCtion:GOFT:OPERation" on page 291
- ":FUNCtion:GOFT:SOURce1" on page 292
- ":FUNCtion:GOFT:SOURce2" on page 293

:FUNCtion:SOURce2

N (see page 776)

Command Syntax

```
:FUNCtion:SOURce2 <value>
```

```
<value> ::= {CHANnel<n> | NONE}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :FUNCtion:SOURce2 command specifies the second source for math operations that have two sources (see the :FUNCtion:OPERation command), in other words, ADD, SUBTract, or MULTiply. (The :FUNCtion:SOURce1 command specifies the first source.)

If CHANnel1 or CHANnel2 is selected for :FUNCtion:SOURce1, the SOURce2 selection can be CHANnel1 or CHANnel2.

The :FUNCtion:SOURce2 setting is not used when the :FUNCtion:OPERation is FFT (Fast Fourier Transform).

Query Syntax

```
:FUNCtion:SOURce2?
```

The :FUNCtion:SOURce2? query returns the currently specified second source for math operations.

Return Format

```
<value><NL>
```

```
<value> ::= {CHAN<n> | NONE}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

See Also

- "Introduction to :FUNCtion Commands" on page 283
- ":FUNCtion:OPERation" on page 295
- ":FUNCtion:SOURce1" on page 300

18 :HARDcopy Commands

Set and query the selection of hardcopy device and formatting options. See "Introduction to :HARDcopy Commands" on page 304.

Table 61 :HARDcopy Commands Summary

Command	Query	Options and Query Returns
`:HARDcopy:AREA <area>` (see page 305)	`:HARDcopy:AREA?` (see page 305)	`<area> ::= SCReen`

`:HARDcopy:APRinter <active_printer>` (see page 306)	`:HARDcopy:APRinter?` (see page 306)	`<active_printer> ::= {<index> | <name>}`
		`<index> ::= integer index of printer in list`
		`<name> ::= name of printer in list`

`:HARDcopy:FACTors {{0 | OFF} | {1 | ON}}` (see page 307)	`:HARDcopy:FACTors?` (see page 307)	`{0 | 1}`
`:HARDcopy:FFEed {{0 | OFF} | {1 | ON}}` (see page 308)	`:HARDcopy:FFEed?` (see page 308)	`{0 | 1}`
`:HARDcopy:INKSaver {{0 | OFF} | {1 | ON}}` (see page 309)	`:HARDcopy:INKSaver?` (see page 309)	`{0 | 1}`
`:HARDcopy:LAYout <layout>` (see page 310)	`:HARDcopy:LAYout?` (see page 310)	`<layout> ::= {LANDscape | PORTrait}`
`:HARDcopy:PALette <palette>` (see page 311)	`:HARDcopy:PALette?` (see page 311)	`<palette> ::= {COLor | GRAYscale | NONE}`

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Table 61 :HARDcopy Commands Summary (continued)

Command	Query	Options and Query Returns
n/a	:HARDcopy:PRINter:LIST? (see page 312)	<list> ::= [<printer_spec>] ... [printer_spec>] <printer_spec> ::= "<index>,<active>,<name>;" <index> ::= integer index of printer <active> ::= {Y | N} <name> ::= name of printer
:HARDcopy:STARt (see page 313)	n/a	n/a

Introduction to :HARDcopy Commands

The HARDcopy subsystem provides commands to set and query the selection of hardcopy device and formatting options such as inclusion of instrument settings (FACTors) and generation of formfeed (FFEed).

:HARDC is an acceptable short form for :HARDcopy.

Reporting the Setup

Use :HARDcopy? to query setup information for the HARDcopy subsystem.

Return Format

The following is a sample response from the :HARDcopy? query. In this case, the query was issued following the *RST command.

```
:HARD:APR "";AREA SCR;FACT 0;FFE 0;INKS 1;PAL NONE;LAY PORT
```

:HARDcopy:AREA

N (see page 776)

Command Syntax

```
:HARDcopy:AREA <area>
```

```
<area> ::= SCReen
```

The :HARDcopy:AREA command controls what part of the display area is printed. Currently, the only legal choice is SCReen.

Query Syntax

```
:HARDcopy:AREA?
```

The :HARDcopy:AREA? query returns the selected display area.

Return Format

```
<area><NL>
```

```
<area> ::= SCR
```

See Also

- "Introduction to :HARDcopy Commands" on page 304
- ":HARDcopy:STARt" on page 313
- ":HARDcopy:APRinter" on page 306
- ":HARDcopy:PRINter:LIST" on page 312
- ":HARDcopy:FACTors" on page 307
- ":HARDcopy:FFEed" on page 308
- ":HARDcopy:INKSaver" on page 309
- ":HARDcopy:LAYout" on page 310
- ":HARDcopy:PALette" on page 311

:HARDcopy:APRinter

N (see page 776)

Command Syntax

```
:HARDcopy:APRinter <active_printer>
```

```
<active_printer> ::= {<index> | <name>}
```

```
<index> ::= integer index of printer in list
```

```
<name> ::= name of printer in list
```

The :HARDcopy:APRinter command sets the active printer.

Query Syntax

```
:HARDcopy:APRinter?
```

The :HARDcopy:APRinter? query returns the name of the active printer.

Return Format

```
<name><NL>
```

```
<name> ::= name of printer in list
```

See Also

- "Introduction to :HARDcopy Commands" on page 304
- ":HARDcopy:PRINter:LIST" on page 312
- ":HARDcopy:STARt" on page 313

:HARDcopy:FACTors

N (see page 776)

Command Syntax

```
:HARDcopy:FACTors <factors>
```

```
<factors> ::= {{OFF | 0} | {ON | 1}}
```

The HARDcopy:FACTors command controls whether the scale factors are output on the hardcopy dump.

Query Syntax

```
:HARDcopy:FACTors?
```

The :HARDcopy:FACTors? query returns a flag indicating whether oscilloscope instrument settings are output on the hardcopy.

Return Format

```
<factors><NL>
```

```
<factors> ::= {0 | 1}
```

See Also

- "Introduction to :HARDcopy Commands" on page 304
- ":HARDcopy:STARt" on page 313
- ":HARDcopy:FFEed" on page 308
- ":HARDcopy:INKSaver" on page 309
- ":HARDcopy:LAYout" on page 310
- ":HARDcopy:PALette" on page 311

:HARDcopy:FFEed

N (see page 776)

Command Syntax

```
:HARDcopy:FFEed <ffeed>
```

```
<ffeed> ::= {{OFF | 0} | {ON | 1}}
```

The HARDcopy:FFEed command controls whether a formfeed is output between the screen image and factors of a hardcopy dump.

Query Syntax

```
:HARDcopy:FFEed?
```

The :HARDcopy:FFEed? query returns a flag indicating whether a formfeed is output at the end of the hardcopy dump.

Return Format

```
<ffeed><NL>
```

```
<ffeed> ::= {0 | 1}
```

See Also

- "Introduction to :HARDcopy Commands" on page 304
- ":HARDcopy:STARt" on page 313
- ":HARDcopy:FACTors" on page 307
- ":HARDcopy:INKSaver" on page 309
- ":HARDcopy:LAYout" on page 310
- ":HARDcopy:PALette" on page 311

:HARDcopy:INKSaver

N (see page 776)

Command Syntax

```
:HARDcopy:INKSaver <value>
```

```
<value> ::= {{OFF | 0} | {ON | 1}}
```

The HARDcopy:INKSaver command controls whether the graticule colors are inverted or not.

Query Syntax

```
:HARDcopy:INKSaver?
```

The :HARDcopy:INKSaver? query returns a flag indicating whether graticule colors are inverted or not.

Return Format

```
<value><NL>
```

```
<value> ::= {0 | 1}
```

See Also

- "Introduction to :HARDcopy Commands" on page 304
- ":HARDcopy:STARt" on page 313
- ":HARDcopy:FACTors" on page 307
- ":HARDcopy:FFEed" on page 308
- ":HARDcopy:LAYout" on page 310
- ":HARDcopy:PALette" on page 311

:HARDcopy:LAYout

N (see page 776)

Command Syntax

```
:HARDcopy:LAYout <layout>
```

```
<layout> ::= {LANDscape | PORTrait}
```

The :HARDcopy:LAYout command sets the hardcopy layout mode.

Query Syntax

```
:HARDcopy:LAYout?
```

The :HARDcopy:LAYout? query returns the selected hardcopy layout mode.

Return Format

```
<layout><NL>
```

```
<layout> ::= {LAND | PORT}
```

See Also

- "Introduction to :HARDcopy Commands" on page 304
- ":HARDcopy:STARt" on page 313
- ":HARDcopy:FACTors" on page 307
- ":HARDcopy:PALette" on page 311
- ":HARDcopy:FFEed" on page 308
- ":HARDcopy:INKSaver" on page 309

:HARDcopy:PALette

N (see page 776)

Command Syntax

```
:HARDcopy:PALette <palette>
```

```
<palette> ::= {COLor | GRAYscale | NONE}
```

The :HARDcopy:PALette command sets the hardcopy palette color.

The oscilloscope's print driver cannot print color images to color laser printers, so the COLor option is not available when connected to laser printers.

Query Syntax

```
:HARDcopy:PALette?
```

The :HARDcopy:PALette? query returns the selected hardcopy palette color.

Return Format

```
<palette><NL>
```

```
<palette> ::= {COL | GRAY | NONE}
```

See Also

- ["Introduction to :HARDcopy Commands"] on page 304
- ":HARDcopy:STARt" on page 313
- ":HARDcopy:FACTors" on page 307
- ":HARDcopy:LAYout" on page 310
- ":HARDcopy:FFEed" on page 308
- ":HARDcopy:INKSaver" on page 309

:HARDcopy:PRINter:LIST

N (see page 776)

Query Syntax

```
:HARDcopy:PRINter:LIST?
```

The :HARDcopy:PRINter:LIST? query returns a list of available printers. The list can be empty.

Return Format

```
<list><NL>

<list> ::= [<printer_spec>] ... [printer_spec>]

<printer_spec> ::= "<index>,<active>,<name>;"

<index> ::= integer index of printer

<active> ::= {Y | N}

<name> ::= name of printer (for example "DESKJET 950C")
```

See Also

- "Introduction to :HARDcopy Commands" on page 304
- ":HARDcopy:APRinter" on page 306
- ":HARDcopy:STARt" on page 313

:HARDcopy:STARt

N (see page 776)

Command Syntax

```
:HARDcopy:STARt
```

The :HARDcopy:STARt command starts a print job.

See Also

- "Introduction to :HARDcopy Commands" on page 304
- ":HARDcopy:APRinter" on page 306
- ":HARDcopy:PRINter:LIST" on page 312
- ":HARDcopy:FACTors" on page 307
- ":HARDcopy:FFEed" on page 308
- ":HARDcopy:INKSaver" on page 309
- ":HARDcopy:LAYout" on page 310
- ":HARDcopy:PALette" on page 311

19 :MARKer Commands

Set and query the settings of X-axis markers (X1 and X2 cursors) and the Y-axis markers (Y1 and Y2 cursors). See "Introduction to :MARKer Commands" on page 316.

Table 62 :MARKer Commands Summary

Command	Query	Options and Query Returns
:MARKer:MODE <mode> (see page 318)	:MARKer:MODE? (see page 318)	<mode> ::= {OFF | MEASurement | MANual | WAVeform}
:MARKer:X1Position <position>[suffix] (see page 319)	:MARKer:X1Position? (see page 319)	<position> ::= X1 cursor position value in NR3 format [suffix] ::= {s | ms | us | ns | ps | Hz | kHz | MHz} <return_value> ::= X1 cursor position value in NR3 format
:MARKer:X1Y1source <source> (see page 320)	:MARKer:X1Y1source? (see page 320)	<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format EXTernal available for MANUAL mode only <return_value> ::= <source>
:MARKer:X2Position <position>[suffix] (see page 321)	:MARKer:X2Position? (see page 321)	<position> ::= X2 cursor position value in NR3 format [suffix] ::= {s | ms | us | ns | ps | Hz | kHz | MHz} <return_value> ::= X2 cursor position value in NR3 format

Table 62 :MARKer Commands Summary (continued)

Command	Query	Options and Query Returns
:MARKer:X2Y2source <source> (see page 322)	:MARKer:X2Y2source? (see page 322)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= <source>
n/a	:MARKer:XDELta? (see page 323)	<return_value> ::= X cursors delta value in NR3 format
:MARKer:XUNits <mode> (see page 324)	:MARKer:XUNits? (see page 324)	<units> ::= {SEConds | HERTz | DEGRees | PERCent}
:MARKer:XUNits:USE (see page 325)	n/a	n/a
:MARKer:Y1Position <position>[suffix] (see page 326)	:MARKer:Y1Position? (see page 326)	<position> ::= Y1 cursor position value in NR3 format [suffix] ::= {V | mV | dB} <return_value> ::= Y1 cursor position value in NR3 format
:MARKer:Y2Position <position>[suffix] (see page 327)	:MARKer:Y2Position? (see page 327)	<position> ::= Y2 cursor position value in NR3 format [suffix] ::= {V | mV | dB} <return_value> ::= Y2 cursor position value in NR3 format
n/a	:MARKer:YDELta? (see page 328)	<return_value> ::= Y cursors delta value in NR3 format
:MARKer:YUNits <mode> (see page 329)	:MARKer:YUNits? (see page 329)	<units> ::= {BASE | PERCent}
:MARKer:YUNits:USE (see page 330)	n/a	n/a

Introduction to :MARKer Commands

The MARKer subsystem commands set and query the settings of X-axis markers (X1 and X2 cursors) and the Y-axis markers (Y1 and Y2 cursors). You can set and query the marker mode and source, the position of the X and Y cursors, and query delta X and delta Y cursor values.

Reporting the Setup

Use :MARKer? to query setup information for the MARKer subsystem.

Return Format

The following is a sample response from the :MARKer? query. In this case, the query was issued following a *RST and ":MARKer:MODE MANual" command.

```
:MARK:X1Y1 CHAN1;X2Y2 CHAN1;MODE MAN
```

:MARKer:MODE

N (see page 776)

Command Syntax

```
:MARKer:MODE <mode>
```

```
<mode> ::= {OFF | MEASurement | MANual | WAVeform}
```

The :MARKer:MODE command sets the cursors mode:

- OFF — removes the cursor information from the display.
- MANual — enables manual placement of the X and Y cursors.

  If the front-panel cursors are off, or are set to the front-panel Hex or Binary mode, setting :MARKer:MODE MANual will put the cursors in the front-panel Normal mode.
- MEASurement — cursors track the most recent measurement.

  Setting the mode to MEASurement sets the marker sources (:MARKer:X1Y1source and :MARKer:X2Y2source) to the measurement source (:MEASure:SOURce). Setting the measurement source remotely always sets the marker sources.
- WAVeform — the Y1 cursor tracks the voltage value at the X1 cursor of the waveform specified by the X1Y1source, and the Y2 cursor does the same for the X2 cursor and its X2Y2source.

Query Syntax

```
:MARKer:MODE?
```

The :MARKer:MODE? query returns the current cursors mode.

Return Format

```
<mode><NL>
```

```
<mode> ::= {OFF | MEAS | MAN | WAV}
```

See Also

- "Introduction to :MARKer Commands" on page 316
- ":MARKer:X1Y1source" on page 320
- ":MARKer:X2Y2source" on page 322
- ":MEASure:SOURce" on page 364
- ":MARKer:X1Position" on page 319
- ":MARKer:X2Position" on page 321
- ":MARKer:Y1Position" on page 326
- ":MARKer:Y2Position" on page 327

:MARKer:X1Position

N (see page 776)

Command Syntax

```
:MARKer:X1Position <position> [suffix]
```

```
<position> ::= X1 cursor position in NR3 format
```

```
<suffix> ::= {s | ms | us | ns | ps | Hz | kHz | MHz}
```

The :MARKer:X1Position command:

- Sets :MARKer:MODE to MANual if it is not currently set to WAVeform (see ":MARKer:MODE" on page 318).
- Sets the X1 cursor position to the specified value.

X cursor units are set by the :MARKer:XUNits command.

Query Syntax

```
:MARKer:X1Position?
```

The :MARKer:X1Position? query returns the current X1 cursor position. This is functionally equivalent to the obsolete :MEASure:TSTArt command/query.

NOTE **If the front-panel cursors are off, the marker position values are not defined and an error is generated. Make sure to set :MARKer:MODE to MANual or WAVeform to put the cursors in the front-panel Normal mode.**

Return Format

```
<position><NL>
```

```
<position> ::= X1 cursor position in NR3 format
```

See Also

- "Introduction to :MARKer Commands" on page 316
- ":MARKer:MODE" on page 318
- ":MARKer:X2Position" on page 321
- ":MARKer:X1Y1source" on page 320
- ":MARKer:X2Y2source" on page 322
- ":MARKer:XUNits" on page 324
- ":MEASure:TSTArt" on page 716

:MARKer:X1Y1source

N (see page 776)

Command Syntax

```
:MARKer:X1Y1source <source>

<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r> | EXTernal
}

<n> ::= 1 to (# analog channels) in NR1 format

<r> ::= {1 | 2}

EXTernal available for MANUAL mode only
```

The :MARKer:X1Y1source command sets the source for the cursors. The channel you specify must be enabled for cursors to be displayed. If the channel or function is not on, an error message is issued.

If the marker mode is not currently WAVeform (see ":MARKer:MODE" on page 318):

- Sending a :MARKer:X1Y1source command will put the cursors in the MANual mode.
- Setting the source for one pair of markers (for example, X1Y1) sets the source for the other (for example, X2Y2).

If the marker mode is currently WAVeform, the X1Y1 source can be set separate from the X2Y2 source.

If :MARKer:MODE is set to OFF or MANual, setting :MEASure:SOURce to CHANnel<n>, FUNCtion, MATH, or WMEMory<r> will also set :MARKer:X1Y1source and :MARKer:X2Y2source to this value.

NOTE MATH is an alias for FUNCtion. The query will return FUNC if the source is FUNCtion or MATH.

Query Syntax

```
:MARKer:X1Y1source?
```

The :MARKer:X1Y1source? query returns the current source for the cursors. If all channels are off or if :MARKer:MODE is set to OFF, the query returns NONE.

Return Format

```
<source><NL>

<source> ::= {CHAN<n> | FUNC | FFT | WMEM<r> | EXT | NONE}
```

See Also

- "Introduction to :MARKer Commands" on page 316
- ":MARKer:MODE" on page 318
- ":MARKer:X2Y2source" on page 322
- ":MEASure:SOURce" on page 364

:MARKer:X2Position

N (see page 776)

Command Syntax

```
:MARKer:X2Position <position> [suffix]
```

```
<position> ::= X2 cursor position in NR3 format
```

```
<suffix> ::= {s | ms | us | ns | ps | Hz | kHz | MHz}
```

The :MARKer:X2Position command:

- Sets :MARKer:MODE to MANual if it is not currently set to WAVeform (see ":MARKer:MODE" on page 318).
- Sets the X2 cursor position to the specified value.

X cursor units are set by the :MARKer:XUNits command.

Query Syntax

```
:MARKer:X2Position?
```

The :MARKer:X2Position? query returns current X2 cursor position. This is functionally equivalent to the obsolete :MEASure:TSTOp command/query.

NOTE If the front-panel cursors are off, the marker position values are not defined and an error is generated. Make sure to set :MARKer:MODE to MANual or WAVeform to put the cursors in the front-panel Normal mode.

Return Format

```
<position><NL>
```

```
<position> ::= X2 cursor position in NR3 format
```

See Also

- "Introduction to :MARKer Commands" on page 316
- ":MARKer:MODE" on page 318
- ":MARKer:X1Position" on page 319
- ":MARKer:X2Y2source" on page 322
- ":MARKer:XUNits" on page 324
- ":MEASure:TSTOp" on page 717

:MARKer:X2Y2source

N (see page 776)

Command Syntax

```
:MARKer:X2Y2source <source>

<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}

<n> ::= 1 to (# analog channels) in NR1 format

<r> ::= {1 | 2}
```

The :MARKer:X2Y2source command sets the source for the cursors. The channel you specify must be enabled for cursors to be displayed. If the channel or function is not on, an error message is issued.

If the marker mode is not currently WAVeform (see ":MARKer:MODE" on page 318):

- Sending a :MARKer:X2Y2source command will put the cursors in the MANual mode.
- Setting the source for one pair of markers (for example, X2Y2) sets the source for the other (for example, X1Y1).

If the marker mode is currently WAVeform, the X2Y2 source can be set separate from the X1Y1 source.

If :MARKer:MODE is set to OFF or MANual, setting :MEASure:SOURce to CHANnel<n>, FUNCtion, MATH, or WMEMory<r> will also set :MARKer:X1Y1source and :MARKer:X2Y2source to this value.

NOTE MATH is an alias for FUNCtion. The query will return FUNC if the source is FUNCtion or MATH.

Query Syntax

```
:MARKer:X2Y2source?
```

The :MARKer:X2Y2source? query returns the current source for the cursors. If all channels are off or if :MARKer:MODE is set to OFF, the query returns NONE.

Return Format

```
<source><NL>

<source> ::= {CHAN<n> | FUNC | WMEM<r> | NONE}
```

See Also

- "Introduction to :MARKer Commands" on page 316
- ":MARKer:MODE" on page 318
- ":MARKer:X1Y1source" on page 320
- ":MEASure:SOURce" on page 364

:MARKer:XDELta

N (see page 776)

Query Syntax

```
:MARKer:XDELta?
```

The MARKer:XDELta? query returns the value difference between the current X1 and X2 cursor positions.

Xdelta = (Value at X2 cursor) - (Value at X1 cursor)

X cursor units are set by the :MARKer:XUNits command.

NOTE If the front-panel cursors are off, the marker position values are not defined. Make sure to set :MARKer:MODE to MANual or WAVeform to put the cursors in the front-panel Normal mode.

Return Format

```
<value><NL>

<value> ::= difference value in NR3 format.
```

See Also

- "Introduction to :MARKer Commands" on page 316
- ":MARKer:MODE" on page 318
- ":MARKer:X1Position" on page 319
- ":MARKer:X2Position" on page 321
- ":MARKer:X1Y1source" on page 320
- ":MARKer:X2Y2source" on page 322
- ":MARKer:XUNits" on page 324

:MARKer:XUNits

N (see page 776)

Command Syntax

```
:MARKer:XUNits <units>
```

```
<units> ::= {SEConds | HERTz | DEGRees | PERCent}
```

The :MARKer:XUNits command sets the X cursors units:

- SEConds — for making time measurements.
- HERTz — for making frequency measurements.
- DEGRees — for making phase measurements. Use the :MARKer:XUNits:USE command to set the current X1 location as 0 degrees and the current X2 location as 360 degrees.
- PERCent — for making ratio measurements. Use the :MARKer:XUNits:USE command to set the current X1 location as 0 percent and the current X2 location as 100 percent.

Changing X units affects the input and output values of the :MARKer:X1Position, :MARKer:X2Position, and :MARKer:XDELta commands/queries.

Query Syntax

```
:MARKer:XUNits?
```

The :MARKer:XUNits? query returns the current X cursors units.

Return Format

```
<units><NL>
```

```
<units> ::= {SEC | HERT | DEGR | PERC}
```

See Also

- "Introduction to :MARKer Commands" on page 316
- ":MARKer:XUNits:USE" on page 325
- ":MARKer:X1Y1source" on page 320
- ":MARKer:X2Y2source" on page 322
- ":MEASure:SOURce" on page 364
- ":MARKer:X1Position" on page 319
- ":MARKer:X2Position" on page 321

:MARKer:XUNits:USE

N (see page 776)

Command Syntax

```
:MARKer:XUNits:USE
```

When DEGRees is selected for :MARKer:XUNits, the :MARKer:XUNits:USE command sets the current X1 location as 0 degrees and the current X2 location as 360 degrees.

When PERCent is selected for :MARKer:XUNits, the :MARKer:XUNits:USE command sets the current X1 location as 0 percent and the current X2 location as 100 percent.

Once the 0 and 360 degree or 0 and 100 percent locations are set, inputs to and outputs from the :MARKer:X1Position, :MARKer:X2Position, and :MARKer:XDELta commands/queries are relative to the set locations.

See Also

- "Introduction to :MARKer Commands" on page 316
- ":MARKer:XUNits" on page 324
- ":MARKer:X1Y1source" on page 320
- ":MARKer:X2Y2source" on page 322
- ":MEASure:SOURce" on page 364
- ":MARKer:X1Position" on page 319
- ":MARKer:X2Position" on page 321
- ":MARKer:XDELta" on page 323

:MARKer:Y1Position

N (see page 776)

Command Syntax

```
:MARKer:Y1Position <position> [suffix]
```

```
<position> ::= Y1 cursor position in NR3 format
```

```
<suffix> ::= {mV | V | dB}
```

If the :MARKer:MODE is not currently set to WAVeform (see ":MARKer:MODE" on page 318), the :MARKer:Y1Position command:

- Sets :MARKer:MODE to MANual.
- Sets the Y1 cursor position to the specified value.

Y cursor units are set by the :MARKer:YUNits command.

When the :MARKer:MODE is set to WAVeform, Y positions cannot be set.

Query Syntax

```
:MARKer:Y1Position?
```

The :MARKer:Y1Position? query returns current Y1 cursor position. This is functionally equivalent to the obsolete :MEASure:VSTArt command/query.

NOTE If the front-panel cursors are off or are set to Binary or Hex Mode, the marker position values are not defined and an error is generated. Make sure to set :MARKer:MODE to MANual or WAVeform to put the cursors in the front-panel Normal mode.

Return Format

```
<position><NL>
```

```
<position> ::= Y1 cursor position in NR3 format
```

See Also

- "Introduction to :MARKer Commands" on page 316
- ":MARKer:MODE" on page 318
- ":MARKer:X1Y1source" on page 320
- ":MARKer:X2Y2source" on page 322
- ":MARKer:Y2Position" on page 327
- ":MARKer:YUNits" on page 329
- ":MEASure:VSTArt" on page 721

:MARKer:Y2Position

N (see page 776)

Command Syntax

```
:MARKer:Y2Position <position> [suffix]
```

```
<position> ::= Y2 cursor position in NR3 format
```

```
<suffix> ::= {mV | V | dB}
```

If the :MARKer:MODE is not currently set to WAVeform (see ":MARKer:MODE" on page 318), the :MARKer:Y1Position command:

- Sets :MARKer:MODE to MANual.
- Sets the Y2 cursor position to the specified value.

Y cursor units are set by the :MARKer:YUNits command.

When the :MARKer:MODE is set to WAVeform, Y positions cannot be set.

Query Syntax

```
:MARKer:Y2Position?
```

The :MARKer:Y2Position? query returns current Y2 cursor position. This is functionally equivalent to the obsolete :MEASure:VSTOp command/query.

NOTE If the front-panel cursors are off or are set to Binary or Hex Mode, the marker position values are not defined and an error is generated. Make sure to set :MARKer:MODE to MANual or WAVeform to put the cursors in the front-panel Normal mode.

Return Format

```
<position><NL>
```

```
<position> ::= Y2 cursor position in NR3 format
```

See Also

- "Introduction to :MARKer Commands" on page 316
- ":MARKer:MODE" on page 318
- ":MARKer:X1Y1source" on page 320
- ":MARKer:X2Y2source" on page 322
- ":MARKer:Y1Position" on page 326
- ":MARKer:YUNits" on page 329
- ":MEASure:VSTOp" on page 722

:MARKer:YDELta

N (see page 776)

Query Syntax

```
:MARKer:YDELta?
```

The :MARKer:YDELta? query returns the value difference between the current Y1 and Y2 cursor positions.

Ydelta = (Value at Y2 cursor) - (Value at Y1 cursor)

NOTE If the front-panel cursors are off or are set to Binary or Hex Mode, the marker position values are not defined. Make sure to set :MARKer:MODE to MANual or WAVeform to put the cursors in the front-panel Normal mode.

Y cursor units are set by the :MARKer:YUNits command.

Return Format

```
<value><NL>

<value> ::= difference value in NR3 format
```

See Also

- "Introduction to :MARKer Commands" on page 316
- ":MARKer:MODE" on page 318
- ":MARKer:X1Y1source" on page 320
- ":MARKer:X2Y2source" on page 322
- ":MARKer:Y1Position" on page 326
- ":MARKer:Y2Position" on page 327
- ":MARKer:YUNits" on page 329

:MARKer:YUNits

N (see page 776)

Command Syntax

```
:MARKer:YUNits <units>
```

```
<units> ::= {BASE | PERCent}
```

The :MARKer:YUNits command sets the Y cursors units:

- BASE — for making measurements in the units associated with the cursors source.
- PERCent — for making ratio measurements. Use the :MARKer:YUNits:USE command to set the current Y1 location as 0 percent and the current Y2 location as 100 percent.

Changing Y units affects the input and output values of the :MARKer:Y1Position, :MARKer:Y2Position, and :MARKer:YDELta commands/queries.

Query Syntax

```
:MARKer:YUNits?
```

The :MARKer:YUNits? query returns the current Y cursors units.

Return Format

```
<units><NL>
```

```
<units> ::= {BASE | PERC}
```

See Also

- "Introduction to :MARKer Commands" on page 316
- ":MARKer:YUNits:USE" on page 330
- ":MARKer:X1Y1source" on page 320
- ":MARKer:X2Y2source" on page 322
- ":MEASure:SOURce" on page 364
- ":MARKer:Y1Position" on page 326
- ":MARKer:Y2Position" on page 327
- ":MARKer:YDELta" on page 328

:MARKer:YUNits:USE

N (see page 776)

Command Syntax

```
:MARKer:YUNits:USE
```

When PERCent is selected for :MARKer:YUNits, the :MARKer:YUNits:USE command sets the current Y1 location as 0 percent and the current Y2 location as 100 percent.

Once the 0 and 100 percent locations are set, inputs to and outputs from the :MARKer:Y1Position, :MARKer:Y2Position, and :MARKer:YDELta commands/queries are relative to the set locations.

See Also

- "Introduction to :MARKer Commands" on page 316
- ":MARKer:YUNits" on page 329
- ":MARKer:X1Y1source" on page 320
- ":MARKer:X2Y2source" on page 322
- ":MEASure:SOURce" on page 364
- ":MARKer:Y1Position" on page 326
- ":MARKer:Y2Position" on page 327
- ":MARKer:YDELta" on page 328

20 :MEASure Commands

Select automatic measurements to be made and control time markers. See "Introduction to :MEASure Commands" on page 339.

Table 63 :MEASure Commands Summary

Command	Query	Options and Query Returns
`:MEASure:ALL` (see page 341)	n/a	n/a

`:MEASure:BRATe [<source>]` (see page 342)	`:MEASure:BRATe? [<source>]` (see page 342)	`<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal}`
		`<n> ::= 1 to (# of analog channels) in NR1 format`
		`<r> ::= 1 to (# ref waveforms) in NR1 format`
		`<return_value> ::= bit rate in Hz, NR3 format`

`:MEASure:CLEar` (see page 343)	n/a	n/a

`:MEASure:COUNter [<source>]` (see page 344)	`:MEASure:COUNter? [<source>]` (see page 344)	`<source> ::= {CHANnel<n> | EXTernal}`
		`<n> ::= 1 to (# analog channels) in NR1 format`
		`<return_value> ::= counter frequency in Hertz in NR3 format`

Table 63 :MEASure Commands Summary (continued)

Command	Query	Options and Query Returns
:MEASure:DEFine DELay, <delay spec>[,<source>] (see page 345)	:MEASure:DEFine? DELay[,<source>] (see page 346)	<delay spec> ::= <edge_spec1>,<edge_spec2> edge_spec1 ::= [<slope>]<occurrence> edge_spec2 ::= [<slope>]<occurrence> <slope> ::= {+ | -} <occurrence> ::= integer <source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}

:MEASure:DEFine THResholds, <threshold spec>[,<source>] (see page 345)	:MEASure:DEFine? THResholds[,<source>] (see page 346)	<threshold spec> ::= {STANdard} | {<threshold mode>,<upper>, <middle>,<lower>}
		<threshold mode> ::= {PERCent | ABSolute}
		<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r>}

:MEASure:DELay [<source1>] [,<source2>] (see page 348)	:MEASure:DELay? [<source1>] [,<source2>] (see page 348)	<source1,2> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= floating-point number delay time in seconds in NR3 format
:MEASure:DUTYcycle [<source>] (see page 350)	:MEASure:DUTYcycle? [<source>] (see page 350)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= ratio of positive pulse width to period in NR3 format

Table 63 :MEASure Commands Summary (continued)

Command	Query	Options and Query Returns

`:MEASure:FALLtime [<source>]` (see page 351)	`:MEASure:FALLtime? [<source>]` (see page 351)	`<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}`
		`<n> ::= 1 to (# analog channels) in NR1 format`
		`<r> ::= 1-2 in NR1 format`
		`<return_value> ::= time in seconds between the lower and upper thresholds in NR3 format`

`:MEASure:FREQuency [<source>]` (see page 352)	`:MEASure:FREQuency? [<source>]` (see page 352)	`<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal}`
		`<n> ::= 1 to (# analog channels) in NR1 format`
		`<r> ::= 1-2 in NR1 format`
		`<return_value> ::= frequency in Hertz in NR3 format`

`:MEASure:NDUTy [<source>]` (see page 353)	`:MEASure:NDUTy? [<source>]` (see page 353)	`<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal}`
		`<n> ::= 1 to (# analog channels) in NR1 format`
		`<r> ::= 1 to (# ref waveforms) in NR1 format`
		`<return_value> ::= ratio of negative pulse width to period in NR3 format`

`:MEASure:NWIDth [<source>]` (see page 354)	`:MEASure:NWIDth? [<source>]` (see page 354)	`<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal}`
		`<n> ::= 1 to (# analog channels) in NR1 format`
		`<r> ::= 1-2 in NR1 format`
		`<return_value> ::= negative pulse width in seconds-NR3 format`

Table 63 :MEASure Commands Summary (continued)

Command	Query	Options and Query Returns
:MEASure:OVERshoot [<source>] (see page 355)	:MEASure:OVERshoot? [<source>] (see page 355)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= the percent of the overshoot of the selected waveform in NR3 format
:MEASure:PERiod [<source>] (see page 357)	:MEASure:PERiod? [<source>] (see page 357)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= waveform period in seconds in NR3 format
:MEASure:PHASe [<source1>] [,<source2>] (see page 358)	:MEASure:PHASe? [<source1>] [,<source2>] (see page 358)	<source1,2> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= the phase angle value in degrees in NR3 format
:MEASure:PREShoot [<source>] (see page 359)	:MEASure:PREShoot? [<source>] (see page 359)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= the percent of preshoot of the selected waveform in NR3 format

Table 63 :MEASure Commands Summary (continued)

Command	Query	Options and Query Returns

`:MEASure:PWIDth [<source>]` (see page 360)	`:MEASure:PWIDth? [<source>]` (see page 360)	`<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal}`
		`<n> ::= 1 to (# analog channels) in NR1 format`
		`<r> ::= 1-2 in NR1 format`
		`<return_value> ::= width of positive pulse in seconds in NR3 format`

`:MEASure:RISetime [<source>]` (see page 361)	`:MEASure:RISetime? [<source>]` (see page 361)	`<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}`
		`<n> ::= 1 to (# analog channels) in NR1 format`
		`<r> ::= 1-2 in NR1 format`
		`<return_value> ::= rise time in seconds in NR3 format`

`:MEASure:SDEViation [<source>]` (see page 362)	`:MEASure:SDEViation? [<source>]` (see page 362)	`<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}`
		`<n> ::= 1 to (# analog channels) in NR1 format`
		`<r> ::= 1 to (# ref waveforms) in NR1 format`
		`<return_value> ::= calculated std deviation in NR3 format`

`:MEASure:SHOW {1 | ON}` (see page 363)	`:MEASure:SHOW?` (see page 363)	`{1}`

`:MEASure:SOURce <source1> [,<source2>]` (see page 364)	`:MEASure:SOURce?` (see page 364)	`<source1,2> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal}`
		`<n> ::= 1 to (# analog channels) in NR1 format`
		`<r> ::= 1-2 in NR1 format`
		`<return_value> ::= {<source> | NONE}`

Table 63 :MEASure Commands Summary (continued)

Command	Query	Options and Query Returns
n/a	:MEASure:TEDGe? <slope><occurrence>[,<source>] (see page 366)	<slope> ::= direction of the waveform <occurrence> ::= the transition to be reported <source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= time in seconds of the specified transition
n/a	:MEASure:TVALue? <value>, [<slope>]<occurrence> [,<source>] (see page 368)	<value> ::= voltage level that the waveform must cross. <slope> ::= direction of the waveform when <value> is crossed. <occurrence> ::= transitions reported. <source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= time in seconds of specified voltage crossing in NR3 format
:MEASure:VAMPlitude [<source>] (see page 370)	:MEASure:VAMPlitude? [<source>] (see page 370)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= the amplitude of the selected waveform in volts in NR3 format

Table 63 :MEASure Commands Summary (continued)

Command	Query	Options and Query Returns
:MEASure:VAVerage [<interval>][,][<source>] (see page 371)	:MEASure:VAVerage? [<interval>][,][<source>] (see page 371)	<interval> ::= {CYCLe | DISPlay} <source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= calculated average voltage in NR3 format
:MEASure:VBASe [<source>] (see page 372)	:MEASure:VBASe? [<source>] (see page 372)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <base_voltage> ::= voltage at the base of the selected waveform in NR3 format
:MEASure:VMAX [<source>] (see page 373)	:MEASure:VMAX? [<source>] (see page 373)	<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= maximum voltage of the selected waveform in NR3 format
:MEASure:VMIN [<source>] (see page 374)	:MEASure:VMIN? [<source>] (see page 374)	<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= minimum voltage of the selected waveform in NR3 format

Table 63 :MEASure Commands Summary (continued)

Command	Query	Options and Query Returns
:MEASure:VPP [<source>] (see page 375)	:MEASure:VPP? [<source>] (see page 375)	<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= voltage peak-to-peak of the selected waveform in NR3 format

:MEASure:VRMS [<interval>][,][<type>][,][<source>] (see page 376)	:MEASure:VRMS? [<interval>][,][<type>][,][<source>] (see page 376)	<interval> ::= {CYCLe | DISPlay}
		<type> ::= {AC | DC}
		<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}
		<n> ::= 1 to (# analog channels) in NR1 format
		<r> ::= 1-2 in NR1 format
		<return_value> ::= calculated dc RMS voltage in NR3 format

n/a	:MEASure:VTIMe? <vtime>[,<source>] (see page 377)	<vtime> ::= displayed time from trigger in seconds in NR3 format <source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= voltage at the specified time in NR3 format
:MEASure:VTOP [<source>] (see page 378)	:MEASure:VTOP? [<source>] (see page 378)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format <return_value> ::= voltage at the top of the waveform in NR3 format
:MEASure:WINDow <type> (see page 379)	:MEASure:WINDow? (see page 379)	<type> ::= {MAIN | ZOOM | AUTO}

Table 63 :MEASure Commands Summary (continued)

Command	Query	Options and Query Returns

`:MEASure:XMAX [<source>]` (see page 380)	`:MEASure:XMAX? [<source>]` (see page 380)	`<source> ::= {CHANnel<n> | FUNCtion | FFT | MATH | WMEMory<r>}`
		`<n> ::= 1 to (# analog channels) in NR1 format`
		`<r> ::= 1 to (# ref waveforms) in NR1 format`
		`<return_value> ::= horizontal value of the maximum in NR3 format`

`:MEASure:XMIN [<source>]` (see page 381)	`:MEASure:XMIN? [<source>]` (see page 381)	`<source> ::= {CHANnel<n> | FUNCtion | FFT | MATH | WMEMory<r>}`
		`<n> ::= 1 to (# analog channels) in NR1 format`
		`<r> ::= 1 to (# ref waveforms) in NR1 format`
		`<return_value> ::= horizontal value of the maximum in NR3 format`

Introduction to :MEASure Commands

The commands in the MEASure subsystem are used to make parametric measurements on displayed waveforms.

Measurement Setup

To make a measurement, the portion of the waveform required for that measurement must be displayed on the oscilloscope screen.

Measurement Type	Portion of waveform that must be displayed
period, duty cycle, or frequency	at least one complete cycle
pulse width	the entire pulse
rise time	rising edge, top and bottom of pulse
fall time	falling edge, top and bottom of pulse

Measurement Error

If a measurement cannot be made (typically because the proper portion of the waveform is not displayed), the value +9.9E+37 is returned for that measurement.

Making Measurements

If more than one waveform, edge, or pulse is displayed, time measurements are made on the portion of the displayed waveform closest to the trigger reference (left, center, or right).

When making measurements in the zoomed (delayed) time base mode (:TIMebase:MODE WINDow), the oscilloscope will attempt to make the measurement inside the zoomed sweep window. If the measurement is an average and there are not three edges, the oscilloscope will revert to the mode of making the measurement at the start of the main sweep.

When the command form is used, the measurement result is displayed on the instrument. When the query form of these measurements is used, the measurement is made one time, and the measurement result is returned over the bus.

Measurements are made on the displayed waveforms specified by the :MEASure:SOURce command. The MATH source is an alias for the FUNCtion source.

Not all measurements are available on the FFT (Fast Fourier Transform).

Reporting the Setup

Use the :MEASure? query to obtain setup information for the MEASure subsystem. (Currently, this is only :MEASure:SOURce.)

Return Format

The following is a sample response from the :MEASure? query. In this case, the query was issued following a *RST command.

```
:MEAS:SOUR CHAN1,CHAN2;STAT ON
```

:MEASure:ALL

N (see page 776)

Command Syntax

```
:MEASure:ALL
```

This command installs a Snapshot All measurement on the screen.

See Also

- "Introduction to :MEASure Commands" on page 339

:MEASure:BRATe

N (see page 776)

Command Syntax

```
:MEASure:BRATe [<source>]

<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal}

<n> ::= 1 to (# of analog channels) in NR1 format

<r> ::= 1 to (# ref waveforms) in NR1 format
```

The :MEASure:BRATe command installs a screen measurement and starts the bit rate measurement. If the optional source parameter is specified, the currently specified source is modified.

NOTE This command is not available if the source is FFT (Fast Fourier Transform).

Query Syntax

```
:MEASure:BRATe? [<source>]
```

The :MEASure:BRATe? query measures all positive and negative pulse widths on the waveform, takes the minimum value found of either width type and inverts that minimum width to give a value in Hertz.

Return Format

```
<value><NL>

<value> ::= the bit rate value in Hertz
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:SOURce" on page 364
- ":MEASure:FREQuency" on page 352
- ":MEASure:PERiod" on page 357

:MEASure:CLEar

N (see page 776)

Command Syntax

```
:MEASure:CLEar
```

This command clears all selected measurements and markers from the screen.

See Also

- "Introduction to :MEASure Commands" on page 339

:MEASure:COUNter

N (see page 776)

Command Syntax

```
:MEASure:COUNter [<source>]

<source> ::= {CHANnel<n> | EXTernal}

<n> ::= 1 to (# analog channels) in NR1 format
```

The :MEASure:COUNter command installs a screen measurement and starts a counter measurement. If the optional source parameter is specified, the current source is modified. Any channel except Math may be selected for the source.

The counter measurement counts trigger level crossings at the selected trigger slope and displays the results in Hz. The gate time for the measurement is automatically adjusted to be 100 ms or twice the current time window, whichever is longer, up to 1 second. The counter measurement can measure frequencies up to 125 MHz. The minimum frequency supported is 1/(2 X gate time).

The Y cursor shows the the edge threshold level used in the measurement.

Only one counter measurement may be displayed at a time.

NOTE This command is not available if the source is MATH.

Query Syntax

```
:MEASure:COUNter? [<source>]
```

The :MEASure:COUNter? query measures and outputs the counter frequency of the specified source.

NOTE The :MEASure:COUNter? query times out if the counter measurement is installed on the front panel. Use :MEASure:CLEar to remove the front-panel measurement before executing the :MEASure:COUNter? query.

Return Format

```
<source><NL>

<source> ::= count in Hertz in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:SOURce" on page 364
- ":MEASure:FREQuency" on page 352
- ":MEASure:CLEar" on page 343

:MEASure:DEFine

N (see page 776)

Command Syntax

```
:MEASure:DEFine <meas_spec>[,<source>]

<meas_spec> ::= {DELay | THResholds}

<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r>}

<n> ::= 1 to (# analog channels) in NR1 format

<r> ::= {1 | 2}
```

The :MEASure:DEFine command sets up the definition for measurements by specifying the delta time or threshold values. Changing these values may affect the results of other measure commands. The table below identifies which measurement results that can be affected by redefining the DELay specification or the THResholds values. For example, changing the THResholds definition from the default 10%, 50%, and 90% values may change the returned measurement result.

MEASure Command	DELay	THResholds
DUTYcycle		x
DELay	x	x
FALLtime		x
FREQuency		x
NWIDth		x
OVERshoot		x
PERiod		x
PHASe		x
PREShoot		x
PWIDth		x
RISetime		x
VAVerage		x
VRMS		x

:MEASure:DEFine DELay Command Syntax

```
:MEASure:DEFine DELay,<delay spec>[,<source>]

<delay spec> ::= <edge_spec1>,<edge_spec2>

<edge_spec1> ::= [<slope>]<occurrence>

<edge_spec2> ::= [<slope>]<occurrence>

<slope> ::= {+ | -}
```

```
<occurrence> ::= integer
```

This command defines the behavior of the :MEASure:DELay? query by specifying the start and stop edge to be used. <edge_spec1> specifies the slope and edge number on source1. <edge_spec2> specifies the slope and edge number on source2. The measurement is taken as:

delay = t(<edge_spec2>) - t(<edge_spec1>)

NOTE **The :MEASure:DELay command and the front-panel delay measurement use an auto-edge selection method to determine the actual edge used for the measurement. The :MEASure:DEFine command has no effect on these delay measurements. The edges specified by the :MEASure:DEFine command only define the edges used by the :MEASure:DELay? query.**

:MEASure:DEFine THResholds Command Syntax

```
:MEASure:DEFine THResholds,<threshold spec>[,<source>]
```

```
<threshold spec> ::= {STANdard}
                     | {<threshold mode>,<upper>,<middle>,<lower>}
```

```
<threshold mode> ::= {PERCent | ABSolute}
```

for <threshold mode> = PERCent:

```
<upper>, <middle>, <lower> ::= A number specifying the upper, middle,
                               and lower threshold percentage values
                               between Vbase and Vtop in NR3 format.
```

for <threshold mode> = ABSolute:

```
<upper>, <middle>, <lower> ::= A number specifying the upper, middle,
                               and lower threshold absolute values in
                               NR3 format.
```

- STANdard threshold specification sets the lower, middle, and upper measurement thresholds to 10%, 50%, and 90% values between Vbase and Vtop.
- Threshold mode PERCent sets the measurement thresholds to any user-defined percentages between 5% and 95% of values between Vbase and Vtop.
- Threshold mode ABSolute sets the measurement thresholds to absolute values. ABSolute thresholds are dependent on channel scaling (:CHANnel<n>:RANGe or ":CHANnel<n>:SCALe" on page 215:CHANnel<n>:SCALe), probe attenuation (:CHANnel<n>:PROBe), and probe units (:CHANnel<n>:UNITs). Always set these values first before setting ABSolute thresholds.

Query Syntax

```
:MEASure:DEFine? <meas_spec>[,<source>]
```

```
<meas_spec> ::= {DELay | THResholds}
```

The :MEASure:DEFine? query returns the current edge specification for the delay measurements setup or the current specification for the thresholds setup.

Return Format for <meas_spec> = DELay:

```
{ <edge_spec1> | <edge_spec2> | <edge_spec1>,<edge_spec2>} <NL>
```

for <meas_spec> = THResholds and <threshold mode> = PERCent:

```
THR,PERC,<upper>,<middle>,<lower><NL>
```

```
<upper>, <middle>, <lower> ::= A number specifying the upper, middle,
                               and lower threshold percentage values
                               between Vbase and Vtop in NR3 format.
```

for <meas_spec> = THResholds and <threshold mode> = ABSolute:

```
THR,ABS,<upper>,<middle>,<lower><NL>
```

```
<upper>, <middle>, <lower> ::= A number specifying the upper, middle,
                               and lower threshold voltages in NR3
                               format.
```

for <threshold spec> = STANdard:

```
THR,PERC,+90.0,+50.0,+10.0
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:DELay" on page 348
- ":MEASure:SOURce" on page 364
- ":CHANnel<n>:RANGe" on page 214
- ":CHANnel<n>:SCALe" on page 215
- ":CHANnel<n>:PROBe" on page 208
- ":CHANnel<n>:UNITs" on page 216

:MEASure:DELay

N (see page 776)

Command Syntax

```
:MEASure:DELay [<source1>][,<source2>]

<source1>, <source2> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}

<n> ::= 1 to (# analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

The :MEASure:DELay command places the instrument in the continuous measurement mode and starts a delay measurement.

The measurement is taken as:

delay = t(<edge spec 2>) - t(<edge spec 1>)

where the <edge spec> definitions are set by the :MEASure:DEFine command

NOTE

The :MEASure:DELay command and the front-panel delay measurement differ from the :MEASure:DELay? query.

The delay command or front-panel measurement run the delay measurement in auto-edge select mode. In this mode, you can select the edge polarity, but the instrument will select the edges that will make the best possible delay measurement. The source1 edge chosen will be the edge that meets the polarity specified and is closest to the trigger reference point. The source2 edge selected will be that edge of the specified polarity that gives the first of the following criteria:

- **The smallest positive delay value that is less than source1 period.**
- **The smallest negative delay that is less than source1 period.**
- **The smallest absolute value of delay.**

The :MEASure:DELay? query will make the measurement using the edges specified by the :MEASure:DEFine command.

Query Syntax

```
:MEASure:DELay? [<source1>][,<source2>]
```

The :MEASure:DELay? query measures and returns the delay between source1 and source2. The delay measurement is made from the user-defined slope and edge count of the signal connected to source1, to the defined slope and edge count of the signal connected to source2. Delay measurement slope and edge parameters are selected using the :MEASure:DEFine command.

Also in the :MEASure:DEFine command, you can set upper, middle, and lower threshold values. *It is the middle threshold value that is used when performing the delay query.* The standard upper, middle, and lower measurement thresholds are

90%, 50%, and 10% values between Vbase and Vtop. If you want to move the delay measurement point nearer to Vtop or Vbase, you must change the threshold values with the :MEASure:DEFine THResholds command.

Return Format

```
<value><NL>

<value> ::= floating-point number delay time in seconds in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:DEFine" on page 345
- ":MEASure:PHASe" on page 358

:MEASure:DUTYcycle

C (see page 776)

Command Syntax

```
:MEASure:DUTYcycle [<source>]

<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal}

<n> ::= 1 to (# of analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

The :MEASure:DUTYcycle command installs a screen measurement and starts a duty cycle measurement on the current :MEASure:SOURce. If the optional source parameter is specified, the current source is modified.

NOTE The signal must be displayed to make the measurement. This command is not available if the source is FFT (Fast Fourier Transform).

Query Syntax

```
:MEASure:DUTYcycle? [<source>]
```

The :MEASure:DUTYcycle? query measures and outputs the duty cycle of the signal specified by the :MEASure:SOURce command. The value returned for the duty cycle is the ratio of the positive pulse width to the period. The positive pulse width and the period of the specified signal are measured, then the duty cycle is calculated with the following formula:

duty cycle = (+pulse width/period)*100

Return Format

```
<value><NL>

<value> ::= ratio of positive pulse width to period in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:PERiod" on page 357
- ":MEASure:PWIDth" on page 360
- ":MEASure:SOURce" on page 364

Example Code

- "Example Code" on page 364

:MEASure:FALLtime

C (see page 776)

Command Syntax

```
:MEASure:FALLtime [<source>]

<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}

<n> ::= 1 to (# analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

The :MEASure:FALLtime command installs a screen measurement and starts a fall-time measurement. For highest measurement accuracy, set the sweep speed as fast as possible, while leaving the falling edge of the waveform on the display. If the optional source parameter is specified, the current source is modified.

NOTE This command is not available if the source is FFT (Fast Fourier Transform).

Query Syntax

```
:MEASure:FALLtime? [<source>]
```

The :MEASure:FALLtime? query measures and outputs the fall time of the displayed falling (negative-going) edge closest to the trigger reference. The fall time is determined by measuring the time at the upper threshold of the falling edge, then measuring the time at the lower threshold of the falling edge, and calculating the fall time with the following formula:

fall time = time at lower threshold - time at upper threshold

Return Format

```
<value><NL>

<value> ::= time in seconds between the lower threshold and upper
            threshold in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:RISetime" on page 361
- ":MEASure:SOURce" on page 364

:MEASure:FREQuency

C (see page 776)

Command Syntax

```
:MEASure:FREQuency [<source>]

<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal}

<n> ::= 1 to (# of analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

The :MEASure:FREQuency command installs a screen measurement and starts a frequency measurement. If the optional source parameter is specified, the current source is modified.

IF the edge on the screen closest to the trigger reference is rising:

THEN frequency = 1/(time at trailing rising edge - time at leading rising edge)

ELSE frequency = 1/(time at trailing falling edge - time at leading falling edge)

NOTE This command is not available if the source is FFT (Fast Fourier Transform).

Query Syntax

```
:MEASure:FREQuency? [<source>]
```

The :MEASure:FREQuency? query measures and outputs the frequency of the cycle on the screen closest to the trigger reference.

Return Format

```
<source><NL>

<source> ::= frequency in Hertz in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:SOURce" on page 364
- ":MEASure:PERiod" on page 357

Example Code

- "Example Code" on page 364

:MEASure:NDUTy

N (see page 776)

Command Syntax

```
:MEASure:NDUTy [<source>]

<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal}

<n> ::= 1 to (# of analog channels) in NR1 format

<r> ::= 1 to (# ref waveforms) in NR1 format
```

The :MEASure:NDUTy command installs a screen measurement and starts a negative duty cycle measurement on the current :MEASure:SOURce. If the optional source parameter is specified, the current source is modified.

NOTE **The signal must be displayed to make the measurement. This command is not available if the source is FFT (Fast Fourier Transform).**

Query Syntax

```
:MEASure:NDUTy? [<source>]
```

The :MEASure:NDUTy? query measures and outputs the negative duty cycle of the signal specified by the :MEASure:SOURce command. The value returned for the duty cycle is the ratio of the negative pulse width to the period. The negative pulse width and the period of the specified signal are measured, then the duty cycle is calculated with the following formula:

-duty cycle = (-pulse width/period)*100

Return Format

```
<value><NL>

<value> ::= ratio of negative pulse width to period in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:PERiod" on page 357
- ":MEASure:NWIDth" on page 354
- ":MEASure:SOURce" on page 364
- ":MEASure:DUTYcycle" on page 350

:MEASure:NWIDth

🟩C (see page 776)

Command Syntax

```
:MEASure:NWIDth [<source>]

<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal}

<n> ::= 1 to (# of analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

The :MEASure:NWIDth command installs a screen measurement and starts a negative pulse width measurement. If the optional source parameter is not specified, the current source is modified.

NOTE This command is not available if the source is FFT (Fast Fourier Transform).

Query Syntax

```
:MEASure:NWIDth? [<source>]
```

The :MEASure:NWIDth? query measures and outputs the width of the negative pulse on the screen closest to the trigger reference using the midpoint between the upper and lower thresholds.

FOR the negative pulse closest to the trigger point:

width = (time at trailing rising edge - time at leading falling edge)

Return Format

```
<value><NL>

<value> ::= negative pulse width in seconds in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:SOURce" on page 364
- ":MEASure:PWIDth" on page 360
- ":MEASure:PERiod" on page 357

:MEASure:OVERshoot

C (see page 776)

Command Syntax

```
:MEASure:OVERshoot [<source>]
```

```
<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

```
<r> ::= 1-2 in NR1 format
```

The :MEASure:OVERshoot command installs a screen measurement and starts an overshoot measurement. If the optional source parameter is specified, the current source is modified.

NOTE This command is not available if the source is FFT (Fast Fourier Transform).

Query Syntax

```
:MEASure:OVERshoot? [<source>]
```

The :MEASure:OVERshoot? query measures and returns the overshoot of the edge closest to the trigger reference, displayed on the screen. The method used to determine overshoot is to make three different vertical value measurements: Vtop, Vbase, and either Vmax or Vmin, depending on whether the edge is rising or falling.

For a rising edge:

overshoot = ((Vmax-Vtop) / (Vtop-Vbase)) x 100

For a falling edge:

overshoot = ((Vbase-Vmin) / (Vtop-Vbase)) x 100

Vtop and Vbase are taken from the normal histogram of all waveform vertical values. The extremum of Vmax or Vmin is taken from the waveform interval right after the chosen edge, halfway to the next edge. This more restricted definition is used instead of the normal one, because it is conceivable that a signal may have more preshoot than overshoot, and the normal extremum would then be dominated by the preshoot of the following edge.

Return Format

```
<overshoot><NL>
```

```
<overshoot>::= the percent of the overshoot of the selected waveform in
NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:PREShoot" on page 359
- ":MEASure:SOURce" on page 364
- ":MEASure:VMAX" on page 373

- ":MEASure:VTOP" on page 378
- ":MEASure:VBASe" on page 372
- ":MEASure:VMIN" on page 374

:MEASure:PERiod

C (see page 776)

Command Syntax

```
:MEASure:PERiod [<source>]

<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal}

<n> ::= 1 to (# of analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

The :MEASure:PERiod command installs a screen measurement and starts the period measurement. If the optional source parameter is specified, the current source is modified.

NOTE This command is not available if the source is FFT (Fast Fourier Transform).

Query Syntax

```
:MEASure:PERiod? [<source>]
```

The :MEASure:PERiod? query measures and outputs the period of the cycle closest to the trigger reference on the screen. The period is measured at the midpoint of the upper and lower thresholds.

IF the edge closest to the trigger reference on screen is rising:

THEN period = (time at trailing rising edge - time at leading rising edge)

ELSE period = (time at trailing falling edge - time at leading falling edge)

Return Format

```
<value><NL>

<value> ::= waveform period in seconds in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:SOURce" on page 364
- ":MEASure:NWIDth" on page 354
- ":MEASure:PWIDth" on page 360
- ":MEASure:FREQuency" on page 352

Example Code

- "Example Code" on page 364

:MEASure:PHASe

N (see page 776)

Command Syntax

```
:MEASure:PHASe [<source1>][,<source2>]

<source1>, <source2> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}

<n> ::= 1 to (# analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

The :MEASure:PHASe command places the instrument in the continuous measurement mode and starts a phase measurement.

Query Syntax

```
:MEASure:PHASe? [<source1>][,<source2>]
```

The :MEASure:PHASe? query measures and returns the phase between the specified sources.

A phase measurement is a combination of the period and delay measurements. First, the period is measured on source1. Then the delay is measured between source1 and source2. The edges used for delay are the source1 rising edge used for the period measurement closest to the horizontal reference and the rising edge on source 2. See :MEASure:DELay for more detail on selecting the 2nd edge.

The phase is calculated as follows:

phase = (delay / period of input 1) x 360

Return Format

```
<value><NL>

<value> ::= the phase angle value in degrees in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:DELay" on page 348
- ":MEASure:PERiod" on page 357
- ":MEASure:SOURce" on page 364

:MEASure:PREShoot

C (see page 776)

Command Syntax

```
:MEASure:PREShoot [<source>]

<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}

<n> ::= 1 to (# analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

The :MEASure:PREShoot command installs a screen measurement and starts a preshoot measurement. If the optional source parameter is specified, the current source is modified.

Query Syntax

```
:MEASure:PREShoot? [<source>]
```

The :MEASure:PREShoot? query measures and returns the preshoot of the edge closest to the trigger, displayed on the screen. The method used to determine preshoot is to make three different vertical value measurements: Vtop, Vbase, and either Vmin or Vmax, depending on whether the edge is rising or falling.

For a rising edge:

preshoot = ((Vmin-Vbase) / (Vtop-Vbase)) x 100

For a falling edge:

preshoot = ((Vmax-Vtop) / (Vtop-Vbase)) x 100

Vtop and Vbase are taken from the normal histogram of all waveform vertical values. The extremum of Vmax or Vmin is taken from the waveform interval right before the chosen edge, halfway back to the previous edge. This more restricted definition is used instead of the normal one, because it is likely that a signal may have more overshoot than preshoot, and the normal extremum would then be dominated by the overshoot of the preceding edge.

Return Format

```
<value><NL>

<value> ::= the percent of preshoot of the selected waveform
            in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:SOURce" on page 364
- ":MEASure:VMIN" on page 374
- ":MEASure:VMAX" on page 373
- ":MEASure:VTOP" on page 378
- ":MEASure:VBASe" on page 372

:MEASure:PWIDth

C (see page 776)

Command Syntax

```
:MEASure:PWIDth [<source>]

<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal}

<n> ::= 1 to (# of analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

The :MEASure:PWIDth command installs a screen measurement and starts the positive pulse width measurement. If the optional source parameter is specified, the current source is modified.

NOTE This command is not available if the source is FFT (Fast Fourier Transform).

Query Syntax

```
:MEASure:PWIDth? [<source>]
```

The :MEASure:PWIDth? query measures and outputs the width of the displayed positive pulse closest to the trigger reference. Pulse width is measured at the midpoint of the upper and lower thresholds.

IF the edge on the screen closest to the trigger is falling:

THEN width = (time at trailing falling edge - time at leading rising edge)

ELSE width = (time at leading falling edge - time at leading rising edge)

Return Format

```
<value><NL>

<value> ::= width of positive pulse in seconds in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:SOURce" on page 364
- ":MEASure:NWIDth" on page 354
- ":MEASure:PERiod" on page 357

:MEASure:RISetime

C (see page 776)

Command Syntax

```
:MEASure: RISetime [<source>]

<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}

<n> ::= 1 to (# analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

The :MEASure:RISetime command installs a screen measurement and starts a rise-time measurement. If the optional source parameter is specified, the current source is modified.

NOTE This command is not available if the source is FFT (Fast Fourier Transform).

Query Syntax

```
:MEASure: RISetime? [<source>]
```

The :MEASure:RISetime? query measures and outputs the rise time of the displayed rising (positive-going) edge closest to the trigger reference. For maximum measurement accuracy, set the sweep speed as fast as possible while leaving the leading edge of the waveform on the display. The rise time is determined by measuring the time at the lower threshold of the rising edge and the time at the upper threshold of the rising edge, then calculating the rise time with the following formula:

rise time = time at upper threshold - time at lower threshold

Return Format

```
<value><NL>

<value> ::= rise time in seconds in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:SOURce" on page 364
- ":MEASure:FALLtime" on page 351

:MEASure:SDEViation

N (see page 776)

Command Syntax

```
:MEASure:SDEViation [<source>]

<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}

<n> ::= 1-2 or 1-4 (# of analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

NOTE This ":MEASure:VRMS DISPlay, AC" command is the preferred syntax for making standard deviation measurements.

The :MEASure:SDEViation command installs a screen measurement and starts std deviation measurement. If the optional source parameter is specified, the current source is modified.

NOTE This command is not available if the source is FFT (Fast Fourier Transform).

Query Syntax

```
:MEASure:SDEViation? [<source>]
```

The :MEASure:SDEViation? query measures and outputs the std deviation of the selected waveform. The oscilloscope computes the std deviation on all displayed data points.

Return Format

```
<value><NL>

<value> ::= calculated std deviation value in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:VRMS" on page 376
- ":MEASure:SOURce" on page 364

:MEASure:SHOW

N (see page 776)

Command Syntax

```
:MEASure:SHOW <show>
```

```
<show> ::= {1 | ON}
```

The :MEASure:SHOW command enables markers for tracking measurements on the display. This feature is always on.

Query Syntax

```
:MEASure:SHOW?
```

The :MEASure:SHOW? query returns the current state of the markers.

Return Format

```
<show><NL>
```

```
<show> ::= 1
```

See Also

- "Introduction to :MEASure Commands" on page 339

:MEASure:SOURce

C (see page 776)

Command Syntax

```
:MEASure:SOURce <source1>[,<source2>]

<source1>,<source2> ::= {CHANnel<n> | FUNCtion
                        | MATH | WMEMory<r> | EXTernal}

<n> ::= 1 to (# of analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

The :MEASure:SOURce command sets the default sources for measurements. The specified sources are used as the sources for the MEASure subsystem commands if the sources are not explicitly set with the command.

If a source is specified for any measurement, the current source is changed to this new value.

If :MARKer:MODE is set to OFF or MANual, setting :MEASure:SOURce to CHANnel<n>, FUNCtion, or MATH will also set :MARKer:X1Y1source to source1 and :MARKer:X2Y2source to source2.

EXTernal is only a valid source for the counter measurement (and <source1>).

Query Syntax

```
:MEASure:SOURce?
```

The :MEASure:SOURce? query returns the current source selections. If source2 is not specified, the query returns "NONE" for source2. If all channels are off, the query returns "NONE,NONE". Source2 only applies to :MEASure:DELay and :MEASure:PHASe measurements.

NOTE MATH is an alias for FUNCtion. The query will return FUNC if the source is FUNCtion or MATH.

Return Format

```
<source1>,<source2><NL>

<source1>,<source2> ::= {CHAN<n> | FUNC | WMWM<r>
                        | EXT | NONE}
```

See Also:

- "Introduction to :MEASure Commands" on page 339
- ":MARKer:MODE" on page 318
- ":MARKer:X1Y1source" on page 320
- ":MARKer:X2Y2source" on page 322
- ":MEASure:DELay" on page 348
- ":MEASure:PHASe" on page 358

Example Code

```
' MEASURE - The commands in the MEASURE subsystem are used to make
' measurements on displayed waveforms.
```

```
myScope.WriteString ":MEASURE:SOURCE CHANNEL1"   ' Source to measure.
myScope.WriteString ":MEASURE:FREQUENCY?"   ' Query for frequency.
varQueryResult = myScope.ReadNumber   ' Read frequency.
MsgBox "Frequency:" + vbCrLf _
      + FormatNumber(varQueryResult / 1000, 4) + " kHz"
myScope.WriteString ":MEASURE:DUTYCYCLE?"   ' Query for duty cycle.
varQueryResult = myScope.ReadNumber   ' Read duty cycle.
MsgBox "Duty cycle:" + vbCrLf _
      + FormatNumber(varQueryResult, 3) + "%"
myScope.WriteString ":MEASURE:RISETIME?"   ' Query for risetime.
varQueryResult = myScope.ReadNumber   ' Read risetime.
MsgBox "Risetime:" + vbCrLf _
      + FormatNumber(varQueryResult * 1000000, 4) + " us"
myScope.WriteString ":MEASURE:VPP?"   ' Query for Pk to Pk voltage.
varQueryResult = myScope.ReadNumber   ' Read VPP.
MsgBox "Peak to peak voltage:" + vbCrLf _
      + FormatNumber(varQueryResult, 4) + " V"
myScope.WriteString ":MEASURE:VMAX?"   ' Query for Vmax.
varQueryResult = myScope.ReadNumber   ' Read Vmax.
MsgBox "Maximum voltage:" + vbCrLf _
      + FormatNumber(varQueryResult, 4) + " V"
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:MEASure:TEDGe

N (see page 776)

Query Syntax

```
:MEASure:TEDGe? <slope><occurrence>[,<source>]

<slope> ::= direction of the waveform. A rising slope is indicated by a
            space or plus sign (+). A falling edge is indicated by a
            minus sign (-).

<occurrence> ::= the transition to be reported. If the occurrence number
                 is one, the first crossing from the left screen edge is
                 reported.  If the number is two, the second crossing is
                 reported, etc.

<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal}

<n> ::= 1 to (# of analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

When the :MEASure:TEDGe query is sent, the displayed signal is searched for the specified transition. The time interval between the trigger event and this occurrence is returned as the response to the query. The sign of the slope selects a rising (+) or falling (-) edge. If no sign is specified for the slope, it is assumed to be the rising edge.

The magnitude of occurrence defines the occurrence to be reported. For example, +3 returns the time for the third time the waveform crosses the midpoint threshold in the positive direction. Once this crossing is found, the oscilloscope reports the time at that crossing in seconds, with the trigger point (time zero) as the reference.

If the specified crossing cannot be found, the oscilloscope reports +9.9E+37. This value is returned if the waveform does not cross the specified vertical value, or if the waveform does not cross the specified vertical value for the specific number of times in the direction specified.

You can make delay and phase measurements using the MEASure:TEDGe command:

Delay = time at the nth rising or falling edge of the channel - time at the same edge of another channel

Phase = (delay between channels / period of channel) x 360

For an example of making a delay and phase measurement, see ":MEASure:TEDGe Code" on page 367.

If the optional source parameter is specified, the current source is modified.

NOTE This query is not available if the source is FFT (Fast Fourier Transform).

Return Format

```
<value><NL>

<value> ::= time in seconds of the specified transition in NR3 format
```

:MEASure:TEDGe Code

```
' Make a delay measurement between channel 1 and 2.
Dim dblChan1Edge1 As Double
Dim dblChan2Edge1 As Double
Dim dblChan1Edge2 As Double
Dim dblDelay As Double
Dim dblPeriod As Double
Dim dblPhase As Double

' Query time at 1st rising edge on ch1.
myScope.WriteString ":MEASURE:TEDGE? +1, CHAN1"

' Read time at edge 1 on ch 1.
dblChan1Edge1 = myScope.ReadNumber

' Query time at 1st rising edge on ch2.
myScope.WriteString ":MEASURE:TEDGE? +1, CHAN2"

' Read time at edge 1 on ch 2.
dblChan2Edge1 = myScope.ReadNumber

' Calculate delay time between ch1 and ch2.
dblDelay = dblChan2Edge1 - dblChan1Edge1

' Write calculated delay time to screen.
MsgBox "Delay = " + vbCrLf + CStr(dblDelay)

' Make a phase difference measurement between channel 1 and 2.
' Query time at 1st rising edge on ch1.
myScope.WriteString ":MEASURE:TEDGE? +2, CHAN1"

' Read time at edge 2 on ch 1.
dblChan1Edge2 = myScope.ReadNumber

' Calculate period of ch 1.
dblPeriod = dblChan1Edge2 - dblChan1Edge1

' Calculate phase difference between ch1 and ch2.
dblPhase = (dblDelay / dblPeriod) * 360
MsgBox "Phase = " + vbCrLf + CStr(dblPhase)
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:TVALue" on page 368
- ":MEASure:VTIMe" on page 377

:MEASure:TVALue

C (see page 776)

Query Syntax

```
:MEASure:TVALue? <value>, [<slope>]<occurrence>[,<source>]

<value> ::= the vertical value that the waveform must cross.  The
            value can be volts or a math function value such as dB,
            Vs, or V/s.

<slope> ::= direction of the waveform.  A rising slope is indicated
            by a plus sign (+).  A falling edge is indicated by a
            minus sign (-).

<occurrence> ::= the transition to be reported. If the occurrence
                 number is one, the first crossing is reported.  If
                 the number is two, the second crossing is reported,
                 etc.

<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}

<n> ::= 1 to (# analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

When the :MEASure:TVALue? query is sent, the displayed signal is searched for the specified value level and transition. The time interval between the trigger event and this defined occurrence is returned as the response to the query.

The specified value can be negative or positive. To specify a negative value, use a minus sign (-). The sign of the slope selects a rising (+) or falling (-) edge. If no sign is specified for the slope, it is assumed to be the rising edge.

The magnitude of the occurrence defines the occurrence to be reported. For example, +3 returns the time for the third time the waveform crosses the specified value level in the positive direction. Once this value crossing is found, the oscilloscope reports the time at that crossing in seconds, with the trigger point (time zero) as the reference.

If the specified crossing cannot be found, the oscilloscope reports +9.9E+37. This value is returned if the waveform does not cross the specified value, or if the waveform does not cross the specified value for the specified number of times in the direction specified.

If the optional source parameter is specified, the current source is modified.

NOTE This query is not available if the source is FFT (Fast Fourier Transform).

Return Format

```
<value><NL>

<value> ::= time in seconds of the specified value crossing in
            NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:TEDGe" on page 366
- ":MEASure:VTIMe" on page 377

:MEASure:VAMPlitude

C (see page 776)

Command Syntax

```
:MEASure:VAMPlitude [<source>]

<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}

<n> ::= 1 to (# analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

The :MEASure:VAMPlitude command installs a screen measurement and starts a vertical amplitude measurement. If the optional source parameter is specified, the current source is modified.

Query Syntax

```
:MEASure:VAMPlitude? [<source>]
```

The :MEASure:VAMPlitude? query measures and returns the vertical amplitude of the waveform. To determine the amplitude, the instrument measures Vtop and Vbase, then calculates the amplitude as follows:

vertical amplitude = Vtop - Vbase

Return Format

```
<value><NL>

<value> ::= the amplitude of the selected waveform in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:SOURce" on page 364
- ":MEASure:VBASe" on page 372
- ":MEASure:VTOP" on page 378
- ":MEASure:VPP" on page 375

:MEASure:VAVerage

C (see page 776)

Command Syntax

```
:MEASure:VAVerage [<interval>][,][<source>]

<interval> ::= {CYCLe | DISPlay}

<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r>}

<n> ::= 1 to (# of analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

The :MEASure:VAVerage command installs a screen measurement and starts an average value measurement. If the optional source parameter is specified, the current source is modified.

The <interval> option lets you specify the measurement interval: either an integral number of cycles, or the full screen. If <interval> is not specified, DISPlay is implied.

Query Syntax

```
:MEASure:VAVerage? [<interval>][,][<source>]
```

The :MEASure:VAVerage? query returns the average value of an integral number of periods of the signal. If at least three edges are not present, the oscilloscope averages all data points.

Return Format

```
<value><NL>

<value> ::= calculated average value in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:SOURce" on page 364

:MEASure:VBASe

C (see page 776)

Command Syntax

```
:MEASure:VBASe [<source>]

<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}

<n> ::= 1 to (# analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

The :MEASure:VBASe command installs a screen measurement and starts a waveform base value measurement. If the optional source parameter is specified, the current source is modified.

NOTE This command is not available if the source is FFT (Fast Fourier Transform).

Query Syntax

```
:MEASure:VBASe? [<source>]
```

The :MEASure:VBASe? query returns the vertical value at the base of the waveform. The base value of a pulse is normally not the same as the minimum value.

Return Format

```
<base_voltage><NL>

<base_voltage> ::= value at the base of the selected waveform in
                   NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:SOURce" on page 364
- ":MEASure:VTOP" on page 378
- ":MEASure:VAMPlitude" on page 370
- ":MEASure:VMIN" on page 374

:MEASure:VMAX

C (see page 776)

Command Syntax

```
:MEASure:VMAX [<source>]

<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r>}

<n> ::= 1 to (# of analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

The :MEASure:VMAX command installs a screen measurement and starts a maximum vertical value measurement. If the optional source parameter is specified, the current source is modified.

Query Syntax

```
:MEASure:VMAX? [<source>]
```

The :MEASure:VMAX? query measures and outputs the maximum vertical value present on the selected waveform.

Return Format

```
<value><NL>

<value> ::= maximum vertical value of the selected waveform in
            NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:SOURce" on page 364
- ":MEASure:VMIN" on page 374
- ":MEASure:VPP" on page 375
- ":MEASure:VTOP" on page 378

:MEASure:VMIN

C (see page 776)

Command Syntax

```
:MEASure:VMIN [<source>]

<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r>}

<n> ::= 1 to (# analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

The :MEASure:VMIN command installs a screen measurement and starts a minimum vertical value measurement. If the optional source parameter is specified, the current source is modified.

Query Syntax

```
:MEASure:VMIN? [<source>]
```

The :MEASure:VMIN? query measures and outputs the minimum vertical value present on the selected waveform.

Return Format

```
<value><NL>

<value> ::= minimum vertical value of the selected waveform in
            NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:SOURce" on page 364
- ":MEASure:VBASe" on page 372
- ":MEASure:VMAX" on page 373
- ":MEASure:VPP" on page 375

:MEASure:VPP

C (see page 776)

Command Syntax

```
:MEASure:VPP [<source>]

<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r>}

<n> ::= 1 to (# analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

The :MEASure:VPP command installs a screen measurement and starts a vertical peak-to-peak measurement. If the optional source parameter is specified, the current source is modified.

Query Syntax

```
:MEASure:VPP? [<source>]
```

The :MEASure:VPP? query measures the maximum and minimum vertical value for the selected source, then calculates the vertical peak-to-peak value and returns that value. The peak-to-peak value (Vpp) is calculated with the following formula:

Vpp = Vmax - Vmin

Vmax and Vmin are the vertical maximum and minimum values present on the selected source.

Return Format

```
<value><NL>

<value> ::= vertical peak to peak value in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:SOURce" on page 364
- ":MEASure:VMAX" on page 373
- ":MEASure:VMIN" on page 374
- ":MEASure:VAMPlitude" on page 370

:MEASure:VRMS

C (see page 776)

Command Syntax

```
:MEASure:VRMS [<interval>][,<type>][,<source>]

<interval> ::= {CYCLe | DISPlay}

<type> ::= {AC | DC}

<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}

<n> ::= 1 to (# analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

The :MEASure:VRMS command installs a screen measurement and starts an RMS value measurement. If the optional source parameter is specified, the current source is modified.

The <interval> option lets you specify the measurement interval: either an integral number of cycles, or the full screen. If <interval> is not specified, DISPlay is implied.

The <type> option lets you choose between a DC RMS measurement and an AC RMS measurement. If <type> is not specified, DC is implied.

NOTE This command is not available if the source is FFT (Fast Fourier Transform).

Query Syntax

```
:MEASure:VRMS? [<interval>][,<type>][,<source>]
```

The :MEASure:VRMS? query measures and outputs the dc RMS value of the selected waveform. The dc RMS value is measured on an integral number of periods of the displayed signal. If at least three edges are not present, the oscilloscope computes the RMS value on all displayed data points.

Return Format

```
<value><NL>

<value> ::= calculated dc RMS value in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:SOURce" on page 364

:MEASure:VTIMe

N (see page 776)

Query Syntax

```
:MEASure:VTIMe? <vtime_argument>[,<source>]

<vtime_argument> ::= time from trigger in seconds

<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r> | EXTernal}

<n> ::= 1 to (# of analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

The :MEASure:VTIMe? query returns the value at a specified time on the source specified with :MEASure:SOURce. The specified time must be on the screen and is referenced to the trigger event. If the optional source parameter is specified, the current source is modified.

For the EXT digital waveform source, the returned value is either 1 or 0, based on the threshold voltage setting.

NOTE This query is not available if the source is FFT (Fast Fourier Transform).

Return Format

```
<value><NL>

<value> ::= value at the specified time in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:SOURce" on page 364
- ":MEASure:TEDGe" on page 366
- ":MEASure:TVALue" on page 368

:MEASure:VTOP

C (see page 776)

Command Syntax

```
:MEASure:VTOP [<source>]
```

```
<source> ::= {CHANnel<n> | FUNCtion | MATH}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

```
<r> ::= 1-2 in NR1 format
```

The :MEASure:VTOP command installs a screen measurement and starts a waveform top value measurement.

NOTE This query is not available if the source is FFT (Fast Fourier Transform).

Query Syntax

```
:MEASure:VTOP? [<source>]
```

The :MEASure:VTOP? query returns the vertical value at the top of the waveform. The top value of the pulse is normally not the same as the maximum value.

Return Format

```
<value><NL>
```

```
<value> ::= vertical value at the top of the waveform in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:SOURce" on page 364
- ":MEASure:VMAX" on page 373
- ":MEASure:VAMPlitude" on page 370
- ":MEASure:VBASe" on page 372

:MEASure:WINDow

N (see page 776)

Command Syntax

```
:MEASure:WINDow <type>
```

```
<type> ::= {MAIN | ZOOM | AUTO}
```

When the zoomed time base is displayed, the :MEASure:WINDow command lets you specify the measurement window:

- MAIN — the measurement window is the upper, Main window.
- ZOOM — the measurement window is the lower, Zoom window.
- AUTO — the measurement is attempted in the lower, Zoom window; if it cannot be made there, the upper, Main window is used.

Query Syntax

```
:MEASure:WINDow?
```

The :MEASure:WINDow? query returns the current measurement window setting.

Return Format

```
<type><NL>
```

```
<type> ::= {MAIN | ZOOM | AUTO}
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:SOURce" on page 364

:MEASure:XMAX

N (see page 776)

Command Syntax

```
:MEASure:XMAX [<source>]

<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}

<n> ::= 1-2 or 1-4 (# of analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

The :MEASure:XMAX command installs a screen measurement and starts an X-at-Max-Y measurement on the selected window. If the optional source parameter is specified, the current source is modified.

NOTE :MEASure:XMAX is an alias for :MEASure:TMAX.

Query Syntax

```
:MEASure:XMAX? [<source>]
```

The :MEASure:XMAX? query measures and returns the horizontal axis value at which the maximum vertical value occurs. If the optional source is specified, the current source is modified. If all channels are off, the query returns 9.9E+37.

Return Format

```
<value><NL>

<value> ::= horizontal value of the maximum in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:XMIN" on page 381
- ":MEASure:TMAX" on page 714

:MEASure:XMIN

N (see page 776)

Command Syntax

```
:MEASure:XMIN [<source>]

<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}

<n> ::= 1-2 or 1-4 (# of analog channels) in NR1 format

<r> ::= 1-2 in NR1 format
```

The :MEASure:XMIN command installs a screen measurement and starts an X-at-Min-Y measurement on the selected window. If the optional source parameter is specified, the current source is modified.

NOTE

:MEASure:XMIN is an alias for :MEASure:TMIN.

Query Syntax

```
:MEASure:XMIN? [<source>]
```

The :MEASure:XMIN? query measures and returns the horizontal axis value at which the minimum vertical value occurs. If the optional source is specified, the current source is modified. If all channels are off, the query returns 9.9E+37.

Return Format

```
<value><NL>

<value> ::= horizontal value of the minimum in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:XMAX" on page 380
- ":MEASure:TMIN" on page 715

21 :MTESt Commands

Mask testing is available on the DSOX1000-Series oscilloscope models.

The MTESt subsystem commands and queries control the mask test features. See "Introduction to :MTESt Commands" on page 385.

Table 64 :MTESt Commands Summary

Command	Query	Options and Query Returns
`:MTESt:ALL {{0 | OFF} | {1 | ON}}` (see page 388)	`:MTESt:ALL?` (see page 388)	`{0 | 1}`
`:MTESt:AMASk:CREate` (see page 389)	n/a	n/a

`:MTESt:AMASk:SOURce <source>` (see page 390)	`:MTESt:AMASk:SOURce?` (see page 390)	`<source> ::= CHANnel<n>`
		`<n> ::= {1 | 2 | 3 | 4} for 4ch models`
		`<n> ::= {1 | 2} for 2ch models`

`:MTESt:AMASk:UNITs <units>` (see page 391)	`:MTESt:AMASk:UNITs?` (see page 391)	`<units> ::= {CURRent | DIVisions}`
`:MTESt:AMASk:XDELta <value>` (see page 392)	`:MTESt:AMASk:XDELta?` (see page 392)	`<value> ::= X delta value in NR3 format`
`:MTESt:AMASk:YDELta <value>` (see page 393)	`:MTESt:AMASk:YDELta?` (see page 393)	`<value> ::= Y delta value in NR3 format`
n/a	`:MTESt:COUNt:FWAVeforms? [CHANnel<n>]` (see page 394)	`<failed> ::= number of failed waveforms in NR1 format`
`:MTESt:COUNt:RESet` (see page 395)	n/a	n/a
n/a	`:MTESt:COUNt:TIME?` (see page 396)	`<time> ::= elapsed seconds in NR3 format`
n/a	`:MTESt:COUNt:WAVeforms?` (see page 397)	`<count> ::= number of waveforms in NR1 format`

Table 64 :MTESt Commands Summary (continued)

Command	Query	Options and Query Returns
:MTESt:DATA <mask> (see page 398)	:MTESt:DATA? (see page 398)	<mask> ::= data in IEEE 488.2 # format.
:MTESt:DELete (see page 399)	n/a	n/a
:MTESt:ENABle {{0 | OFF} | {1 | ON}} (see page 400)	:MTESt:ENABle? (see page 400)	{0 | 1}
:MTESt:LOCK {{0 | OFF} | {1 | ON}} (see page 401)	:MTESt:LOCK? (see page 401)	{0 | 1}
:MTESt:RMODe <rmode> (see page 402)	:MTESt:RMODe? (see page 402)	<rmode> ::= {FORever | TIME | SIGMa | WAVeforms}
:MTESt:RMODe:FACTion:MEASure {{0 | OFF} | {1 | ON}} (see page 403)	:MTESt:RMODe:FACTion:MEASure? (see page 403)	{0 | 1}
:MTESt:RMODe:FACTion:PRINt {{0 | OFF} | {1 | ON}} (see page 404)	:MTESt:RMODe:FACTion:PRINt? (see page 404)	{0 | 1}
:MTESt:RMODe:FACTion:SAVE {{0 | OFF} | {1 | ON}} (see page 405)	:MTESt:RMODe:FACTion:SAVE? (see page 405)	{0 | 1}
:MTESt:RMODe:FACTion:STOP {{0 | OFF} | {1 | ON}} (see page 406)	:MTESt:RMODe:FACTion:STOP? (see page 406)	{0 | 1}
:MTESt:RMODe:SIGMa <level> (see page 407)	:MTESt:RMODe:SIGMa? (see page 407)	<level> ::= from 0.1 to 9.3 in NR3 format
:MTESt:RMODe:TIME <seconds> (see page 408)	:MTESt:RMODe:TIME? (see page 408)	<seconds> ::= from 1 to 86400 in NR3 format
:MTESt:RMODe:WAVeforms <count> (see page 409)	:MTESt:RMODe:WAVeforms? (see page 409)	<count> ::= number of waveforms in NR1 format
:MTESt:SCALe:BIND {{0 | OFF} | {1 | ON}} (see page 410)	:MTESt:SCALe:BIND? (see page 410)	{0 | 1}
:MTESt:SCALe:X1 <x1_value> (see page 411)	:MTESt:SCALe:X1? (see page 411)	<x1_value> ::= X1 value in NR3 format

Table 64 :MTESt Commands Summary (continued)

Command	Query	Options and Query Returns
:MTESt:SCALe:XDELta <xdelta_value> (see page 412)	:MTESt:SCALe:XDELta? (see page 412)	<xdelta_value> ::= X delta value in NR3 format
:MTESt:SCALe:Y1 <y1_value> (see page 413)	:MTESt:SCALe:Y1? (see page 413)	<y1_value> ::= Y1 value in NR3 format
:MTESt:SCALe:Y2 <y2_value> (see page 414)	:MTESt:SCALe:Y2? (see page 414)	<y2_value> ::= Y2 value in NR3 format
:MTESt:SOURce <source> (see page 415)	:MTESt:SOURce? (see page 415)	<source> ::= {CHANnel<n> | NONE} <n> ::= {1 | 2 | 3 | 4} for 4ch models <n> ::= {1 | 2} for 2ch models
n/a	:MTESt:TITLe? (see page 416)	<title> ::= a string of up to 128 ASCII characters

Introduction to :MTESt Commands

Mask testing automatically compares the current displayed waveform with the boundaries of a set of polygons that you define. Any waveform or sample that falls within the boundaries of one or more polygons is recorded as a failure.

Reporting the Setup

Use :MTESt? to query setup information for the MTESt subsystem.

Return Format

The following is a sample response from the :MTESt? query. In this case, the query was issued following a *RST command.

```
:MTES:SOUR CHAN1;ENAB 0;LOCK 1;:MTES:AMAS:SOUR CHAN1;UNIT DIV;XDEL
+2.50000000E-001;YDEL +2.50000000E-001;:MTES:SCAL:X1 +200.000E-06;XDEL
+400.000E-06;Y1 -3.00000E+00;Y2 +3.00000E+00;BIND 0;:MTES:RMOD
FOR;RMOD:TIME +1E+00;WAV 1000;SIGM +6.0E+00;:MTES:RMOD:FACT:STOP
0;PRIN 0;SAVE 0
```

Example Code

```
' Mask testing commands example.
' -------------------------------------------------------------------

Option Explicit

Public myMgr As VisaComLib.ResourceManager
Public myScope As VisaComLib.FormattedIO488
Public varQueryResult As Variant
Public strQueryResult As String
```

```
Private Declare Sub Sleep Lib "kernel32" (ByVal dwMilliseconds As Long)

Sub Main()

  On Error GoTo VisaComError

  ' Create the VISA COM I/O resource.
  Set myMgr = New VisaComLib.ResourceManager
  Set myScope = New VisaComLib.FormattedIO488
  Set myScope.IO = _
        myMgr.Open("USB0::0x0957::0x17A6::US50210029::0::INSTR")
  myScope.IO.Clear   ' Clear the interface.

  ' Make sure oscilloscope is running.
  myScope.WriteString ":RUN"

  ' Set mask test termination conditions.
  myScope.WriteString ":MTESt:RMODe SIGMa"
  myScope.WriteString ":MTESt:RMODe?"
  strQueryResult = myScope.ReadString
  Debug.Print "Mask test termination mode: " + strQueryResult

  myScope.WriteString ":MTESt:RMODe:SIGMa 4.2"
  myScope.WriteString ":MTESt:RMODe:SIGMa?"
  varQueryResult = myScope.ReadNumber
  Debug.Print "Mask test termination 'test sigma': " + _
      FormatNumber(varQueryResult)

  ' Use auto-mask to create mask.
  myScope.WriteString ":MTESt:AMASk:SOURce CHANnel1"
  myScope.WriteString ":MTESt:AMASk:SOURce?"
  strQueryResult = myScope.ReadString
  Debug.Print "Mask test auto-mask source: " + strQueryResult

  myScope.WriteString ":MTESt:AMASk:UNITs DIVisions"
  myScope.WriteString ":MTESt:AMASk:UNITs?"
  strQueryResult = myScope.ReadString
  Debug.Print "Mask test auto-mask units: " + strQueryResult

  myScope.WriteString ":MTESt:AMASk:XDELta 0.1"
  myScope.WriteString ":MTESt:AMASk:XDELta?"
  varQueryResult = myScope.ReadNumber
  Debug.Print "Mask test auto-mask X delta: " + _
      FormatNumber(varQueryResult)

  myScope.WriteString ":MTESt:AMASk:YDELta 0.1"
  myScope.WriteString ":MTESt:AMASk:YDELta?"
  varQueryResult = myScope.ReadNumber
  Debug.Print "Mask test auto-mask Y delta: " + _
      FormatNumber(varQueryResult)

  ' Enable "Auto Mask Created" event (bit 10, &H400)
  myScope.WriteString "*CLS"
  myScope.WriteString ":MTEenable " + CStr(CInt("&H400"))

  ' Create mask.
  myScope.WriteString ":MTESt:AMASk:CREate"
  Debug.Print "Auto-mask created, mask test automatically enabled."

  ' Set up timeout variables.
  Dim lngTimeout As Long   ' Max millisecs to wait.
  Dim lngElapsed As Long
  lngTimeout = 60000   ' 60 seconds.

  ' Wait until mask is created.
  lngElapsed = 0
  Do While lngElapsed <= lngTimeout
    myScope.WriteString ":OPERegister:CONDition?"
    varQueryResult = myScope.ReadNumber
    ' Operation Status Condition Register MTE bit (bit 9, &H200).
    If (varQueryResult And &H200) <> 0 Then
      Exit Do
    Else
      Sleep 100   ' Small wait to prevent excessive queries.
      lngElapsed = lngElapsed + 100
    End If
  Loop

  ' Look for RUN bit = stopped (mask test termination).
  lngElapsed = 0
  Do While lngElapsed <= lngTimeout
    myScope.WriteString ":OPERegister:CONDition?"
    varQueryResult = myScope.ReadNumber
    ' Operation Status Condition Register RUN bit (bit 3, &H8).
    If (varQueryResult And &H8) = 0 Then
      Exit Do
    Else
      Sleep 100   ' Small wait to prevent excessive queries.
      lngElapsed = lngElapsed + 100
    End If
  Loop

  ' Get total waveforms, failed waveforms, and test time.
  myScope.WriteString ":MTESt:COUNt:WAVeforms?"
  strQueryResult = myScope.ReadString
  Debug.Print "Mask test total waveforms: " + strQueryResult

  myScope.WriteString ":MTESt:COUNt:FWAVeforms?"
  strQueryResult = myScope.ReadString
  Debug.Print "Mask test failed waveforms: " + strQueryResult

  myScope.WriteString ":MTESt:COUNt:TIME?"
  strQueryResult = myScope.ReadString
  Debug.Print "Mask test elapsed seconds: " + strQueryResult

  Exit Sub

VisaComError:
  MsgBox "VISA COM Error:" + vbCrLf + Err.Description

End Sub
```

:MTESt:ALL

N (see page 776)

Command Syntax

```
:MTESt:ALL <on_off>
```

```
<on_off> ::= {{1 | ON} | {0 | OFF}}
```

The :MTESt:ALL command specifies the channel(s) that are included in the mask test:

- ON — All displayed analog channels are included in the mask test.
- OFF — Just the selected source channel is included in the test.

Query Syntax

```
:MTESt:ENABle?
```

The :MTESt:ENABle? query returns the current setting.

Return Format

```
<on_off><NL>
```

```
<on_off> ::= {1 | 0}
```

See Also

- "Introduction to :MTESt Commands" on page 385

:MTESt:AMASk:CREate

N (see page 776)

Command Syntax `:MTESt:AMASk:CREate`

The :MTESt:AMASk:CREate command automatically constructs a mask around the current selected channel, using the tolerance parameters defined by the :MTESt:AMASk:XDELta, :MTESt:AMASk:YDELta, and :MTESt:AMASk:UNITs commands. The mask only encompasses the portion of the waveform visible on the display, so you must ensure that the waveform is acquired and displayed consistently to obtain repeatable results.

The :MTESt:SOURce command selects the channel and should be set before using this command.

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:AMASk:XDELta" on page 392
- ":MTESt:AMASk:YDELta" on page 393
- ":MTESt:AMASk:UNITs" on page 391
- ":MTESt:AMASk:SOURce" on page 390
- ":MTESt:SOURce" on page 415

Example Code

- "Example Code" on page 385

:MTESt:AMASk:SOURce

N (see page 776)

Command Syntax

```
:MTESt:AMASk:SOURce <source>
```

```
<source> ::= CHANnel<n>
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :MTESt:AMASk:SOURce command selects the source for the interpretation of the :MTESt:AMASk:XDELta and :MTESt:AMASk:YDELta parameters when :MTESt:AMASk:UNITs is set to CURRent.

When UNITs are CURRent, the XDELta and YDELta parameters are defined in terms of the channel units, as set by the :CHANnel<n>:UNITs command, of the selected source.

Suppose that UNITs are CURRent and that you set SOURce to CHANNEL1, which is using units of volts. Then you can define AMASk:XDELta in terms of volts and AMASk:YDELta in terms of seconds.

This command is the same as the :MTESt:SOURce command.

Query Syntax

```
:MTESt:AMASk:SOURce?
```

The :MTESt:AMASk:SOURce? query returns the currently set source.

Return Format

```
<source> ::= CHAN<n>
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:AMASk:XDELta" on page 392
- ":MTESt:AMASk:YDELta" on page 393
- ":MTESt:AMASk:UNITs" on page 391
- ":MTESt:SOURce" on page 415

Example Code

- "Example Code" on page 385

:MTESt:AMASk:UNITs

N (see page 776)

Command Syntax

```
:MTESt:AMASk:UNITs <units>

<units> ::= {CURRent | DIVisions}
```

The :MTESt:AMASk:UNITs command alters the way the mask test subsystem interprets the tolerance parameters for automasking as defined by :MTESt:AMASk:XDELta and :MTESt:AMASk:YDELta commands.

- CURRent — the mask test subsystem uses the units as set by the :CHANnel<n>:UNITs command, usually time for ΔX and voltage for ΔY.
- DIVisions — the mask test subsystem uses the graticule as the measurement system, so tolerance settings are specified as parts of a screen division. The mask test subsystem maintains separate XDELta and YDELta settings for CURRent and DIVisions. Thus, XDELta and YDELta are not converted to new values when the UNITs setting is changed.

Query Syntax

```
:MTESt:AMASk:UNITs?
```

The :MTESt:AMASk:UNITs query returns the current measurement units setting for the mask test automask feature.

Return Format

```
<units><NL>

<units> ::= {CURR | DIV}
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:AMASk:XDELta" on page 392
- ":MTESt:AMASk:YDELta" on page 393
- ":CHANnel<n>:UNITs" on page 216
- ":MTESt:AMASk:SOURce" on page 390
- ":MTESt:SOURce" on page 415

Example Code

- "Example Code" on page 385

:MTESt:AMASk:XDELta

N (see page 776)

Command Syntax

```
:MTESt:AMASk:XDELta <value>

<value> ::= X delta value in NR3 format
```

The :MTESt:AMASk:XDELta command sets the tolerance in the X direction around the waveform for the automasking feature. The absolute value of the tolerance will be added and subtracted to horizontal values of the waveform to determine the boundaries of the mask.

The horizontal tolerance value is interpreted based on the setting specified by the :MTESt:AMASk:UNITs command; thus, if you specify 250-E3, the setting for :MTESt:AMASk:UNITs is CURRent, and the current setting specifies time in the horizontal direction, the tolerance will be ±250 ms. If the setting for :MTESt:AMASk:UNITs is DIVisions, the same X delta value will set the tolerance to ±250 millidivisions, or 1/4 of a division.

Query Syntax

```
:MTESt:AMASk:XDELta?
```

The :MTEST:AMASk:XDELta? query returns the current setting of the ΔX tolerance for automasking. If your computer program will interpret this value, it should also request the current measurement system using the :MTESt:AMASk:UNITs query.

Return Format

```
<value><NL>

<value> ::= X delta value in NR3 format
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:AMASk:UNITs" on page 391
- ":MTESt:AMASk:YDELta" on page 393
- ":MTESt:AMASk:SOURce" on page 390
- ":MTESt:SOURce" on page 415

Example Code

- "Example Code" on page 385

:MTESt:AMASk:YDELta

N (see page 776)

Command Syntax

```
:MTESt:AMASk:YDELta <value>
```

```
<value> ::= Y delta value in NR3 format
```

The :MTESt:AMASk:YDELta command sets the vertical tolerance around the waveform for the automasking feature. The absolute value of the tolerance will be added and subtracted to vertical values of the waveform to determine the boundaries of the mask.

The vertical tolerance value is interpreted based on the setting specified by the :MTESt:AMASk:UNITs command; thus, if you specify 250-E3, the setting for :MTESt:AMASk:UNITs is CURRent, and the current setting specifies voltage in the vertical direction, the tolerance will be ±250 mV. If the setting for :MTESt:AMASk:UNITs is DIVisions, the same Y delta value will set the tolerance to ±250 millidivisions, or 1/4 of a division.

Query Syntax

```
:MTESt:AMASk:YDELta?
```

The :MTESt:AMASk:YDELta? query returns the current setting of the ΔY tolerance for automasking. If your computer program will interpret this value, it should also request the current measurement system using the :MTESt:AMASk:UNITs query.

Return Format

```
<value><NL>
```

```
<value> ::= Y delta value in NR3 format
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:AMASk:UNITs" on page 391
- ":MTESt:AMASk:XDELta" on page 392
- ":MTESt:AMASk:SOURce" on page 390
- ":MTESt:SOURce" on page 415

Example Code

- "Example Code" on page 385

:MTESt:COUNt:FWAVeforms

N (see page 776)

Query Syntax

```
:MTESt:COUNt:FWAVeforms? [CHANnel<n>]
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :MTESt:COUNt:FWAVeforms? query returns the total number of failed waveforms in the current mask test run. This count is for all regions and all waveforms collected on the channel specified by the optional parameter or collected on the currently specified source channel (:MTESt:SOURce) if there is no parameter.

Return Format

```
<failed><NL>
```

```
<failed> ::= number of failed waveforms in NR1 format.
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:COUNt:WAVeforms" on page 397
- ":MTESt:COUNt:TIME" on page 396
- ":MTESt:COUNt:RESet" on page 395
- ":MTESt:SOURce" on page 415

Example Code

- "Example Code" on page 385

:MTESt:COUNt:RESet

N (see page 776)

Command Syntax

```
:MTESt:COUNt:RESet
```

The :MTESt:COUNt:RESet command resets the mask statistics.

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:COUNt:WAVeforms" on page 397
- ":MTESt:COUNt:FWAVeforms" on page 394
- ":MTESt:COUNt:TIME" on page 396

:MTESt:COUNt:TIME

N (see page 776)

Query Syntax

```
:MTESt:COUNt:TIME?
```

The :MTESt:COUNt:TIME? query returns the elapsed time in the current mask test run.

Return Format

```
<time><NL>

<time> ::= elapsed seconds in NR3 format.
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:COUNt:WAVeforms" on page 397
- ":MTESt:COUNt:FWAVeforms" on page 394
- ":MTESt:COUNt:RESet" on page 395

Example Code

- "Example Code" on page 385

:MTESt:COUNt:WAVeforms

N (see page 776)

Query Syntax

```
:MTESt:COUNt:WAVeforms?
```

The :MTESt:COUNt:WAVeforms? query returns the total number of waveforms acquired in the current mask test run.

Return Format

```
<count><NL>

<count> ::= number of waveforms in NR1 format.
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:COUNt:FWAVeforms" on page 394
- ":MTESt:COUNt:TIME" on page 396
- ":MTESt:COUNt:RESet" on page 395

Example Code

- "Example Code" on page 385

:MTESt:DATA

N (see page 776)

Command Syntax

```
:MTESt:DATA <mask>
```

```
<mask> ::= binary block data in IEEE 488.2 # format.
```

The :MTESt:DATA command loads a mask from binary block data. These are the data bytes found in a *.msk file.

Query Syntax

```
:MTESt:DATA?
```

The :MTESt:DATA? query returns a mask in binary block data format. The format for the data transmission is the # definite-length format defined in the IEEE 488.2 specification.

Return Format

```
<mask><NL>
```

```
<mask> ::= binary block data in IEEE 488.2 # format
```

See Also

- ":SAVE:MASK[:STARt]" on page 434
- ":RECall:MASK[:STARt]" on page 420

:MTESt:DELete

N (see page 776)

Command Syntax

```
:MTESt:DELete
```

The :MTESt:DELete command clears the currently loaded mask.

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:AMASk:CREate" on page 389

:MTESt:ENABle

N (see page 776)

Command Syntax

```
:MTESt:ENABle <on_off>

<on_off> ::= {{1 | ON} | {0 | OFF}}
```

The :MTESt:ENABle command enables or disables the mask test features.

- ON — Enables the mask test features.
- OFF — Disables the mask test features.

Query Syntax

```
:MTESt:ENABle?
```

The :MTESt:ENABle? query returns the current state of mask test features.

Return Format

```
<on_off><NL>

<on_off> ::= {1 | 0}
```

See Also

- "Introduction to :MTESt Commands" on page 385

:MTESt:LOCK

N (see page 776)

Command Syntax

```
:MTESt:LOCK <on_off>
```

```
<on_off> ::= {{1 | ON} | {0 | OFF}}
```

The :MTESt:LOCK command enables or disables the mask lock feature:

- ON — Locks a mask to the SOURce. As the vertical or horizontal scaling or position of the SOURce changes, the mask is redrawn accordingly.
- OFF — The mask is static and does not move.

Query Syntax

```
:MTESt:LOCK?
```

The :MTESt:LOCK? query returns the current mask lock setting.

Return Format

```
<on_off><NL>
```

```
<on_off> ::= {1 | 0}
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:SOURce" on page 415

:MTESt:RMODe

N (see page 776)

Command Syntax

```
:MTESt:RMODe <rmode>
```

```
<rmode> ::= {FORever | SIGMa | TIME | WAVeforms}
```

The :MTESt:RMODe command specifies the termination conditions for the mask test:

- FORever — the mask test runs until it is turned off.
- SIGMa — the mask test runs until the Sigma level is reached. This level is set by the ":MTESt:RMODe:SIGMa" on page 407 command.
- TIME — the mask test runs for a fixed amount of time. The amount of time is set by the ":MTESt:RMODe:TIME" on page 408 command.
- WAVeforms — the mask test runs until a fixed number of waveforms are acquired. The number of waveforms is set by the ":MTESt:RMODe:WAVeforms" on page 409 command.

Query Syntax

```
:MTESt:RMODe?
```

The :MTESt:RMODe? query returns the currently set termination condition.

Return Format

```
<rmode><NL>
```

```
<rmode> ::= {FOR | SIGM | TIME | WAV}
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:RMODe:SIGMa" on page 407
- ":MTESt:RMODe:TIME" on page 408
- ":MTESt:RMODe:WAVeforms" on page 409

Example Code

- "Example Code" on page 385

:MTESt:RMODe:FACTion:MEASure

N (see page 776)

Command Syntax

```
:MTESt:RMODe:FACTion:MEASure <on_off>

<on_off> ::= {{1 | ON} | {0 | OFF}}
```

The :MTESt:RMODe:FACTion:MEASure command sets measuring only mask failures on or off.

When ON, measurements and measurement statistics run only on waveforms that contain a mask violation; passing waveforms do not affect measurements and measurement statistics.

This mode is not available when the acquisition mode is set to Averaging.

Query Syntax

```
:MTESt:RMODe:FACTion:MEASure?
```

The :MTESt:RMODe:FACTion:MEASure? query returns the current mask failure measure setting.

Return Format

```
<on_off><NL>

<on_off> ::= {1 | 0}
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:RMODe:FACTion:PRINt" on page 404
- ":MTESt:RMODe:FACTion:SAVE" on page 405
- ":MTESt:RMODe:FACTion:STOP" on page 406

:MTESt:RMODe:FACTion:PRINt

N (see page 776)

Command Syntax

```
:MTESt:RMODe:FACTion:PRINt <on_off>
```

```
<on_off> ::= {{1 | ON} | {0 | OFF}}
```

The :MTESt:RMODe:FACTion:PRINt command sets printing on mask failures on or off.

NOTE **Setting :MTESt:RMODe:FACTion:PRINt ON automatically sets :MTESt:RMODe:FACTion:SAVE OFF.**

See Chapter 18, ":HARDcopy Commands," starting on page 303 for more information on setting the hardcopy device and formatting options.

Query Syntax

```
:MTESt:RMODe:FACTion:PRINt?
```

The :MTESt:RMODe:FACTion:PRINt? query returns the current mask failure print setting.

Return Format

```
<on_off><NL>
```

```
<on_off> ::= {1 | 0}
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:RMODe:FACTion:MEASure" on page 403
- ":MTESt:RMODe:FACTion:SAVE" on page 405
- ":MTESt:RMODe:FACTion:STOP" on page 406

:MTESt:RMODe:FACTion:SAVE

N (see page 776)

Command Syntax

```
:MTESt:RMODe:FACTion:SAVE <on_off>
```

```
<on_off> ::= {{1 | ON} | {0 | OFF}}
```

The :MTESt:RMODe:FACTion:SAVE command sets saving on mask failures on or off.

NOTE **Setting :MTESt:RMODe:FACTion:SAVE ON automatically sets :MTESt:RMODe:FACTion:PRINt OFF.**

See Chapter 23, ":SAVE Commands," starting on page 425 for more information on save options.

Query Syntax

```
:MTESt:RMODe:FACTion:SAVE?
```

The :MTESt:RMODe:FACTion:SAVE? query returns the current mask failure save setting.

Return Format

```
<on_off><NL>
```

```
<on_off> ::= {1 | 0}
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:RMODe:FACTion:MEASure" on page 403
- ":MTESt:RMODe:FACTion:PRINt" on page 404
- ":MTESt:RMODe:FACTion:STOP" on page 406

:MTESt:RMODe:FACTion:STOP

N (see page 776)

Command Syntax

```
:MTESt:RMODe:FACTion:STOP <on_off>
```

```
<on_off> ::= {{1 | ON} | {0 | OFF}}
```

The :MTESt:RMODe:FACTion:STOP command sets stopping on a mask failure on or off. When this setting is ON and a mask violation is detected, the mask test is stopped and the acquisition system is stopped.

Query Syntax

```
:MTESt:RMODe:FACTion:STOP?
```

The :MTESt:RMODe:FACTion:STOP? query returns the current mask failure stop setting.

Return Format

```
<on_off><NL>
```

```
<on_off> ::= {1 | 0}
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:RMODe:FACTion:MEASure" on page 403
- ":MTESt:RMODe:FACTion:PRINt" on page 404
- ":MTESt:RMODe:FACTion:SAVE" on page 405

:MTESt:RMODe:SIGMa

N (see page 776)

Command Syntax

```
:MTESt:RMODe:SIGMa <level>
```

```
<level> ::= from 0.1 to 9.3 in NR3 format
```

When the :MTESt:RMODe command is set to SIGMa, the :MTESt:RMODe:SIGMa command sets the *test sigma* level to which a mask test runs. *Test sigma* is the best achievable process sigma, assuming no failures. (*Process sigma* is calculated using the number of failures per test.) The *test sigma* level indirectly specifies the number of waveforms that must be tested (in order to reach the sigma level).

Query Syntax

```
:MTESt:RMODe:SIGMa?
```

The :MTESt:RMODe:SIGMa? query returns the current Sigma level setting.

Return Format

```
<level><NL>
```

```
<level> ::= from 0.1 to 9.3 in NR3 format
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:RMODe" on page 402

Example Code

- "Example Code" on page 385

:MTESt:RMODe:TIME

N (see page 776)

Command Syntax

```
:MTESt:RMODe:TIME <seconds>
```

```
<seconds> ::= from 1 to 86400 in NR3 format
```

When the :MTESt:RMODe command is set to TIME, the :MTESt:RMODe:TIME command sets the number of seconds for a mask test to run.

Query Syntax

```
:MTESt:RMODe:TIME?
```

The :MTESt:RMODe:TIME? query returns the number of seconds currently set.

Return Format

```
<seconds><NL>
```

```
<seconds> ::= from 1 to 86400 in NR3 format
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:RMODe" on page 402

:MTESt:RMODe:WAVeforms

N (see page 776)

Command Syntax

```
:MTESt:RMODe:WAVeforms <count>

<count> ::= number of waveforms in NR1 format
            from 1 to 2,000,000,000
```

When the :MTESt:RMODe command is set to WAVeforms, the :MTESt:RMODe:WAVeforms command sets the number of waveform acquisitions that are mask tested.

Query Syntax

```
:MTESt:RMODe:WAVeforms?
```

The :MTESt:RMODe:WAVeforms? query returns the number of waveforms currently set.

Return Format

```
<count><NL>

<count> ::= number of waveforms in NR1 format
            from 1 to 2,000,000,000
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:RMODe" on page 402

:MTESt:SCALe:BIND

N (see page 776)

Command Syntax

```
:MTESt:SCALe:BIND <on_off>
```

```
<on_off> ::= {{1 | ON} | {0 | OFF}}
```

The :MTESt:SCALe:BIND command enables or disables Bind 1 & 0 Levels (Bind -1 & 0 Levels for inverted masks) control:

- ON —

  If the Bind 1 & 0 Levels control is enabled, the 1 Level and the 0 Level controls track each other. Adjusting either the 1 Level or the 0 Level control shifts the position of the mask up or down without changing its size.

  If the Bind -1 & 0 Levels control is enabled, the -1 Level and the 0 Level controls track each other. Adjusting either the -1 Level or the 0 Level control shifts the position of the mask up or down without changing its size.

- OFF —

  If the Bind 1 & 0 Levels control is disabled, adjusting either the 1 Level or the 0 Level control changes the vertical height of the mask.

  If the Bind -1 & 0 Levels control is disabled, adjusting either the -1 Level or the 0 Level control changes the vertical height of the mask.

Query Syntax

```
:MTESt:SCALe:BIND?
```

The :MTESt:SCALe:BIND? query returns the value of the Bind 1&0 control (Bind -1&0 for inverted masks).

Return Format

```
<on_off><NL>
```

```
<on_off> ::= {1 | 0}
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:SCALe:X1" on page 411
- ":MTESt:SCALe:XDELta" on page 412
- ":MTESt:SCALe:Y1" on page 413
- ":MTESt:SCALe:Y2" on page 414

:MTESt:SCALe:X1

N (see page 776)

Command Syntax

```
:MTESt:SCALe:X1 <x1_value>
```

```
<x1_value> ::= X1 value in NR3 format
```

The :MTESt:SCALe:X1 command defines where X=0 in the base coordinate system used for mask testing. The other X-coordinate is defined by the :MTESt:SCALe:XDELta command. Once the X1 and XDELta coordinates are set, all X values of vertices in the mask regions are defined with respect to this value, according to the equation:

```
X = (X * ΔX) + X1
```

Thus, if you set X1 to 100 ms, and XDELta to 100 ms, an X value of 0.100 is a vertex at 110 ms.

The oscilloscope uses this equation to normalize vertices. This simplifies reprogramming to handle different data rates. For example, if you halve the period of the waveform of interest, you need only to adjust the XDELta value to set up the mask for the new waveform.

The X1 value is a time value specifying the location of the X1 coordinate, which will then be treated as X=0 for mask regions coordinates.

Query Syntax

```
:MTESt:SCALe:X1?
```

The :MTESt:SCALe:X1? query returns the current X1 coordinate setting.

Return Format

```
<x1_value><NL>
```

```
<x1_value> ::= X1 value in NR3 format
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:SCALe:BIND" on page 410
- ":MTESt:SCALe:XDELta" on page 412
- ":MTESt:SCALe:Y1" on page 413
- ":MTESt:SCALe:Y2" on page 414

:MTESt:SCALe:XDELta

N (see page 776)

Command Syntax

```
:MTESt:SCALe:XDELta <xdelta_value>
```

```
<xdelta_value> ::= X delta value in NR3 format
```

The :MTESt:SCALe:XDELta command defines the position of the X2 marker with respect to the X1 marker. In the mask test coordinate system, the X1 marker defines where X=0; thus, the X2 marker defines where X=1.

Because all X vertices of the regions defined for mask testing are normalized with respect to X1 and ∆X, redefining ∆X also moves those vertices to stay in the same locations with respect to X1 and ∆X. Thus, in many applications, it is best if you define XDELta as a pulse width or bit period. Then, a change in data rate without corresponding changes in the waveform can easily be handled by changing ∆X.

The X-coordinate of polygon vertices is normalized using this equation:

```
X = (X * ∆X) + X1
```

The X delta value is a time value specifying the distance of the X2 marker with respect to the X1 marker.

For example, if the period of the waveform you wish to test is 1 ms, setting ∆X to 1 ms ensures that the waveform's period is between the X1 and X2 markers.

Query Syntax

```
:MTESt:SCALe:XDELta?
```

The :MTESt:SCALe:XDELta? query returns the current value of ∆X.

Return Format

```
<xdelta_value><NL>
```

```
<xdelta_value> ::= X delta value in NR3 format
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:SCALe:BIND" on page 410
- ":MTESt:SCALe:X1" on page 411
- ":MTESt:SCALe:Y1" on page 413
- ":MTESt:SCALe:Y2" on page 414

:MTESt:SCALe:Y1

N (see page 776)

Command Syntax

```
:MTESt:SCALe:Y1 <y1_value>
```

```
<y1_value> ::= Y1 value in NR3 format
```

The :MTESt:SCALe:Y1 command defines where Y=0 in the coordinate system for mask testing. All Y values of vertices in the coordinate system are defined with respect to the boundaries set by SCALe:Y1 and SCALe:Y2 according to the equation:

```
Y = (Y * (Y2 - Y1)) + Y1
```

Thus, if you set Y1 to 100 mV, and Y2 to 1 V, a Y value of 0.100 in a vertex is at 190 mV.

The Y1 value is a voltage value specifying the point at which Y=0.

Query Syntax

```
:MTESt:SCALe:Y1?
```

The :MTESt:SCALe:Y1? query returns the current setting of the Y1 marker.

Return Format

```
<y1_value><NL>
```

```
<y1_value> ::= Y1 value in NR3 format
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:SCALe:BIND" on page 410
- ":MTESt:SCALe:X1" on page 411
- ":MTESt:SCALe:XDELta" on page 412
- ":MTESt:SCALe:Y2" on page 414

:MTESt:SCALe:Y2

N (see page 776)

Command Syntax

```
:MTESt:SCALe:Y2 <y2_value>
```

```
<y2_value> ::= Y2 value in NR3 format
```

The :MTESt:SCALe:Y2 command defines the Y2 marker in the coordinate system for mask testing. All Y values of vertices in the coordinate system are defined with respect to the boundaries defined by SCALe:Y1 and SCALe:Y2 according to the following equation:

```
Y = (Y * (Y2 - Y1)) + Y1
```

Thus, if you set Y1 to 100 mV, and Y2 to 1 V, a Y value of 0.100 in a vertex is at 190 mV.

The Y2 value is a voltage value specifying the location of the Y2 marker.

Query Syntax

```
:MTESt:SCALe:Y2?
```

The :MTESt:SCALe:Y2? query returns the current setting of the Y2 marker.

Return Format

```
<y2_value><NL>
```

```
<y2_value> ::= Y2 value in NR3 format
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:SCALe:BIND" on page 410
- ":MTESt:SCALe:X1" on page 411
- ":MTESt:SCALe:XDELta" on page 412
- ":MTESt:SCALe:Y1" on page 413

:MTESt:SOURce

N (see page 776)

Command Syntax

```
:MTESt:SOURce <source>
```

```
<source> ::= CHANnel<n>
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :MTESt:SOURce command selects the channel which is configured by the commands contained in a mask file when it is loaded.

Query Syntax

```
:MTESt:SOURce?
```

The :MTESt:SOURce? query returns the channel which is configured by the commands contained in the current mask file.

Return Format

```
<source><NL>
```

```
<source> ::= {CHAN<n> | NONE}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:AMASk:SOURce" on page 390

:MTESt:TITLe

N (see page 776)

Query Syntax

```
:MTESt:TITLe?
```

The :MTESt:TITLe? query returns the mask title which is a string of up to 128 characters. The title is displayed in the mask test dialog box and mask test tab when a mask file is loaded.

Return Format

```
<title><NL>

<title> ::= a string of up to 128 ASCII characters.
```

See Also

- "Introduction to :MTESt Commands" on page 385

22 :RECall Commands

Recall previously saved oscilloscope setups, reference waveforms, and masks.

Table 65 :RECall Commands Summary

Command	Query	Options and Query Returns
`:RECall:FILename <base_name>` (see page 419)	`:RECall:FILename?` (see page 419)	`<base_name> ::= quoted ASCII string`

`:RECall:MASK[:STARt] [<file_spec>]` (see page 420)	n/a	`<file_spec> ::= {<internal_loc> | <file_name>}`
		`<internal_loc> ::= 0-3; an integer in NR1 format`
		`<file_name> ::= quoted ASCII string`

`:RECall:PWD <path_name>` (see page 421)	`:RECall:PWD?` (see page 421)	`<path_name> ::= quoted ASCII string`

`:RECall:SETup[:STARt] [<file_spec>]` (see page 422)	n/a	`<file_spec> ::= {<internal_loc> | <file_name>}`
		`<internal_loc> ::= 0-9; an integer in NR1 format`
		`<file_name> ::= quoted ASCII string`

`:RECall:WMEMory<r>[:STARt] [<file_name>]` (see page 423)	n/a	`<r> ::= 1-2 in NR1 format`
		`<file_name> ::= quoted ASCII string`
		`If extension included in file name, it must be ".h5".`

Introduction to :RECall Commands

The :RECall subsystem provides commands to recall previously saved oscilloscope setups, reference waveforms, and masks.

Reporting the Setup

Use :RECall? to query setup information for the RECall subsystem.

Return Format

The following is a sample response from the :RECall? query. In this case, the query was issued following the *RST command.

```
:REC:FIL "scope_0"
```

:RECall:FILename

N (see page 776)

Command Syntax

```
:RECall:FILename <base_name>
```

```
<base_name> ::= quoted ASCII string
```

The :RECall:FILename command specifies the source for any RECall operations.

NOTE This command specifies a file's base name only, without path information or an extension.

Query Syntax

```
:RECall:FILename?
```

The :RECall:FILename? query returns the current RECall filename.

Return Format

```
<base_name><NL>
```

```
<base_name> ::= quoted ASCII string
```

See Also

- "Introduction to :RECall Commands" on page 417
- ":RECall:SETup[:STARt]" on page 422
- ":SAVE:FILename" on page 428

:RECall:MASK[:STARt]

N (see page 776)

Command Syntax

```
:RECall:MASK[:STARt] [<file_spec>]

<file_spec> ::= {<internal_loc> | <file_name>}

<internal_loc> ::= 0-3; an integer in NR1 format

<file_name> ::= quoted ASCII string
```

The :RECall:MASK[:STARt] command recalls a mask.

NOTE If a file extension is provided as part of a specified <file_name>, it must be ".msk".

See Also

- "Introduction to :RECall Commands" on page 417
- ":RECall:FILename" on page 419
- ":SAVE:MASK[:STARt]" on page 434
- ":MTESt:DATA" on page 398

:RECall:PWD

N (see page 776)

Command Syntax

```
:RECall:PWD <path_name>
```

```
<path_name> ::= quoted ASCII string
```

The :RECall:PWD command sets the present working directory for recall operations.

Query Syntax

```
:RECall:PWD?
```

The :RECall:PWD? query returns the currently set working directory for recall operations.

Return Format

```
<path_name><NL>
```

```
<path_name> ::= quoted ASCII string
```

See Also

- "Introduction to :RECall Commands" on page 417
- ":SAVE:PWD" on page 436

:RECall:SETup[:STARt]

N (see page 776)

Command Syntax

```
:RECall:SETup[:STARt] [<file_spec>]
```

```
<file_spec> ::= {<internal_loc> | <file_name>}
```

```
<internal_loc> ::= 0-9; an integer in NR1 format
```

```
<file_name> ::= quoted ASCII string
```

The :RECall:SETup[:STARt] command recalls an oscilloscope setup.

NOTE If a file extension is provided as part of a specified <file_name>, it must be ".scp".

See Also

- "Introduction to :RECall Commands" on page 417
- ":RECall:FILename" on page 419
- ":SAVE:SETup[:STARt]" on page 437

:RECall:WMEMory<r>[:STARt]

N (see page 776)

Command Syntax

```
:RECall:WMEMory<r>[:STARt] [<file_name>]

<r> ::= 1-2 in NR1 format

<file_name> ::= quoted ASCII string
```

The :RECall:WMEMory<r>[:STARt] command recalls a reference waveform.

NOTE If a file extension is provided as part of a specified <file_name>, it must be ".h5".

See Also

- "Introduction to :RECall Commands" on page 417
- ":RECall:FILename" on page 419
- ":SAVE:WMEMory[:STARt]" on page 444

23 :SAVE Commands

Save oscilloscope setups, screen images, and data. See "Introduction to :SAVE Commands" on page 426.

Table 66 :SAVE Commands Summary

Command	Query	Options and Query Returns
:SAVE:FILename <base_name> (see page 428)	:SAVE:FILename? (see page 428)	<base_name> ::= quoted ASCII string
:SAVE:IMAGe[:STARt] [<file_name>] (see page 429)	n/a	<file_name> ::= quoted ASCII string
:SAVE:IMAGe:FACTors {{0 | OFF} | {1 | ON}} (see page 430)	:SAVE:IMAGe:FACTors? (see page 430)	{0 | 1}
:SAVE:IMAGe:FORMat <format> (see page 431)	:SAVE:IMAGe:FORMat? (see page 431)	<format> ::= {TIFF | {BMP | BMP24bit} | BMP8bit | PNG | NONE}
:SAVE:IMAGe:INKSaver {{0 | OFF} | {1 | ON}} (see page 432)	:SAVE:IMAGe:INKSaver? (see page 432)	{0 | 1}
:SAVE:IMAGe:PALette <palette> (see page 433)	:SAVE:IMAGe:PALette? (see page 433)	<palette> ::= {COLor | GRAYscale | MONochrome}
:SAVE:MASK[:STARt] [<file_spec>] (see page 434)	n/a	<file_spec> ::= {<internal_loc> | <file_name>} <internal_loc> ::= 0-3; an integer in NR1 format <file_name> ::= quoted ASCII string
:SAVE:MULTi[:STARt] [<file_name>] (see page 435)	n/a	<file_name> ::= quoted ASCII string

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Table 66 :SAVE Commands Summary (continued)

Command	Query	Options and Query Returns
:SAVE:PWD <path_name> (see page 436)	:SAVE:PWD? (see page 436)	<path_name> ::= quoted ASCII string
:SAVE:SETup[:STARt] [<file_spec>] (see page 437)	n/a	<file_spec> ::= {<internal_loc> | <file_name>} <internal_loc> ::= 0-9; an integer in NR1 format <file_name> ::= quoted ASCII string
:SAVE:WAVeform[:STARt] [<file_name>] (see page 438)	n/a	<file_name> ::= quoted ASCII string
:SAVE:WAVeform:FORMat <format> (see page 439)	:SAVE:WAVeform:FORMat? (see page 439)	<format> ::= {ASCiixy | CSV | BINary | NONE}
:SAVE:WAVeform:LENGth <length> (see page 440)	:SAVE:WAVeform:LENGth? (see page 440)	<length> ::= 100 to max. length; an integer in NR1 format
:SAVE:WAVeform:LENGth:MAX {{0 | OFF} | {1 | ON}} (see page 441)	:SAVE:WAVeform:LENGth:MAX? (see page 441)	{0 | 1}
:SAVE:WAVeform:SEGMented <option> (see page 442)	:SAVE:WAVeform:SEGMented? (see page 442)	<option> ::= {ALL | CURRent}
:SAVE:WMEMory:SOURce <source> (see page 443)	:SAVE:WMEMory:SOURce? (see page 443)	<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>} <n> ::= 1 to (# analog channels) in NR1 format <r> ::= 1-2 in NR1 format NOTE: Only ADD or SUBtract math operations can be saved as reference waveforms. <return_value> ::= <source>
:SAVE:WMEMory[:STARt] [<file_name>] (see page 444)	n/a	<file_name> ::= quoted ASCII string If extension included in file name, it must be ".h5".

Introduction to :SAVE Commands The :SAVE subsystem provides commands to save oscilloscope setups, screen images, and data.

:SAV is an acceptable short form for :SAVE.

Reporting the Setup

Use :SAVE? to query setup information for the SAVE subsystem.

Return Format

The following is a sample response from the :SAVE? query. In this case, the query was issued following the *RST command.

```
:SAVE:FIL "";:SAVE:IMAG:AREA GRAT;FACT 0;FORM TIFF;INKS 0;PAL
MON;:SAVE:PWD "C:/setups/";:SAVE:WAV:FORM NONE;LENG 1000;SEGM CURR
```

:SAVE:FILename

N (see page 776)

Command Syntax

```
:SAVE:FILename <base_name>
```

```
<base_name> ::= quoted ASCII string
```

The :SAVE:FILename command specifies the source for any SAVE operations.

NOTE This command specifies a file's base name only, without path information or an extension.

Query Syntax

```
:SAVE:FILename?
```

The :SAVE:FILename? query returns the current SAVE filename.

Return Format

```
<base_name><NL>
```

```
<base_name> ::= quoted ASCII string
```

See Also

- "Introduction to :SAVE Commands" on page 426
- ":SAVE:IMAGe[:STARt]" on page 429
- ":SAVE:SETup[:STARt]" on page 437
- ":SAVE:WAVeform[:STARt]" on page 438
- ":SAVE:PWD" on page 436
- ":RECall:FILename" on page 419

:SAVE:IMAGe[:STARt]

N (see page 776)

Command Syntax

```
:SAVE:IMAGe[:STARt] [<file_name>]
```

```
<file_name> ::= quoted ASCII string
```

The :SAVE:IMAGe[:STARt] command saves an image.

NOTE Be sure to set the :SAVE:IMAGe:FORMat before saving an image. If the format is NONE, the save image command will not succeed.

NOTE If a file extension is provided as part of a specified <file_name>, and it does not match the extension expected by the format specified in :SAVE:IMAGe:FORMat, the format will be changed if the extension is a valid image file extension.

NOTE If the extension ".bmp" is used and the current :SAVE:IMAGe:FORMat is not BMP or BMP8, the format will be changed to BMP.

See Also

- "Introduction to :SAVE Commands" on page 426
- ":SAVE:IMAGe:FACTors" on page 430
- ":SAVE:IMAGe:FORMat" on page 431
- ":SAVE:IMAGe:INKSaver" on page 432
- ":SAVE:IMAGe:PALette" on page 433
- ":SAVE:FILename" on page 428

:SAVE:IMAGe:FACTors

N (see page 776)

Command Syntax

```
:SAVE:IMAGe:FACTors <factors>
```

```
<factors> ::= {{OFF | 0} | {ON | 1}}
```

The :SAVE:IMAGe:FACTors command controls whether the oscilloscope factors are output along with the image.

NOTE Factors are written to a separate file with the same path and base name but with the ".txt" extension.

Query Syntax

```
:SAVE:IMAGe:FACTors?
```

The :SAVE:IMAGe:FACTors? query returns a flag indicating whether oscilloscope factors are output along with the image.

Return Format

```
<factors><NL>
```

```
<factors> ::= {0 | 1}
```

See Also

- "Introduction to :SAVE Commands" on page 426
- ":SAVE:IMAGe[:STARt]" on page 429
- ":SAVE:IMAGe:FORMat" on page 431
- ":SAVE:IMAGe:INKSaver" on page 432
- ":SAVE:IMAGe:PALette" on page 433

:SAVE:IMAGe:FORMat

N (see page 776)

Command Syntax

```
:SAVE:IMAGe:FORMat <format>

<format> ::= {{BMP | BMP24bit} | BMP8bit | PNG}
```

The :SAVE:IMAGe:FORMat command sets the image format type.

Query Syntax

```
:SAVE:IMAGe:FORMat?
```

The :SAVE:IMAGe:FORMat? query returns the selected image format type.

Return Format

```
<format><NL>

<format> ::= {BMP | BMP8 | PNG | NONE}
```

When NONE is returned, it indicates that a waveform data file format is currently selected.

See Also

- "Introduction to :SAVE Commands" on page 426
- ":SAVE:IMAGe[:STARt]" on page 429
- ":SAVE:IMAGe:FACTors" on page 430
- ":SAVE:IMAGe:INKSaver" on page 432
- ":SAVE:IMAGe:PALette" on page 433
- ":SAVE:WAVeform:FORMat" on page 439

:SAVE:IMAGe:INKSaver

N (see page 776)

Command Syntax

```
:SAVE:IMAGe:INKSaver <value>

<value> ::= {{OFF | 0} | {ON | 1}}
```

The :SAVE:IMAGe:INKSaver command controls whether the graticule colors are inverted or not.

Query Syntax

```
:SAVE:IMAGe:INKSaver?
```

The :SAVE:IMAGe:INKSaver? query returns a flag indicating whether graticule colors are inverted or not.

Return Format

```
<value><NL>

<value> ::= {0 | 1}
```

See Also

- "Introduction to :SAVE Commands" on page 426
- ":SAVE:IMAGe[:STARt]" on page 429
- ":SAVE:IMAGe:FACTors" on page 430
- ":SAVE:IMAGe:FORMat" on page 431
- ":SAVE:IMAGe:PALette" on page 433

:SAVE:IMAGe:PALette

N (see page 776)

Command Syntax

```
:SAVE:IMAGe:PALette <palette>
```

```
<palette> ::= {COLor | GRAYscale}
```

The :SAVE:IMAGe:PALette command sets the image palette color.

Query Syntax

```
:SAVE:IMAGe:PALette?
```

The :SAVE:IMAGe:PALette? query returns the selected image palette color.

Return Format

```
<palette><NL>
```

```
<palette> ::= {COL | GRAY}
```

See Also

- "Introduction to :SAVE Commands" on page 426
- ":SAVE:IMAGe[:STARt]" on page 429
- ":SAVE:IMAGe:FACTors" on page 430
- ":SAVE:IMAGe:FORMat" on page 431
- ":SAVE:IMAGe:INKSaver" on page 432

:SAVE:MASK[:STARt]

N (see page 776)

Command Syntax

```
:SAVE:MASK[:STARt] [<file_spec>]

<file_spec> ::= {<internal_loc> | <file_name>}

<internal_loc> ::= 0-3; an integer in NR1 format

<file_name> ::= quoted ASCII string
```

The :SAVE:MASK[:STARt] command saves a mask.

NOTE If a file extension is provided as part of a specified <file_name>, it must be ".msk".

See Also

- "Introduction to :SAVE Commands" on page 426
- ":SAVE:FILename" on page 428
- ":RECall:MASK[:STARt]" on page 420
- ":MTESt:DATA" on page 398

:SAVE:MULTi[:STARt]

N (see page 776)

Command Syntax

```
:SAVE:MULTi[:STARt] [<file_name>]
```

```
<file_name> ::= quoted ASCII string
```

The :SAVE:MULTi[:STARt] command saves multi-channel waveform data to a file. This file can be opened by the N8900A InfiniiView oscilloscope analysis software.

NOTE If a file extension is provided as part of a specified <file_name>, it must be ".h5".

See Also

- "Introduction to :SAVE Commands" on page 426
- ":SAVE:FILename" on page 428
- ":SAVE:PWD" on page 436

:SAVE:PWD

N (see page 776)

Command Syntax

```
:SAVE:PWD <path_name>
```

```
<path_name> ::= quoted ASCII string
```

The :SAVE:PWD command sets the present working directory for save operations.

Query Syntax

```
:SAVE:PWD?
```

The :SAVE:PWD? query returns the currently set working directory for save operations.

Return Format

```
<path_name><NL>
```

```
<path_name> ::= quoted ASCII string
```

See Also

- "Introduction to :SAVE Commands" on page 426
- ":SAVE:FILename" on page 428
- ":RECall:PWD" on page 421

:SAVE:SETup[:STARt]

N (see page 776)

Command Syntax

```
:SAVE:SETup[:STARt] [<file_spec>]

<file_spec> ::= {<internal_loc> | <file_name>}

<internal_loc> ::= 0-9; an integer in NR1 format

<file_name> ::= quoted ASCII string
```

The :SAVE:SETup[:STARt] command saves an oscilloscope setup.

NOTE If a file extension is provided as part of a specified <file_name>, it must be ".scp".

See Also

- "Introduction to :SAVE Commands" on page 426
- ":SAVE:FILename" on page 428
- ":RECall:SETup[:STARt]" on page 422

:SAVE:WAVeform[:STARt]

N (see page 776)

Command Syntax

```
:SAVE:WAVeform[:STARt] [<file_name>]
```

```
<file_name> ::= quoted ASCII string
```

The :SAVE:WAVeform[:STARt] command saves oscilloscope waveform data to a file.

NOTE Be sure to set the :SAVE:WAVeform:FORMat before saving waveform data. If the format is NONE, the save waveform command will not succeed.

NOTE If a file extension is provided as part of a specified <file_name>, and it does not match the extension expected by the format specified in :SAVE:WAVeform:FORMat, the format will be changed if the extension is a valid waveform file extension.

See Also

- "Introduction to :SAVE Commands" on page 426
- ":SAVE:WAVeform:FORMat" on page 439
- ":SAVE:WAVeform:LENGth" on page 440
- ":SAVE:FILename" on page 428
- ":RECall:SETup[:STARt]" on page 422

:SAVE:WAVeform:FORMat

N (see page 776)

Command Syntax

```
:SAVE:WAVeform:FORMat <format>
```

```
<format> ::= {ASCiixy | CSV | BINary}
```

The :SAVE:WAVeform:FORMat command sets the waveform data format type:

- ASCiixy — creates comma-separated value files for each analog channel that is displayed (turned on). The proper file extension for this format is ".csv".
- CSV — creates one comma-separated value file that contains information for all analog channels that are displayed (turned on). The proper file extension for this format is ".csv".
- BINary — creates an oscilloscope binary data format file. See the *User's Guide* for a description of this format. The proper file extension for this format is ".bin".

Query Syntax

```
:SAVE:WAVeform:FORMat?
```

The :SAVE:WAVeform:FORMat? query returns the selected waveform data format type.

Return Format

```
<format><NL>
```

```
<format> ::= {ASC | CSV | BIN | NONE}
```

When NONE is returned, it indicates that an image file format is currently selected.

See Also

- "Introduction to :SAVE Commands" on page 426
- ":SAVE:WAVeform[:STARt]" on page 438
- ":SAVE:WAVeform:LENGth" on page 440
- ":SAVE:IMAGe:FORMat" on page 431

:SAVE:WAVeform:LENGth

N (see page 776)

Command Syntax

```
:SAVE:WAVeform:LENGth <length>
```

```
<length> ::= 100 to max. length; an integer in NR1 format
```

When the :SAVE:WAVeform:LENGth:MAX setting is OFF, the :SAVE:WAVeform:LENGth command sets the waveform data length (that is, the number of points saved).

When the :SAVE:WAVeform:LENGth:MAX setting is ON, the :SAVE:WAVeform:LENGth setting has no effect.

Query Syntax

```
:SAVE:WAVeform:LENGth?
```

The :SAVE:WAVeform:LENGth? query returns the current waveform data length setting.

Return Format

```
<length><NL>
```

```
<length> ::= 100 to max. length; an integer in NR1 format
```

See Also

- "Introduction to :SAVE Commands" on page 426
- ":SAVE:WAVeform:LENGth:MAX" on page 441
- ":SAVE:WAVeform[:STARt]" on page 438
- ":WAVeform:POINts" on page 625
- ":SAVE:WAVeform:FORMat" on page 439

:SAVE:WAVeform:LENGth:MAX

N (see page 776)

Command Syntax

```
:SAVE:WAVeform:LENGth:MAX <setting>
```

```
<setting> ::= {{OFF | 0} | {ON | 1}}
```

The :SAVE:WAVeform:LENGth:MAX command specifies whether maximum number of waveform data points is saved.

When OFF, the :SAVE:WAVeform:LENGth command specifies the number of waveform data points saved.

Query Syntax

```
:SAVE:WAVeform:LENGth:MAX?
```

The :SAVE:WAVeform:LENGth:MAX? query returns the current setting.

Return Format

```
<setting><NL>
```

```
<setting> ::= {0 | 1}
```

See Also

- "Introduction to :SAVE Commands" on page 426
- ":SAVE:WAVeform[:STARt]" on page 438
- ":SAVE:WAVeform:LENGth" on page 440

:SAVE:WAVeform:SEGMented

N (see page 776)

Command Syntax

```
:SAVE:WAVeform:SEGMented <option>

<option> ::= {ALL | CURRent}
```

When segmented memory is used for acquisitions, the :SAVE:WAVeform:SEGMented command specifies which segments are included when the waveform is saved:

- ALL — all acquired segments are saved.
- CURRent — only the currently selected segment is saved.

Query Syntax

```
:SAVE:WAVeform:SEGMented?
```

The :SAVE:WAVeform:SEGMented? query returns the current segmented waveform save option setting.

Return Format

```
<option><NL>

<option> ::= {ALL | CURR}
```

See Also

- ["Introduction to :SAVE Commands"](#) on page 426
- [":SAVE:WAVeform[:STARt]"](#) on page 438
- [":SAVE:WAVeform:FORMat"](#) on page 439
- [":SAVE:WAVeform:LENGth"](#) on page 440

:SAVE:WMEMory:SOURce

N (see page 776)

Command Syntax

```
:SAVE:WMEMory:SOURce <source>

<source> ::= {CHANnel<n> | FUNCtion | MATH | WMEMory<r>}

<n> ::= 1 to (# analog channels) in NR1 format

<r> ::= {1 | 2}
```

The :SAVE:WMEMory:SOURce command selects the source to be saved as a reference waveform file.

NOTE Only ADD or SUBtract math operations can be saved as reference waveforms.

NOTE MATH is an alias for FUNCtion. The query will return FUNC if the source is FUNCtion or MATH.

Query Syntax

```
:SAVE:WMEMory:SOURce?
```

The :SAVE:WMEMory:SOURce? query returns the source to be saved as a reference waveform file.

Return Format

```
<source><NL>

<source> ::= {CHAN<n> | FUNC | WMEM<r> | NONE}
```

See Also

- "Introduction to :SAVE Commands" on page 426
- ":SAVE:WMEMory[:STARt]" on page 444
- ":RECall:WMEMory<r>[:STARt]" on page 423

:SAVE:WMEMory[:STARt]

N (see page 776)

Command Syntax

```
:SAVE:WMEMory[:STARt] [<file_name>]
```

```
<file_name> ::= quoted ASCII string
```

The :SAVE:WMEMory[:STARt] command saves oscilloscope waveform data to a reference waveform file.

NOTE If a file extension is provided as part of a specified <file_name>, it must be ".h5".

See Also

- "Introduction to :SAVE Commands" on page 426
- ":SAVE:WMEMory:SOURce" on page 443
- ":RECall:WMEMory<r>[:STARt]" on page 423

24 :SBUS<n> Commands

Control the modes and parameters for each serial bus decode/trigger type. See:

Introduction to :SBUS<n> Commands

The :SBUS subsystem commands control the serial decode bus viewing, mode, and other options.

NOTE

These commands are only valid on oscilloscope models when a serial decode option has been licensed. The CAN, LIN, and SPI serial decode and triggering options are available on the DSOX1000-Series oscilloscope models only.

The following serial bus decode/trigger types are available (see ":TRIGger:MODE" on page 574).

- **CAN (Controller Area Network) triggering**— will trigger on CAN version 2.0A and 2.0B signals. Setup consists of connecting the oscilloscope to a CAN signal. Baud rate, signal source, and signal polarity, and type of data to trigger on can be specified. You can trigger on CAN data and identifier patterns and you can set the bit sample point.
- **IIC (Inter-IC bus) triggering**— consists of connecting the oscilloscope to the serial data (SDA) line and the serial clock (SCL) line, then triggering on a stop/start condition, a restart, a missing acknowledge, or on a read/write frame with a specific device address and data value.
- **LIN (Local Interconnect Network) triggering**— will trigger on LIN sync break at the beginning of a message frame.You can trigger on Sync Break, Frame IDs, or Frame IDs and Data.

- **SPI (Serial Peripheral Interface) triggering**— consists of connecting the oscilloscope to a clock, data (MOSI or MISO), and framing signal. You can then trigger on a data pattern during a specific framing period. The serial data string can be specified to be from 4 to 64 bits long.
- **UART/RS-232 triggering** (with Option 232) — lets you trigger on RS-232 serial data.

Reporting the Setup

Use :SBUS<n>? to query setup information for the :SBUS<n> subsystem.

Return Format

The following is a sample response from the :SBUS1? query. In this case, the query was issued following a *RST command.

```
:SBUS1:DISP 0;MODE IIC;:SBUS1:IIC:ASIZ BIT7;:SBUS1:IIC:TRIG:TYPE
STAR;QUAL EQU;:SBUS1:IIC:SOUR:CLOC CHAN1;DATA
CHAN2;:SBUS1:IIC:TRIG:PATT:ADDR -1;DATA -1;DATA2 -1
```

General :SBUS<n> Commands

Table 67 General :SBUS<n> Commands Summary

Command	Query	Options and Query Returns
:SBUS<n>:DISPlay {{0 | OFF} | {1 | ON}} (see page 448)	:SBUS<n>:DISPlay? (see page 448)	{0 | 1}
:SBUS<n>:MODE <mode> (see page 449)	:SBUS<n>:MODE? (see page 449)	<mode> ::= {CAN | IIC | LIN | SPI | UART}

:SBUS<n>:DISPlay

N (see page 776)

Command Syntax

```
:SBUS<n>:DISPlay <display>
```

```
<display> ::= {{1 | ON} | {0 | OFF}}
```

The :SBUS<n>:DISPlay command turns displaying of the serial decode bus on or off.

NOTE This command is only valid when a serial decode option has been licensed.

Query Syntax

```
:SBUS<n>:DISPlay?
```

The :SBUS<n>:DISPlay? query returns the current display setting of the serial decode bus.

Return Format

```
<display><NL>
```

```
<display> ::= {0 | 1}
```

Errors

- "-241, Hardware missing" on page 739

See Also

- "Introduction to :SBUS<n> Commands" on page 445
- ":CHANnel<n>:DISPlay" on page 203
- ":VIEW" on page 162
- ":BLANk" on page 140
- ":STATus" on page 159

:SBUS<n>:MODE

N (see page 776)

Command Syntax

```
:SBUS<n>:MODE <mode>
```

```
<mode> ::= {CAN | IIC | LIN | SPI | UART}
```

The :SBUS<n>:MODE command determines the decode mode for the serial bus.

NOTE This command is only valid when a serial decode option has been licensed. The CAN, LIN, and SPI serial decode and triggering options are available on the DSOX1000-Series oscilloscope models.

Query Syntax

```
:SBUS<n>:MODE?
```

The :SBUS<n>:MODE? query returns the current serial bus decode mode setting.

Return Format

```
<mode><NL>
```

```
<mode> ::= {CAN | IIC | LIN | SPI | UART | NONE}
```

Errors

- "-241, Hardware missing" on page 739

See Also

- "Introduction to :SBUS<n> Commands" on page 445
- ":SBUS<n>:CAN Commands" on page 450
- ":SBUS<n>:IIC Commands" on page 467
- ":SBUS<n>:LIN Commands" on page 477
- ":SBUS<n>:SPI Commands" on page 491
- ":SBUS<n>:UART Commands" on page 507

:SBUS<n>:CAN Commands

NOTE These commands are valid on DSOX1000-Series oscilloscopes when the automotive CAN and LIN serial decode license (AUTO) is enabled.

Table 68 :SBUS<n>:CAN Commands Summary

Command	Query	Options and Query Returns
n/a	:SBUS<n>:CAN:COUNt:ERRor? (see page 452)	<frame_count> ::= integer in NR1 format
n/a	:SBUS<n>:CAN:COUNt:OVERload? (see page 453)	<frame_count> ::= integer in NR1 format
:SBUS<n>:CAN:COUNt:RESet (see page 454)	n/a	n/a
n/a	:SBUS<n>:CAN:COUNt:TOTal? (see page 455)	<frame_count> ::= integer in NR1 format
n/a	:SBUS<n>:CAN:COUNt:UTILization? (see page 456)	<percent> ::= floating-point in NR3 format
:SBUS<n>:CAN:SAMPlepoint <value> (see page 457)	:SBUS<n>:CAN:SAMPlepoint? (see page 457)	<value> ::= {60 | 62.5 | 68 | 70 | 75 | 80 | 87.5} in NR3 format
:SBUS<n>:CAN:SIGNal:BAUDrate <baudrate> (see page 458)	:SBUS<n>:CAN:SIGNal:BAUDrate? (see page 458)	<baudrate> ::= integer from 10000 to 4000000 in 100 b/s increments, or 5000000
:SBUS<n>:CAN:SIGNal:DEFinition <value> (see page 459)	:SBUS<n>:CAN:SIGNal:DEFinition? (see page 459)	<value> ::= {CANH | CANL | RX | TX | DIFFerential | DIFL | DIFH}
:SBUS<n>:CAN:SOURce <source> (see page 460)	:SBUS<n>:CAN:SOURce? (see page 460)	<source> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:SBUS<n>:CAN:TRIGger <condition> (see page 461)	:SBUS<n>:CAN:TRIGger? (see page 462)	<condition> ::= {SOF | DATA | ERRor | IDData | IDEither | IDRemote | ALLerrors | OVERload | ACKerror}

:SBUS<n>:CAN:TRIGger:PATTern:DATA <string> (see page 463)	:SBUS<n>:CAN:TRIGger:PATTern:DATA? (see page 463)	<string> ::= "nn...n" where n ::= {0 | 1 | X | $}
		<string ::= "0xnn...n" where n ::= {0,..,9 | A,..,F | X | $}

Table 68 :SBUS<n>:CAN Commands Summary (continued)

Command	Query	Options and Query Returns
:SBUS<n>:CAN:TRIGger:PATTern:DATA:LENGth <length> (see page 464)	:SBUS<n>:CAN:TRIGger:PATTern:DATA:LENGth? (see page 464)	<length> ::= integer from 1 to 8 in NR1 format

:SBUS<n>:CAN:TRIGger:PATTern:ID <string> (see page 465)	:SBUS<n>:CAN:TRIGger:PATTern:ID? (see page 465)	<string> ::= "nn...n" where n ::= {0 | 1 | X | $}
		<string ::= "0xnn...n" where n ::= {0,..,9 | A,..,F | X | $}

:SBUS<n>:CAN:TRIGger:PATTern:ID:MODE <value> (see page 466)	:SBUS<n>:CAN:TRIGger:PATTern:ID:MODE? (see page 466)	<value> ::= {STANdard | EXTended}

:SBUS<n>:CAN:COUNt:ERRor

N (see page 776)

Query Syntax

```
:SBUS<n>:CAN:COUNt:ERRor?
```

Returns the error frame count.

Return Format

```
<frame_count><NL>

<frame_count> ::= integer in NR1 format
```

Errors

- "-241, Hardware missing" on page 739

See Also

- ":SBUS<n>:CAN:COUNt:RESet" on page 454
- "Introduction to :SBUS<n> Commands" on page 445
- ":SBUS<n>:MODE" on page 449
- ":SBUS<n>:CAN Commands" on page 450

:SBUS<n>:CAN:COUNt:OVERload

N (see page 776)

Query Syntax

```
:SBUS<n>:CAN:COUNt:OVERload?
```

Returns the overload frame count.

Return Format

```
<frame_count><NL>

<frame_count> ::= integer in NR1 format
```

Errors

- "-241, Hardware missing" on page 739

See Also

- ":SBUS<n>:CAN:COUNt:RESet" on page 454
- "Introduction to :SBUS<n> Commands" on page 445
- ":SBUS<n>:MODE" on page 449
- ":SBUS<n>:CAN Commands" on page 450

:SBUS<n>:CAN:COUNt:RESet

N (see page 776)

Command Syntax `:SBUS<n>:CAN:COUNt:RESet`

Resets the frame counters.

Errors

- "-241, Hardware missing" on page 739

See Also

- ":SBUS<n>:CAN:COUNt:ERRor" on page 452
- ":SBUS<n>:CAN:COUNt:OVERload" on page 453
- ":SBUS<n>:CAN:COUNt:TOTal" on page 455
- ":SBUS<n>:CAN:COUNt:UTILization" on page 456
- "Introduction to :SBUS<n> Commands" on page 445
- ":SBUS<n>:MODE" on page 449
- ":SBUS<n>:CAN Commands" on page 450

:SBUS<n>:CAN:COUNt:TOTal

N (see page 776)

Query Syntax

```
:SBUS<n>:CAN:COUNt:TOTal?
```

Returns the total frame count.

Return Format

```
<frame_count><NL>

<frame_count> ::= integer in NR1 format
```

Errors

- "-241, Hardware missing" on page 739

See Also

- ":SBUS<n>:CAN:COUNt:RESet" on page 454
- "Introduction to :SBUS<n> Commands" on page 445
- ":SBUS<n>:MODE" on page 449
- ":SBUS<n>:CAN Commands" on page 450

:SBUS<n>:CAN:COUNt:UTILization

N (see page 776)

Query Syntax

```
:SBUS<n>:CAN:COUNt:UTILization?
```

Returns the percent utilization.

Return Format

```
<percent><NL>

<percent> ::= floating-point in NR3 format
```

Errors

- "-241, Hardware missing" on page 739

See Also

- ":SBUS<n>:CAN:COUNt:RESet" on page 454
- "Introduction to :SBUS<n> Commands" on page 445
- ":SBUS<n>:MODE" on page 449
- ":SBUS<n>:CAN Commands" on page 450

:SBUS<n>:CAN:SAMPlepoint

N (see page 776)

Command Syntax

```
:SBUS<n>:CAN:SAMPlepoint <value>
```

```
<value><NL>
```

```
<value> ::= {60 | 62.5 | 68 | 70 | 75 | 80 | 87.5} in NR3 format
```

The :SBUS<n>:CAN:SAMPlepoint command sets the point during the bit time where the bit level is sampled to determine whether the bit is dominant or recessive. The sample point represents the percentage of time between the beginning of the bit time to the end of the bit time.

Query Syntax

```
:SBUS<n>:CAN:SAMPlepoint?
```

The :SBUS<n>:CAN:SAMPlepoint? query returns the current CAN sample point setting.

Return Format

```
<value><NL>
```

```
<value> ::= {60 | 62.5 | 68 | 70 | 75 | 80 | 87.5} in NR3 format
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:MODE" on page 449
- ":SBUS<n>:CAN:TRIGger" on page 461

:SBUS<n>:CAN:SIGNal:BAUDrate

N (see page 776)

Command Syntax

```
:SBUS<n>:CAN:SIGNal:BAUDrate <baudrate>
```

```
<baudrate> ::= integer from 10000 to 4000000 in 100 b/s increments,
               or 5000000
```

The :SBUS<n>:CAN:SIGNal:BAUDrate command sets the standard baud rate of the CAN signal from 10 kb/s to 4 Mb/s in 100 b/s increments. If you enter a baud rate that is not divisible by 100 b/s, the baud rate is set to the nearest baud rate divisible by 100 b/s.

You can also set the baud rate of the CAN signal to 5 Mb/s. Fractional baud rates between 4 Mb/s and 5 Mb/s are not allowed.

If the baud rate you select does not match the system baud rate, false triggers may occur.

Query Syntax

```
:SBUS<n>:CAN:SIGNal:BAUDrate?
```

The :SBUS<n>:CAN:SIGNal:BAUDrate? query returns the current CAN baud rate setting.

Return Format

```
<baudrate><NL>
```

```
<baudrate> ::= integer from 10000 to 4000000 in 100 b/s increments,
               or 5000000
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:MODE" on page 449
- ":SBUS<n>:CAN:TRIGger" on page 461
- ":SBUS<n>:CAN:SIGNal:DEFinition" on page 459
- ":SBUS<n>:CAN:SOURce" on page 460

:SBUS<n>:CAN:SIGNal:DEFinition

N (see page 776)

Command Syntax

```
:SBUS<n>:CAN:SIGNal:DEFinition <value>

<value> ::= {CANH | CANL | RX | TX | DIFFerential | DIFL | DIFH}
```

The :SBUS<n>:CAN:SIGNal:DEFinition command sets the CAN signal type when :SBUS<n>:CAN:TRIGger is set to SOF (start of frame). These signals can be set to:

Dominant high signals:

- CANH — the actual CAN_H differential bus signal.
- DIFH — the CAN differential (H-L) bus signal connected to an analog source channel using a differential probe.

Dominant low signals:

- CANL — the actual CAN_L differential bus signal.
- RX — the Receive signal from the CAN bus transceiver.
- TX — the Transmit signal to the CAN bus transceiver.
- DIFL — the CAN differential (L-H) bus signal connected to an analog source channel using a differential probe.
- DIFFerential — the CAN differential bus signal connected to an analog source channel using a differential probe. This is the same as DIFL.

Query Syntax

```
:SBUS<n>:CAN:SIGNal:DEFinition?
```

The :SBUS<n>:CAN:SIGNal:DEFinition? query returns the current CAN signal type.

Return Format

```
<value><NL>

<value> ::= {CANH | CANL | RX | TX | DIFL | DIFH}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:MODE" on page 449
- ":SBUS<n>:CAN:SIGNal:BAUDrate" on page 458
- ":SBUS<n>:CAN:SOURce" on page 460
- ":SBUS<n>:CAN:TRIGger" on page 461

:SBUS<n>:CAN:SOURce

N (see page 776)

Command Syntax

```
:SBUS<n>:CAN:SOURce <source>
```

```
<source> ::= {CHANnel<n> | EXTernal}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :SBUS<n>:CAN:SOURce command sets the source for the CAN signal.

Query Syntax

```
:SBUS<n>:CAN:SOURce?
```

The :SBUS<n>:CAN:SOURce? query returns the current source for the CAN signal.

Return Format

```
<source><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:MODE" on page 449
- ":SBUS<n>:CAN:TRIGger" on page 461
- ":SBUS<n>:CAN:SIGNal:DEFinition" on page 459

:SBUS<n>:CAN:TRIGger

N (see page 776)

Command Syntax

```
:SBUS<n>:CAN:TRIGger <condition>

<condition> ::= {SOF | DATA | ERRor | IDData | IDEither | IDRemote |
                 ALLerrors | OVERload | ACKerror}
```

The :SBUS<n>:CAN:TRIGger command sets the CAN trigger on condition:

- SOF - will trigger on the Start of Frame (SOF) bit of a Data frame, Remote Transfer Request (RTR) frame, or an Overload frame.
- DATA - will trigger on CAN Data frames matching the specified Id, Data, and the DLC (Data length code).
- ERRor - will trigger on CAN Error frame.
- IDData - will trigger on CAN frames matching the specified Id of a Data frame.
- IDEither - will trigger on the specified Id, regardless if it is a Remote frame or a Data frame.
- IDRemote - will trigger on CAN frames matching the specified Id of a Remote frame.
- ALLerrors - will trigger on CAN active error frames and unknown bus conditions.
- OVERload - will trigger on CAN overload frames.
- ACKerror - will trigger on a data or remote frame acknowledge bit that is recessive.

The table below shows the programming parameter and the corresponding front-panel softkey selection:

Remote <condition> parameter	Front-panel Trigger on: softkey selection (softkey text - softkey popup text)
SOF	SOF - Start of Frame
DATA	ID & Data - Data Frame ID and Data
ERRor	Error - Error frame
IDData	ID & ~RTR - Data Frame ID (~RTR)
IDEither	ID - Remote or Data Frame ID
IDRemote	ID & RTR - Remote Frame ID (RTR)
ALLerrors	All Errors - All Errors
OVERload	Overload - Overload Frame
ACKerror	Ack Error - Acknowledge Error

CAN Id specification is set by the :SBUS<n>:CAN:TRIGger:PATTern:ID and:SBUS<n>:CAN:TRIGger:PATTern:ID:MODE commands.

CAN Data specification is set by the :SBUS<n>:CAN:TRIGger:PATTern:DATA command.

CAN Data Length Code is set by the :SBUS<n>:CAN:TRIGger:PATTern:DATA:LENGth command.

Query Syntax

```
:SBUS<n>:CAN:TRIGger?
```

The :SBUS<n>:CAN:TRIGger? query returns the current CAN trigger on condition.

Return Format

```
<condition><NL>

<condition> ::= {SOF | DATA | ERR | IDD | IDE | IDR | ALL | OVER | ACK}
```

Errors

- "-241, Hardware missing" on page 739

See Also

- "Introduction to :SBUS<n> Commands" on page 445
- ":SBUS<n>:MODE" on page 449
- ":SBUS<n>:CAN:TRIGger:PATTern:DATA" on page 463
- ":SBUS<n>:CAN:TRIGger:PATTern:DATA:LENGth" on page 464
- ":SBUS<n>:CAN:TRIGger:PATTern:ID" on page 465
- ":SBUS<n>:CAN:TRIGger:PATTern:ID:MODE" on page 466
- ":SBUS<n>:CAN:SIGNal:DEFinition" on page 459
- ":SBUS<n>:CAN:SOURce" on page 460

:SBUS<n>:CAN:TRIGger:PATTern:DATA

N (see page 776)

Command Syntax

```
:SBUS<n>:CAN:TRIGger:PATTern:DATA <string>
```

```
<string> ::= "nn...n" where n ::= {0 | 1 | X | $}
```

```
<string ::= "0xnn...n" where n ::= {0,..,9 | A,..,F | X | $}
```

The :SBUS<n>:CAN:TRIGger:PATTern:DATA command defines the CAN data pattern resource according to the string parameter. This pattern, along with the data length (set by the :SBUS<n>:CAN:TRIGger:PATTern:DATA:LENGth command), control the data pattern searched for in each CAN message.

If the string parameter starts with "0x", it is a hexadecimal string made up of hexadecimal and X (don't care) characters; otherwise, it is a binary string made up of 0, 1, and X (don't care) characters.

NOTE If more bits are sent for <string> than specified by the :SBUS<n>:CAN:TRIGger:PATTern:DATA:LENGth command, the most significant bits will be truncated. If the data length is changed after the <string> is programmed, the added or deleted bits will be added to or deleted from the least significant bits.

Query Syntax

```
:SBUS<n>:CAN:TRIGger:PATTern:DATA?
```

The :SBUS<n>:CAN:TRIGger:PATTern:DATA? query returns the current settings of the specified CAN data pattern resource in the binary string format.

Return Format

```
<string><NL> in nondecimal format
```

Errors

- "-241, Hardware missing" on page 739

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:CAN:TRIGger:PATTern:DATA:LENGth" on page 464
- ":SBUS<n>:CAN:TRIGger:PATTern:ID" on page 465

:SBUS<n>:CAN:TRIGger:PATTern:DATA:LENGth

N (see page 776)

Command Syntax

```
:SBUS<n>:CAN:TRIGger:PATTern:DATA:LENGth <length>
```

```
<length> ::= integer from 1 to 8 in NR1 format
```

The :SBUS<n>:CAN:TRIGger:PATTern:DATA:LENGth command sets the number of 8-bit bytes in the CAN data string. The number of bytes in the string can be anywhere from 1 bytes to 8 bytes (64 bits). The value for these bytes is set by the :SBUS<n>:CAN:TRIGger:PATTern:DATA command.

Query Syntax

```
:SBUS<n>:CAN:TRIGger:PATTern:DATA:LENGth?
```

The :SBUS<n>:CAN:TRIGger:PATTern:DATA:LENGth? query returns the current CAN data pattern length setting.

Return Format

```
<count><NL>
```

```
<count> ::= integer from 1 to 8 in NR1 format
```

Errors

- "-241, Hardware missing" on page 739

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:CAN:TRIGger:PATTern:DATA" on page 463
- ":SBUS<n>:CAN:SOURce" on page 460

:SBUS<n>:CAN:TRIGger:PATTern:ID

N (see page 776)

Command Syntax

```
:SBUS<n>:CAN:TRIGger:PATTern:ID <string>
```

```
<string> ::= "nn...n" where n ::= {0 | 1 | X | $}
```

```
<string ::= "0xnn...n" where n ::= {0,..,9 | A,..,F | X | $}
```

The :SBUS<n>:CAN:TRIGger:PATTern:ID command defines the CAN identifier pattern resource according to the string parameter. This pattern, along with the identifier mode (set by the :SBUS<n>:CAN:TRIGger:PATTern:ID:MODE command), control the identifier pattern searched for in each CAN message.

If the string parameter starts with "0x", it is a hexadecimal string made up of hexadecimal and X (don't care) characters; otherwise, it is a binary string made up of 0, 1, and X (don't care) characters.

NOTE

The ID pattern resource string is always 29 bits. Only 11 of these bits are used when the :SBUS<n>:CAN:TRIGger:PATTern:ID:MODE is STANdard.

A string longer than 29 bits is truncated to 29 bits when setting the ID pattern resource.

Query Syntax

```
:SBUS<n>:CAN:TRIGger:PATTern:ID?
```

The :SBUS<n>:CAN:TRIGger:PATTern:ID? query returns the current settings of the specified CAN identifier pattern resource in the 29-bit binary string format.

Return Format

```
<string><NL> in 29-bit binary string format
```

Errors

- "-241, Hardware missing" on page 739

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:CAN:TRIGger:PATTern:ID:MODE" on page 466
- ":SBUS<n>:CAN:TRIGger:PATTern:DATA" on page 463

:SBUS<n>:CAN:TRIGger:PATTern:ID:MODE

N (see page 776)

Command Syntax

```
:SBUS<n>:CAN:TRIGger:PATTern:ID:MODE <value>
```

```
<value> ::= {STANdard | EXTended}
```

The :SBUS<n>:CAN:TRIGger:PATTern:ID:MODE command sets the CAN identifier mode. STANdard selects the standard 11-bit identifier. EXTended selects the extended 29-bit identifier. The CAN identifier is set by the :SBUS<n>:CAN:TRIGger:PATTern:ID command.

Query Syntax

```
:SBUS<n>:CAN:TRIGger:PATTern:ID:MODE?
```

The :SBUS<n>:CAN:TRIGger:PATTern:ID:MODE? query returns the current setting of the CAN identifier mode.

Return Format

```
<value><NL>
```

```
<value> ::= {STAN | EXT}
```

Errors

- "-241, Hardware missing" on page 739

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:MODE" on page 449
- ":SBUS<n>:CAN:TRIGger:PATTern:DATA" on page 463
- ":SBUS<n>:CAN:TRIGger:PATTern:DATA:LENGth" on page 464
- ":SBUS<n>:CAN:TRIGger:PATTern:ID" on page 465

:SBUS<n>:IIC Commands

NOTE These commands are valid when the low-speed IIC and SPI serial decode license (EMBD) is enabled.

Table 69 :SBUS<n>:IIC Commands Summary

Command	Query	Options and Query Returns
:SBUS<n>:IIC:ASIZe <size> (see page 468)	:SBUS<n>:IIC:ASIZe? (see page 468)	<size> ::= {BIT7 | BIT8}
:SBUS<n>:IIC[:SOURce]:CLOCk <source> (see page 469)	:SBUS<n>:IIC[:SOURce]:CLOCk? (see page 469)	<source> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:SBUS<n>:IIC[:SOURce]:DATA <source> (see page 470)	:SBUS<n>:IIC[:SOURce]:DATA? (see page 470)	<source> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:SBUS<n>:IIC:TRIGger:PATTern:ADDRess <value> (see page 471)	:SBUS<n>:IIC:TRIGger:PATTern:ADDRess? (see page 471)	<value> ::= integer or <string> <string> ::= "0xnn" n ::= {0,..,9 | A,..,F}
:SBUS<n>:IIC:TRIGger:PATTern:DATA <value> (see page 472)	:SBUS<n>:IIC:TRIGger:PATTern:DATA? (see page 472)	<value> ::= integer or <string> <string> ::= "0xnn" n ::= {0,..,9 | A,..,F}
:SBUS<n>:IIC:TRIGger:PATTern:DATa2 <value> (see page 473)	:SBUS<n>:IIC:TRIGger:PATTern:DATa2? (see page 473)	<value> ::= integer or <string> <string> ::= "0xnn" n ::= {0,..,9 | A,..,F}
:SBUS<n>:IIC:TRIGger:QUALifier <value> (see page 474)	:SBUS<n>:IIC:TRIGger:QUALifier? (see page 474)	<value> ::= {EQUal | NOTequal | LESSthan | GREaterthan}
:SBUS<n>:IIC:TRIGger[:TYPE] <type> (see page 475)	:SBUS<n>:IIC:TRIGger[:TYPE]? (see page 475)	<type> ::= {STARt | STOP | READ7 | READEprom | WRITe7 | WRITe10 | NACKnowledge | ANACk | R7Data2 | W7Data2 | RESTart}

:SBUS<n>:IIC:ASIZe

N (see page 776)

Command Syntax

```
:SBUS<n>:IIC:ASIZe <size>
```

```
<size> ::= {BIT7 | BIT8}
```

The :SBUS<n>:IIC:ASIZe command determines whether the Read/Write bit is included as the LSB in the display of the IIC address field of the decode bus.

Query Syntax

```
:SBUS<n>:IIC:ASIZe?
```

The :SBUS<n>:IIC:ASIZe? query returns the current IIC address width setting.

Return Format

```
<mode><NL>
```

```
<mode> ::= {BIT7 | BIT8}
```

Errors

- "-241, Hardware missing" on page 739

See Also

- "Introduction to :SBUS<n> Commands" on page 445
- ":SBUS<n>:IIC Commands" on page 467

:SBUS<n>:IIC[:SOURce]:CLOCk

N (see page 776)

Command Syntax

```
:SBUS<n>:IIC[:SOURce]:CLOCk <source>

<source> ::= {CHANnel<n> | EXTernal}

<n> ::= 1 to (# analog channels) in NR1 format
```

The :SBUS<n>:IIC[:SOURce]:CLOCk command sets the source for the IIC serial clock (SCL).

Query Syntax

```
:SBUS<n>:IIC[:SOURce]:CLOCk?
```

The :SBUS<n>:IIC[:SOURce]:CLOCk? query returns the current source for the IIC serial clock.

Return Format

```
<source><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:IIC[:SOURce]:DATA" on page 470

:SBUS<n>:IIC[:SOURce]:DATA

N (see page 776)

Command Syntax

```
:SBUS<n>:IIC[:SOURce]:DATA <source>

<source> ::= {CHANnel<n> | EXTernal}

<n> ::= 1 to (# analog channels) in NR1 format
```

The :SBUS<n>:IIC[:SOURce]:DATA command sets the source for IIC serial data (SDA).

Query Syntax

```
:SBUS<n>:IIC[:SOURce]:DATA?
```

The :SBUS<n>:IIC[:SOURce]:DATA? query returns the current source for IIC serial data.

Return Format

```
<source><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:IIC[:SOURce]:CLOCk" on page 469

:SBUS<n>:IIC:TRIGger:PATTern:ADDRess

N (see page 776)

Command Syntax

```
:SBUS<n>:IIC:TRIGger:PATTern:ADDRess <value>

<value> ::= integer or <string>

<string> ::= "0xnn" where n ::= {0,..,9 | A,..,F}
```

The :SBUS<n>:IIC:TRIGger:PATTern:ADDRess command sets the address for IIC data.The address can range from 0x00 to 0x7F (7-bit) or 0x3FF (10-bit) hexadecimal. Use the don't care address (-1 or 0xFFFFFFFF) to ignore the address value.

Query Syntax

```
:SBUS<n>:IIC:TRIGger:PATTern:ADDRess?
```

The :SBUS<n>:IIC:TRIGger:PATTern:ADDRess? query returns the current address for IIC data.

Return Format

```
<value><NL>

<value> ::= integer
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:IIC:TRIGger:PATTern:DATA" on page 472
- ":SBUS<n>:IIC:TRIGger:PATTern:DATa2" on page 473
- ":SBUS<n>:IIC:TRIGger[:TYPE]" on page 475

:SBUS<n>:IIC:TRIGger:PATTern:DATA

N (see page 776)

Command Syntax

```
:SBUS<n>:IIC:TRIGger:PATTern:DATA <value>

<value> ::= integer or <string>

<string> ::= "0xnn" where n ::= {0,..,9 | A,..,F}
```

The :SBUS<n>:IIC:TRIGger:PATTern:DATA command sets IIC data. The data value can range from 0x00 to 0x0FF (hexadecimal). Use the don't care data pattern (-1 or 0xFFFFFFFF) to ignore the data value.

Query Syntax

```
:SBUS<n>:IIC:TRIGger:PATTern:DATA?
```

The :SBUS<n>:IIC:TRIGger:PATTern:DATA? query returns the current pattern for IIC data.

Return Format

```
<value><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:IIC:TRIGger:PATTern:ADDRess" on page 471
- ":SBUS<n>:IIC:TRIGger:PATTern:DATa2" on page 473
- ":SBUS<n>:IIC:TRIGger[:TYPE]" on page 475

:SBUS<n>:IIC:TRIGger:PATTern:DATa2

N (see page 776)

Command Syntax

```
:SBUS<n>:IIC:TRIGger:PATTern:DATa2 <value>
```

```
<value> ::= integer or <string>
```

```
<string> ::= "0xnn" where n ::= {0,..,9 | A,..,F}
```

The :SBUS<n>:IIC:TRIGger:PATTern:DATa2 command sets IIC data 2. The data value can range from 0x00 to 0x0FF (hexadecimal). Use the don't care data pattern (-1 or 0xFFFFFFFF) to ignore the data value.

Query Syntax

```
:SBUS<n>:IIC:TRIGger:PATTern:DATa2?
```

The :SBUS<n>:IIC:TRIGger:PATTern:DATa2? query returns the current pattern for IIC data 2.

Return Format

```
<value><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:IIC:TRIGger:PATTern:ADDRess" on page 471
- ":SBUS<n>:IIC:TRIGger:PATTern:DATA" on page 472
- ":SBUS<n>:IIC:TRIGger[:TYPE]" on page 475

:SBUS<n>:IIC:TRIGger:QUALifier

N (see page 776)

Command Syntax

```
:SBUS<n>:IIC:TRIGger:QUALifier <value>

<value> ::= {EQUal | NOTequal | LESSthan | GREaterthan}
```

The :SBUS<n>:IIC:TRIGger:QUALifier command sets the IIC data qualifier when TRIGger:IIC:TRIGger[:TYPE] is set to READEprom.

Query Syntax

```
:SBUS<n>:IIC:TRIGger:QUALifier?
```

The :SBUS<n>:IIC:TRIGger:QUALifier? query returns the current IIC data qualifier value.

Return Format

```
<value><NL>

<value> ::= {EQUal | NOTequal | LESSthan | GREaterthan}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:IIC:TRIGger[:TYPE]" on page 475

:SBUS<n>:IIC:TRIGger[:TYPE]

N (see page 776)

Command Syntax

```
:SBUS<n>:IIC:TRIGger[:TYPE] <value>
```

```
<value> ::= {STARt | STOP | READ7 | READEprom | WRITe7 | WRITe10
| NACKnowledge | ANACk | R7Data2 | W7Data2 | RESTart}
```

The :SBUS<n>:IIC:TRIGger[:TYPE] command sets the IIC trigger type:

- STARt — Start condition.
- STOP — Stop condition.
- READ7 — 7-bit address frame containing (Start:Address7:Read:Ack:Data). The value READ is also accepted for READ7.
- R7Data2 — 7-bit address frame containing (Start:Address7:Read:Ack:Data:Ack:Data2).
- READEprom — EEPROM data read.
- WRITe7 — 7-bit address frame containing (Start:Address7:Write:Ack:Data). The value WRITe is also accepted for WRITe7.
- W7Data2 — 7-bit address frame containing (Start:Address7:Write:Ack:Data:Ack:Data2).
- WRITe10 — 10-bit address frame containing (Start:Address byte1:Write:Ack:Address byte 2:Data).
- NACKnowledge — Missing acknowledge.
- ANACk — Address with no acknowledge.
- RESTart — Another start condition occurs before a stop condition.

NOTE The short form of READ7 (READ7), READEprom (READE), WRITe7 (WRIT7), and WRITe10 (WRIT10) do not follow the defined Long Form to Short Form Truncation Rules (see page 778).

Query Syntax

```
:SBUS<n>:IIC:TRIGger[:TYPE]?
```

The :SBUS<n>:IIC:TRIGger[:TYPE]? query returns the current IIC trigger type value.

Return Format

```
<value><NL>
```

```
<value> ::= {STAR | STOP | READ7 | READE | WRIT7 | WRIT10 | NACK | ANAC
            | R7D2 | W7D2 | REST}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:IIC:TRIGger:PATTern:ADDRess" on page 471
- ":SBUS<n>:IIC:TRIGger:PATTern:DATA" on page 472

- ":SBUS<n>:IIC:TRIGger:PATTern:DATa2" on page 473
- ":SBUS<n>:IIC:TRIGger:QUALifier" on page 474
- "Long Form to Short Form Truncation Rules" on page 778

:SBUS<n>:LIN Commands

NOTE These commands are valid on DSOX1000-Series oscilloscopes when the automotive CAN and LIN serial decode license (AUTO) is enabled.

Table 70 :SBUS<n>:LIN Commands Summary

Command	Query	Options and Query Returns
:SBUS<n>:LIN:PARity {{0 | OFF} | {1 | ON}} (see page 479)	:SBUS<n>:LIN:PARity? (see page 479)	{0 | 1}
:SBUS<n>:LIN:SAMPlepoint <value> (see page 480)	:SBUS<n>:LIN:SAMPlepoint? (see page 480)	<value> ::= {60 | 62.5 | 68 | 70 | 75 | 80 | 87.5} in NR3 format
:SBUS<n>:LIN:SIGNal:BAUDrate <baudrate> (see page 481)	:SBUS<n>:LIN:SIGNal:BAUDrate? (see page 481)	<baudrate> ::= integer from 2400 to 625000 in 100 b/s increments
:SBUS<n>:LIN:SOURce <source> (see page 482)	:SBUS<n>:LIN:SOURce? (see page 482)	<source> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:SBUS<n>:LIN:STANdard <std> (see page 483)	:SBUS<n>:LIN:STANdard? (see page 483)	<std> ::= {LIN13 | LIN20}
:SBUS<n>:LIN:SYNCbreak <value> (see page 484)	:SBUS<n>:LIN:SYNCbreak? (see page 484)	<value> ::= integer = {11 | 12 | 13}
:SBUS<n>:LIN:TRIGger <condition> (see page 485)	:SBUS<n>:LIN:TRIGger? (see page 485)	<condition> ::= {SYNCbreak | ID | DATA}
:SBUS<n>:LIN:TRIGger:ID <value> (see page 486)	:SBUS<n>:LIN:TRIGger:ID? (see page 486)	<value> ::= 7-bit integer in decimal, <nondecimal>, or <string> from 0-63 or 0x00-0x3f <nondecimal> ::= #Hnn where n ::= {0,..,9 | A,..,F} for hexadecimal <nondecimal> ::= #Bnn...n where n ::= {0 | 1} for binary <string> ::= "0xnn" where n ::= {0,..,9 | A,..,F} for hexadecimal

Table 70 :SBUS<n>:LIN Commands Summary (continued)

Command	Query	Options and Query Returns
:SBUS<n>:LIN:TRIGger:PATTern:DATA <string> (see page 487)	:SBUS<n>:LIN:TRIGger:PATTern:DATA? (see page 487)	<string> ::= "n" where n ::= 32-bit integer in unsigned decimal when <base> = DECimal <string> ::= "nn...n" where n ::= {0 | 1 | X | $} when <base> = BINary <string> ::= "0xnn...n" where n ::= {0,..,9 | A,..,F | X | $} when <base> = HEX
:SBUS<n>:LIN:TRIGger:PATTern:DATA:LENGth <length> (see page 489)	:SBUS<n>:LIN:TRIGger:PATTern:DATA:LENGth? (see page 489)	<length> ::= integer from 1 to 8 in NR1 format
:SBUS<n>:LIN:TRIGger:PATTern:FORMat <base> (see page 490)	:SBUS<n>:LIN:TRIGger:PATTern:FORMat? (see page 490)	<base> ::= {BINary | HEX | DECimal}

:SBUS<n>:LIN:PARity

N (see page 776)

Command Syntax

```
:SBUS<n>:LIN:PARity <display>

<display> ::= {{1 | ON} | {0 | OFF}}
```

The :SBUS<n>:LIN:PARity command determines whether the parity bits are included as the most significant bits (MSB) in the display of the Frame Id field in the LIN decode bus.

Query Syntax

```
:SBUS<n>:LIN:PARity?
```

The :SBUS<n>:LIN:PARity? query returns the current LIN parity bits display setting of the serial decode bus.

Return Format

```
<display><NL>

<display> ::= {0 | 1}
```

Errors

- "-241, Hardware missing" on page 739

See Also

- "Introduction to :SBUS<n> Commands" on page 445
- ":SBUS<n>:LIN Commands" on page 477

:SBUS<n>:LIN:SAMPlepoint

N (see page 776)

Command Syntax

```
:SBUS<n>:LIN:SAMPlepoint <value>
```

```
<value><NL>
```

```
<value> ::= {60 | 62.5 | 68 | 70 | 75 | 80 | 87.5} in NR3 format
```

The :SBUS<n>:LIN:SAMPlepoint command sets the point during the bit time where the bit level is sampled to determine whether the bit is dominant or recessive. The sample point represents the percentage of time between the beginning of the bit time to the end of the bit time.

NOTE **The sample point values are not limited by the baud rate.**

Query Syntax

```
:SBUS<n>:LIN:SAMPlepoint?
```

The :SBUS<n>:LIN:SAMPlepoint? query returns the current LIN sample point setting.

Return Format

```
<value><NL>
```

```
<value> ::= {60 | 62.5 | 68 | 70 | 75 | 80 | 87.5} in NR3 format
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:LIN:TRIGger" on page 485

:SBUS<n>:LIN:SIGNal:BAUDrate

N (see page 776)

Command Syntax

```
:SBUS<n>:LIN:SIGNal:BAUDrate <baudrate>
```

```
<baudrate> ::= integer from 2400 to 625000 in 100 b/s increments
```

The :SBUS<n>:LIN:SIGNal:BAUDrate command sets the standard baud rate of the LIN signal from 2400 b/s to 625 kb/s in 100 b/s increments. If you enter a baud rate that is not divisible by 100 b/s, the baud rate is set to the nearest baud rate divisible by 100 b/s.

Query Syntax

```
:SBUS<n>:LIN:SIGNal:BAUDrate?
```

The :SBUS<n>:LIN:SIGNal:BAUDrate? query returns the current LIN baud rate setting.

Return Format

```
<baudrate><NL>
```

```
<baudrate> ::= integer from 2400 to 625000 in 100 b/s increments
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:LIN:TRIGger" on page 485
- ":SBUS<n>:LIN:SOURce" on page 482

:SBUS<n>:LIN:SOURce

N (see page 776)

Command Syntax

```
:SBUS<n>:LIN:SOURce <source>

<source> ::= {CHANnel<n> | EXTernal}

<n> ::= 1 to (# analog channels) in NR1 format
```

The :SBUS<n>:LIN:SOURce command sets the source for the LIN signal.

Query Syntax

```
:SBUS<n>:LIN:SOURce?
```

The :SBUS<n>:LIN:SOURce? query returns the current source for the LIN signal.

Return Format

```
<source><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:LIN:TRIGger" on page 485

:SBUS<n>:LIN:STANdard

N (see page 776)

Command Syntax

```
:SBUS<n>:LIN:STANdard <std>
```

```
<std> ::= {LIN13 | LIN20}
```

The :SBUS<n>:LIN:STANdard command sets the LIN standard in effect for triggering and decoding to be LIN1.3 or LIN2.0.

Query Syntax

```
:SBUS<n>:LIN:STANdard?
```

The :SBUS<n>:LIN:STANdard? query returns the current LIN standard setting.

Return Format

```
<std><NL>
```

```
<std> ::= {LIN13 | LIN20}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:LIN:SOURce" on page 482

:SBUS<n>:LIN:SYNCbreak

N (see page 776)

Command Syntax

```
:SBUS<n>:LIN:SYNCbreak <value>
```

```
<value> ::= integer = {11 | 12 | 13}
```

The :SBUS<n>:LIN:SYNCbreak command sets the length of the LIN sync break to be greater than or equal to 11, 12, or 13 clock lengths. The sync break is the idle period in the bus activity at the beginning of each packet that distinguishes one information packet from the previous one.

Query Syntax

```
:SBUS<n>:LIN:SYNCbreak?
```

The :SBUS<n>:LIN:SYNCbreak? query returns the current LIN sync break setting.

Return Format

```
<value><NL>
```

```
<value> ::= {11 | 12 | 13}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:LIN:SOURce" on page 482

:SBUS<n>:LIN:TRIGger

N (see page 776)

Command Syntax

```
:SBUS<n>:LIN:TRIGger <condition>

<condition> ::= {SYNCbreak | ID | DATA}
```

The :SBUS<n>:LIN:TRIGger command sets the LIN trigger condition to be:

- SYNCbreak — Sync Break.
- ID — Frame ID.

  Use the :SBUS<n>:LIN:TRIGger:ID command to specify the frame ID.
- DATA — Frame ID and Data.

  Use the :SBUS<n>:LIN:TRIGger:ID command to specify the frame ID.

  Use the :SBUS<n>:LIN:TRIGger:PATTern:DATA:LENGth and :SBUS<n>:LIN:TRIGger:PATTern:DATA commands to specify the data string length and value.

Query Syntax

```
:SBUS<n>:LIN:TRIGger?
```

The :SBUS<n>:LIN:TRIGger? query returns the current LIN trigger value.

Return Format

```
<condition><NL>

<condition> ::= {SYNC | ID | DATA}
```

Errors

- "-241, Hardware missing" on page 739

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:LIN:TRIGger:ID" on page 486
- ":SBUS<n>:LIN:TRIGger:PATTern:DATA:LENGth" on page 489
- ":SBUS<n>:LIN:TRIGger:PATTern:DATA" on page 487
- ":SBUS<n>:LIN:SOURce" on page 482

:SBUS<n>:LIN:TRIGger:ID

N (see page 776)

Command Syntax

```
:SBUS<n>:LIN:TRIGger:ID <value>

<value> ::= 7-bit integer in decimal, <nondecimal>, or <string>
            from 0-63 or 0x00-0x3f

<nondecimal> ::= #Hnn where n ::= {0,..,9 | A,..,F} for hexadecimal

<nondecimal> ::= #Bnn...n where n ::= {0 | 1} for binary

<string> ::= "0xnn" where n ::= {0,..,9 | A,..,F} for hexadecimal
```

The :SBUS<n>:LIN:TRIGger:ID command defines the LIN identifier searched for in each CAN message when the LIN trigger mode is set to frame ID.

Setting the ID to a value of "-1" results in "0xXX" which is equivalent to all IDs.

Query Syntax

```
:SBUS<n>:LIN:TRIGger:ID?
```

The :SBUS<n>:LIN:TRIGger:ID? query returns the current LIN identifier setting.

Return Format

```
<value><NL>

<value> ::= integer in decimal
```

Errors

- "-241, Hardware missing" on page 739

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:LIN:TRIGger" on page 485
- ":SBUS<n>:LIN:SOURce" on page 482

:SBUS<n>:LIN:TRIGger:PATTern:DATA

N (see page 776)

Command Syntax

```
:SBUS<n>:LIN:TRIGger:PATTern:DATA <string>

<string> ::= "n" where n ::= 32-bit integer in unsigned decimal when
             <base> = DECimal

<string> ::= "nn...n" where n ::= {0 | 1 | X | $} when
             <base> = BINary

<string> ::= "0xnn...n" where n ::= {0,..,9 | A,..,F | X | $} when
             <base> = HEX
```

NOTE <base> is specified with the :SBUS<n>:LIN:TRIGger:PATTern:FORMat command. The default <base> is BINary.

The :SBUS<n>:LIN:TRIGger:PATTern:DATA command specifies the LIN trigger data pattern searched for in each LIN data field.

Set a <string> bit to "0" or "1" to set the corresponding bit in the data pattern to low or high, respectively.

Set a <string> bit to "X" to ignore (mask off) that bit in the data pattern.

Use the "$" character to indicate that the value of the corresponding bit will not be changed (the existing bit value is used).

When <base> = DECimal, the "X" and "$" characters cannot be entered. When queried, the "$" character is returned when any bits in the pattern have the value of "X" and <base> = DECimal. When any bits in a given nibble have the value of "X" and <base> = HEX, the "$" character is returned for the corresponding nibble.

NOTE The length of the trigger data value is determined by the :SBUS<n>:LIN:TRIGger:PATTern:DATA:LENGth command.

NOTE If more bits are sent for <string> than the specified trigger pattern data length, the most significant bits will be truncated. If the data length size is changed after the <string> is programmed, the added or deleted bits will be added to or deleted from the least significant bits.

Query Syntax

```
:SBUS<n>:LIN:TRIGger:PATTern:DATA?
```

The :SBUS<n>:LIN:TRIGger:PATTern:DATA? query returns the currently specified LIN trigger data pattern.

Return Format

```
<string><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:LIN:TRIGger:PATTern:FORMat" on page 490
- ":SBUS<n>:LIN:TRIGger" on page 485
- ":SBUS<n>:LIN:TRIGger:PATTern:DATA:LENGth" on page 489

:SBUS<n>:LIN:TRIGger:PATTern:DATA:LENGth

N (see page 776)

Command Syntax

```
:SBUS<n>:LIN:TRIGger:PATTern:DATA:LENGth <length>
```

```
<length> ::= integer from 1 to 8 in NR1 format
```

The :SBUS<n>:LIN:TRIGger:PATTern:DATA:LENGth command sets the number of 8-bit bytes in the LIN data string. The number of bytes in the string can be anywhere from 1 bytes to 8 bytes (64 bits). The value for these bytes is set by the :SBUS<n>:LIN:TRIGger:PATTern:DATA command.

Query Syntax

```
:SBUS<n>:LIN:TRIGger:PATTern:DATA:LENGth?
```

The :SBUS<n>:LIN:TRIGger:PATTern:DATA:LENGth? query returns the current LIN data pattern length setting.

Return Format

```
<count><NL>
```

```
<count> ::= integer from 1 to 8 in NR1 format
```

Errors

- "-241, Hardware missing" on page 739

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:LIN:TRIGger:PATTern:DATA" on page 487
- ":SBUS<n>:LIN:SOURce" on page 482

:SBUS<n>:LIN:TRIGger:PATTern:FORMat

N (see page 776)

Command Syntax

```
:SBUS<n>:LIN:TRIGger:PATTern:FORMat <base>
```

```
<base> ::= {BINary | HEX | DECimal}
```

The :SBUS<n>:LIN:TRIGger:PATTern:FORMat command sets the entry (and query) number base used by the :SBUS<n>:LIN:TRIGger:PATTern:DATA command. The default <base> is BINary.

Query Syntax

```
:SBUS<n>:LIN:TRIGger:PATTern:FORMat?
```

The :SBUS<n>:LIN:TRIGger:PATTern:FORMat? query returns the currently set number base for LIN pattern data.

Return Format

```
<base><NL>
```

```
<base> ::= {BIN | HEX | DEC}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:LIN:TRIGger:PATTern:DATA" on page 487
- ":SBUS<n>:LIN:TRIGger:PATTern:DATA:LENGth" on page 489

:SBUS<n>:SPI Commands

NOTE These commands are valid on DSOX1000-Series oscilloscopes when the low-speed IIC and SPI serial decode license (EMBD) is enabled.

Table 71 :SBUS<n>:SPI Commands Summary

Command	Query	Options and Query Returns
:SBUS<n>:SPI:BITorder <order> (see page 493)	:SBUS<n>:SPI:BITorder ? (see page 493)	<order> ::= {LSBFirst | MSBFirst}
:SBUS<n>:SPI:CLOCk:SLOPe <slope> (see page 494)	:SBUS<n>:SPI:CLOCk:SLOPe? (see page 494)	<slope> ::= {NEGative | POSitive}
:SBUS<n>:SPI:CLOCk:TIMeout <time_value> (see page 495)	:SBUS<n>:SPI:CLOCk:TIMeout? (see page 495)	<time_value> ::= time in seconds in NR3 format
:SBUS<n>:SPI:FRAMing <value> (see page 496)	:SBUS<n>:SPI:FRAMing? (see page 496)	<value> ::= {CHIPselect | {NCHipselect | NOTC} | TIMeout}
:SBUS<n>:SPI:SOURce:CLOCk <source> (see page 497)	:SBUS<n>:SPI:SOURce:CLOCk? (see page 497)	<value> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:SBUS<n>:SPI:SOURce:FRAMe <source> (see page 498)	:SBUS<n>:SPI:SOURce:FRAMe? (see page 498)	<value> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:SBUS<n>:SPI:SOURce:MISO <source> (see page 499)	:SBUS<n>:SPI:SOURce:MISO? (see page 499)	<value> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:SBUS<n>:SPI:SOURce:MOSI <source> (see page 500)	:SBUS<n>:SPI:SOURce:MOSI? (see page 500)	<value> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format

:SBUS<n>:SPI:TRIGger:PATTern:MISO:DATA <string> (see page 501)	:SBUS<n>:SPI:TRIGger:PATTern:MISO:DATA? (see page 501)	<string> ::= "nn...n" where n ::= {0 | 1 | X | $}
		<string ::= "0xnn...n" where n ::= {0,..,9 | A,..,F | X | $}

:SBUS<n>:SPI:TRIGger:PATTern:MISO:WIDTh <width> (see page 502)	:SBUS<n>:SPI:TRIGger:PATTern:MISO:WIDTh? (see page 502)	<width> ::= integer from 4 to 64 in NR1 format

Table 71 :SBUS<n>:SPI Commands Summary (continued)

Command	Query	Options and Query Returns
:SBUS<n>:SPI:TRIGger:PATTern:MOSI:DATA <string> (see page 503)	:SBUS<n>:SPI:TRIGger:PATTern:MOSI:DATA? (see page 503)	<string> ::= "nn...n" where n ::= {0 | 1 | X | $} <string ::= "0xnn...n" where n ::= {0,..,9 | A,..,F | X | $}
:SBUS<n>:SPI:TRIGger:PATTern:MOSI:WIDTh <width> (see page 504)	:SBUS<n>:SPI:TRIGger:PATTern:MOSI:WIDTh? (see page 504)	<width> ::= integer from 4 to 64 in NR1 format
:SBUS<n>:SPI:TRIGger:TYPE <value> (see page 505)	:SBUS<n>:SPI:TRIGger:TYPE? (see page 505)	<value> ::= {MOSI | MISO}
:SBUS<n>:SPI:WIDTh <word_width> (see page 506)	:SBUS<n>:SPI:WIDTh? (see page 506)	<word_width> ::= integer 4-16 in NR1 format

:SBUS<n>:SPI:BITorder

N (see page 776)

Command Syntax

```
:SBUS<n>:SPI:BITorder <order>

<order> ::= {LSBFirst | MSBFirst}
```

The :SBUS<n>:SPI:BITorder command selects the bit order, most significant bit first (MSB) or least significant bit first (LSB), used when displaying data in the serial decode waveform and in the Lister.

Query Syntax

```
:SBUS<n>:SPI:BITorder?
```

The :SBUS<n>:SPI:BITorder? query returns the current SPI decode bit order.

Return Format

```
<order><NL>

<order> ::= {LSBF | MSBF}
```

Errors

- "-241, Hardware missing" on page 739

See Also

- "Introduction to :SBUS<n> Commands" on page 445
- ":SBUS<n>:MODE" on page 449
- ":SBUS<n>:SPI Commands" on page 491

:SBUS<n>:SPI:CLOCk:SLOPe

N (see page 776)

Command Syntax

```
:SBUS<n>:SPI:CLOCk:SLOPe <slope>

<slope> ::= {NEGative | POSitive}
```

The :SBUS<n>:SPI:CLOCk:SLOPe command specifies the rising edge (POSitive) or falling edge (NEGative) of the SPI clock source that will clock in the data.

Query Syntax

```
:SBUS<n>:SPI:CLOCk:SLOPe?
```

The :SBUS<n>:SPI:CLOCk:SLOPe? query returns the current SPI clock source slope.

Return Format

```
<slope><NL>

<slope> ::= {NEG | POS}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:SPI:CLOCk:TIMeout" on page 495
- ":SBUS<n>:SPI:SOURce:CLOCk" on page 497

:SBUS<n>:SPI:CLOCk:TIMeout

N (see page 776)

Command Syntax

```
:SBUS<n>:SPI:CLOCk:TIMeout <time_value>
```

```
<time_value> ::= time in seconds in NR3 format
```

The :SBUS<n>:SPI:CLOCk:TIMeout command sets the SPI signal clock timeout resource in seconds from 100 ns to 10 s when the :SBUS<n>:SPI:FRAMing command is set to TIMeout. The timer is used to frame a signal by a clock timeout.

Query Syntax

```
:SBUS<n>:SPI:CLOCk:TIMeout?
```

The :SBUS<n>:SPI:CLOCk:TIMeout? query returns current SPI clock timeout setting.

Return Format

```
<time value><NL>
```

```
<time_value> ::= time in seconds in NR3 format
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:SPI:CLOCk:SLOPe" on page 494
- ":SBUS<n>:SPI:SOURce:CLOCk" on page 497
- ":SBUS<n>:SPI:FRAMing" on page 496

:SBUS<n>:SPI:FRAMing

N (see page 776)

Command Syntax

```
:SBUS<n>:SPI:FRAMing <value>

<value> ::= {CHIPselect | {NCHipselect | NOTC} | TIMeout}
```

The :SBUS<n>:SPI:FRAMing command sets the SPI trigger framing value. If TIMeout is selected, the timeout value is set by the :SBUS<n>:SPI:CLOCk:TIMeout command.

NOTE The NOTC value is deprecated. It is the same as NCHipselect.

Query Syntax

```
:SBUS<n>:SPI:FRAMing?
```

The :SBUS<n>:SPI:FRAMing? query returns the current SPI framing value.

Return Format

```
<value><NL>

<value> ::= {CHIP | NCH | TIM}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:SPI:CLOCk:TIMeout" on page 495
- ":SBUS<n>:SPI:SOURce:FRAMe" on page 498

:SBUS<n>:SPI:SOURce:CLOCk

N (see page 776)

Command Syntax

```
:SBUS<n>:SPI:SOURce:CLOCk <source>

<source> ::= {CHANnel<n> | EXTernal}

<n> ::= 1 to (# analog channels) in NR1 format
```

The :SBUS<n>:SPI:SOURce:CLOCk command sets the source for the SPI serial clock.

Query Syntax

```
:SBUS<n>:SPI:SOURce:CLOCk?
```

The :SBUS<n>:SPI:SOURce:CLOCk? query returns the current source for the SPI serial clock.

Return Format

```
<source><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:SPI:CLOCk:SLOPe" on page 494
- ":SBUS<n>:SPI:CLOCk:TIMeout" on page 495
- ":SBUS<n>:SPI:SOURce:FRAMe" on page 498
- ":SBUS<n>:SPI:SOURce:MOSI" on page 500
- ":SBUS<n>:SPI:SOURce:MISO" on page 499

:SBUS<n>:SPI:SOURce:FRAMe

N (see page 776)

Command Syntax

```
:SBUS<n>:SPI:SOURce:FRAMe <source>

<source> ::= {CHANnel<n> | EXTernal}

<n> ::= 1 to (# analog channels) in NR1 format
```

The :SBUS<n>:SPI:SOURce:FRAMe command sets the frame source when :SBUS<n>:SPI:FRAMing is set to CHIPselect or NOTChipselect.

Query Syntax

```
:SBUS<n>:SPI:SOURce:FRAMe?
```

The :SBUS<n>:SPI:SOURce:FRAMe? query returns the current frame source for the SPI serial frame.

Return Format

```
<source><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:SPI:SOURce:CLOCk" on page 497
- ":SBUS<n>:SPI:SOURce:MOSI" on page 500
- ":SBUS<n>:SPI:SOURce:MISO" on page 499
- ":SBUS<n>:SPI:FRAMing" on page 496

:SBUS<n>:SPI:SOURce:MISO

N (see page 776)

Command Syntax

```
:SBUS<n>:SPI:SOURce:MISO <source>

<source> ::= {CHANnel<n> | EXTernal}

<n> ::= 1 to (# analog channels) in NR1 format
```

The :SBUS<n>:SPI:SOURce:MISO command sets the source for the SPI serial MISO data.

Query Syntax

```
:SBUS<n>:SPI:SOURce:MISO?
```

The :SBUS<n>:SPI:SOURce:MISO? query returns the current source for the SPI serial MISO data.

Return Format

```
<source><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:SPI:SOURce:MOSI" on page 500
- ":SBUS<n>:SPI:SOURce:CLOCk" on page 497
- ":SBUS<n>:SPI:SOURce:FRAMe" on page 498
- ":SBUS<n>:SPI:TRIGger:PATTern:MISO:DATA" on page 501
- ":SBUS<n>:SPI:TRIGger:PATTern:MOSI:DATA" on page 503
- ":SBUS<n>:SPI:TRIGger:PATTern:MISO:WIDTh" on page 502
- ":SBUS<n>:SPI:TRIGger:PATTern:MOSI:WIDTh" on page 504

:SBUS<n>:SPI:SOURce:MOSI

N (see page 776)

Command Syntax

```
:SBUS<n>:SPI:SOURce:MOSI <source>

<source> ::= {CHANnel<n> | EXTernal}

<n> ::= 1 to (# analog channels) in NR1 format
```

The :SBUS<n>:SPI:SOURce:MOSI command sets the source for the SPI serial MOSI data.

You can also use the equivalent :SBUS<n>:SPI:SOURce:DATA command to set the MOSI data source.

Query Syntax

```
:SBUS<n>:SPI:SOURce:MOSI?
```

The :SBUS<n>:SPI:SOURce:MOSI? query returns the current source for the SPI serial MOSI data.

Return Format

```
<source><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:SPI:SOURce:MISO" on page 499
- ":SBUS<n>:SPI:SOURce:CLOCk" on page 497
- ":SBUS<n>:SPI:SOURce:FRAMe" on page 498
- ":SBUS<n>:SPI:TRIGger:PATTern:MISO:DATA" on page 501
- ":SBUS<n>:SPI:TRIGger:PATTern:MOSI:DATA" on page 503
- ":SBUS<n>:SPI:TRIGger:PATTern:MISO:WIDTh" on page 502
- ":SBUS<n>:SPI:TRIGger:PATTern:MOSI:WIDTh" on page 504

:SBUS<n>:SPI:TRIGger:PATTern:MISO:DATA

N (see page 776)

Command Syntax

```
:SBUS<n>:SPI:TRIGger:PATTern:MISO:DATA <string>
```

```
<string> ::= "nn...n" where n ::= {0 | 1 | X | $}
```

```
<string ::= "0xnn...n" where n ::= {0,..,9 | A,..,F | X | $}
```

The :SBUS<n>:SPI:TRIGger:PATTern:MISO:DATA command defines the SPI data pattern resource according to the string parameter. This pattern, along with the data width, control the data pattern searched for in the data stream.

If the string parameter starts with "0x", it is a hexadecimal string made up of hexadecimal and X (don't care) characters; otherwise, it is a binary string made up of 0, 1, and X (don't care) characters.

NOTE **The :SBUS<n>:SPI:TRIGger:PATTern:MISO:WIDTh should be set before :SBUS<n>:SPI:TRIGger:PATTern:MISO:DATA.**

Query Syntax

```
:SBUS<n>:SPI:TRIGger:PATTern:MISO:DATA?
```

The :SBUS<n>:SPI:TRIGger:PATTern:MISO:DATA? query returns the current settings of the specified SPI data pattern resource in the binary string format.

Return Format

```
<string><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:SPI:TRIGger:PATTern:MISO:WIDTh" on page 502
- ":SBUS<n>:SPI:SOURce:MISO" on page 499

:SBUS<n>:SPI:TRIGger:PATTern:MISO:WIDTh

N (see page 776)

Command Syntax

```
:SBUS<n>:SPI:TRIGger:PATTern:MISO:WIDTh <width>
```

```
<width> ::= integer from 4 to 64 in NR1 format
```

The :SBUS<n>:SPI:TRIGger:PATTern:MISO:WIDTh command sets the width of the SPI data pattern anywhere from 4 bits to 64 bits.

NOTE **The :SBUS<n>:SPI:TRIGger:PATTern:MISO:WIDTh should be set before :SBUS<n>:SPI:TRIGger:PATTern:MISO:DATA.**

Query Syntax

```
:SBUS<n>:SPI:TRIGger:PATTern:MISO:WIDTh?
```

The :SBUS<n>:SPI:TRIGger:PATTern:MISO:WIDTh? query returns the current SPI data pattern width setting.

Return Format

```
<width><NL>
```

```
<width> ::= integer from 4 to 64 in NR1 format
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:SPI:TRIGger:PATTern:MISO:DATA" on page 501
- ":SBUS<n>:SPI:SOURce:MISO" on page 499

:SBUS<n>:SPI:TRIGger:PATTern:MOSI:DATA

N (see page 776)

Command Syntax

```
:SBUS<n>:SPI:TRIGger:PATTern:MOSI:DATA <string>

<string> ::= "nn...n" where n ::= {0 | 1 | X | $}

<string ::= "0xnn...n" where n ::= {0,..,9 | A,..,F | X | $}
```

The :SBUS<n>:SPI:TRIGger:PATTern:MOSI:DATA command defines the SPI data pattern resource according to the string parameter. This pattern, along with the data width, control the data pattern searched for in the data stream.

If the string parameter starts with "0x", it is a hexadecimal string made up of hexadecimal and X (don't care) characters; otherwise, it is a binary string made up of 0, 1, and X (don't care) characters.

NOTE The :SBUS<n>:SPI:TRIGger:PATTern:MOSI:WIDTh should be set before :SBUS<n>:SPI:TRIGger:PATTern:MOSI:DATA.

Query Syntax

```
:SBUS<n>:SPI:TRIGger:PATTern:MOSI:DATA?
```

The :SBUS<n>:SPI:TRIGger:PATTern:MOSI:DATA? query returns the current settings of the specified SPI data pattern resource in the binary string format.

Return Format

```
<string><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:SPI:TRIGger:PATTern:MOSI:WIDTh" on page 504
- ":SBUS<n>:SPI:SOURce:MOSI" on page 500

:SBUS<n>:SPI:TRIGger:PATTern:MOSI:WIDTh

N (see page 776)

Command Syntax

```
:SBUS<n>:SPI:TRIGger:PATTern:MOSI:WIDTh <width>
```

```
<width> ::= integer from 4 to 64 in NR1 format
```

The :SBUS<n>:SPI:TRIGger:PATTern:MOSI:WIDTh command sets the width of the SPI data pattern anywhere from 4 bits to 64 bits.

NOTE **The :SBUS<n>:SPI:TRIGger:PATTern:MOSI:WIDTh should be set before :SBUS<n>:SPI:TRIGger:PATTern:MOSI:DATA.**

Query Syntax

```
:SBUS<n>:SPI:TRIGger:PATTern:MOSI:WIDTh?
```

The :SBUS<n>:SPI:TRIGger:PATTern:MOSI:WIDTh? query returns the current SPI data pattern width setting.

Return Format

```
<width><NL>
```

```
<width> ::= integer from 4 to 64 in NR1 format
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:SPI:TRIGger:PATTern:MOSI:DATA" on page 503
- ":SBUS<n>:SPI:SOURce:MOSI" on page 500

:SBUS<n>:SPI:TRIGger:TYPE

N (see page 776)

Command Syntax

```
:SBUS<n>:SPI:TRIGger:TYPE <value>
```

```
<value> ::= {MOSI | MISO}
```

The :SBUS<n>:SPI:TRIGger:TYPE command specifies whether the SPI trigger will be on the MOSI data or the MISO data.

When triggering on MOSI data, the data value is specified by the :SBUS<n>:SPI:TRIGger:PATTern:MOSI:DATA and :SBUS<n>:SPI:TRIGger:PATTern:MOSI:WIDTh commands.

When triggering on MISO data, the data value is specified by the :SBUS<n>:SPI:TRIGger:PATTern:MISO:DATA and :SBUS<n>:SPI:TRIGger:PATTern:MISO:WIDTh commands.

Query Syntax

```
:SBUS<n>:SPI:TRIGger:TYPE?
```

The :SBUS<n>:SPI:TRIGger:TYPE? query returns the current SPI trigger type setting.

Return Format

```
<value><NL>
```

```
<value> ::= {MOSI | MISO}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":SBUS<n>:SPI:SOURce:MOSI" on page 500
- ":SBUS<n>:SPI:SOURce:MISO" on page 499
- ":SBUS<n>:SPI:TRIGger:PATTern:MISO:DATA" on page 501
- ":SBUS<n>:SPI:TRIGger:PATTern:MOSI:DATA" on page 503
- ":SBUS<n>:SPI:TRIGger:PATTern:MISO:WIDTh" on page 502
- ":SBUS<n>:SPI:TRIGger:PATTern:MOSI:WIDTh" on page 504
- ":TRIGger:MODE" on page 574

:SBUS<n>:SPI:WIDTh

N (see page 776)

Command Syntax

```
:SBUS<n>:SPI:WIDTh <word_width>
```

```
<word_width> ::= integer 4-16 in NR1 format
```

The :SBUS<n>:SPI:WIDTh command determines the number of bits in a word of data for SPI.

Query Syntax

```
:SBUS<n>:SPI:WIDTh?
```

The :SBUS<n>:SPI:WIDTh? query returns the current SPI decode word width.

Return Format

```
<word_width><NL>
```

```
<word_width> ::= integer 4-16 in NR1 format
```

Errors

- "-241, Hardware missing" on page 739

See Also

- "Introduction to :SBUS<n> Commands" on page 445
- ":SBUS<n>:MODE" on page 449
- ":SBUS<n>:SPI Commands" on page 491

:SBUS<n>:UART Commands

NOTE These commands are valid when the UART/RS-232 triggering and serial decode license (EMBD) is enabled.

Table 72 :SBUS<n>:UART Commands Summary

Command	Query	Options and Query Returns
:SBUS<n>:UART:BASE <base> (see page 509)	:SBUS<n>:UART:BASE? (see page 509)	<base> ::= {ASCii | BINary | HEX}
:SBUS<n>:UART:BAUDrate <baudrate> (see page 510)	:SBUS<n>:UART:BAUDrate? (see page 510)	<baudrate> ::= integer from 100 to 8000000
:SBUS<n>:UART:BITorder <bitorder> (see page 511)	:SBUS<n>:UART:BITorder? (see page 511)	<bitorder> ::= {LSBFirst | MSBFirst}
n/a	:SBUS<n>:UART:COUNt:ERRor? (see page 512)	<frame_count> ::= integer in NR1 format
:SBUS<n>:UART:COUNt:RESet (see page 513)	n/a	n/a
n/a	:SBUS<n>:UART:COUNt:RXFRames? (see page 514)	<frame_count> ::= integer in NR1 format
n/a	:SBUS<n>:UART:COUNt:TXFRames? (see page 515)	<frame_count> ::= integer in NR1 format
:SBUS<n>:UART:FRAMing <value> (see page 516)	:SBUS<n>:UART:FRAMing? (see page 516)	<value> ::= {OFF | <decimal> | <nondecimal>} <decimal> ::= 8-bit integer from 0-255 (0x00-0xff) <nondecimal> ::= #Hnn where n ::= {0,..,9 | A,..,F} for hexadecimal <nondecimal> ::= #Bnn...n where n ::= {0 | 1} for binary
:SBUS<n>:UART:PARity <parity> (see page 517)	:SBUS<n>:UART:PARity? (see page 517)	<parity> ::= {EVEN | ODD | NONE}
:SBUS<n>:UART:POLarity <polarity> (see page 518)	:SBUS<n>:UART:POLarity? (see page 518)	<polarity> ::= {HIGH | LOW}

Table 72 :SBUS<n>:UART Commands Summary (continued)

Command	Query	Options and Query Returns
:SBUS<n>:UART:SOURce:RX <source> (see page 519)	:SBUS<n>:UART:SOURce:RX? (see page 519)	<source> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:SBUS<n>:UART:SOURce:TX <source> (see page 520)	:SBUS<n>:UART:SOURce:TX? (see page 520)	<source> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:SBUS<n>:UART:TRIGger:BASE <base> (see page 521)	:SBUS<n>:UART:TRIGger:BASE? (see page 521)	<base> ::= {ASCii | HEX}
:SBUS<n>:UART:TRIGger:BURSt <value> (see page 522)	:SBUS<n>:UART:TRIGger:BURSt? (see page 522)	<value> ::= {OFF | 1 to 4096 in NR1 format}
:SBUS<n>:UART:TRIGger:DATA <value> (see page 523)	:SBUS<n>:UART:TRIGger:DATA? (see page 523)	<value> ::= 8-bit integer from 0-255 (0x00-0xff) in decimal, <hexadecimal>, <binary>, or <quoted_string> format <hexadecimal> ::= #Hnn where n ::= {0,..,9 | A,..,F} for hexadecimal <binary> ::= #Bnn...n where n ::= {0 | 1} for binary <quoted_string> ::= any of the 128 valid 7-bit ASCII characters (or standard abbreviations)
:SBUS<n>:UART:TRIGger:IDLE <time_value> (see page 524)	:SBUS<n>:UART:TRIGger:IDLE? (see page 524)	<time_value> ::= time from 1 us to 10 s in NR3 format
:SBUS<n>:UART:TRIGger:QUALifier <value> (see page 525)	:SBUS<n>:UART:TRIGger:QUALifier? (see page 525)	<value> ::= {EQUal | NOTequal | GREaterthan | LESSthan}
:SBUS<n>:UART:TRIGger:TYPE <value> (see page 526)	:SBUS<n>:UART:TRIGger:TYPE? (see page 526)	<value> ::= {RSTArt | RSTOp | RDATa | RD1 | RD0 | RDX | PARityerror | TSTArt | TSTOp | TDATa | TD1 | TD0 | TDX}
:SBUS<n>:UART:WIDTh <width> (see page 527)	:SBUS<n>:UART:WIDTh? (see page 527)	<width> ::= {5 | 6 | 7 | 8 | 9}

:SBUS<n>:UART:BASE

N (see page 776)

Command Syntax

```
:SBUS<n>:UART:BASE <base>
```

```
<base> ::= {ASCii | BINary | HEX}
```

The :SBUS<n>:UART:BASE command determines the base to use for the UART decode and Lister display.

Query Syntax

```
:SBUS<n>:UART:BASE?
```

The :SBUS<n>:UART:BASE? query returns the current UART decode and Lister base setting.

Return Format

```
<base><NL>
```

```
<base> ::= {ASCii | BINary | HEX}
```

Errors

- "-241, Hardware missing" on page 739

See Also

- "Introduction to :SBUS<n> Commands" on page 445
- ":SBUS<n>:UART Commands" on page 507

:SBUS<n>:UART:BAUDrate

N (see page 776)

Command Syntax

```
:SBUS<n>:UART:BAUDrate <baudrate>
```

```
<baudrate> ::= integer from 100 to 8000000
```

The :SBUS<n>:UART:BAUDrate command selects the bit rate (in bps) for the serial decoder and/or trigger when in UART mode. The baud rate can be set from 100 b/s to 8 Mb/s.

If the baud rate you select does not match the system baud rate, false triggers may occur.

Query Syntax

```
:SBUS<n>:UART:BAUDrate?
```

The :SBUS<n>:UART:BAUDrate? query returns the current UART baud rate setting.

Return Format

```
<baudrate><NL>
```

```
<baudrate> ::= integer from 100 to 8000000
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:UART:TRIGger:TYPE" on page 526

:SBUS<n>:UART:BITorder

N (see page 776)

Command Syntax

```
:SBUS<n>:UART:BITorder <bitorder>

<bitorder> ::= {LSBFirst | MSBFirst}
```

The :SBUS<n>:UART:BITorder command specifies the order of transmission used by the physical Tx and Rx input signals for the serial decoder and/or trigger when in UART mode. LSBFirst sets the least significant bit of each message "byte" as transmitted first. MSBFirst sets the most significant bit as transmitted first.

Query Syntax

```
:SBUS<n>:UART:BITorder?
```

The :SBUS<n>:UART:BITorder? query returns the current UART bit order setting.

Return Format

```
<bitorder><NL>

<bitorder> ::= {LSBF | MSBF}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:UART:TRIGger:TYPE" on page 526
- ":SBUS<n>:UART:SOURce:RX" on page 519
- ":SBUS<n>:UART:SOURce:TX" on page 520

:SBUS<n>:UART:COUNt:ERRor

N (see page 776)

Query Syntax

```
:SBUS<n>:UART:COUNt:ERRor?
```

Returns the UART error frame count.

Return Format

```
<frame_count><NL>

<frame_count> ::= integer in NR1 format
```

Errors

- "-241, Hardware missing" on page 739

See Also

- ":SBUS<n>:UART:COUNt:RESet" on page 513
- "Introduction to :SBUS<n> Commands" on page 445
- ":SBUS<n>:MODE" on page 449
- ":SBUS<n>:UART Commands" on page 507

:SBUS<n>:UART:COUNt:RESet

N (see page 776)

Command Syntax

```
:SBUS<n>:UART:COUNt:RESet
```

Resets the UART frame counters.

Errors

- "-241, Hardware missing" on page 739

See Also

- ":SBUS<n>:UART:COUNt:ERRor" on page 512
- ":SBUS<n>:UART:COUNt:RXFRames" on page 514
- ":SBUS<n>:UART:COUNt:TXFRames" on page 515
- "Introduction to :SBUS<n> Commands" on page 445
- ":SBUS<n>:MODE" on page 449
- ":SBUS<n>:UART Commands" on page 507

:SBUS<n>:UART:COUNt:RXFRames

N (see page 776)

Query Syntax

```
:SBUS<n>:UART:COUNt:RXFRames?
```

Returns the UART Rx frame count.

Return Format

```
<frame_count><NL>

<frame_count> ::= integer in NR1 format
```

Errors

- "-241, Hardware missing" on page 739

See Also

- ":SBUS<n>:UART:COUNt:RESet" on page 513
- "Introduction to :SBUS<n> Commands" on page 445
- ":SBUS<n>:MODE" on page 449
- ":SBUS<n>:UART Commands" on page 507

:SBUS<n>:UART:COUNt:TXFRames

N (see page 776)

Query Syntax

```
:SBUS<n>:UART:COUNt:TXFRames?
```

Returns the UART Tx frame count.

Return Format

```
<frame_count><NL>

<frame_count> ::= integer in NR1 format
```

Errors

- "-241, Hardware missing" on page 739

See Also

- ":SBUS<n>:UART:COUNt:RESet" on page 513
- "Introduction to :SBUS<n> Commands" on page 445
- ":SBUS<n>:MODE" on page 449
- ":SBUS<n>:UART Commands" on page 507

:SBUS<n>:UART:FRAMing

N (see page 776)

Command Syntax

```
:SBUS<n>:UART:FRAMing <value>

<value> ::= {OFF | <decimal> | <nondecimal>}

<decimal> ::= 8-bit integer in decimal from 0-255 (0x00-0xff)

<nondecimal> ::= #Hnn where n ::= {0,..,9 | A,..,F} for hexadecimal

<nondecimal> ::= #Bnn...n where n ::= {0 | 1} for binary
```

The :SBUS<n>:UART:FRAMing command determines the byte value to use for framing (end of packet) or to turn off framing for UART decode.

Query Syntax

```
:SBUS<n>:UART:FRAMing?
```

The :SBUS<n>:UART:FRAMing? query returns the current UART decode base setting.

Return Format

```
<value><NL>

<value> ::= {OFF | <decimal>}

<decimal> ::= 8-bit integer in decimal from 0-255
```

Errors

- "-241, Hardware missing" on page 739

See Also

- "Introduction to :SBUS<n> Commands" on page 445
- ":SBUS<n>:UART Commands" on page 507

:SBUS<n>:UART:PARity

N (see page 776)

Command Syntax

```
:SBUS<n>:UART:PARity <parity>

<parity> ::= {EVEN | ODD | NONE}
```

The :SBUS<n>:UART:PARity command selects the parity to be used with each message "byte" for the serial decoder and/or trigger when in UART mode.

Query Syntax

```
:SBUS<n>:UART:PARity?
```

The :SBUS<n>:UART:PARity? query returns the current UART parity setting.

Return Format

```
<parity><NL>

<parity> ::= {EVEN | ODD | NONE}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:UART:TRIGger:TYPE" on page 526

:SBUS<n>:UART:POLarity

N (see page 776)

Command Syntax

```
:SBUS<n>:UART:POLarity <polarity>
```

```
<polarity> ::= {HIGH | LOW}
```

The :SBUS<n>:UART:POLarity command selects the polarity as idle low or idle high for the serial decoder and/or trigger when in UART mode.

Query Syntax

```
:SBUS<n>:UART:POLarity?
```

The :SBUS<n>:UART:POLarity? query returns the current UART polarity setting.

Return Format

```
<polarity><NL>
```

```
<polarity> ::= {HIGH | LOW}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:UART:TRIGger:TYPE" on page 526

:SBUS<n>:UART:SOURce:RX

N (see page 776)

Command Syntax

```
:SBUS<n>:UART:SOURce:RX <source>

<source> ::= {CHANnel<n> | EXTernal}

<n> ::= 1 to (# analog channels) in NR1 format
```

The :SBUS<n>:UART:SOURce:RX command controls which signal is used as the Rx source by the serial decoder and/or trigger when in UART mode.

Query Syntax

```
:SBUS<n>:UART:SOURce:RX?
```

The :SBUS<n>:UART:SOURce:RX? query returns the current source for the UART Rx signal.

Return Format

```
<source><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:UART:TRIGger:TYPE" on page 526
- ":SBUS<n>:UART:BITorder" on page 511

:SBUS<n>:UART:SOURce:TX

N (see page 776)

Command Syntax

```
:SBUS<n>:UART:SOURce:TX <source>
```

```
<source> ::= {CHANnel<n> | EXTernal}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :SBUS<n>:UART:SOURce:TX command controls which signal is used as the Tx source by the serial decoder and/or trigger when in UART mode.

Query Syntax

```
:SBUS<n>:UART:SOURce:TX?
```

The :SBUS<n>:UART:SOURce:TX? query returns the current source for the UART Tx signal.

Return Format

```
<source><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:UART:TRIGger:TYPE" on page 526
- ":SBUS<n>:UART:BITorder" on page 511

:SBUS<n>:UART:TRIGger:BASE

N (see page 776)

Command Syntax

```
:SBUS<n>:UART:TRIGger:BASE <base>

<base> ::= {ASCii | HEX}
```

The :SBUS<n>:UART:TRIGger:BASE command sets the front panel UART/RS232 trigger setup data selection option:

- ASCii — front panel data selection is from ASCII values.
- HEX — front panel data selection is from hexadecimal values.

The :SBUS<n>:UART:TRIGger:BASE setting does not affect the :SBUS<n>:UART:TRIGger:DATA command which can always set data values using ASCII or hexadecimal values.

NOTE **The :SBUS<n>:UART:TRIGger:BASE command is independent of the :SBUS<n>:UART:BASE command which affects decode and Lister only.**

Query Syntax

```
:SBUS<n>:UART:TRIGger:BASE?
```

The :SBUS<n>:UART:TRIGger:BASE? query returns the current UART base setting.

Return Format

```
<base><NL>

<base> ::= {ASC | HEX}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:UART:TRIGger:DATA" on page 523

:SBUS<n>:UART:TRIGger:BURSt

N (see page 776)

Command Syntax

```
:SBUS<n>:UART:TRIGger:BURSt <value>
```

```
<value> ::= {OFF | 1 to 4096 in NR1 format}
```

The :SBUS<n>:UART:TRIGger:BURSt command selects the burst value (Nth frame after idle period) in the range 1 to 4096 or OFF, for the trigger when in UART mode.

Query Syntax

```
:SBUS<n>:UART:TRIGger:BURSt?
```

The :SBUS<n>:UART:TRIGger:BURSt? query returns the current UART trigger burst value.

Return Format

```
<value><NL>
```

```
<value> ::= {OFF | 1 to 4096 in NR1 format}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:UART:TRIGger:IDLE" on page 524
- ":SBUS<n>:UART:TRIGger:TYPE" on page 526

:SBUS<n>:UART:TRIGger:DATA

N (see page 776)

Command Syntax

```
:SBUS<n>:UART:TRIGger:DATA <value>

<value> ::= 8-bit integer from 0-255 (0x00-0xff) in decimal,
            <hexadecimal>, <binary>, or <quoted_string> format

<hexadecimal> ::= #Hnn where n ::= {0,..,9 | A,..,F} for hexadecimal

<binary> ::= #Bnn...n where n ::= {0 | 1} for binary

<quoted_string> ::= any of the 128 valid 7-bit ASCII characters
                    (or standard abbreviations)
```

The :SBUS<n>:UART:TRIGger:DATA command selects the data byte value (0x00 to 0xFF) for the trigger QUALifier when in UART mode. The data value is used when one of the RD or TD trigger types is selected.

When entering an ASCII character via the quoted string, it must be one of the 128 valid characters (case-sensitive): "NUL", "SOH", "STX", "ETX", "EOT", "ENQ", "ACK", "BEL", "BS", "HT", "LF", "VT", "FF", "CR", "SO","SI", "DLE", "DC1", "DC2", "DC3", "DC4", "NAK", "SYN", "ETB", "CAN", "EM", "SUB", "ESC", "FS","GS", "RS", "US", "SP", "!", "\"", "#", "$", "%","&", "\'", "(", ")", "*", "+", ",", "-", ".", "/","0", "1", "2", "3", "4", "5", "6", "7", "8", "9",":", ";", "<", "=", ">", "?", "@", "A", "B", "C","D", "E", "F", "G", "H", "I", "J", "K", "L", "M","N", "O", "P", "Q", "R", "S", "T", "U", "V", "W", "X", "Y", "Z","[", "\\", "]", "^", "_", "`", "a", "b", "c", "d", "e", "f", "g", "h", "i", "j", "k", "l", "m", "n", "o", "p", "q", "r", "s", "t", "u", "v", "w", "x", "y", "z", "{", "|", "}", "~", or "DEL".

Query Syntax

```
:SBUS<n>:UART:TRIGger:DATA?
```

The :SBUS<n>:UART:TRIGger:DATA? query returns the current UART trigger data value.

Return Format

```
<value><NL>

<value> ::= 8-bit integer in decimal from 0-255
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:UART:TRIGger:BASE" on page 521
- ":SBUS<n>:UART:TRIGger:TYPE" on page 526

:SBUS<n>:UART:TRIGger:IDLE

N (see page 776)

Command Syntax

```
:SBUS<n>:UART:TRIGger:IDLE <time_value>
```

```
<time_value> ::= time from 1 us to 10 s in NR3 format
```

The :SBUS<n>:UART:TRIGger:IDLE command selects the value of the idle period for burst trigger in the range from 1 us to 10 s when in UART mode.

Query Syntax

```
:SBUS<n>:UART:TRIGger:IDLE?
```

The :SBUS<n>:UART:TRIGger:IDLE? query returns the current UART trigger idle period time.

Return Format

```
<time_value><NL>
```

```
<time_value> ::= time from 1 us to 10 s in NR3 format
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:UART:TRIGger:BURSt" on page 522
- ":SBUS<n>:UART:TRIGger:TYPE" on page 526

:SBUS<n>:UART:TRIGger:QUALifier

N (see page 776)

Command Syntax

```
:SBUS<n>:UART:TRIGger:QUALifier <value>
```

```
<value> ::= {EQUal | NOTequal | GREaterthan | LESSthan}
```

The :SBUS<n>:UART:TRIGger:QUALifier command selects the data qualifier when :TYPE is set to RDATa, RD1, RD0, RDX, TDATa, TD1, TD0, or TDX for the trigger when in UART mode.

Query Syntax

```
:SBUS<n>:UART:TRIGger:QUALifier?
```

The :SBUS<n>:UART:TRIGger:QUALifier? query returns the current UART trigger qualifier.

Return Format

```
<value><NL>
```

```
<value> ::= {EQU | NOT | GRE | LESS}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:UART:TRIGger:TYPE" on page 526

:SBUS<n>:UART:TRIGger:TYPE

N (see page 776)

Command Syntax

```
:SBUS<n>:UART:TRIGger:TYPE <value>

<value> ::= {RSTArt | RSTOp | RDATa | RD1 | RD0 | RDX | PARityerror
            | TSTArt | TSTOp | TDATa | TD1 | TD0 | TDX}
```

The :SBUS<n>:UART:TRIGger:TYPE command selects the UART trigger type.

When one of the RD or TD types is selected, the :SBUS<n>:UART:TRIGger:DATA and :SBUS<n>:UART:TRIGger:QUALifier commands are used to specify the data value and comparison operator.

The RD1, RD0, RDX, TD1, TD0, and TDX types (for triggering on data and alert bit values) are only valid when a 9-bit width has been selected.

Query Syntax

```
:SBUS<n>:UART:TRIGger:TYPE?
```

The :SBUS<n>:UART:TRIGger:TYPE? query returns the current UART trigger data value.

Return Format

```
<value><NL>

<value> ::= {RSTA | RSTO | RDAT | RD1 | RD0 | RDX | PAR | TSTA |
            TSTO | TDAT | TD1 | TD0 | TDX}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:UART:TRIGger:DATA" on page 523
- ":SBUS<n>:UART:TRIGger:QUALifier" on page 525
- ":SBUS<n>:UART:WIDTh" on page 527

:SBUS<n>:UART:WIDTh

N (see page 776)

Command Syntax

```
:SBUS<n>:UART:WIDTh <width>
```

```
<width> ::= {5 | 6 | 7 | 8 | 9}
```

The :SBUS<n>:UART:WIDTh command determines the number of bits (5-9) for each message "byte" for the serial decoder and/or trigger when in UART mode.

Query Syntax

```
:SBUS<n>:UART:WIDTh?
```

The :SBUS<n>:UART:WIDTh? query returns the current UART width setting.

Return Format

```
<width><NL>
```

```
<width> ::= {5 | 6 | 7 | 8 | 9}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":SBUS<n>:UART:TRIGger:TYPE" on page 526

25 :SYSTem Commands

Control basic system functions of the oscilloscope. See "Introduction to :SYSTem Commands" on page 530.

Table 73 :SYSTem Commands Summary

Command	Query	Options and Query Returns

:SYSTem:DATE <date> (see page 531)	:SYSTem:DATE? (see page 531)	<date> ::= <year>,<month>,<day>
		<year> ::= 4-digit year in NR1 format
		<month> ::= {1,..,12 | JANuary | FEBruary | MARch | APRil | MAY | JUNe | JULy | AUGust | SEPtember | OCTober | NOVember | DECember}
		<day> ::= {1,..31}

:SYSTem:DSP <string> (see page 532)	n/a	<string> ::= up to 75 characters as a quoted ASCII string
n/a	:SYSTem:ERRor? (see page 533)	<error> ::= an integer error code <error string> ::= quoted ASCII string. See Error Messages (see page 737).
:SYSTem:LOCK <value> (see page 534)	:SYSTem:LOCK? (see page 534)	<value> ::= {{1 | ON} | {0 | OFF}}
:SYSTem:MENU <menu> (see page 535)	n/a	<menu> ::= {MASK | MEASure | SEGMented | LISTer}
:SYSTem:PERSona[:MANufacturer] <manufacturer_string> (see page 536)	:SYSTem:PERSona[:MANufacturer]? (see page 536)	<manufacturer_string> ::= quoted ASCII string, up to 63 characters
:SYSTem:PERSona[:MANufacturer]:DEFault (see page 537)	n/a	Sets manufacturer string to "KEYSIGHT TECHNOLOGIES"
:SYSTem:PRESet (see page 538)	n/a	See :SYSTem:PRESet (see page 538)

Table 73 :SYSTem Commands Summary (continued)

Command	Query	Options and Query Returns
:SYSTem:PROTection:LOCK <value> (see page 541)	:SYSTem:PROTection:LOCK? (see page 541)	<value> ::= {{1 | ON} | {0 | OFF}}

:SYSTem:RLOGger <setting>[,<file_name>[,<write_mode>]] (see page 542)	n/a	<setting> ::= {{0 | OFF} | {1 | ON}}
		<file_name> ::= quoted ASCII string
		<write_mode> ::= {CREate | APPend}

:SYSTem:RLOGger:DESTination <dest> (see page 543)	:SYSTem:RLOGger:DESTination? (see page 543)	<dest> ::= {FILE | SCReen | BOTH}
:SYSTem:RLOGger:DISPlay {{0 | OFF} | {1 | ON}} (see page 544)	:SYSTem:RLOGger:DISPlay? (see page 544)	<setting> ::= {0 | 1}
:SYSTem:RLOGger:FNAMe <file_name> (see page 545)	:SYSTem:RLOGger:FNAMe? (see page 545)	<file_name> ::= quoted ASCII string
:SYSTem:RLOGger:STATe {{0 | OFF} | {1 | ON}} (see page 546)	:SYSTem:RLOGger:STATe? (see page 546)	<setting> ::= {0 | 1}
:SYSTem:RLOGger:TRANsparent {{0 | OFF} | {1 | ON}} (see page 547)	:SYSTem:RLOGger:TRANsparent? (see page 547)	<setting> ::= {0 | 1}
:SYSTem:RLOGger:WMODe <write_mode> (see page 548)	:SYSTem:RLOGger:WMODe? (see page 548)	<write_mode> ::= {CREate | APPend}
:SYSTem:SETup <setup_data> (see page 549)	:SYSTem:SETup? (see page 549)	<setup_data> ::= data in IEEE 488.2 # format.
:SYSTem:TIME <time> (see page 551)	:SYSTem:TIME? (see page 551)	<time> ::= hours,minutes,seconds in NR1 format

Introduction to :SYSTem Commands

SYSTem subsystem commands enable writing messages to the display, setting and reading both the time and the date, querying for errors, and saving and recalling setups.

:SYSTem:DATE

N (see page 776)

Command Syntax

```
:SYSTem:DATE <date>
```

```
<date> ::= <year>,<month>,<day>
```

```
<year> ::= 4-digit year in NR1 format
```

```
<month> ::= {1,..,12 | JANuary | FEBruary | MARch | APRil | MAY | JUNe
            | JULy | AUGust | SEPtember | OCTober | NOVember | DECember}
```

```
<day> ::= {1,..,31}
```

The :SYSTem:DATE command sets the date. Validity checking is performed to ensure that the date is valid.

Query Syntax

```
:SYSTem:DATE?
```

The SYSTem:DATE? query returns the date.

Return Format

```
<year>,<month>,<day><NL>
```

See Also

- "Introduction to :SYSTem Commands" on page 530
- ":SYSTem:TIME" on page 551

:SYSTem:DSP

N (see page 776)

Command Syntax

```
:SYSTem:DSP <string>

<string> ::= quoted ASCII string (up to 75 characters)
```

The :SYSTem:DSP command writes the quoted string (excluding quotation marks) to a text box in the center of the display. Use :SYStem:DSP "" to remotely remove the message from the display. (Two sets of quote marks without a space between them creates a NULL string.) Press any menu key to manually remove the message from the display.

See Also

- "Introduction to :SYSTem Commands" on page 530

:SYSTem:ERRor

C (see page 776)

Query Syntax

```
:SYSTem:ERRor?
```

The :SYSTem:ERRor? query outputs the next error number and text from the error queue. The instrument has an error queue that is 30 errors deep and operates on a first-in, first-out basis. Repeatedly sending the :SYSTem:ERRor? query returns the errors in the order that they occurred until the queue is empty. Any further queries then return zero until another error occurs.

Return Format

```
<error number>,<error string><NL>

<error number> ::= an integer error code in NR1 format

<error string> ::= quoted ASCII string containing the error message
```

Error messages are listed in Chapter 32, “Error Messages,” starting on page 737.

See Also

- "Introduction to :SYSTem Commands" on page 530
- "*ESR (Standard Event Status Register)" on page 112
- "*CLS (Clear Status)" on page 109

:SYSTem:LOCK

N (see page 776)

Command Syntax

```
:SYSTem:LOCK <value>
```

```
<value> ::= {{1 | ON} | {0 | OFF}}
```

The :SYSTem:LOCK command disables the front panel. LOCK ON is the equivalent of sending a local lockout message over the programming interface.

Query Syntax

```
:SYSTem:LOCK?
```

The :SYSTem:LOCK? query returns the lock status of the front panel.

Return Format

```
<value><NL>
```

```
<value> ::= {1 | 0}
```

See Also

- "Introduction to :SYSTem Commands" on page 530

:SYSTem:MENU

N (see page 776)

Command Syntax

```
:SYSTem:MENU <menu>

<menu> ::= {MASK | MEASure | SEGMented}
```

The :SYSTem:MENU command changes the front panel softkey menu.

:SYSTem:PERSona[:MANufacturer]

N (see page 776)

Command Syntax

```
:SYSTem:PERSona[:MANufacturer] <manufacturer_string>

<manufacturer_string> ::= ::= quoted ASCII string, up to 63 characters
```

The :SYSTem:PERSona[:MANufacturer] command lets you change the manufacturer string portion of the identification string returned by the *IDN? query.

The default manufacturer string is "KEYSIGHT TECHNOLOGIES".

If your remote programs depend on a legacy manufacturer string, for example, you could use this command to set the manufacturer string to "AGILENT TECHNOLOGIES".

Query Syntax

```
:SYSTem:PERSona[:MANufacturer]?
```

The :SYSTem:PERSona[:MANufacturer]? query returns the currently set manufacturer string.

Return Format

```
<manufacturer_string><NL>
```

See Also

- "*IDN (Identification Number)" on page 114
- ":SYSTem:PERSona[:MANufacturer]:DEFault" on page 537
- "Introduction to :SYSTem Commands" on page 530

:SYSTem:PERSona[:MANufacturer]:DEFault

N (see page 776)

Command Syntax

```
:SYSTem:PERSona[:MANufacturer]:DEFault
```

The :SYSTem:PERSona[:MANufacturer]:DEFault command sets the manufacturer string to "KEYSIGHT TECHNOLOGIES".

See Also

- "*IDN (Identification Number)" on page 114
- ":SYSTem:PERSona[:MANufacturer]" on page 536
- "Introduction to :SYSTem Commands" on page 530

:SYSTem:PRESet

C (see page 776)

Command Syntax

```
:SYSTem:PRESet
```

The :SYSTem:PRESet command places the instrument in a known state. This is the same as pressing the **[Default Setup]** key or **[Save/Recall] > Default/Erase > Default Setup** on the front panel.

When you perform a default setup, some user settings (like preferences) remain unchanged. To reset all user settings to their factory defaults, use the *RST command.

Reset conditions are:

Acquire Menu	
Mode	Normal
Averaging	Off
# Averages	8

Analog Channel Menu	
Channel 1	On
Channel 2	Off
Volts/division	5.00 V
Offset	0.00
Coupling	DC
Probe attenuation	10:1
Vernier	Off
Invert	Off
BW limit	Off
Impedance	1 M Ohm (cannot be changed)
Units	Volts
Skew	0

Cursor Menu	
Source	Channel 1

Display Menu	
Persistence	Off
Grid	20%

Quick Meas Menu	
Source	Channel 1

Run Control	
	Scope is running

Time Base Menu	
Main time/division	100 us
Main time base delay	0.00 s
Delay time/division	500 ns
Delay time base delay	0.00 s
Reference	center
Mode	main
Vernier	Off

Trigger Menu	
Type	Edge
Mode	Auto
Coupling	dc
Source	Channel 1
Level	0.0 V
Slope	Positive
HF Reject and noise reject	Off
Holdoff	60 ns
External probe attenuation	10:1
External Units	Volts
External Impedance	1 M Ohm (cannot be changed)

See Also

- "Introduction to Common (*) Commands" on page 107
- "*RST (Reset)" on page 119

:SYSTem:PROTection:LOCK

N (see page 776)

Command Syntax

```
:SYSTem:PROTection:LOCK <value>

<value> ::= {{1 | ON} | {0 | OFF}}
```

The :SYSTem:PROTection:LOCK command disables the fifty ohm impedance setting for all analog channels.

Query Syntax

```
:SYSTem:PROTection:LOCK?
```

The :SYSTem:PROTection:LOCK? query returns the analog channel protection lock status.

Return Format

```
<value><NL>

<value> ::= {1 | 0}
```

See Also

- "Introduction to :SYSTem Commands" on page 530

:SYSTem:RLOGger

N (see page 776)

Command Syntax

```
:SYSTem:RLOGger <setting>[,<file_name>[,<write_mode>]]

<setting> ::= {{0 | OFF} | {1 | ON}}

<file_name> ::= quoted ASCII string

<write_mode> ::= {CREate | APPend}
```

The :SYSTem:RLOGger command enables or disables remote command logging, optionally specifying the log file name and write mode.

See Also

- ":SYSTem:RLOGger:DESTination" on page 543
- ":SYSTem:RLOGger:DISPlay" on page 544
- ":SYSTem:RLOGger:FNAMe" on page 545
- ":SYSTem:RLOGger:STATe" on page 546
- ":SYSTem:RLOGger:TRANsparent" on page 547
- ":SYSTem:RLOGger:WMODe" on page 548

:SYSTem:RLOGger:DESTination

N (see page 776)

Command Syntax

```
:SYSTem:RLOGger:DESTination <dest>
```

```
<dest> ::= {FILE | SCReen | BOTH}
```

The :SYSTem:RLOGger:DESTination command specifies whether remote commands are logged to a text file (on a connected USB storage device), logged to the screen, or both.

NOTE If the destination is changed while remote command logging is running, remote command logging is turned off.

Query Syntax

```
:SYSTem:RLOGger:DESTination?
```

The :SYSTem:RLOGger:DESTination? query returns the remote command logging destination.

Return Format

```
<dest><NL>
```

```
<dest> ::= {FILE | SCR | BOTH}
```

See Also

- ":SYSTem:RLOGger" on page 542
- ":SYSTem:RLOGger:DISPlay" on page 544
- ":SYSTem:RLOGger:FNAMe" on page 545
- ":SYSTem:RLOGger:STATe" on page 546
- ":SYSTem:RLOGger:TRANsparent" on page 547
- ":SYSTem:RLOGger:WMODe" on page 548

:SYSTem:RLOGger:DISPlay

N (see page 776)

Command Syntax

```
:SYSTem:RLOGger:DISPlay {{0 | OFF} | {1 | ON}}
```

The :SYSTem:RLOGger:DISPlay command enables or disables the screen display of logged remote commands and their return values (if applicable).

Query Syntax

```
:SYSTem:RLOGger:DISPlay?
```

The :SYSTem:RLOGger:DISPlay? query returns whether the screen display for remote command logging is enabled or disabled.

Return Format

```
<setting><NL>

<setting> ::= {0 | 1}
```

See Also

- ":SYSTem:RLOGger" on page 542
- ":SYSTem:RLOGger:DESTination" on page 543
- ":SYSTem:RLOGger:FNAMe" on page 545
- ":SYSTem:RLOGger:STATe" on page 546
- ":SYSTem:RLOGger:TRANsparent" on page 547
- ":SYSTem:RLOGger:WMODe" on page 548

:SYSTem:RLOGger:FNAMe

N (see page 776)

Command Syntax

```
:SYSTem:RLOGger:FNAMe <file_name>
```

```
<file_name> ::= quoted ASCII string
```

The :SYSTem:RLOGger:FNAMe command specifies the remote command log file name.

Because log files are ASCII text files, the ".txt" extension is automatically added to the name specified.

Query Syntax

```
:SYSTem:RLOGger:FNAMe?
```

The :SYSTem:RLOGger:FNAMe? query returns the remote command log file name.

Return Format

```
<file_name><NL>
```

See Also

- ":SYSTem:RLOGger" on page 542
- ":SYSTem:RLOGger:DESTination" on page 543
- ":SYSTem:RLOGger:DISPlay" on page 544
- ":SYSTem:RLOGger:STATe" on page 546
- ":SYSTem:RLOGger:TRANsparent" on page 547
- ":SYSTem:RLOGger:WMODe" on page 548

:SYSTem:RLOGger:STATe

N (see page 776)

Command Syntax

```
:SYSTem:RLOGger:STATe {{0 | OFF} | {1 | ON}}
```

The :SYSTem:RLOGger:STATe command enables or disables remote command logging.

Query Syntax

```
:SYSTem:RLOGger:STATe?
```

The :SYSTem:RLOGger:STATe? query returns the remote command logging state.

Return Format

```
<setting><NL>

<setting> ::= {0 | 1}
```

See Also

- ":SYSTem:RLOGger" on page 542
- ":SYSTem:RLOGger:DESTination" on page 543
- ":SYSTem:RLOGger:DISPlay" on page 544
- ":SYSTem:RLOGger:FNAMe" on page 545
- ":SYSTem:RLOGger:TRANsparent" on page 547
- ":SYSTem:RLOGger:WMODe" on page 548

:SYSTem:RLOGger:TRANsparent

N (see page 776)

Command Syntax

```
:SYSTem:RLOGger:TRANsparent {{0 | OFF} | {1 | ON}}
```

The :SYSTem:RLOGger:TRANsparent command specifies whether the screen display background for remote command logging is transparent or solid.

Query Syntax

```
:SYSTem:RLOGger:TRANsparent?
```

The :SYSTem:RLOGger:TRANsparent? query returns the setting for transparent screen display background.

Return Format

```
<setting><NL>

<setting> ::= {0 | 1}
```

See Also

- ":SYSTem:RLOGger" on page 542
- ":SYSTem:RLOGger:DESTination" on page 543
- ":SYSTem:RLOGger:DISPlay" on page 544
- ":SYSTem:RLOGger:FNAMe" on page 545
- ":SYSTem:RLOGger:STATe" on page 546
- ":SYSTem:RLOGger:WMODe" on page 548

:SYSTem:RLOGger:WMODe

N (see page 776)

Command Syntax

```
:SYSTem:RLOGger:WMODe <write_mode>

<write_mode> ::= {CREate | APPend}
```

The :SYSTem:RLOGger:WMODe command specifies the remote command logging write mode.

Query Syntax

```
:SYSTem:RLOGger:WMODe?
```

The :SYSTem:RLOGger:WMODe? query returns the remote command logging write mode.

Return Format

```
<write_mode><NL>

<write_mode> ::= {CRE | APP}
```

See Also

- ":SYSTem:RLOGger" on page 542
- ":SYSTem:RLOGger:DESTination" on page 543
- ":SYSTem:RLOGger:DISPlay" on page 544
- ":SYSTem:RLOGger:FNAMe" on page 545
- ":SYSTem:RLOGger:STATe" on page 546
- ":SYSTem:RLOGger:TRANsparent" on page 547

:SYSTem:SETup

C (see page 776)

Command Syntax

```
:SYSTem:SETup <setup_data>

<setup_data> ::= binary block data in IEEE 488.2 # format.
```

The :SYSTem:SETup command sets the oscilloscope as defined by the data in the setup (learn) string sent from the controller. The setup string does not change the interface mode or interface address.

Query Syntax

```
:SYSTem:SETup?
```

The :SYSTem:SETup? query operates the same as the *LRN? query. It outputs the current oscilloscope setup in the form of a learn string to the controller. The setup (learn) string is sent and received as a binary block of data. The format for the data transmission is the # format defined in the IEEE 488.2 specification.

Return Format

```
<setup_data><NL>

<setup_data> ::= binary block data in IEEE 488.2 # format
```

See Also

- "Introduction to :SYSTem Commands" on page 530
- "*LRN (Learn Device Setup)" on page 115

Example Code

```
' SAVE_SYSTEM_SETUP - The :SYSTEM:SETUP? query returns a program
' message that contains the current state of the instrument.  Its
' format is a definite-length binary block, for example,
' #800075595<setup string><NL>
' where the setup string is 75595 bytes in length.
myScope.WriteString ":SYSTEM:SETUP?"
varQueryResult = myScope.ReadIEEEBlock(BinaryType_UI1)
CheckForInstrumentErrors   ' After reading query results.

' Output setup string to a file:
Dim strPath As String
strPath = "c:\scope\config\setup.dat"

' Open file for output.
Close #1   ' If #1 is open, close it.
Open strPath For Binary Access Write Lock Write As #1
Put #1, , varQueryResult   ' Write data.
Close #1   ' Close file.

' RESTORE_SYSTEM_SETUP - Read the setup string from a file and
' write it back to the oscilloscope.
Dim varSetupString As Variant
strPath = "c:\scope\config\setup.dat"

' Open file for input.
Open strPath For Binary Access Read As #1
Get #1, , varSetupString   ' Read data.
Close #1   ' Close file.
```

```
' Write setup string back to oscilloscope using ":SYSTEM:SETUP"
' command:
myScope.WriteIEEEBlock ":SYSTEM:SETUP ", varSetupString
CheckForInstrumentErrors
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:SYSTem:TIME

N (see page 776)

Command Syntax

```
:SYSTem:TIME <time>

<time> ::= hours,minutes,seconds in NR1 format
```

The :SYSTem:TIME command sets the system time, using a 24-hour format. Commas are used as separators. Validity checking is performed to ensure that the time is valid.

Query Syntax

```
:SYSTem:TIME? <time>
```

The :SYSTem:TIME? query returns the current system time.

Return Format

```
<time><NL>

<time> ::= hours,minutes,seconds in NR1 format
```

See Also

- "Introduction to :SYSTem Commands" on page 530
- ":SYSTem:DATE" on page 531

26 :TIMebase Commands

Control all horizontal sweep functions. See "Introduction to :TIMebase Commands" on page 554.

Table 74 :TIMebase Commands Summary

Command	Query	Options and Query Returns
:TIMebase:MODE <value> (see page 555)	:TIMebase:MODE? (see page 555)	<value> ::= {MAIN | WINDow | XY | ROLL}
:TIMebase:POSition <pos> (see page 556)	:TIMebase:POSition? (see page 556)	<pos> ::= time from the trigger event to the display reference point in NR3 format
:TIMebase:RANGe <range_value> (see page 557)	:TIMebase:RANGe? (see page 557)	<range_value> ::= time for 10 div in seconds in NR3 format
:TIMebase:REFerence {LEFT | CENTer | RIGHt} (see page 558)	:TIMebase:REFerence? (see page 558)	<return_value> ::= {LEFT | CENTer | RIGHt}
:TIMebase:SCALe <scale_value> (see page 559)	:TIMebase:SCALe? (see page 559)	<scale_value> ::= time/div in seconds in NR3 format
:TIMebase:VERNier {{0 | OFF} | {1 | ON}} (see page 560)	:TIMebase:VERNier? (see page 560)	{0 | 1}
:TIMebase:WINDow:POSition <pos> (see page 561)	:TIMebase:WINDow:POSition? (see page 561)	<pos> ::= time from the trigger event to the zoomed view reference point in NR3 format
:TIMebase:WINDow:RANGe <range_value> (see page 562)	:TIMebase:WINDow:RANGe? (see page 562)	<range value> ::= range value in seconds in NR3 format for the zoomed window
:TIMebase:WINDow:SCALe <scale_value> (see page 563)	:TIMebase:WINDow:SCALe? (see page 563)	<scale_value> ::= scale value in seconds in NR3 format for the zoomed window

Introduction to :TIMebase Commands

The TIMebase subsystem commands control the horizontal (X-axis) functions and set the oscilloscope to X-Y mode (where channel 1 becomes the X input and channel 2 becomes the Y input). The time per division, delay, vernier control, and reference can be controlled for the main and window (zoomed) time bases.

Reporting the Setup

Use :TIMebase? to query setup information for the TIMebase subsystem.

Return Format

The following is a sample response from the :TIMebase? query. In this case, the query was issued following a *RST command.

```
:TIM:MODE MAIN;REF CENT;MAIN:RANG +1.00E-03;POS +0.0E+00
```

:TIMebase:MODE

C (see page 776)

Command Syntax

```
:TIMebase:MODE <value>

<value> ::= {MAIN | WINDow | XY | ROLL}
```

The :TIMebase:MODE command sets the current time base. There are four time base modes:

- MAIN — The normal time base mode is the main time base. It is the default time base mode after the *RST (Reset) command.
- WINDow — In the WINDow (zoomed or delayed) time base mode, measurements are made in the zoomed time base if possible; otherwise, the measurements are made in the main time base.
- XY — In the XY mode, the :TIMebase:RANGe, :TIMebase:POSition, and :TIMebase:REFerence commands are not available. No measurements are available in this mode.
- ROLL — In the ROLL mode, data moves continuously across the display from left to right. The oscilloscope runs continuously and is untriggered. The :TIMebase:REFerence selection changes to RIGHt.

Query Syntax

```
:TIMebase:MODE?
```

The :TIMebase:MODE query returns the current time base mode.

Return Format

```
<value><NL>

<value> ::= {MAIN | WIND | XY | ROLL}
```

See Also

- "Introduction to :TIMebase Commands" on page 554
- "*RST (Reset)" on page 119
- ":TIMebase:RANGe" on page 557
- ":TIMebase:POSition" on page 556
- ":TIMebase:REFerence" on page 558

Example Code

```
' TIMEBASE_MODE - (not executed in this example)
' Set the time base mode to MAIN, DELAYED, XY, or ROLL.

' Set time base mode to main.
myScope.WriteString ":TIMEBASE:MODE MAIN"
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:TIMebase:POSition

C (see page 776)

Command Syntax

```
:TIMebase:POSition <pos>

<pos> ::= time in seconds from the trigger to the display reference
          in NR3 format
```

The :TIMebase:POSition command sets the time interval between the trigger event and the display reference point on the screen. The display reference point is either left, right, or center and is set with the :TIMebase:REFerence command. The maximum position value depends on the time/division settings.

NOTE This command is an alias for the :TIMebase:DELay command.

Query Syntax

```
:TIMebase:POSition?
```

The :TIMebase:POSition? query returns the current time from the trigger to the display reference in seconds.

Return Format

```
<pos><NL>

<pos> ::= time in seconds from the trigger to the display reference
          in NR3 format
```

See Also

- "Introduction to :TIMebase Commands" on page 554
- ":TIMebase:REFerence" on page 558
- ":TIMebase:RANGe" on page 557
- ":TIMebase:SCALe" on page 559
- ":TIMebase:WINDow:POSition" on page 561
- ":TIMebase:DELay" on page 734

:TIMebase:RANGe

C (see page 776)

Command Syntax

```
:TIMebase:RANGe <range_value>
```

```
<range_value> ::= time for 10 div in seconds in NR3 format
```

The :TIMebase:RANGe command sets the full-scale horizontal time in seconds for the main window. The range is 10 times the current time-per-division setting.

Query Syntax

```
:TIMebase:RANGe?
```

The :TIMebase:RANGe query returns the current full-scale range value for the main window.

Return Format

```
<range_value><NL>
```

```
<range_value> ::= time for 10 div in seconds in NR3 format
```

See Also

- "Introduction to :TIMebase Commands" on page 554
- ":TIMebase:MODE" on page 555
- ":TIMebase:SCALe" on page 559
- ":TIMebase:WINDow:RANGe" on page 562

Example Code

```
   ' TIME_RANGE - Sets the full scale horizontal time in seconds.  The
   ' range value is 10 times the time per division.
   myScope.WriteString ":TIM:RANG 2e-3"   ' Set the time range to 0.002
seconds.
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:TIMebase:REFerence

C (see page 776)

Command Syntax

```
:TIMebase:REFerence <reference>
```

```
<reference> ::= {LEFT | CENTer | RIGHt}
```

The :TIMebase:REFerence command sets the time reference to one division from the left side of the screen, to the center of the screen, or to one division from the right side of the screen. Time reference is the point on the display where the trigger point is referenced.

Query Syntax

```
:TIMebase:REFerence?
```

The :TIMebase:REFerence? query returns the current display reference for the main window.

Return Format

```
<reference><NL>
```

```
<reference> ::= {LEFT | CENT | RIGH}
```

See Also

- "Introduction to :TIMebase Commands" on page 554
- ":TIMebase:MODE" on page 555

Example Code

```
   ' TIME_REFERENCE - Possible values are LEFT, CENTer, or RIGHt.
   '  - LEFT sets the display reference one time division from the left.
   '  - CENTer sets the display reference to the center of the screen.
   '  - RIGHt sets the display reference one time division from the righ
t.
   myScope.WriteString ":TIMebase:REFerence CENTer"   ' Set reference to
 center.
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:TIMebase:SCALe

N (see page 776)

Command Syntax

```
:TIMebase:SCALe <scale_value>
```

```
<scale_value> ::= time/div in seconds in NR3 format
```

The :TIMebase:SCALe command sets the horizontal scale or units per division for the main window.

Query Syntax

```
:TIMebase:SCALe?
```

The :TIMebase:SCALe? query returns the current horizontal scale setting in seconds per division for the main window.

Return Format

```
<scale_value><NL>
```

```
<scale_value> ::= time/div in seconds in NR3 format
```

See Also

- "Introduction to :TIMebase Commands" on page 554
- ":TIMebase:RANGe" on page 557
- ":TIMebase:WINDow:SCALe" on page 563
- ":TIMebase:WINDow:RANGe" on page 562

:TIMebase:VERNier

N (see page 776)

Command Syntax

```
:TIMebase:VERNier <vernier value>
```

```
<vernier value> ::= {{1 | ON} | {0 | OFF}
```

The :TIMebase:VERNier command specifies whether the time base control's vernier (fine horizontal adjustment) setting is ON (1) or OFF (0).

Query Syntax

```
:TIMebase:VERNier?
```

The :TIMebase:VERNier? query returns the current state of the time base control's vernier setting.

Return Format

```
<vernier value><NL>
```

```
<vernier value> ::= {0 | 1}
```

See Also

- "Introduction to :TIMebase Commands" on page 554

:TIMebase:WINDow:POSition

C (see page 776)

Command Syntax

```
:TIMebase:WINDow:POSition <pos value>
```

```
<pos value> ::= time from the trigger event to the zoomed (delayed)
                view reference point in NR3 format
```

The :TIMebase:WINDow:POSition command sets the horizontal position in the zoomed (delayed) view of the main sweep. The main sweep range and the main sweep horizontal position determine the range for this command. The value for this command must keep the zoomed view window within the main sweep range.

Query Syntax

```
:TIMebase:WINDow:POSition?
```

The :TIMebase:WINDow:POSition? query returns the current horizontal window position setting in the zoomed view.

Return Format

```
<value><NL>
```

```
<value> ::= position value in seconds
```

See Also

- "Introduction to :TIMebase Commands" on page 554
- ":TIMebase:MODE" on page 555
- ":TIMebase:POSition" on page 556
- ":TIMebase:RANGe" on page 557
- ":TIMebase:SCALe" on page 559
- ":TIMebase:WINDow:RANGe" on page 562
- ":TIMebase:WINDow:SCALe" on page 563

:TIMebase:WINDow:RANGe

C (see page 776)

Command Syntax

```
:TIMebase:WINDow:RANGe <range value>
```

```
<range value> ::= range value in seconds in NR3 format
```

The :TIMebase:WINDow:RANGe command sets the full-scale horizontal time in seconds for the zoomed (delayed) window. The range is 10 times the current zoomed view window seconds per division setting. The main sweep range determines the range for this command. The maximum value is one half of the :TIMebase:RANGe value.

Query Syntax

```
:TIMebase:WINDow:RANGe?
```

The :TIMebase:WINDow:RANGe? query returns the current window timebase range setting.

Return Format

```
<value><NL>
```

```
<value> ::= range value in seconds
```

See Also

- "Introduction to :TIMebase Commands" on page 554
- ":TIMebase:RANGe" on page 557
- ":TIMebase:POSition" on page 556
- ":TIMebase:SCALe" on page 559

:TIMebase:WINDow:SCALe

N (see page 776)

Command Syntax

```
:TIMebase:WINDow:SCALe <scale_value>
```

```
<scale_value> ::= scale value in seconds in NR3 format
```

The :TIMebase:WINDow:SCALe command sets the zoomed (delayed) window horizontal scale (seconds/division). The main sweep scale determines the range for this command. The maximum value is one half of the :TIMebase:SCALe value.

Query Syntax

```
:TIMebase:WINDow:SCALe?
```

The :TIMebase:WINDow:SCALe? query returns the current zoomed window scale setting.

Return Format

```
<scale_value><NL>
```

```
<scale_value> ::= current seconds per division for the zoomed window
```

See Also

- "Introduction to :TIMebase Commands" on page 554
- ":TIMebase:RANGe" on page 557
- ":TIMebase:POSition" on page 556
- ":TIMebase:SCALe" on page 559
- ":TIMebase:WINDow:RANGe" on page 562

27 :TRIGger Commands

Control the trigger modes and parameters for each trigger type. See:

- "Introduction to :TRIGger Commands" on page 565
- "General :TRIGger Commands" on page 567
- ":TRIGger[:EDGE] Commands" on page 577
- ":TRIGger:GLITch Commands" on page 583 (Pulse Width trigger)
- ":TRIGger:PATTern Commands" on page 591 (DSOX1000-Series oscilloscopes only)
- ":TRIGger:SHOLd Commands" on page 596 (DSOX1000-Series oscilloscopes only)
- ":TRIGger:TRANsition Commands" on page 602 (DSOX1000-Series oscilloscopes only)
- ":TRIGger:TV Commands" on page 607

Introduction to :TRIGger Commands

The commands in the TRIGger subsystem define the conditions for an internal trigger. Many of these commands are valid in multiple trigger modes.

The default trigger mode is :EDGE.

The trigger subsystem controls the trigger sweep mode and the trigger specification. The trigger sweep (see ":TRIGger:SWEep" on page 576) can be AUTO or NORMal.

- **NORMal** mode — displays a waveform only if a trigger signal is present and the trigger conditions are met. Otherwise the oscilloscope does not trigger and the display is not updated. This mode is useful for low-repetitive-rate signals.
- **AUTO** trigger mode — generates an artificial trigger event if the trigger specification is not satisfied within a preset time, acquires unsynchronized data and displays it.

  AUTO mode is useful for signals other than low-repetitive-rate signals. You must use this mode to display a DC signal because there are no edges on which to trigger.

The following trigger types are available (see ":TRIGger:MODE" on page 574).

- **Edge triggering**— identifies a trigger by looking for a specified slope and voltage level on a waveform.

- **Pulse width triggering**— (:TRIGger:GLITch commands) sets the oscilloscope to trigger on a positive pulse or on a negative pulse of a specified width.
- **Pattern triggering**— identifies a trigger condition by looking for a specified pattern. This pattern is a logical AND combination of the channels. You can also trigger on a specified time duration of a pattern.
- **TV triggering**— is used to capture the complicated waveforms of television equipment. The trigger circuitry detects the vertical and horizontal interval of the waveform and produces triggers based on the TV trigger settings you selected. TV triggering requires greater than ¼ division of sync amplitude with any analog channel as the trigger source.

Reporting the Setup

Use :TRIGger? to query setup information for the TRIGger subsystem.

Return Format

The return format for the TRIGger? query varies depending on the current mode. The following is a sample response from the :TRIGger? query. In this case, the query was issued following a *RST command.

```
:TRIG:MODE EDGE;SWE AUTO;NREJ 0;HFR 0;HOLD +60.0000000000000E-09;
:TRIG:EDGE:SOUR CHAN1;LEV +0.00000E+00;SLOP POS;REJ OFF;COUP DC
```

General :TRIGger Commands

Table 75 General :TRIGger Commands Summary

Command	Query	Options and Query Returns
:TRIGger:FORCe (see page 568)	n/a	n/a
:TRIGger:HFReject {{0 | OFF} | {1 | ON}} (see page 569)	:TRIGger:HFReject? (see page 569)	{0 | 1}
:TRIGger:HOLDoff <holdoff_time> (see page 570)	:TRIGger:HOLDoff? (see page 570)	<holdoff_time> ::= 60 ns to 10 s in NR3 format
:TRIGger:LEVel:ASETup (see page 571)	n/a	n/a
:TRIGger:LEVel:HIGH <level>, <source> (see page 572)	:TRIGger:LEVel:HIGH? <source> (see page 572)	<level> ::= .75 x full-scale voltage from center screen in NR3 format. <source> ::= CHANnel<n> <n> ::= 1 to (# analog channels) in NR1 format
:TRIGger:LEVel:LOW <level>, <source> (see page 573)	:TRIGger:LEVel:LOW? <source> (see page 573)	<level> ::= .75 x full-scale voltage from center screen in NR3 format. <source> ::= CHANnel<n> <n> ::= 1 to (# analog channels) in NR1 format

:TRIGger:MODE <mode> (see page 574)	:TRIGger:MODE? (see page 574)	<mode> ::= {EDGE | GLITch | PATTern | SHOLd | TRANsition | TV | SBUS1}
		<return_value> ::= {<mode> | <none>}
		<none> ::= query returns "NONE" if the :TIMebase:MODE is ROLL or XY

:TRIGger:NREJect {{0 | OFF} | {1 | ON}} (see page 575)	:TRIGger:NREJect? (see page 575)	{0 | 1}
:TRIGger:SWEep <sweep> (see page 576)	:TRIGger:SWEep? (see page 576)	<sweep> ::= {AUTO | NORMal}

:TRIGger:FORCe

N (see page 776)

Command Syntax

```
:TRIGger:FORCe
```

The :TRIGger:FORCe command causes an acquisition to be captured even though the trigger condition has not been met. This command is equivalent to the front panel **[Force Trigger]** key.

See Also

- "Introduction to :TRIGger Commands" on page 565

:TRIGger:HFReject

C (see page 776)

Command Syntax

```
:TRIGger:HFReject <value>

<value> ::= {{0 | OFF} | {1 | ON}}
```

The :TRIGger:HFReject command turns the high frequency reject filter off and on. The high frequency reject filter adds a 50 kHz low-pass filter in the trigger path to remove high frequency components from the trigger waveform. Use this filter to remove high-frequency noise, such as AM or FM broadcast stations, from the trigger path.

Query Syntax

```
:TRIGger:HFReject?
```

The :TRIGger:HFReject? query returns the current high frequency reject filter mode.

Return Format

```
<value><NL>

<value> ::= {0 | 1}
```

See Also

- ["Introduction to :TRIGger Commands"](#) on page 565
- [":TRIGger[:EDGE]:REJect"](#) on page 580

:TRIGger:HOLDoff

C (see page 776)

Command Syntax

```
:TRIGger:HOLDoff <holdoff_time>
```

```
<holdoff_time> ::= 60 ns to 10 s in NR3 format
```

The :TRIGger:HOLDoff command defines the holdoff time value in seconds. Holdoff keeps a trigger from occurring until after a certain amount of time has passed since the last trigger. This feature is valuable when a waveform crosses the trigger level multiple times during one period of the waveform. Without holdoff, the oscilloscope could trigger on each of the crossings, producing a confusing waveform. With holdoff set correctly, the oscilloscope always triggers on the same crossing. The correct holdoff setting is typically slightly less than one period.

Query Syntax

```
:TRIGger:HOLDoff?
```

The :TRIGger:HOLDoff? query returns the holdoff time value for the current trigger mode.

Return Format

```
<holdoff_time><NL>
```

```
<holdoff_time> ::= the holdoff time value in seconds in NR3 format.
```

See Also

- "Introduction to :TRIGger Commands" on page 565

:TRIGger:LEVel:ASETup

N (see page 776)

Command Syntax

```
:TRIGger:LEVel:ASETup
```

The :TRIGger:LEVel:ASETup command automatically sets the trigger levels of all displayed analog channels to their waveforms' 50% values.

If AC coupling is used, the trigger levels are set to 0 V.

When High and Low (dual) trigger levels are used (as with Rise/Fall Time and Runt triggers, for example), this command has no effect.

See Also

- ":TRIGger[:EDGE]:LEVel" on page 579

:TRIGger:LEVel:HIGH

N (see page 776)

Command Syntax

```
:TRIGger:LEVel:HIGH <level>, <source>
```

```
<level> ::= 0.75 x full-scale voltage from center screen in NR3 format
            for internal triggers
```

```
<source> ::= {CHANnel<n> | EXTernal}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :TRIGger:LEVel:HIGH command sets the high trigger voltage level voltage for the specified source.

Query Syntax

```
:TRIGger:LEVel:HIGH? <source>
```

The :TRIGger:LEVel:HIGH? query returns the high trigger voltage level for the specified source.

Return Format

```
<level><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:LEVel:LOW" on page 573
- ":TRIGger[:EDGE]:SOURce" on page 582

:TRIGger:LEVel:LOW

N (see page 776)

Command Syntax

```
:TRIGger:LEVel:LOW <level>, <source>

<level> ::= 0.75 x full-scale voltage from center screen in NR3 format
            for internal triggers

<source> ::= {CHANnel<n> | EXTernal}

<n> ::= 1 to (# analog channels) in NR1 format
```

The :TRIGger:LEVel:LOW command sets the low trigger voltage level voltage for the specified source.

Query Syntax

```
:TRIGger:LEVel:LOW? <source>
```

The :TRIGger:LEVel:LOW? query returns the low trigger voltage level for the specified source.

Return Format

```
<level><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:LEVel:HIGH" on page 572
- ":TRIGger[:EDGE]:SOURce" on page 582

:TRIGger:MODE

C (see page 776)

Command Syntax

```
:TRIGger:MODE <mode>

<mode> ::= {EDGE | GLITch | PATTern | SHOLd | TRANsition | TV | SBUS1}
```

The :TRIGger:MODE command selects the trigger mode (trigger type).

NOTE The PATTern, SHOLd, and TRANsition modes are available on the DSOX1000-Series oscilloscopes only.

Query Syntax

```
:TRIGger:MODE?
```

The :TRIGger:MODE? query returns the current trigger mode. If the :TIMebase:MODE is ROLL or XY, the query returns "NONE".

Return Format

```
<mode><NL>

<mode> ::= {EDGE | GLIT | PATT | SHOL | TRAN | TV | SBUS1}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:SWEep" on page 576
- ":TIMebase:MODE" on page 555

Example Code

```
' TRIGGER_MODE - Set the trigger mode to EDGE.
myScope.WriteString ":TRIGger:MODE EDGE"
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:TRIGger:NREJect

C (see page 776)

Command Syntax

```
:TRIGger:NREJect <value>
```

```
<value> ::= {{0 | OFF} | {1 | ON}}
```

The :TRIGger:NREJect command turns the noise reject filter off and on. When the noise reject filter is on, the trigger circuitry is less sensitive to noise but may require a greater amplitude waveform to trigger the oscilloscope. This command is not valid in TV trigger mode.

Query Syntax

```
:TRIGger:NREJect?
```

The :TRIGger:NREJect? query returns the current noise reject filter mode.

Return Format

```
<value><NL>
```

```
<value> ::= {0 | 1}
```

See Also

- "Introduction to :TRIGger Commands" on page 565

:TRIGger:SWEep

C (see page 776)

Command Syntax

```
:TRIGger:SWEep <sweep>

<sweep> ::= {AUTO | NORMal}
```

The :TRIGger:SWEep command selects the trigger sweep mode.

When AUTO sweep mode is selected, a baseline is displayed in the absence of a signal. If a signal is present but the oscilloscope is not triggered, the unsynchronized signal is displayed instead of a baseline.

When NORMal sweep mode is selected and no trigger is present, the instrument does not sweep, and the data acquired on the previous trigger remains on the screen.

NOTE This feature is called "Mode" on the instrument's front panel.

Query Syntax

```
:TRIGger:SWEep?
```

The :TRIGger:SWEep? query returns the current trigger sweep mode.

Return Format

```
<sweep><NL>

<sweep> ::= current trigger sweep mode
```

See Also

- "Introduction to :TRIGger Commands" on page 565

:TRIGger[:EDGE] Commands

Table 76 :TRIGger[:EDGE] Commands Summary

Command	Query	Options and Query Returns
:TRIGger[:EDGE]:COUPling {AC | DC | LFReject} (see page 578)	:TRIGger[:EDGE]:COUPling? (see page 578)	{AC | DC | LFReject}
:TRIGger[:EDGE]:LEVel <level> [,<source>] (see page 579)	:TRIGger[:EDGE]:LEVel? [<source>] (see page 579)	For internal triggers, <level> ::= .75 x full-scale voltage from center screen in NR3 format. For external triggers, <level> ::= ±(external range setting) in NR3 format. <source> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:TRIGger[:EDGE]:REJect {OFF | LFReject | HFReject} (see page 580)	:TRIGger[:EDGE]:REJect? (see page 580)	{OFF | LFReject | HFReject}
:TRIGger[:EDGE]:SLOPe <polarity> (see page 581)	:TRIGger[:EDGE]:SLOPe? (see page 581)	<polarity> ::= {POSitive | NEGative | EITHer | ALTernate}
:TRIGger[:EDGE]:SOURce <source> (see page 582)	:TRIGger[:EDGE]:SOURce? (see page 582)	<source> ::= {CHANnel<n> | EXTernal | LINE | WGEN} <n> ::= 1 to (# analog channels) in NR1 format

:TRIGger[:EDGE]:COUPling

C (see page 776)

Command Syntax

```
:TRIGger[:EDGE]:COUPling <coupling>
```

```
<coupling> ::= {AC | DC | LFReject}
```

The :TRIGger[:EDGE]:COUPling command sets the input coupling for the selected trigger sources. The coupling can be set to AC, DC, or LFReject.

- AC coupling places a high-pass filter (10 Hz for analog channels, and 3.5 Hz for all External trigger inputs) in the trigger path, removing dc offset voltage from the trigger waveform. Use AC coupling to get a stable edge trigger when your waveform has a large dc offset.
- LFReject coupling places a 50 KHz high-pass filter in the trigger path.
- DC coupling allows dc and ac signals into the trigger path.

NOTE **The :TRIGger[:EDGE]:COUPling and the :TRIGger[:EDGE]:REJect selections are coupled. Changing the setting of the :TRIGger[:EDGE]:REJect can change the COUPling setting.**

Query Syntax

```
:TRIGger[:EDGE]:COUPling?
```

The :TRIGger[:EDGE]:COUPling? query returns the current coupling selection.

Return Format

```
<coupling><NL>
```

```
<coupling> ::= {AC | DC | LFR}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":TRIGger[:EDGE]:REJect" on page 580

:TRIGger[:EDGE]:LEVel

C (see page 776)

Command Syntax

```
:TRIGger[:EDGE]:LEVel <level>

<level> ::= <level>[,<source>]

<level> ::= 0.75 x full-scale voltage from center screen in NR3 format
            for internal triggers

<level> ::= ±(external range setting) in NR3 format
            for external triggers

<source> ::= {CHANnel<n> | EXTernal}

<n> ::= 1 to (# analog channels) in NR1 format
```

The :TRIGger[:EDGE]:LEVel command sets the trigger level voltage for the active trigger source.

NOTE If the optional source is specified and is not the active source, the level on the active source is not affected and the active source is not changed.

Query Syntax

```
:TRIGger[:EDGE]:LEVel? [<source>]
```

The :TRIGger[:EDGE]:LEVel? query returns the trigger level of the current trigger source.

Return Format

```
<level><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger[:EDGE]:SOURce" on page 582
- ":EXTernal:RANGe" on page 253

:TRIGger[:EDGE]:REJect

C (see page 776)

Command Syntax

```
:TRIGger[:EDGE]:REJect <reject>

<reject> ::= {OFF | LFReject | HFReject}
```

The :TRIGger[:EDGE]:REJect command turns the low-frequency or high-frequency reject filter on or off. You can turn on one of these filters at a time.

- The high frequency reject filter adds a 50 kHz low-pass filter in the trigger path to remove high frequency components from the trigger waveform. Use the high frequency reject filter to remove high-frequency noise, such as AM or FM broadcast stations, from the trigger path.
- The low frequency reject filter adds a 50 kHz high-pass filter in series with the trigger waveform to remove any unwanted low frequency components from a trigger waveform, such as power line frequencies, that can interfere with proper triggering.

NOTE The :TRIGger[:EDGE]:REJect and the :TRIGger[:EDGE]:COUPling selections are coupled. Changing the setting of the :TRIGger[:EDGE]:COUPling can change the COUPling setting.

Query Syntax

```
:TRIGger[:EDGE]:REJect?
```

The :TRIGger[:EDGE]:REJect? query returns the current status of the reject filter.

Return Format

```
<reject><NL>

<reject> ::= {OFF | LFR | HFR}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:HFReject" on page 569
- ":TRIGger[:EDGE]:COUPling" on page 578

:TRIGger[:EDGE]:SLOPe

C (see page 776)

Command Syntax

```
:TRIGger[:EDGE]:SLOPe <slope>

<slope> ::= {NEGative | POSitive | EITHer | ALTernate}
```

The :TRIGger[:EDGE]:SLOPe command specifies the slope of the edge for the trigger. The SLOPe command is not valid in TV trigger mode. Instead, use :TRIGger:TV:POLarity to set the polarity in TV trigger mode.

Query Syntax

```
:TRIGger[:EDGE]:SLOPe?
```

The :TRIGger[:EDGE]:SLOPe? query returns the current trigger slope.

Return Format

```
<slope><NL>

<slope> ::= {NEG | POS | EITH | ALT}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":TRIGger:TV:POLarity" on page 610

Example Code

```
' TRIGGER_EDGE_SLOPE - Sets the slope of the edge for the trigger.

' Set the slope to positive.
myScope.WriteString ":TRIGGER:EDGE:SLOPE POSITIVE"
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:TRIGger[:EDGE]:SOURce

C (see page 776)

Command Syntax

```
:TRIGger[:EDGE]:SOURce <source>

<source> ::= {CHANnel<n> | EXTernal | LINE | WGEN}

<n> ::= 1 to (# analog channels) in NR1 format
```

The :TRIGger[:EDGE]:SOURce command selects the input that produces the trigger.

- EXTernal — triggers on the rear panel EXT TRIG IN signal.
- LINE — triggers at the 50% level of the rising or falling edge of the AC power source signal.
- WGEN — triggers at the 50% level of the rising edge of the waveform generator output signal. This option is not available when the DC or NOISe waveforms are selected.

Query Syntax

```
:TRIGger[:EDGE]:SOURce?
```

The :TRIGger[:EDGE]:SOURce? query returns the current source. If all channels are off, the query returns "NONE."

Return Format

```
<source><NL>

<source> ::= {CHAN<n> | EXT | LINE | WGEN | NONE}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574

Example Code

```
   ' TRIGGER_EDGE_SOURCE - Selects the channel that actually produces th
e
   ' edge trigger.  Any channel can be selected.
   myScope.WriteString ":TRIGger:EDGE:SOURce CHANnel1"
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:TRIGger:GLITch Commands

Table 77 :TRIGger:GLITch Commands Summary

Command	Query	Options and Query Returns
:TRIGger:GLITch:GREaterthan <greater_than_time>[suffix] (see page 584)	:TRIGger:GLITch:GREaterthan? (see page 584)	<greater_than_time> ::= floating-point number in NR3 format [suffix] ::= {s | ms | us | ns | ps}
:TRIGger:GLITch:LESSthan <less_than_time>[suffix] (see page 585)	:TRIGger:GLITch:LESSthan? (see page 585)	<less_than_time> ::= floating-point number in NR3 format [suffix] ::= {s | ms | us | ns | ps}
:TRIGger:GLITch:LEVel <level> [<source>] (see page 586)	:TRIGger:GLITch:LEVel? (see page 586)	For internal triggers, <level> ::= .75 x full-scale voltage from center screen in NR3 format. For external triggers, <level> ::= ±(external range setting) in NR3 format. <source> ::= {CHANnel<n> | EXTernal} <n> ::= 1 to (# analog channels) in NR1 format
:TRIGger:GLITch:POLarity <polarity> (see page 587)	:TRIGger:GLITch:POLarity? (see page 587)	<polarity> ::= {POSitive | NEGative}
:TRIGger:GLITch:QUALifier <qualifier> (see page 588)	:TRIGger:GLITch:QUALifier? (see page 588)	<qualifier> ::= {GREaterthan | LESSthan | RANGe}
:TRIGger:GLITch:RANGe <less_than_time>[suffix], <greater_than_time>[suffix] (see page 589)	:TRIGger:GLITch:RANGe? (see page 589)	<less_than_time> ::= 15 ns to 10 seconds in NR3 format <greater_than_time> ::= 10 ns to 9.99 seconds in NR3 format [suffix] ::= {s | ms | us | ns | ps}
:TRIGger:GLITch:SOURce <source> (see page 590)	:TRIGger:GLITch:SOURce? (see page 590)	<source> ::= {CHANnel<n>} <n> ::= 1 to (# analog channels) in NR1 format

:TRIGger:GLITch:GREaterthan

N (see page 776)

Command Syntax

```
:TRIGger:GLITch:GREaterthan <greater_than_time>[<suffix>]
```

```
<greater_than_time> ::= floating-point number in NR3 format
```

```
<suffix> ::= {s | ms | us | ns | ps}
```

The :TRIGger:GLITch:GREaterthan command sets the minimum pulse width duration for the selected :TRIGger:GLITch:SOURce.

Query Syntax

```
:TRIGger:GLITch:GREaterthan?
```

The :TRIGger:GLITch:GREaterthan? query returns the minimum pulse width duration time for :TRIGger:GLITch:SOURce.

Return Format

```
<greater_than_time><NL>
```

```
<greater_than_time> ::= floating-point number in NR3 format.
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:GLITch:SOURce" on page 590
- ":TRIGger:GLITch:QUALifier" on page 588
- ":TRIGger:MODE" on page 574

:TRIGger:GLITch:LESSthan

N (see page 776)

Command Syntax

```
:TRIGger:GLITch:LESSthan <less_than_time>[<suffix>]

<less_than_time> ::= floating-point number in NR3 format

<suffix> ::= {s | ms | us | ns | ps}
```

The :TRIGger:GLITch:LESSthan command sets the maximum pulse width duration for the selected :TRIGger:GLITch:SOURce.

Query Syntax

```
:TRIGger:GLITch:LESSthan?
```

The :TRIGger:GLITch:LESSthan? query returns the pulse width duration time for :TRIGger:GLITch:SOURce.

Return Format

```
<less_than_time><NL>

<less_than_time> ::= floating-point number in NR3 format.
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:GLITch:SOURce" on page 590
- ":TRIGger:GLITch:QUALifier" on page 588
- ":TRIGger:MODE" on page 574

:TRIGger:GLITch:LEVel

N (see page 776)

Command Syntax

```
:TRIGger:GLITch:LEVel <level_argument>

<level_argument> ::= <level>[, <source>]

<level> ::= .75 x full-scale voltage from center screen in NR3 format
            for internal triggers

<level> ::= ±(external range setting) in NR3 format
            for external triggers

<source> ::= {CHANnel<n> | EXTernal}

<n> ::= 1 to (# analog channels) in NR1 format
```

The :TRIGger:GLITch:LEVel command sets the trigger level voltage for the active pulse width trigger.

Query Syntax

```
:TRIGger:GLITch:LEVel?
```

The :TRIGger:GLITch:LEVel? query returns the trigger level of the current pulse width trigger mode. If all channels are off, the query returns "NONE."

Return Format

```
<level_argument><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":TRIGger:GLITch:SOURce" on page 590
- ":EXTernal:RANGe" on page 253

:TRIGger:GLITch:POLarity

N (see page 776)

Command Syntax

```
:TRIGger:GLITch:POLarity <polarity>
```

```
<polarity> ::= {POSitive | NEGative}
```

The :TRIGger:GLITch:POLarity command sets the polarity for the glitch pulse width trigger.

Query Syntax

```
:TRIGger:GLITch:POLarity?
```

The :TRIGger:GLITch:POLarity? query returns the glitch pulse width trigger polarity.

Return Format

```
<polarity><NL>
```

```
<polarity> ::= {POS | NEG}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":TRIGger:GLITch:SOURce" on page 590

:TRIGger:GLITch:QUALifier

N (see page 776)

Command Syntax

```
:TRIGger:GLITch:QUALifier <operator>
```

```
<operator> ::= {GREaterthan | LESSthan | RANGe}
```

This command sets the mode of operation of the glitch pulse width trigger. The oscilloscope can trigger on a pulse width that is greater than a time value, less than a time value, or within a range of time values.

Query Syntax

```
:TRIGger:GLITch:QUALifier?
```

The :TRIGger:GLITch:QUALifier? query returns the glitch pulse width qualifier.

Return Format

```
<operator><NL>
```

```
<operator> ::= {GRE | LESS | RANG}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:GLITch:SOURce" on page 590
- ":TRIGger:MODE" on page 574

:TRIGger:GLITch:RANGe

N (see page 776)

Command Syntax

```
:TRIGger:GLITch:RANGe <less_than_time>[suffix],
                      <greater_than_time>[suffix]
```

```
<less_than_time> ::= (15 ns - 10 seconds) in NR3 format
```

```
<greater_than_time> ::= (10 ns - 9.99 seconds) in NR3 format
```

```
[suffix] ::= {s | ms | us | ns | ps}
```

The :TRIGger:GLITch:RANGe command sets the pulse width duration for the selected :TRIGger:GLITch:SOURce. You can enter the parameters in any order — the smaller value becomes the <greater_than_time> and the larger value becomes the <less_than_time>.

Query Syntax

```
:TRIGger:GLITch:RANGe?
```

The :TRIGger:GLITch:RANGe? query returns the pulse width duration time for :TRIGger:GLITch:SOURce.

Return Format

```
<less_than_time>,<greater_than_time><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:GLITch:SOURce" on page 590
- ":TRIGger:GLITch:QUALifier" on page 588
- ":TRIGger:MODE" on page 574

:TRIGger:GLITch:SOURce

N (see page 776)

Command Syntax

```
:TRIGger:GLITch:SOURce <source>

<source> ::= {DIGital<d> | CHANnel<n>}

<n> ::= 1 to (# analog channels) in NR1 format

<d> ::= 0 to (# digital channels - 1) in NR1 format
```

The :TRIGger:GLITch:SOURce command selects the channel that produces the pulse width trigger.

Query Syntax

```
:TRIGger:GLITch:SOURce?
```

The :TRIGger:GLITch:SOURce? query returns the current pulse width source. If all channels are off, the query returns "NONE".

Return Format

```
<source><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":TRIGger:GLITch:LEVel" on page 586
- ":TRIGger:GLITch:POLarity" on page 587
- ":TRIGger:GLITch:QUALifier" on page 588
- ":TRIGger:GLITch:RANGe" on page 589

Example Code

- "Example Code" on page 582

:TRIGger:PATTern Commands

NOTE The :TRIGger:PATTern commands are available on the DSOX1000-Series oscilloscopes only.

Table 78 :TRIGger:PATTern Commands Summary

Command	Query	Options and Query Returns

`:TRIGger:PATTern <string>[,<edge_source>,<edge>]` (see page 592)	`:TRIGger:PATTern?` (see page 592)	`<string> ::= "nn...n" where n ::= {0 | 1 | X | R | F} when <base> = ASCii`
		`<string> ::= "0xnn...n" where n ::= {0,..,9 | A,..,F | X | $} when <base> = HEX`
		`<edge_source> ::= {CHANnel<n> | EXTernal | NONE}`
		`<n> ::= 1 to (# analog channels) in NR1 format`
		`<edge> ::= {POSitive | NEGative}`

`:TRIGger:PATTern:FORMat <base>` (see page 594)	`:TRIGger:PATTern:FORMat?` (see page 594)	`<base> ::= {ASCii | HEX}`
`:TRIGger:PATTern:QUALifier <qualifier>` (see page 595)	`:TRIGger:PATTern:QUALifier?` (see page 595)	`<qualifier> ::= ENTered`

:TRIGger:PATTern

C (see page 776)

Command Syntax

```
:TRIGger:PATTern <pattern>

<pattern> ::= <string>[,<edge_source>,<edge>]

<string> ::= "nn...n" where n ::= {0 | 1 | X | R | F} when
             <base> = ASCii

<string> ::= "0xnn...n" where n ::= {0,..,9 | A,..,F | X | $} when
             <base> = HEX

<edge_source> ::= {CHANnel<n> | EXTernal | NONE}

<n> ::= 1 to (# of analog channels) in NR1 format

<edge> ::= {POSitive | NEGative}
```

The :TRIGger:PATTern command specifies the channel values to be used in the pattern trigger.

In the <string> parameter, each bit corresponds to a channel as described in the following table:

Oscilloscope Models	Value and Mask Bit Assignments
2 analog + 1 external trigger input	Bit 0 - external trigger input. Bits 1 and 2 - analog channels 2 and 1.

The format of the <string> parameter depends on the :TRIGger:PATTern:FORMat command setting:

- When the format is ASCii, the string looks just like the string you see on the oscilloscope's front panel, made up of 0, 1, X (don't care), R (rising edge), and F (falling edge) characters.
- When the format is HEX, the string begins with "0x" and contains hex digit characters or X (don't care for all four bits in the nibble).

  With the hex format string, you can use the <edge_source> and <edge> parameters to specify an edge on one of the channels.

NOTE **The optional <edge_source> and <edge> parameters should be sent together or not at all. The edge can be specified in the ASCII <string> parameter. If the edge source and edge parameters are used, they take precedence.**

You can only specify an edge on one channel. When an edge is specified, the :TRIGger:PATTern:QUALifier does not apply.

Query Syntax

```
:TRIGger:PATTern?
```

The :TRIGger:PATTern? query returns the pattern string, edge source, and edge.

Return Format

```
<string>,<edge_source>,<edge><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:PATTern:FORMat" on page 594
- ":TRIGger:PATTern:QUALifier" on page 595
- ":TRIGger:MODE" on page 574

:TRIGger:PATTern:FORMat

N (see page 776)

Command Syntax

```
:TRIGger:PATTern:FORMat <base>
```

```
<base> ::= {ASCii | HEX}
```

The :TRIGger:PATTern:FORMat command sets the entry (and query) number base used by the :TRIGger:PATTern command. The default <base> is ASCii.

Query Syntax

```
:TRIGger:PATTern:FORMat?
```

The :TRIGger:PATTern:FORMat? query returns the currently set number base for pattern trigger patterns.

Return Format

```
<base><NL>
```

```
<base> ::= {ASC | HEX}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:PATTern" on page 592

:TRIGger:PATTern:QUALifier

N (see page 776)

Command Syntax

```
:TRIGger:PATTern:QUALifier <qualifier>
```

```
<qualifier> ::= ENTered
```

The :TRIGger:PATTern:QUALifier command qualifies when the trigger occurs.

In the InfiniiVision 1000 X-Series oscilloscopes, the trigger always occurs when the pattern is entered.

Query Syntax

```
:TRIGger:PATTern:QUALifier?
```

The :TRIGger:PATTern:QUALifier? query returns the trigger duration qualifier.

Return Format

```
<qualifier><NL>
```

See Also

- "Introduction to :TRIGger Commands" on page 565

:TRIGger:SHOLd Commands

NOTE The :TRIGger:SHOLd commands are available on the DSOX1000-Series oscilloscopes only.

Table 79 :TRIGger:SHOLd Commands Summary

Command	Query	Options and Query Returns
`:TRIGger:SHOLd:SLOPe <slope>` (see page 597)	`:TRIGger:SHOLd:SLOPe?` (see page 597)	`<slope> ::= {NEGative | POSitive}`

`:TRIGger:SHOLd:SOURce:CLOCk <source>` (see page 598)	`:TRIGger:SHOLd:SOURce:CLOCk?` (see page 598)	`<source> ::= {CHANnel<n>}`
		 `<n> ::= 1 to (# analog channels) in NR1 format`

`:TRIGger:SHOLd:SOURce:DATA <source>` (see page 599)	`:TRIGger:SHOLd:SOURce:DATA?` (see page 599)	`<source> ::= {CHANnel<n>}`
		 `<n> ::= 1 to (# analog channels) in NR1 format`

`:TRIGger:SHOLd:TIME:HOLD <time>[suffix]` (see page 600)	`:TRIGger:SHOLd:TIME:HOLD?` (see page 600)	`<time> ::= floating-point number in NR3 format`
		 `[suffix] ::= {s | ms | us | ns | ps}`

`:TRIGger:SHOLd:TIME:SETup <time>[suffix]` (see page 601)	`:TRIGger:SHOLd:TIME:SETup?` (see page 601)	`<time> ::= floating-point number in NR3 format`
		 `[suffix] ::= {s | ms | us | ns | ps}`

:TRIGger:SHOLd:SLOPe

N (see page 776)

Command Syntax

```
:TRIGger:SHOLd:SLOPe <slope>

<slope> ::= {NEGative | POSitive}
```

The :TRIGger:SHOLd:SLOPe command specifies whether the rising edge or the falling edge of the clock signal is used.

Query Syntax

```
:TRIGger:SHOLd:SLOPe?
```

The :TRIGger:SHOLd:SLOPe? query returns the current rising or falling edge setting.

Return Format

```
<slope><NL>

<slope> ::= {NEG | POS}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":TRIGger:SHOLd:SOURce:CLOCk" on page 598
- ":TRIGger:SHOLd:SOURce:DATA" on page 599

:TRIGger:SHOLd:SOURce:CLOCk

N (see page 776)

Command Syntax

```
:TRIGger:SHOLd:SOURce:CLOCk <source>

<source> ::= {CHANnel<n>}

<n> ::= 1 to (# analog channels) in NR1 format
```

The :TRIGger:SHOLd:SOURce:CLOCk command selects the input channel probing the clock signal.

Query Syntax

```
:TRIGger:SHOLd:SOURce:CLOCk?
```

The :TRIGger:SHOLd:SOURce:CLOCk? query returns the currently set clock signal source.

Return Format

```
<source><NL>

<source> ::= {CHAN<n>}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":TRIGger:SHOLd:SLOPe" on page 597

:TRIGger:SHOLd:SOURce:DATA

N (see page 776)

Command Syntax

```
:TRIGger:SHOLd:SOURce:DATA <source>
```

```
<source> ::= {CHANnel<n>}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :TRIGger:SHOLd:SOURce:DATA command selects the input channel probing the data signal.

Query Syntax

```
:TRIGger:SHOLd:SOURce:DATA?
```

The :TRIGger:SHOLd:SOURce:DATA? query returns the currently set data signal source.

Return Format

```
<source><NL>
```

```
<source> ::= {CHAN<n>}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":TRIGger:SHOLd:SLOPe" on page 597

:TRIGger:SHOLd:TIME:HOLD

N (see page 776)

Command Syntax

```
:TRIGger:SHOLd:TIME:HOLD <time>[suffix]

<time> ::= floating-point number in NR3 format

[suffix] ::= {s | ms | us | ns | ps}
```

The :TRIGger:SHOLd:TIME:HOLD command sets the hold time.

Query Syntax

```
:TRIGger:SHOLd:TIME:HOLD?
```

The :TRIGger:SHOLd:TIME:HOLD? query returns the currently specified hold time.

Return Format

```
<time><NL>

<time> ::= floating-point number in NR3 format
```

See Also

- "Introduction to :TRIGger Commands" on page 565

:TRIGger:SHOLd:TIME:SETup

N (see page 776)

Command Syntax

```
:TRIGger:SHOLd:TIME:SETup <time>[suffix]
```

```
<time> ::= floating-point number in NR3 format
```

```
[suffix] ::= {s | ms | us | ns | ps}
```

The :TRIGger:SHOLd:TIME:SETup command sets the setup time.

Query Syntax

```
:TRIGger:SHOLd:TIME:SETup?
```

The :TRIGger:SHOLd:TIME:SETup? query returns the currently specified setup time.

Return Format

```
<time><NL>
```

```
<time> ::= floating-point number in NR3 format
```

See Also

- "Introduction to :TRIGger Commands" on page 565

:TRIGger:TRANsition Commands

NOTE The :TRIGger:TRANsition commands are available on the DSOX1000-Series oscilloscopes only.

The :TRIGger:TRANsition commands set the rise/fall time trigger options.

Table 80 :TRIGger:TRANsition Commands Summary

Command	Query	Options and Query Returns
`:TRIGger:TRANsition:QUALifier <qualifier>` (see page 603)	`:TRIGger:TRANsition:QUALifier?` (see page 603)	`<qualifier> ::= {GREaterthan | LESSthan}`
`:TRIGger:TRANsition:SLOPe <slope>` (see page 604)	`:TRIGger:TRANsition:SLOPe?` (see page 604)	`<slope> ::= {NEGative | POSitive}`

`:TRIGger:TRANsition:SOURce <source>` (see page 605)	`:TRIGger:TRANsition:SOURce?` (see page 605)	`<source> ::= {CHANnel<n>}`
		`<n> ::= 1 to (# analog channels) in NR1 format`

`:TRIGger:TRANsition:TIME <time>[suffix]` (see page 606)	`:TRIGger:TRANsition:TIME?` (see page 606)	`<time> ::= floating-point number in NR3 format`
		`[suffix] ::= {s | ms | us | ns | ps}`

:TRIGger:TRANsition:QUALifier

N (see page 776)

Command Syntax

```
:TRIGger:TRANsition:QUALifier <qualifier>

<qualifier> ::= {GREaterthan | LESSthan}
```

The :TRIGger:TRANsition:QUALifier command specifies whether you are looking for rise/fall times greater than or less than a certain time value. The time value is set using the :TRIGger:TRANsition:TIME command.

Query Syntax

```
:TRIGger:TRANsition:QUALifier?
```

The :TRIGger:TRANsition:QUALifier? query returns the current rise/fall time trigger qualifier setting.

Return Format

```
<qualifier><NL>

<qualifier> ::= {GRE | LESS}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:TRANsition:TIME" on page 606
- ":TRIGger:MODE" on page 574

:TRIGger:TRANsition:SLOPe

N (see page 776)

Command Syntax

```
:TRIGger:TRANsition:SLOPe <slope>
```

```
<slope> ::= {NEGative | POSitive}
```

The :TRIGger:TRANsition:SLOPe command specifies a POSitive rising edge or a NEGative falling edge.

Query Syntax

```
:TRIGger:TRANsition:SLOPe?
```

The :TRIGger:TRANsition:SLOPe? query returns the current rise/fall time trigger slope setting.

Return Format

```
<slope><NL>
```

```
<slope> ::= {NEG | POS}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":TRIGger:TRANsition:SOURce" on page 605

:TRIGger:TRANsition:SOURce

N (see page 776)

Command Syntax

```
:TRIGger:TRANsition:SOURce <source>
```

```
<source> ::= {CHANnel<n>}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :TRIGger:TRANsition:SOURce command selects the channel used to produce the trigger.

Query Syntax

```
:TRIGger:TRANsition:SOURce?
```

The :TRIGger:TRANsition:SOURce? query returns the current transition trigger source.

Return Format

```
<source><NL>
```

```
<source> ::= {CHAN<n>}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":TRIGger:TRANsition:SLOPe" on page 604

:TRIGger:TRANsition:TIME

N (see page 776)

Command Syntax

```
:TRIGger:TRANsition:TIME <time>[suffix]
```

```
<time> ::= floating-point number in NR3 format
```

```
[suffix] ::= {s | ms | us | ns | ps}
```

The :TRIGger:TRANsition:TIME command sets the time value for rise/fall time triggers. You also use the :TRIGger:TRANsition:QUALifier command to specify whether you are triggering on times greater than or less than this time value.

Query Syntax

```
:TRIGger:TRANsition:TIME?
```

The :TRIGger:TRANsition:TIME? query returns the current rise/fall time trigger time value.

Return Format

```
<time><NL>
```

```
<time> ::= floating-point number in NR3 format
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:TRANsition:QUALifier" on page 603

:TRIGger:TV Commands

Table 81 :TRIGger:TV Commands Summary

Command	Query	Options and Query Returns
:TRIGger:TV:LINE <line number> (see page 608)	:TRIGger:TV:LINE? (see page 608)	<line number> ::= integer in NR1 format
:TRIGger:TV:MODE <tv mode> (see page 609)	:TRIGger:TV:MODE? (see page 609)	<tv mode> ::= {FIEld1 | FIEld2 | AFIelds | ALINes | LFIeld1 | LFIeld2 | LALTernate}
:TRIGger:TV:POLarity <polarity> (see page 610)	:TRIGger:TV:POLarity? (see page 610)	<polarity> ::= {POSitive | NEGative}
:TRIGger:TV:SOURce <source> (see page 611)	:TRIGger:TV:SOURce? (see page 611)	<source> ::= {CHANnel<n>} <n> ::= 1 to (# analog channels) in NR1 format
:TRIGger:TV:STANdard <standard> (see page 612)	:TRIGger:TV:STANdard? (see page 612)	<standard> ::= {NTSC | PAL | PALM | SECam}

:TRIGger:TV:LINE

N (see page 776)

Command Syntax

```
:TRIGger:TV:LINE <line_number>
```

```
<line_number> ::= integer in NR1 format
```

The :TRIGger:TV:LINE command allows triggering on a specific line of video. The line number limits vary with the standard and mode, as shown in the following table.

Table 82 TV Trigger Line Number Limits

TV Standard	Mode		
	LFIeld1	LFIeld2	LALTernate
NTSC	1 to 263	1 to 262	1 to 262
PAL	1 to 313	314 to 625	1 to 312
PAL-M	1 to 263	264 to 525	1 to 262
SECAM	1 to 313	314 to 625	1 to 312

Query Syntax

```
:TRIGger:TV:LINE?
```

The :TRIGger:TV:LINE? query returns the current TV trigger line number setting.

Return Format

```
<line_number><NL>
```

```
<line_number>::= integer in NR1 format
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:TV:STANdard" on page 612
- ":TRIGger:TV:MODE" on page 609

:TRIGger:TV:MODE

N (see page 776)

Command Syntax

```
:TRIGger:TV:MODE <mode>

<mode> ::= {FIEld1 | FIEld2 | AFIelds | ALINes
           | LFIeld1 | LFIeld2 | LALTernate}
```

The :TRIGger:TV:MODE command selects the TV trigger mode and field.

Old forms for <mode> are accepted:

<mode>	Old Forms Accepted
FIEld1	F1
FIEld2	F2
AFIelds	ALLFields, ALLFLDS
ALINes	ALLLines
LFIeld1	LINEF1, LINEFIELD1
LFIeld2	LINEF2, LINEFIELD2
LALTernate	LINEAlt

Query Syntax

```
:TRIGger:TV:MODE?
```

The :TRIGger:TV:MODE? query returns the TV trigger mode.

Return Format

```
<value><NL>

<value> ::= {FIE1 | FIE2 | AFI | ALIN | LFI1 | LFI2 | LALT}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:TV:STANdard" on page 612
- ":TRIGger:MODE" on page 574

:TRIGger:TV:POLarity

N (see page 776)

Command Syntax

```
:TRIGger:TV:POLarity <polarity>
```

```
<polarity> ::= {POSitive | NEGative}
```

The :TRIGger:TV:POLarity command sets the polarity for the TV trigger.

Query Syntax

```
:TRIGger:TV:POLarity?
```

The :TRIGger:TV:POLarity? query returns the TV trigger polarity.

Return Format

```
<polarity><NL>
```

```
<polarity> ::= {POS | NEG}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":TRIGger:TV:SOURce" on page 611

:TRIGger:TV:SOURce

N (see page 776)

Command Syntax

```
:TRIGger:TV:SOURce <source>
```

```
<source> ::= {CHANnel<n>}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :TRIGger:TV:SOURce command selects the channel used to produce the trigger.

Query Syntax

```
:TRIGger:TV:SOURce?
```

The :TRIGger:TV:SOURce? query returns the current TV trigger source.

Return Format

```
<source><NL>
```

```
<source> ::= {CHAN<n>}
```

See Also

- "Introduction to :TRIGger Commands" on page 565
- ":TRIGger:MODE" on page 574
- ":TRIGger:TV:POLarity" on page 610

Example Code

- "Example Code" on page 582

:TRIGger:TV:STANdard

N (see page 776)

Command Syntax

```
:TRIGger:TV:STANdard <standard>

<standard> ::= {NTSC | PALM | PAL | SECam}
```

The :TRIGger:TV:STANdard command selects the video standard:

- NTSC
- PAL
- PAL-M
- SECAM

Query Syntax

```
:TRIGger:TV:STANdard?
```

The :TRIGger:TV:STANdard? query returns the current TV trigger standard setting.

Return Format

```
<standard><NL>

<standard> ::= {NTSC | PALM | PAL | SEC}
```

28 :WAVeform Commands

Provide access to waveform data. See "Introduction to :WAVeform Commands" on page 615.

Table 83 :WAVeform Commands Summary

Command	Query	Options and Query Returns
:WAVeform:BYTeorder <value> (see page 620)	:WAVeform:BYTeorder? (see page 620)	<value> ::= {LSBFirst | MSBFirst}
n/a	:WAVeform:COUNt? (see page 621)	<count> ::= an integer from 1 to 65536 in NR1 format
n/a	:WAVeform:DATA? (see page 622)	<binary block length bytes>, <binary data> For example, to transmit 1000 bytes of data, the syntax would be: #800001000<1000 bytes of data><NL> 8 is the number of digits that follow 00001000 is the number of bytes to be transmitted <1000 bytes of data> is the actual data
:WAVeform:FORMat <value> (see page 624)	:WAVeform:FORMat? (see page 624)	<value> ::= {WORD | BYTE | ASCII}
:WAVeform:POINts <# points> (see page 625)	:WAVeform:POINts? (see page 625)	<# points> ::= {100 | 250 | 500 | 1000 | <points_mode>} if waveform points mode is NORMal <# points> ::= {100 | 250 | 500 | 1000 | 2000 ... 8000000 in 1-2-5 sequence | <points_mode>} if waveform points mode is MAXimum or RAW <points_mode> ::= {NORMal | MAXimum | RAW}

Table 83 :WAVeform Commands Summary (continued)

Command	Query	Options and Query Returns
:WAVeform:POINts:MODE <points_mode> (see page 627)	:WAVeform:POINts:MODE? (see page 627)	<points_mode> ::= {NORMal | MAXimum | RAW}
n/a	:WAVeform:PREamble? (see page 629)	<preamble_block> ::= <format NR1>, <type NR1>,<points NR1>,<count NR1>, <xincrement NR3>, <xorigin NR3>, <xreference NR1>,<yincrement NR3>, <yorigin NR3>, <yreference NR1> <format> ::= an integer in NR1 format: • 0 for BYTE format • 1 for WORD format • 2 for ASCii format <type> ::= an integer in NR1 format: • 0 for NORMal type • 1 for PEAK detect type • 3 for AVERage type • 4 for HRESolution type <count> ::= Average count, or 1 if PEAK detect type or NORMal; an integer in NR1 format
n/a	:WAVeform:SEGMented:COUNt? (see page 632)	<count> ::= an integer from 2 to 1000 in NR1 format (with SGM license)
n/a	:WAVeform:SEGMented:TTAG? (see page 633)	<time_tag> ::= in NR3 format (with SGM license)
:WAVeform:SOURce <source> (see page 634)	:WAVeform:SOURce? (see page 634)	<source> ::= {CHANnel<n> | FUNCtion | MATH} <n> ::= 1 to (# analog channels) in NR1 format
:WAVeform:SOURce:SUBSource <subsource> (see page 638)	:WAVeform:SOURce:SUBSource? (see page 638)	<subsource> ::= {{SUB0 | RX | MOSI} | {SUB1 | TX | MISO}}
n/a	:WAVeform:TYPE? (see page 639)	<return_mode> ::= {NORM | PEAK | AVER | HRES}
:WAVeform:UNSigned {{0 | OFF} | {1 | ON}} (see page 640)	:WAVeform:UNSigned? (see page 640)	{0 | 1}

Table 83 :WAVeform Commands Summary (continued)

Command	Query	Options and Query Returns
`:WAVeform:VIEW <view>` (see page 641)	`:WAVeform:VIEW?` (see page 641)	`<view> ::= {MAIN}`
n/a	`:WAVeform:XINCrement?` (see page 642)	`<return_value> ::= x-increment in the current preamble in NR3 format`
n/a	`:WAVeform:XORigin?` (see page 643)	`<return_value> ::= x-origin value in the current preamble in NR3 format`
n/a	`:WAVeform:XREFerence?` (see page 644)	`<return_value> ::= 0 (x-reference value in the current preamble in NR1 format)`
n/a	`:WAVeform:YINCrement?` (see page 645)	`<return_value> ::= y-increment value in the current preamble in NR3 format`
n/a	`:WAVeform:YORigin?` (see page 646)	`<return_value> ::= y-origin in the current preamble in NR3 format`
n/a	`:WAVeform:YREFerence?` (see page 647)	`<return_value> ::= y-reference value in the current preamble in NR1 format`

Introduction to :WAVeform Commands

The WAVeform subsystem is used to transfer data to a controller from the oscilloscope waveform memories. The queries in this subsystem will only operate when the channel selected by :WAVeform:SOURce is on.

Waveform Data and Preamble

The waveform record is actually contained in two portions: the preamble and waveform data. The waveform record must be read from the oscilloscope by the controller using two separate commands, :WAVeform:DATA (see page 622) and :WAVeform:PREamble (see page 629). The waveform data is the actual data acquired for each point in the specified source. The preamble contains the information for interpreting the waveform data, which includes the number of points acquired, the format of acquired data, and the type of acquired data. The preamble also contains the X and Y increments, origins, and references for the acquired data, so that word and byte data can be translated to time and voltage values.

Data Acquisition Types

There are four types of waveform acquisitions that can be selected for analog channels with the :ACQuire:TYPE command (see page 185): NORMal, AVERage, PEAK, and HRESolution. When the data is acquired using the :DIGitize command (see page 141) or :RUN command (see page 156), the data is placed in the channel buffer of the specified source.

Once you have acquired data with the :DIGitize command, the instrument is stopped. If the instrument is restarted (via the programming interface or the front panel), or if any instrument setting is changed, the data acquired with the :DIGitize command may be overwritten.You should first acquire the data with the :DIGitize command, then immediately read the data with the :WAVeform:DATA? query (see page 622) before changing any instrument setup.

A waveform record consists of either all of the acquired points or a subset of the acquired points. The number of points acquired may be queried using :ACQuire:POINts? (see page 178).

Helpful Hints:

The number of points transferred to the computer is controlled using the :WAVeform:POINts command (see page 625). If :WAVeform:POINts MAXimum is specified and the instrument is not running (stopped, in other words), all of the points that are displayed are transferred. This can be the full oscilloscope acquisition memory in some operating modes. You can ask for fewer points to speed data transfers and minimize controller analysis time. The :WAVeform:POINts may be varied even after data on a channel is acquired. However, this decimation may result in lost pulses and transitions. The number of points selected for transfer using :WAVeform:POINts must be an even divisor of 1,000 or be set to MAXimum. :WAVeform:POINts determines the increment between time buckets that will be transferred. If POINts = MAXimum, the data cannot be decimated. For example:

- `:WAVeform:POINts 1000` — returns time buckets 0, 1, 2, 3, 4 ,.., 999.
- `:WAVeform:POINts 500` — returns time buckets 0, 2, 4, 6, 8 ,.., 998.
- `:WAVeform:POINts 250` — returns time buckets 0, 4, 8, 12, 16 ,.., 996.
- `:WAVeform:POINts 100` — returns time buckets 0, 10, 20, 30, 40 ,.., 990.

Analog Channel Data

NORMal Data

Normal data consists of the last data point (hit) in each time bucket. This data is transmitted over the programming interface in a linear fashion starting with time bucket 0 and going through time bucket n - 1, where n is the number returned by the :WAVeform:POINts? query (see page 625). Only the magnitude values of each data point are transmitted. The first voltage value corresponds to the first time bucket on the left side of the screen and the last value corresponds to the next-to-last time bucket on the right side of the screen. Time buckets without data return 0. The time values for each data point correspond to the position of the data point in the data array. These time values are not transmitted.

AVERage Data

AVERage data consists of the average of the first n hits in a time bucket, where n is the value returned by the :ACQuire:COUNt query (see page 176). Time buckets that have fewer than n hits return the average of the data they do have. If a time bucket does not have any data in it, it returns 0.

This data is transmitted over the interface linearly, starting with time bucket 0 and proceeding through time bucket n-1, where n is the number returned by the :WAVeform:POINts? query (see page 625). The first value corresponds to a point at the left side of the screen and the last value corresponds to one point away from the right side of the screen. The maximum number of points that can be returned in average mode is 8192 unless ACQuire:COUNt has been set to 1.

PEAK Data

Peak detect display mode is used to detect glitches for time base settings of 500 us/div and slower. In this mode, the oscilloscope can sample more data than it can store and display. So, when peak detect is turned on, the oscilloscope scans through the extra data, picks up the minimum and maximum for each time bucket, then stores the data in an array. Each time bucket contains two data sample.

The array is transmitted over the interface bus linearly, starting with time bucket 0 proceeding through time bucket n-1, where n is the number returned by the :WAVeform:POINts? query (see page 625). In each time bucket, two values are transmitted, first the minimum, followed by the maximum. The first pair of values corresponds to the time bucket at the leftmost side of the screen. The last pair of values corresponds to the time bucket at the far right side of the screen. In :ACQuire:TYPE PEAK mode (see page 185), the value returned by the :WAVeform:XINCrement query (see page 642) should be doubled to find the time difference between the min-max pairs.

HRESolution Data

The high resolution (*smoothing*) mode is used to reduce noise at slower sweep speeds where the digitizer samples faster than needed to fill memory for the displayed time range.

Data Conversion

Word or byte data sent from the oscilloscope must be scaled for useful interpretation. The values used to interpret the data are the X and Y references, X and Y origins, and X and Y increments. These values are read from the waveform preamble. Each channel has its own waveform preamble.

In converting a data value to a voltage value, the following formula is used:

voltage = [(data value - yreference) * yincrement] + yorigin

If the :WAVeform:FORMat data format is ASCii (see page 624), the data values are converted internally and sent as floating point values separated by commas.

In converting a data value to time, the time value of a data point can be determined by the position of the data point. For example, the fourth data point sent with :WAVeform:XORigin = 16 ns, :WAVeform:XREFerence = 0, and :WAVeform:XINCrement = 2 ns, can be calculated using the following formula:

time = [(data point number - xreference) * xincrement] + xorigin

This would result in the following calculation for time bucket 3:

time = [(3 - 0) * 2 ns] + 16 ns = 22 ns

In :ACQuire:TYPE PEAK mode (see page 185), because data is acquired in max-min pairs, modify the previous time formula to the following:

time=[(data pair number - xreference) * xincrement * 2] + xorigin

Data Format for Transfer

There are three formats for transferring waveform data over the interface: BYTE, WORD and ASCii (see ":WAVeform:FORMat" on page 624). BYTE, WORD and ASCii formatted waveform records are transmitted using the arbitrary block program data format specified in IEEE 488.2.

When you use the block data format, the ASCII character string "#8<DD...D>" is sent prior to sending the actual data. The 8 indicates how many Ds follow. The Ds are ASCII numbers that indicate how many data bytes follow.

For example, if 1000 points will be transferred, and the WORD format was specified, the block header "#800001000" would be sent. The 8 indicates that eight length bytes follow, and 00001000 indicates that 1000 binary data bytes follow.

Use the :WAVeform:UNSigned command (see page 640) to control whether data values are sent as unsigned or signed integers. This command can be used to match the instrument's internal data type to the data type used by the programming language. This command has no effect if the data format is ASCii.

Data Format for Transfer - ASCii format

The ASCii format (see ":WAVeform:FORMat" on page 624) provides access to the waveform data as real Y-axis values without using Y origin, Y reference, and Y increment to convert the binary data. Values are transferred as ASCii digits in floating point format separated by commas. In ASCii format, holes are represented by the value 9.9e+37. The setting of :WAVeform:BYTeorder (see page 620) and :WAVeform:UNSigned (see page 640) have no effect when the format is ASCii.

Data Format for Transfer - WORD format

WORD format (see ":WAVeform:FORMat" on page 624) provides 16-bit access to the waveform data. In the WORD format, the number of data bytes is twice the number of data points. The number of data points is the value returned by the :WAVeform:POINts? query (see page 625). If the data intrinsically has less than 16 bits of resolution, the data is left-shifted to provide 16 bits of resolution and the least significant bits are set to 0. Currently, the greatest intrinsic resolution of any data is 12 bits, so at least the lowest 4 bits of data will be 0. If there is a hole in the data, the hole is represented by a 16 bit value equal to 0.

Use :WAVeform:BYTeorder (see page 620) to determine if the least significant byte or most significant byte is to be transferred first. The :BYTeorder command can be used to alter the transmit sequence to match the storage sequence of an integer in the programming language being used.

Data Format for Transfer - BYTE format

The BYTE format (see ":WAVeform:FORMat" on page 624) allows 8-bit access to the waveform data. If the data intrinsically has more than 8 bits of resolution (averaged data), the data is right-shifted (truncated) to fit into 8 bits. If there is a hole in the data, the hole is represented by a value of 0. The BYTE-formatted data transfers over the programming interface faster than ASCii or WORD-formatted data, because in ASCii format, as many as 13 bytes per point are transferred, in BYTE format one byte per point is transferred, and in WORD format two bytes per point are transferred.

The :WAVeform:BYTeorder command (see page 620) has no effect when the data format is BYTE.

Reporting the Setup

The following is a sample response from the :WAVeform? query. In this case, the query was issued following a *RST command.

```
:WAV:UNS 1;VIEW MAIN;BYT MSBF;FORM BYTE;POIN +1000;SOUR CHAN1;SOUR:SUBS
NONE
```

:WAVeform:BYTeorder

C (see page 776)

Command Syntax

```
:WAVeform:BYTeorder <value>
```

```
<value> ::= {LSBFirst | MSBFirst}
```

The :WAVeform:BYTeorder command sets the output sequence of the WORD data.

- MSBFirst — sets the most significant byte to be transmitted first.
- LSBFirst — sets the least significant byte to be transmitted first.

This command affects the transmitting sequence only when :WAVeform:FORMat WORD is selected.

The default setting is MSBFirst.

Query Syntax

```
:WAVeform:BYTeorder?
```

The :WAVeform:BYTeorder query returns the current output sequence.

Return Format

```
<value><NL>
```

```
<value> ::= {LSBF | MSBF}
```

See Also

- "Introduction to :WAVeform Commands" on page 615
- ":WAVeform:DATA" on page 622
- ":WAVeform:FORMat" on page 624
- ":WAVeform:PREamble" on page 629

Example Code

- "Example Code" on page 634
- "Example Code" on page 630

:WAVeform:COUNt

C (see page 776)

Query Syntax

```
:WAVeform:COUNt?
```

The :WAVeform:COUNT? query returns the count used to acquire the current waveform. This may differ from current values if the unit has been stopped and its configuration modified. For all acquisition types except average, this value is 1.

Return Format

```
<count_argument><NL>

<count_argument> ::= an integer from 1 to 65536 in NR1 format
```

See Also

- ["Introduction to :WAVeform Commands"](page 615) on page 615
- [":ACQuire:COUNt"](page 176) on page 176
- [":ACQuire:TYPE"](page 185) on page 185

:WAVeform:DATA

C (see page 776)

Query Syntax

```
:WAVeform:DATA?
```

The :WAVeform:DATA query returns the binary block of sampled data points transmitted using the IEEE 488.2 arbitrary block data format. The binary data is formatted according to the settings of the :WAVeform:UNSigned, :WAVeform:BYTeorder, :WAVeform:FORMat, and :WAVeform:SOURce commands. The number of points returned is controlled by the :WAVeform:POINts command.

In BYTE or WORD waveform formats, these data values have special meaning:

- 0x00 or 0x0000 — Hole. Holes are locations where data has not yet been acquired.

  Another situation where there can be zeros in the data, incorrectly, is when programming over telnet port 5024. Port 5024 provides a command prompt and is intended for ASCII transfers. Use telnet port 5025 instead.
- 0x01 or 0x0001 — Clipped low. These are locations where the waveform is clipped at the bottom of the oscilloscope display.
- 0xFF or 0xFFFF — Clipped high. These are locations where the waveform is clipped at the top of the oscilloscope display.

Return Format

```
<binary block data><NL>
```

See Also

- For a more detailed description of the data returned for different acquisition types, see: "Introduction to :WAVeform Commands" on page 615
- ":WAVeform:UNSigned" on page 640
- ":WAVeform:BYTeorder" on page 620
- ":WAVeform:FORMat" on page 624
- ":WAVeform:POINts" on page 625
- ":WAVeform:PREamble" on page 629
- ":WAVeform:SOURce" on page 634
- ":WAVeform:TYPE" on page 639

Example Code

```
' QUERY_WAVE_DATA - Outputs waveform data that is stored in a buffer.

' Query the oscilloscope for the waveform data.
myScope.WriteString ":WAV:DATA?"

' READ_WAVE_DATA - The wave data consists of two parts: the header,
' and the actual waveform data followed by a new line (NL) character.
' The query data has the following format:
'
'    <header><waveform_data><NL>
'
' Where:
```

```
'    <header> = #800001000 (This is an example header)
' The "#8" may be stripped off of the header and the remaining
' numbers are the size, in bytes, of the waveform data block.  The
' size can vary depending on the number of points acquired for the
' waveform.  You can then read that number of bytes from the
' oscilloscope and the terminating NL character.
'
Dim lngI As Long
Dim lngDataValue As Long

varQueryResult = myScope.ReadIEEEBlock(BinaryType_UI1)
' Unsigned integer bytes.
For lngI = 0 To UBound(varQueryResult) _
    Step (UBound(varQueryResult) / 20)    ' 20 points.
  If intBytesPerData = 2 Then
    lngDataValue = varQueryResult(lngI) * 256 _
        + varQueryResult(lngI + 1)    ' 16-bit value.
  Else
    lngDataValue = varQueryResult(lngI)    ' 8-bit value.
  End If
  strOutput = strOutput + "Data point " + _
    CStr(lngI / intBytesPerData) + ", " + _
    FormatNumber((lngDataValue - lngYReference) _
        * sngYIncrement + sngYOrigin) + " V, " + _
    FormatNumber(((lngI / intBytesPerData - lngXReference) _
        * sngXIncrement + dblXOrigin) * 1000000) + " us" + vbCrLf
Next lngI
MsgBox "Waveform data:" + vbCrLf + strOutput
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:WAVeform:FORMat

C (see page 776)

Command Syntax

```
:WAVeform:FORMat <value>

<value> ::= {WORD | BYTE | ASCii}
```

The :WAVeform:FORMat command sets the data transmission mode for waveform data points. This command controls how the data is formatted when sent from the oscilloscope.

- ASCii formatted data converts the internal integer data values to real Y-axis values. Values are transferred as ASCii digits in floating point notation, separated by commas.

  ASCII formatted data is transferred ASCii text.
- WORD formatted data transfers 16-bit data as two bytes. The :WAVeform:BYTeorder command can be used to specify whether the upper or lower byte is transmitted first. The default (no command sent) is that the upper byte transmitted first.
- BYTE formatted data is transferred as 8-bit bytes.

Query Syntax

```
:WAVeform:FORMat?
```

The :WAVeform:FORMat query returns the current output format for the transfer of waveform data.

Return Format

```
<value><NL>

<value> ::= {WORD | BYTE | ASC}
```

See Also

- "Introduction to :WAVeform Commands" on page 615
- ":WAVeform:BYTeorder" on page 620
- ":WAVeform:SOURce" on page 634
- ":WAVeform:DATA" on page 622
- ":WAVeform:PREamble" on page 629

Example Code

- "Example Code" on page 634

:WAVeform:POINts

C (see page 776)

Command Syntax

```
:WAVeform:POINts <# points>

<# points> ::= {100 | 250 | 500 | 1000 | <points mode>}
               if waveform points mode is NORMal

<# points> ::= {100 | 250 | 500 | 1000 | 2000 | 5000 | 10000 | 20000
               | 50000 | 100000 | 200000 | 500000 | 1000000
               | <points mode>}
               if waveform points mode is MAXimum or RAW

<points mode> ::= {NORMal | MAXimum | RAW}
```

NOTE The <points_mode> option is deprecated. Use the :WAVeform:POINts:MODE command instead.

The :WAVeform:POINts command sets the number of waveform points to be transferred with the :WAVeform:DATA? query. This value represents the points contained in the waveform selected with the :WAVeform:SOURce command.

For the analog sources, the records that can be transferred depend on the waveform points mode. The maximum number of points returned for math (function) waveforms is determined by the NORMal waveform points mode. See the :WAVeform:POINts:MODE command (see page 627) for more information.

Only data visible on the display will be returned.

Query Syntax

```
:WAVeform:POINts?
```

The :WAVeform:POINts query returns the number of waveform points to be transferred when using the :WAVeform:DATA? query. Setting the points mode will affect what data is transferred (see the :WAVeform:POINts:MODE command (see page 627) for more information).

Return Format

```
<# points><NL>

<# points> ::= {100 | 250 | 500 | 1000 | <maximum # points>}
               if waveform points mode is NORMal

<# points> ::= {100 | 250 | 500 | 1000 | 2000 | 5000 | 10000 | 20000
               | 50000 | 100000 | 200000 | 500000 | 1000000
               | <maximum # points>}
               if waveform points mode is MAXimum or RAW
```

NOTE If a full screen of data is not displayed, the number of points returned will not be 1000 or an even divisor of it.

See Also

- ":Introduction to :WAVeform Commands" on page 615
- ":ACQuire:POINts" on page 178
- ":WAVeform:DATA" on page 622
- ":WAVeform:SOURce" on page 634
- ":WAVeform:VIEW" on page 641
- ":WAVeform:PREamble" on page 629
- ":WAVeform:POINts:MODE" on page 627

Example Code

```
' WAVE_POINTS - Specifies the number of points to be transferred
' using the ":WAVeform:DATA?" query.
myScope.WriteString ":WAVeform:POINts 1000"
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:WAVeform:POINts:MODE

N (see page 776)

Command Syntax

```
:WAVeform:POINts:MODE <points_mode>
```

```
<points_mode> ::= {NORMal | MAXimum | RAW}
```

The :WAVeform:POINts:MODE command sets the data record to be transferred with the :WAVeform:DATA? query.

For the analog sources, there are two different records that can be transferred:

- The first is the raw acquisition record. The maximum number of points available in this record is returned by the :ACQuire:POINts? query. The raw acquisition record can only be transferred when the oscilloscope is not running and can only be retrieved from the analog sources.
- The second is referred to as the *measurement record* and is a 62,500-point (maximum) representation of the raw acquisition record. The measurement record can be retrieved from any source.

If the <points_mode> is NORMal the measurement record is retrieved.

If the <points_mode> is RAW, the raw acquisition record is used. Under some conditions, such as when the oscilloscope is running, this data record is unavailable.

If the <points_mode> is MAXimum, whichever record contains the maximum amount of points is used. Usually, this is the raw acquisition record. But, if the raw acquisition record is unavailable (for example, when the oscilloscope is running), the measurement record may have more data. If data is being retrieved as the oscilloscope is stopped and as the data displayed is changing, the data being retrieved can switch between the measurement and raw acquisition records.

Considerations for MAXimum or RAW data retrieval

- The instrument must be stopped (see the :STOP command (see page 160) or the :DIGitize command (see page 141) in the root subsystem) in order to return more than the *measurement record*.
- :TIMebase:MODE must be set to MAIN.
- :ACQuire:TYPE must be set to NORMal or HRESolution.
- MAXimum or RAW will allow up to 100,000 points to be returned. The number of points returned will vary as the instrument's configuration is changed. Use the :WAVeform:POINts? MAXimum query to determine the maximum number of points that can be retrieved at the current settings.

Query Syntax

```
:WAVeform:POINts:MODE?
```

The :WAVeform:POINts:MODE? query returns the current points mode. Setting the points mode will affect what data is transferred. See the discussion above.

Return Format

```
<points_mode><NL>
```

```
<points_mode> ::= {NORMal | MAXimum | RAW}
```

See Also

- "Introduction to :WAVeform Commands" on page 615
- ":WAVeform:DATA" on page 622
- ":ACQuire:POINts" on page 178
- ":WAVeform:VIEW" on page 641
- ":WAVeform:PREamble" on page 629
- ":WAVeform:POINts" on page 625
- ":TIMebase:MODE" on page 555
- ":ACQuire:TYPE" on page 185
- ":ACQuire:COUNt" on page 176

:WAVeform:PREamble

C (see page 776)

Query Syntax

```
:WAVeform:PREamble?
```

The :WAVeform:PREamble query requests the preamble information for the selected waveform source. The preamble data contains information concerning the vertical and horizontal scaling of the data of the corresponding channel.

Return Format

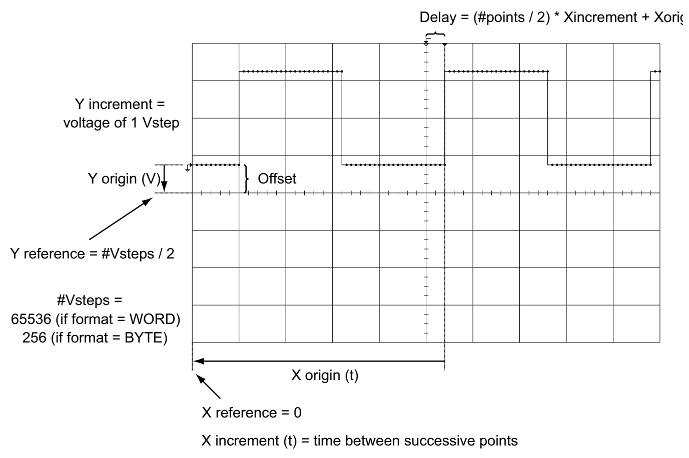
```
<preamble_block><NL>

<preamble_block> ::= <format 16-bit NR1>,
                     <type 16-bit NR1>,
                     <points 32-bit NR1>,
                     <count 32-bit NR1>,
                     <xincrement 64-bit floating point NR3>,
                     <xorigin 64-bit floating point NR3>,
                     <xreference 32-bit NR1>,
                     <yincrement 32-bit floating point NR3>,
                     <yorigin 32-bit floating point NR3>,
                     <yreference 32-bit NR1>

<format> ::= 0 for BYTE format, 1 for WORD format, 4 for ASCii format;
             an integer in NR1 format (format set by :WAVeform:FORMat).

<type> ::= 2 for AVERage type, 0 for NORMal type, 1 for PEAK detect
           type; an integer in NR1 format (type set by :ACQuire:TYPE).

<count> ::= Average count or 1 if PEAK or NORMal; an integer in NR1
            format (count set by :ACQuire:COUNt).
```


Delay = (#points / 2) * Xincrement + Xorig
Y increment = voltage of 1 Vstep
Y origin (V)
Offset
Y reference = #Vsteps / 2
#Vsteps = 65536 (if format = WORD) 256 (if format = BYTE)
X origin (t)
X reference = 0
X increment (t) = time between successive points

See Also

- "Introduction to :WAVeform Commands" on page 615
- ":ACQuire:COUNt" on page 176
- ":ACQuire:POINts" on page 178
- ":ACQuire:TYPE" on page 185

- ":DIGitize" on page 141
- ":WAVeform:COUNt" on page 621
- ":WAVeform:DATA" on page 622
- ":WAVeform:FORMat" on page 624
- ":WAVeform:POINts" on page 625
- ":WAVeform:TYPE" on page 639
- ":WAVeform:XINCrement" on page 642
- ":WAVeform:XORigin" on page 643
- ":WAVeform:XREFerence" on page 644
- ":WAVeform:YINCrement" on page 645
- ":WAVeform:YORigin" on page 646
- ":WAVeform:YREFerence" on page 647

Example Code

```
' GET_PREAMBLE - The preamble block contains all of the current
' WAVEFORM settings.  It is returned in the form <preamble_block><NL>
' where <preamble_block> is:
'    FORMAT        : int16 - 0 = BYTE, 1 = WORD, 4 = ASCII.
'    TYPE          : int16 - 0 = NORMAL, 1 = PEAK DETECT, 2 = AVERAGE
'    POINTS        : int32 - number of data points transferred.
'    COUNT         : int32 - 1 and is always 1.
'    XINCREMENT    : float64 - time difference between data points.
'    XORIGIN       : float64 - always the first data point in memory.
'    XREFERENCE    : int32 - specifies the data point associated with
'                            x-origin.
'    YINCREMENT    : float32 - voltage diff between data points.
'    YORIGIN       : float32 - value is the voltage at center screen.
'    YREFERENCE    : int32 - specifies the data point where y-origin
'                            occurs.
Dim Preamble()
Dim intFormat As Integer
Dim intType As Integer
Dim lngPoints As Long
Dim lngCount As Long
Dim dblXIncrement As Double
Dim dblXOrigin As Double
Dim lngXReference As Long
Dim sngYIncrement As Single
Dim sngYOrigin As Single
Dim lngYReference As Long
Dim strOutput As String

myScope.WriteString ":WAVEFORM:PREAMBLE?"   ' Query for the preamble.
Preamble() = myScope.ReadList   ' Read preamble information.
intFormat = Preamble(0)
intType = Preamble(1)
lngPoints = Preamble(2)
lngCount = Preamble(3)
dblXIncrement = Preamble(4)
dblXOrigin = Preamble(5)
lngXReference = Preamble(6)
```

```
sngYIncrement = Preamble(7)
sngYOrigin = Preamble(8)
lngYReference = Preamble(9)
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:WAVeform:SEGMented:COUNt

N (see page 776)

Query Syntax

```
:WAVeform:SEGMented:COUNt?
```

NOTE

Segmented memory is available on the DSOX1000-Series oscilloscope models that have the SGM license.

The :WAVeform:SEGMented:COUNt query returns the number of memory segments in the acquired data. You can use the :WAVeform:SEGMented:COUNt? query while segments are being acquired (although :DIGitize blocks subsequent queries until the full segmented acquisition is complete).

The segmented memory acquisition mode is enabled with the :ACQuire:MODE command. The number of segments to acquire is set using the :ACQuire:SEGMented:COUNt command, and data is acquired using the :DIGitize, :SINGle, or :RUN commands.

Return Format

```
<count> ::= an integer from 2 to 1000 in NR1 format (count set by
            :ACQuire:SEGMented:COUNt).
```

See Also

- ":ACQuire:MODE" on page 177
- ":ACQuire:SEGMented:COUNt" on page 180
- ":DIGitize" on page 141
- ":SINGle" on page 158
- ":RUN" on page 156
- "Introduction to :WAVeform Commands" on page 615

Example Code

- "Example Code" on page 181

:WAVeform:SEGMented:TTAG

N (see page 776)

Query Syntax

```
:WAVeform:SEGMented:TTAG?
```

NOTE Segmented memory is available on the DSOX1000-Series oscilloscope models that have the SGM license.

The :WAVeform:SEGMented:TTAG? query returns the time tag of the currently selected segmented memory index. The index is selected using the :ACQuire:SEGMented:INDex command.

Return Format

```
<time_tag> ::= in NR3 format
```

See Also

- ":ACQuire:SEGMented:INDex" on page 181
- "Introduction to :WAVeform Commands" on page 615

Example Code

- "Example Code" on page 181

:WAVeform:SOURce

C (see page 776)

Command Syntax

```
:WAVeform:SOURce <source>

<source> ::= {CHANnel<n> | FUNCtion | MATH | FFT | WMEMory<r> | ABUS
    | EXT}

<n> ::= 1 to (# analog channels) in NR1 format

<r> ::= {1 | 2}
```

The :WAVeform:SOURce command selects the analog channel, function, or reference waveform to be used as the source for the :WAVeform commands.

Function capabilities include add, subtract, multiply, and FFT (Fast Fourier Transform) operations.

Query Syntax

```
:WAVeform:SOURce?
```

The :WAVeform:SOURce? query returns the currently selected source for the WAVeform commands.

NOTE MATH is an alias for FUNCtion. The :WAVeform:SOURce? Query returns FUNC if the source is FUNCtion or MATH.

Return Format

```
<source><NL>

<source> ::= {CHAN<n> | FUNC | FFT | WMEM<r> | ABUS | EXT}

<n> ::= 1 to (# analog channels) in NR1 format

<r> ::= {1 | 2}
```

See Also

- "Introduction to :WAVeform Commands" on page 615
- ":DIGitize" on page 141
- ":WAVeform:FORMat" on page 624
- ":WAVeform:BYTeorder" on page 620
- ":WAVeform:DATA" on page 622
- ":WAVeform:PREamble" on page 629

Example Code

```
' WAVEFORM_DATA - To obtain waveform data, you must specify the
' WAVEFORM parameters for the waveform data prior to sending the
' ":WAVEFORM:DATA?" query.  Once these parameters have been sent,
' the waveform data and the preamble can be read.
'
' WAVE_SOURCE - Selects the channel to be used as the source for
' the waveform commands.
myScope.WriteString ":WAVEFORM:SOURCE CHAN1"
```

```
' WAVE_POINTS - Specifies the number of points to be transferred
' using the ":WAVEFORM:DATA?" query.
myScope.WriteString ":WAVEFORM:POINTS 1000"

' WAVE_FORMAT - Sets the data transmission mode for the waveform
' data output.  This command controls whether data is formatted in
' a word or byte format when sent from the oscilloscope.
Dim lngVSteps As Long
Dim intBytesPerData As Integer

' Data in range 0 to 65535.
myScope.WriteString ":WAVEFORM:FORMAT WORD"
lngVSteps = 65536
intBytesPerData = 2

' Data in range 0 to 255.
'myScope.WriteString ":WAVEFORM:FORMAT BYTE"
'lngVSteps = 256
'intBytesPerData = 1

' GET_PREAMBLE - The preamble block contains all of the current
' WAVEFORM settings.  It is returned in the form <preamble_block><NL>
' where <preamble_block> is:
'    FORMAT        : int16 - 0 = BYTE, 1 = WORD, 4 = ASCII.
'    TYPE          : int16 - 0 = NORMAL, 1 = PEAK DETECT, 2 = AVERAGE
'    POINTS        : int32 - number of data points transferred.
'    COUNT         : int32 - 1 and is always 1.
'    XINCREMENT    : float64 - time difference between data points.
'    XORIGIN       : float64 - always the first data point in memory.
'    XREFERENCE    : int32 - specifies the data point associated with
'                            x-origin.
'    YINCREMENT    : float32 - voltage diff between data points.
'    YORIGIN       : float32 - value is the voltage at center screen.
'    YREFERENCE    : int32 - specifies the data point where y-origin
'                            occurs.
Dim Preamble()
Dim intFormat As Integer
Dim intType As Integer
Dim lngPoints As Long
Dim lngCount As Long
Dim dblXIncrement As Double
Dim dblXOrigin As Double
Dim lngXReference As Long
Dim sngYIncrement As Single
Dim sngYOrigin As Single
Dim lngYReference As Long
Dim strOutput As String

myScope.WriteString ":WAVEFORM:PREAMBLE?"   ' Query for the preamble.
Preamble() = myScope.ReadList   ' Read preamble information.
intFormat = Preamble(0)
intType = Preamble(1)
lngPoints = Preamble(2)
lngCount = Preamble(3)
dblXIncrement = Preamble(4)
dblXOrigin = Preamble(5)
lngXReference = Preamble(6)
```

```
sngYIncrement = Preamble(7)
sngYOrigin = Preamble(8)
lngYReference = Preamble(9)
strOutput = ""
'strOutput = strOutput + "Format = " + CStr(intFormat) + vbCrLf
'strOutput = strOutput + "Type = " + CStr(intType) + vbCrLf
'strOutput = strOutput + "Points = " + CStr(lngPoints) + vbCrLf
'strOutput = strOutput + "Count = " + CStr(lngCount) + vbCrLf
'strOutput = strOutput + "X increment = " + _
'            FormatNumber(dblXIncrement * 1000000) + " us" + vbCrLf
'strOutput = strOutput + "X origin = " + _
'            FormatNumber(dblXOrigin * 1000000) + " us" + vbCrLf
'strOutput = strOutput + "X reference = " + _
'            CStr(lngXReference) + vbCrLf
'strOutput = strOutput + "Y increment = " + _
'            FormatNumber(sngYIncrement * 1000) + " mV" + vbCrLf
'strOutput = strOutput + "Y origin = " + _
'            FormatNumber(sngYOrigin) + " V" + vbCrLf
'strOutput = strOutput + "Y reference = " + _
'            CStr(lngYReference) + vbCrLf
strOutput = strOutput + "Volts/Div = " + _
            FormatNumber(lngVSteps * sngYIncrement / 8) + _
            " V" + vbCrLf
strOutput = strOutput + "Offset = " + _
            FormatNumber((lngVSteps / 2 - lngYReference) * _
            sngYIncrement + sngYOrigin) + " V" + vbCrLf
strOutput = strOutput + "Sec/Div = " + _
            FormatNumber(lngPoints * dblXIncrement / 10 * _
            1000000) + " us" + vbCrLf
strOutput = strOutput + "Delay = " + _
            FormatNumber(((lngPoints / 2 - lngXReference) * _
            dblXIncrement + dblXOrigin) * 1000000) + " us" + vbCrLf

' QUERY_WAVE_DATA - Outputs waveform data that is stored in a buffer.

' Query the oscilloscope for the waveform data.
myScope.WriteString ":WAV:DATA?"

' READ_WAVE_DATA - The wave data consists of two parts: the header,
' and the actual waveform data followed by a new line (NL) character.
' The query data has the following format:
'
'    <header><waveform_data><NL>
'
' Where:
'    <header> = #800001000 (This is an example header)
' The "#8" may be stripped off of the header and the remaining
' numbers are the size, in bytes, of the waveform data block.  The
' size can vary depending on the number of points acquired for the
' waveform.  You can then read that number of bytes from the
' oscilloscope and the terminating NL character.
'
Dim lngI As Long
Dim lngDataValue As Long

' Unsigned integer bytes.
varQueryResult = myScope.ReadIEEEBlock(BinaryType_UI1)
```

```
For lngI = 0 To UBound(varQueryResult) _
    Step (UBound(varQueryResult) / 20)    ' 20 points.
  If intBytesPerData = 2 Then
    lngDataValue = varQueryResult(lngI) * 256 _
        + varQueryResult(lngI + 1)    ' 16-bit value.
  Else
    lngDataValue = varQueryResult(lngI)    ' 8-bit value.
  End If
  strOutput = strOutput + "Data point " + _
    CStr(lngI / intBytesPerData) + ", " + _
    FormatNumber((lngDataValue - lngYReference) _
        * sngYIncrement + sngYOrigin) + " V, " + _
    FormatNumber(((lngI / intBytesPerData - lngXReference) _
        * sngXIncrement + dblXOrigin) * 1000000) + " us" + vbCrLf
Next lngI
MsgBox "Waveform data:" + vbCrLf + strOutput
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:WAVeform:SOURce:SUBSource

C (see page 776)

Command Syntax

```
:WAVeform:SOURce:SUBSource <subsource>

<subsource> ::= {{SUB0 | RX | MOSI} | {SUB1 | TX | MISO}}
```

If the :WAVeform:SOURce is SBUS<n> (serial decode), more than one data set may be available, and this command lets you choose from the available data sets.

When using UART serial decode, this option lets you get "TX" data. (TX is an alias for SUB1.) The default, SUB0, specifies "RX" data. (RX is an alias for SUB0.)

When using SPI serial decode, this option lets you get "MISO" data. (MISO is an alias for SUB1.) The default, SUB0, specifies "MOSI" data. (MOSI is an alias for SUB0.)

If the :WAVeform:SOURce is not SBUS, or the :SBUS<n>:MODE is not UART or SPI, the only valid subsource is SUB0.

Query Syntax

```
:WAVeform:SOURce:SUBSource?
```

The :WAVeform:SOURce:SUBSource? query returns the current waveform subsource setting.

Return Format

```
<subsource><NL>

<subsource> ::= {SUB0 | SUB1}
```

See Also

- "Introduction to :WAVeform Commands" on page 615
- ":WAVeform:SOURce" on page 634

:WAVeform:TYPE

C (see page 776)

Query Syntax

```
:WAVeform:TYPE?
```

The :WAVeform:TYPE? query returns the acquisition mode associated with the currently selected waveform. The acquisition mode is set by the :ACQuire:TYPE command.

Return Format

```
<mode><NL>

<mode> ::= {NORM | PEAK | AVER | HRES}
```

NOTE If the :WAVeform:SOURce is POD1 or POD2, the type is always NORM.

See Also

- ":ACQuire:TYPE" on page 185
- "Introduction to :WAVeform Commands" on page 615
- ":WAVeform:DATA" on page 622
- ":WAVeform:PREamble" on page 629
- ":WAVeform:SOURce" on page 634

:WAVeform:UNSigned

C (see page 776)

Command Syntax

```
:WAVeform:UNSigned <unsigned>
```

```
<unsigned> ::= {{0 | OFF} | {1 | ON}}
```

The :WAVeform:UNSigned command turns unsigned mode on or off for the currently selected waveform. Use the WAVeform:UNSigned command to control whether data values are sent as unsigned or signed integers. This command can be used to match the instrument's internal data type to the data type used by the programming language. This command has no effect if the data format is ASCii.

If :WAVeform:SOURce is set to POD1, POD2, BUS1, or BUS2, WAVeform:UNSigned must be set to ON.

Query Syntax

```
:WAVeform:UNSigned?
```

The :WAVeform:UNSigned? query returns the status of unsigned mode for the currently selected waveform.

Return Format

```
<unsigned><NL>
```

```
<unsigned> ::= {0 | 1}
```

See Also

- "Introduction to :WAVeform Commands" on page 615
- ":WAVeform:SOURce" on page 634

:WAVeform:VIEW

C (see page 776)

Command Syntax

```
:WAVeform:VIEW <view>
```

```
<view> ::= {MAIN}
```

The :WAVeform:VIEW command sets the view setting associated with the currently selected waveform. Currently, the only legal value for the view setting is MAIN.

Query Syntax

```
:WAVeform:VIEW?
```

The :WAVeform:VIEW? query returns the view setting associated with the currently selected waveform.

Return Format

```
<view><NL>
```

```
<view> ::= {MAIN}
```

See Also

- "Introduction to :WAVeform Commands" on page 615
- ":WAVeform:POINts" on page 625

:WAVeform:XINCrement

C (see page 776)

Query Syntax

```
:WAVeform:XINCrement?
```

The :WAVeform:XINCrement? query returns the x-increment value for the currently specified source. This value is the time difference between consecutive data points in seconds.

Return Format

```
<value><NL>

<value> ::= x-increment in the current preamble in 64-bit
            floating point NR3 format
```

See Also

- "Introduction to :WAVeform Commands" on page 615
- ":WAVeform:PREamble" on page 629

Example Code

- "Example Code" on page 630

:WAVeform:XORigin

C (see page 776)

Query Syntax

```
:WAVeform:XORigin?
```

The :WAVeform:XORigin? query returns the x-origin value for the currently specified source. XORigin is the X-axis value of the data point specified by the :WAVeform:XREFerence value. In this product, that is always the X-axis value of the first data point (XREFerence = 0).

Return Format

```
<value><NL>

<value> ::= x-origin value in the current preamble in 64-bit
            floating point NR3 format
```

See Also

- "Introduction to :WAVeform Commands" on page 615
- ":WAVeform:PREamble" on page 629
- ":WAVeform:XREFerence" on page 644

Example Code

- "Example Code" on page 630

:WAVeform:XREFerence

C (see page 776)

Query Syntax

```
:WAVeform:XREFerence?
```

The :WAVeform:XREFerence? query returns the x-reference value for the currently specified source. This value specifies the index of the data point associated with the x-origin data value. In this product, the x-reference point is the first point displayed and XREFerence is always 0.

Return Format

```
<value><NL>

<value> ::= x-reference value = 0 in 32-bit NR1 format
```

See Also

- "Introduction to :WAVeform Commands" on page 615
- ":WAVeform:PREamble" on page 629
- ":WAVeform:XORigin" on page 643

Example Code

- "Example Code" on page 630

:WAVeform:YINCrement

C (see page 776)

Query Syntax

```
:WAVeform:YINCrement?
```

The :WAVeform:YINCrement? query returns the y-increment value in volts for the currently specified source. This value is the voltage difference between consecutive data values.

Return Format

```
<value><NL>

<value> ::= y-increment value in the current preamble in 32-bit
            floating point NR3 format
```

See Also

- "Introduction to :WAVeform Commands" on page 615
- ":WAVeform:PREamble" on page 629

Example Code

- "Example Code" on page 630

:WAVeform:YORigin

C (see page 776)

Query Syntax

```
:WAVeform:YORigin?
```

The :WAVeform:YORigin? query returns the y-origin value for the currently specified source. This value is the Y-axis value of the data value specified by the :WAVeform:YREFerence value. For this product, this is the Y-axis value of the center of the screen.

Return Format

```
<value><NL>

<value> ::= y-origin in the current preamble in 32-bit
            floating point NR3 format
```

See Also

- "Introduction to :WAVeform Commands" on page 615
- ":WAVeform:PREamble" on page 629
- ":WAVeform:YREFerence" on page 647

Example Code

- "Example Code" on page 630

:WAVeform:YREFerence

C (see page 776)

Query Syntax

```
:WAVeform:YREFerence?
```

The :WAVeform:YREFerence? query returns the y-reference value for the currently specified source. This value specifies the data point value where the y-origin occurs. In this product, this is the data point value of the center of the screen. It is undefined if the format is ASCii.

Return Format

```
<value><NL>

<value> ::= y-reference value in the current preamble in 32-bit
            NR1 format
```

See Also

- ":Introduction to :WAVeform Commands" on page 615
- ":WAVeform:PREamble" on page 629
- ":WAVeform:YORigin" on page 646

Example Code

- "Example Code" on page 630

29 :WGEN Commands

On G-suffix oscilloscope models, a waveform generator is built into the oscilloscope. You can use the waveform generator to output sine, square, ramp, pulse, DC, and noise waveforms. The :WGEN commands are used to select the waveform function and parameters. See "Introduction to :WGEN Commands" on page 651.

Table 84 :WGEN Commands Summary

Command	Query	Options and Query Returns
:WGEN:FREQuency <frequency> (see page 652)	:WGEN:FREQuency? (see page 652)	<frequency> ::= frequency in Hz in NR3 format
:WGEN:FUNCtion <signal> (see page 653)	:WGEN:FUNCtion? (see page 654)	<signal> ::= {SINusoid | SQUare | RAMP | PULSe | NOISe | DC}
:WGEN:FUNCtion:PULSe:WIDTh <width> (see page 656)	:WGEN:FUNCtion:PULSe:WIDTh? (see page 656)	<width> ::= pulse width in seconds in NR3 format
:WGEN:FUNCtion:RAMP:SYMMetry <percent> (see page 657)	:WGEN:FUNCtion:RAMP:SYMMetry? (see page 657)	<percent> ::= symmetry percentage from 0% to 100% in NR1 format
:WGEN:FUNCtion:SQUare:DCYCle <percent> (see page 658)	:WGEN:FUNCtion:SQUare:DCYCle? (see page 658)	<percent> ::= duty cycle percentage from 20% to 80% in NR1 format
:WGEN:MODulation:AM:DEPTh <percent> (see page 659)	:WGEN:MODulation:AM:DEPTh? (see page 659)	<percent> ::= AM depth percentage from 0% to 100% in NR1 format
:WGEN:MODulation:AM:FREQuency <frequency> (see page 660)	:WGEN:MODulation:AM:FREQuency? (see page 660)	<frequency> ::= modulating waveform frequency in Hz in NR3 format
:WGEN:MODulation:FM:DEViation <frequency> (see page 661)	:WGEN:MODulation:FM:DEViation? (see page 661)	<frequency> ::= frequency deviation in Hz in NR3 format

KEYSIGHT TECHNOLOGIES

Table 84 :WGEN Commands Summary (continued)

Command	Query	Options and Query Returns
:WGEN:MODulation:FM:FREQuency <frequency> (see page 662)	:WGEN:MODulation:FM:FREQuency? (see page 662)	<frequency> ::= modulating waveform frequency in Hz in NR3 format
:WGEN:MODulation:FSKey:FREQuency <percent> (see page 663)	:WGEN:MODulation:FSKey:FREQuency? (see page 663)	<frequency> ::= hop frequency in Hz in NR3 format
:WGEN:MODulation:FSKey:RATE <rate> (see page 664)	:WGEN:MODulation:FSKey:RATE? (see page 664)	<rate> ::= FSK modulation rate in Hz in NR3 format
:WGEN:MODulation:FUNCtion <shape> (see page 665)	:WGEN:MODulation:FUNCtion? (see page 665)	<shape> ::= {SINusoid | SQUare| RAMP}
:WGEN:MODulation:FUNCtion:RAMP:SYMMetry <percent> (see page 666)	:WGEN:MODulation:FUNCtion:RAMP:SYMMetry? (see page 666)	<percent> ::= symmetry percentage from 0% to 100% in NR1 format
:WGEN:MODulation:NOISe <percent> (see page 667)	:WGEN:MODulation:NOISe? (see page 667)	<percent> ::= 0 to 100
:WGEN:MODulation:STATe {{0 | OFF} | {1 | ON}} (see page 668)	:WGEN:MODulation:STATe? (see page 668)	{0 | 1}
:WGEN:MODulation:TYPE <type> (see page 669)	:WGEN:MODulation:TYPE? (see page 669)	<type> ::= {AM | FM | FSK}
:WGEN:OUTPut {{0 | OFF} | {1 | ON}} (see page 671)	:WGEN:OUTPut? (see page 671)	{0 | 1}
:WGEN:OUTPut:LOAD <impedance> (see page 672)	:WGEN:OUTPut:LOAD? (see page 672)	<impedance> ::= {ONEMeg | FIFTy}
:WGEN:OUTPut:POLarity <polarity> (see page 673)	:WGEN:OUTPut:POLarity? (see page 673)	<polarity> ::= {NORMal | INVerted}
:WGEN:PERiod <period> (see page 674)	:WGEN:PERiod? (see page 674)	<period> ::= period in seconds in NR3 format
:WGEN:RST (see page 675)	n/a	n/a
:WGEN:VOLTage <amplitude> (see page 676)	:WGEN:VOLTage? (see page 676)	<amplitude> ::= amplitude in volts in NR3 format

Table 84 :WGEN Commands Summary (continued)

Command	Query	Options and Query Returns
`:WGEN:VOLTage:HIGH <high>` (see page 677)	`:WGEN:VOLTage:HIGH?` (see page 677)	`<high> ::= high-level voltage in volts, in NR3 format`
`:WGEN:VOLTage:LOW <low>` (see page 678)	`:WGEN:VOLTage:LOW?` (see page 678)	`<low> ::= low-level voltage in volts, in NR3 format`
`:WGEN:VOLTage:OFFSet <offset>` (see page 679)	`:WGEN:VOLTage:OFFSet?` (see page 679)	`<offset> ::= offset in volts in NR3 format`

Introduction to :WGEN Commands

The :WGEN subsystem provides commands to select the waveform generator function and parameters.

Reporting the Setup

Use :WGEN? to query setup information for the WGEN subsystem.

Return Format

The following is a sample response from the :WGEN? query. In this case, the query was issued following the *RST command.

```
:WGEN:FUNC SIN;OUTP 0;FREQ +1.0000E+03;VOLT +500.0E-03;VOLT:OFFS
+0.0E+00;:WGEN:OUTP:LOAD ONEM
```

:WGEN:FREQuency

N (see page 776)

Command Syntax

```
:WGEN:FREQuency <frequency>
```

```
<frequency> ::= frequency in Hz in NR3 format
```

For all waveforms except Noise and DC, the :WGEN:FREQuency command specifies the frequency of the waveform.

You can also specify the frequency indirectly using the :WGEN:PERiod command.

Query Syntax

```
:WGEN:FREQuency?
```

The :WGEN:FREQuency? query returns the currently set waveform generator frequency.

Return Format

```
<frequency><NL>
```

```
<frequency> ::= frequency in Hz in NR3 format
```

See Also

- "Introduction to :WGEN Commands" on page 651
- ":WGEN:FUNCtion" on page 653
- ":WGEN:PERiod" on page 674

:WGEN:FUNCtion

N (see page 776)

Command Syntax

```
:WGEN:FUNCtion <signal>

<signal> ::= {SINusoid | SQUare | RAMP | PULSe | NOISe | DC}
```

The :WGEN:FUNCtion command selects the type of waveform:

Waveform Type	Characteristics
SINusoid	Use these commands to set the sine signal parameters: ▪ ":WGEN:FREQuency" on page 652 ▪ ":WGEN:PERiod" on page 674 ▪ ":WGEN:VOLTage" on page 676 ▪ ":WGEN:VOLTage:OFFSet" on page 679 ▪ ":WGEN:VOLTage:HIGH" on page 677 ▪ ":WGEN:VOLTage:LOW" on page 678 The frequency can be adjusted from 100 mHz to 20 MHz.
SQUare	Use these commands to set the square wave signal parameters: ▪ ":WGEN:FREQuency" on page 652 ▪ ":WGEN:PERiod" on page 674 ▪ ":WGEN:VOLTage" on page 676 ▪ ":WGEN:VOLTage:OFFSet" on page 679 ▪ ":WGEN:VOLTage:HIGH" on page 677 ▪ ":WGEN:VOLTage:LOW" on page 678 ▪ ":WGEN:FUNCtion:SQUare:DCYCle" on page 658 The frequency can be adjusted from 100 mHz to 10 MHz. The duty cycle can be adjusted from 20% to 80%.

Waveform Type	Characteristics
RAMP	Use these commands to set the ramp signal parameters: ▪ ":WGEN:FREQuency" on page 652 ▪ ":WGEN:PERiod" on page 674 ▪ ":WGEN:VOLTage" on page 676 ▪ ":WGEN:VOLTage:OFFSet" on page 679 ▪ ":WGEN:VOLTage:HIGH" on page 677 ▪ ":WGEN:VOLTage:LOW" on page 678 ▪ ":WGEN:FUNCtion:RAMP:SYMMetry" on page 657 The frequency can be adjusted from 100 mHz to 100 kHz. Symmetry represents the amount of time per cycle that the ramp waveform is rising and can be adjusted from 0% to 100%.
PULSe	Use these commands to set the pulse signal parameters: ▪ ":WGEN:FREQuency" on page 652 ▪ ":WGEN:PERiod" on page 674 ▪ ":WGEN:VOLTage" on page 676 ▪ ":WGEN:VOLTage:OFFSet" on page 679 ▪ ":WGEN:VOLTage:HIGH" on page 677 ▪ ":WGEN:VOLTage:LOW" on page 678 ▪ ":WGEN:FUNCtion:PULSe:WIDTh" on page 656 The frequency can be adjusted from 100 mHz to 10 MHz. The pulse width can be adjusted from 20 ns to the period minus 20 ns.
DC	Use this command to set the DC level: ▪ ":WGEN:VOLTage:OFFSet" on page 679
NOISe	Use these commands to set the noise signal parameters: ▪ ":WGEN:VOLTage" on page 676 ▪ ":WGEN:VOLTage:OFFSet" on page 679 ▪ ":WGEN:VOLTage:HIGH" on page 677 ▪ ":WGEN:VOLTage:LOW" on page 678

For all waveform types, the output amplitude, into 50 Ω, can be adjusted from 10 mVpp to 2.5 Vpp (or from 20 mVpp to 5 Vpp into and open-circuit load).

Query Syntax

```
:WGEN:FUNCtion?
```

The :WGEN:FUNCtion? query returns the currently selected signal type.

Return Format

```
<signal><NL>

<signal> ::= {SIN | SQU | RAMP | PULS | NOIS | DC}
```

See Also

- "Introduction to :WGEN Commands" on page 651

:WGEN:FUNCtion:PULSe:WIDTh

N (see page 776)

Command Syntax

```
:WGEN:FUNCtion:PULSe:WIDTh <width>
```

```
<width> ::= pulse width in seconds in NR3 format
```

For Pulse waveforms, the :WGEN:FUNCtion:PULSe:WIDTh command specifies the width of the pulse.

The pulse width can be adjusted from 20 ns to the period minus 20 ns.

Query Syntax

```
:WGEN:FUNCtion:PULSe:WIDTh?
```

The :WGEN:FUNCtion:PULSe:WIDTh? query returns the currently set pulse width.

Return Format

```
<width><NL>
```

```
<width> ::= pulse width in seconds in NR3 format
```

See Also

- "Introduction to :WGEN Commands" on page 651
- ":WGEN:FUNCtion" on page 653

:WGEN:FUNCtion:RAMP:SYMMetry

N (see page 776)

Command Syntax

```
:WGEN:FUNCtion:RAMP:SYMMetry <percent>
```

```
<percent> ::= symmetry percentage from 0% to 100% in NR1 format
```

For Ramp waveforms, the :WGEN:FUNCtion:RAMP:SYMMetry command specifies the symmetry of the waveform.

Symmetry represents the amount of time per cycle that the ramp waveform is rising.

Query Syntax

```
:WGEN:FUNCtion:RAMP:SYMMetry?
```

The :WGEN:FUNCtion:RAMP:SYMMetry? query returns the currently set ramp symmetry.

Return Format

```
<percent><NL>
```

```
<percent> ::= symmetry percentage from 0% to 100% in NR1 format
```

See Also

- "Introduction to :WGEN Commands" on page 651
- ":WGEN:FUNCtion" on page 653

:WGEN:FUNCtion:SQUare:DCYCle

N (see page 776)

Command Syntax

```
:WGEN:FUNCtion:SQUare:DCYCle <percent>
```

```
<percent> ::= duty cycle percentage from 20% to 80% in NR1 format
```

For Square waveforms, the :WGEN:FUNCtion:SQUare:DCYCle command specifies the square wave duty cycle.

Duty cycle is the percentage of the period that the waveform is high.

Query Syntax

```
:WGEN:FUNCtion:SQUare:DCYCle?
```

The :WGEN:FUNCtion:SQUare:DCYCle? query returns the currently set square wave duty cycle.

Return Format

```
<percent><NL>
```

```
<percent> ::= duty cycle percentage from 20% to 80% in NR1 format
```

See Also

- "Introduction to :WGEN Commands" on page 651
- ":WGEN:FUNCtion" on page 653

:WGEN:MODulation:AM:DEPTh

N (see page 776)

Command Syntax

```
:WGEN:MODulation:AM:DEPTh <percent>
```

```
<percent> ::= AM depth percentage from 0% to 100% in NR1 format
```

The :WGEN:MODulation:AM:DEPTh command specifies the amount of amplitude modulation.

AM Depth refers to the portion of the amplitude range that will be used by the modulation. For example, a depth setting of 80% causes the output amplitude to vary from 10% to 90% (90% – 10% = 80%) of the original amplitude as the modulating signal goes from its minimum to maximum amplitude.

Query Syntax

```
:WGEN:MODulation:AM:DEPTh?
```

The :WGEN:MODulation:AM:DEPTh? query returns the AM depth percentage setting.

Return Format

```
<percent><NL>
```

```
<percent> ::= AM depth percentage from 0% to 100% in NR1 format
```

See Also

- ":WGEN:MODulation:AM:FREQuency" on page 660
- ":WGEN:MODulation:FM:DEViation" on page 661
- ":WGEN:MODulation:FM:FREQuency" on page 662
- ":WGEN:MODulation:FSKey:FREQuency" on page 663
- ":WGEN:MODulation:FSKey:RATE" on page 664
- ":WGEN:MODulation:FUNCtion" on page 665
- ":WGEN:MODulation:FUNCtion:RAMP:SYMMetry" on page 666
- ":WGEN:MODulation:STATe" on page 668
- ":WGEN:MODulation:TYPE" on page 669

:WGEN:MODulation:AM:FREQuency

N (see page 776)

Command Syntax

```
:WGEN:MODulation:AM:FREQuency <frequency>
```

```
<frequency> ::= modulating waveform frequency in Hz in NR3 format
```

The :WGEN:MODulation:AM:FREQuency command specifies the frequency of the modulating signal.

Query Syntax

```
:WGEN:MODulation:AM:FREQuency?
```

The :WGEN:MODulation:AM:FREQuency? query returns the frequency of the modulating signal.

Return Format

```
<frequency><NL>
```

```
<frequency> ::= modulating waveform frequency in Hz in NR3 format
```

See Also

- ":WGEN:MODulation:AM:DEPTh" on page 659
- ":WGEN:MODulation:FM:DEViation" on page 661
- ":WGEN:MODulation:FM:FREQuency" on page 662
- ":WGEN:MODulation:FSKey:FREQuency" on page 663
- ":WGEN:MODulation:FSKey:RATE" on page 664
- ":WGEN:MODulation:FUNCtion" on page 665
- ":WGEN:MODulation:FUNCtion:RAMP:SYMMetry" on page 666
- ":WGEN:MODulation:STATe" on page 668
- ":WGEN:MODulation:TYPE" on page 669

:WGEN:MODulation:FM:DEViation

N (see page 776)

Command Syntax

```
:WGEN:MODulation:FM:DEViation <frequency>
```

```
<frequency> ::= frequency deviation in Hz in NR3 format
```

The :WGEN:MODulation:FM:DEViation command specifies the frequency deviation from the original carrier signal frequency.

When the modulating signal is at its maximum amplitude, the output frequency is the carrier signal frequency plus the deviation amount, and when the modulating signal is at its minimum amplitude, the output frequency is the carrier signal frequency minus the deviation amount.

The frequency deviation cannot be greater than the original carrier signal frequency.

Also, the sum of the original carrier signal frequency and the frequency deviation must be less than or equal to the maximum frequency for the selected waveform generator function plus 100 kHz.

Query Syntax

```
:WGEN:MODulation:FM:DEViation?
```

The :WGEN:MODulation:FM:DEViation? query returns the frequency deviation setting.

Return Format

```
<frequency><NL>
```

```
<frequency> ::= frequency deviation in Hz in NR3 format
```

See Also

- ":WGEN:MODulation:AM:DEPTh" on page 659
- ":WGEN:MODulation:AM:FREQuency" on page 660
- ":WGEN:MODulation:FM:FREQuency" on page 662
- ":WGEN:MODulation:FSKey:FREQuency" on page 663
- ":WGEN:MODulation:FSKey:RATE" on page 664
- ":WGEN:MODulation:FUNCtion" on page 665
- ":WGEN:MODulation:FUNCtion:RAMP:SYMMetry" on page 666
- ":WGEN:MODulation:STATe" on page 668
- ":WGEN:MODulation:TYPE" on page 669

:WGEN:MODulation:FM:FREQuency

N (see page 776)

Command Syntax

```
:WGEN:MODulation:FM:FREQuency <frequency>
```

```
<frequency> ::= modulating waveform frequency in Hz in NR3 format
```

The :WGEN:MODulation:FM:FREQuency command specifies the frequency of the modulating signal.

Query Syntax

```
:WGEN:MODulation:FM:FREQuency?
```

The :WGEN:MODulation:FM:FREQuency? query returns the frequency of the modulating signal.

Return Format

```
<frequency><NL>
```

```
<frequency> ::= modulating waveform frequency in Hz in NR3 format
```

See Also

- ":WGEN:MODulation:AM:DEPTh" on page 659
- ":WGEN:MODulation:AM:FREQuency" on page 660
- ":WGEN:MODulation:FM:DEViation" on page 661
- ":WGEN:MODulation:FSKey:FREQuency" on page 663
- ":WGEN:MODulation:FSKey:RATE" on page 664
- ":WGEN:MODulation:FUNCtion" on page 665
- ":WGEN:MODulation:FUNCtion:RAMP:SYMMetry" on page 666
- ":WGEN:MODulation:STATe" on page 668
- ":WGEN:MODulation:TYPE" on page 669

:WGEN:MODulation:FSKey:FREQuency

N (see page 776)

Command Syntax

```
:WGEN:MODulation:FSKey:FREQuency <frequency>
```

```
<frequency> ::= hop frequency in Hz in NR3 format
```

The :WGEN:MODulation:FSKey:FREQuency command specifies the "hop frequency".

The output frequency "shifts" between the original carrier frequency and this "hop frequency".

Query Syntax

```
:WGEN:MODulation:FSKey:FREQuency?
```

The :WGEN:MODulation:FSKey:FREQuency? query returns the "hop frequency" setting.

Return Format

```
<frequency><NL>
```

```
<frequency> ::= hop frequency in Hz in NR3 format
```

See Also

- ":WGEN:MODulation:AM:DEPTh" on page 659
- ":WGEN:MODulation:AM:FREQuency" on page 660
- ":WGEN:MODulation:FM:DEViation" on page 661
- ":WGEN:MODulation:FM:FREQuency" on page 662
- ":WGEN:MODulation:FSKey:RATE" on page 664
- ":WGEN:MODulation:FUNCtion" on page 665
- ":WGEN:MODulation:FUNCtion:RAMP:SYMMetry" on page 666
- ":WGEN:MODulation:STATe" on page 668
- ":WGEN:MODulation:TYPE" on page 669

:WGEN:MODulation:FSKey:RATE

N (see page 776)

Command Syntax

```
:WGEN:MODulation:FSKey:RATE <rate>
```

```
<rate> ::= FSK modulation rate in Hz in NR3 format
```

The :WGEN:MODulation:FSKey:RATE command specifies the rate at which the output frequency "shifts".

The FSK rate specifies a digital square wave modulating signal.

Query Syntax

```
:WGEN:MODulation:FSKey:RATE?
```

The :WGEN:MODulation:FSKey:RATE? query returns the FSK rate setting.

Return Format

```
<rate><NL>
```

```
<rate> ::= FSK modulation rate in Hz in NR3 format
```

See Also

- ":WGEN:MODulation:AM:DEPTh" on page 659
- ":WGEN:MODulation:AM:FREQuency" on page 660
- ":WGEN:MODulation:FM:DEViation" on page 661
- ":WGEN:MODulation:FM:FREQuency" on page 662
- ":WGEN:MODulation:FSKey:FREQuency" on page 663
- ":WGEN:MODulation:FUNCtion" on page 665
- ":WGEN:MODulation:FUNCtion:RAMP:SYMMetry" on page 666
- ":WGEN:MODulation:STATe" on page 668
- ":WGEN:MODulation:TYPE" on page 669

:WGEN:MODulation:FUNCtion

N (see page 776)

Command Syntax

```
:WGEN:MODulation:FUNCtion <shape>

<shape> ::= {SINusoid | SQUare| RAMP}
```

The :WGEN:MODulation:FUNCtion command specifies the shape of the modulating signal.

When the RAMP shape is selected, you can specify the amount of time per cycle that the ramp waveform is rising with the :WGEN:MODulation:FUNCtion:RAMP:SYMMetry command.

This command applies to AM and FM modulation. (The FSK modulation signal is a square wave shape.)

Query Syntax

```
:WGEN:MODulation:FUNCtion?
```

The :WGEN:MODulation:FUNCtion? query returns the specified modulating signal shape.

Return Format

```
<shape><NL>

<shape> ::= {SIN | SQU| RAMP}
```

See Also

- ":WGEN:MODulation:AM:DEPTh" on page 659
- ":WGEN:MODulation:AM:FREQuency" on page 660
- ":WGEN:MODulation:FM:DEViation" on page 661
- ":WGEN:MODulation:FM:FREQuency" on page 662
- ":WGEN:MODulation:FSKey:FREQuency" on page 663
- ":WGEN:MODulation:FSKey:RATE" on page 664
- ":WGEN:MODulation:FUNCtion:RAMP:SYMMetry" on page 666
- ":WGEN:MODulation:STATe" on page 668
- ":WGEN:MODulation:TYPE" on page 669

:WGEN:MODulation:FUNCtion:RAMP:SYMMetry

N (see page 776)

Command Syntax

```
:WGEN:MODulation:FUNCtion:RAMP:SYMMetry <percent>
```

```
<percent> ::= symmetry percentage from 0% to 100% in NR1 format
```

The :WGEN:MODulation:FUNCtion:RAMP:SYMMetry command specifies the amount of time per cycle that the ramp waveform is rising. The ramp modulating waveform shape is specified with the :WGEN:MODulation:FUNCtion command.

Query Syntax

```
:WGEN:MODulation:FUNCtion:RAMP:SYMMetry?
```

The :WGEN:MODulation:FUNCtion:RAMP:SYMMetry? query returns ramp symmetry percentage setting.

Return Format

```
<percent><NL>
```

```
<percent> ::= symmetry percentage from 0% to 100% in NR1 format
```

See Also

- ":WGEN:MODulation:AM:DEPTh" on page 659
- ":WGEN:MODulation:AM:FREQuency" on page 660
- ":WGEN:MODulation:FM:DEViation" on page 661
- ":WGEN:MODulation:FM:FREQuency" on page 662
- ":WGEN:MODulation:FSKey:FREQuency" on page 663
- ":WGEN:MODulation:FSKey:RATE" on page 664
- ":WGEN:MODulation:FUNCtion" on page 665
- ":WGEN:MODulation:STATe" on page 668
- ":WGEN:MODulation:TYPE" on page 669

:WGEN:MODulation:NOISe

N (see page 776)

Command Syntax

```
:WGEN:MODulation:NOISe <percent>
```

```
<percent> ::= 0 to 100
```

The :WGEN:MODulation:NOISe command adds noise to the currently selected signal. The sum of the amplitude between the original signal and injected noise is limited to the regular amplitude limit (for example, 5 Vpp in 1 MOhm), so the range for <percent> varies according to current amplitude.

Note that adding noise affects edge triggering on the waveform generator source as well as the waveform generator sync pulse output signal (which can be sent to TRIG OUT). This is because the trigger comparator is located after the noise source.

Query Syntax

```
:WGEN:MODulation:NOISe?
```

The :WGEN:MODulation:NOISe query returns the percent of added noise.

Return Format

```
<percent><NL>
```

```
<percent> ::= 0 to 100
```

See Also

- ":WGEN:FUNCtion" on page 653

:WGEN:MODulation:STATe

N (see page 776)

Command Syntax

```
:WGEN:MODulation:STATe <setting>
```

```
<setting> ::= {{OFF | 0} | {ON | 1}}
```

The :WGEN:MODulation:STATe command enables or disables modulated waveform generator output.

You can enable modulation for all waveform generator function types except pulse, DC, and noise.

Query Syntax

```
:WGEN:MODulation:STATe?
```

The :WGEN:MODulation:STATe? query returns whether the modulated waveform generator output is enabled of disabled.

Return Format

```
<setting><NL>
```

```
<setting> ::= {0 | 1}
```

See Also

- ":WGEN:MODulation:AM:DEPTh" on page 659
- ":WGEN:MODulation:AM:FREQuency" on page 660
- ":WGEN:MODulation:FM:DEViation" on page 661
- ":WGEN:MODulation:FM:FREQuency" on page 662
- ":WGEN:MODulation:FSKey:FREQuency" on page 663
- ":WGEN:MODulation:FSKey:RATE" on page 664
- ":WGEN:MODulation:FUNCtion" on page 665
- ":WGEN:MODulation:FUNCtion:RAMP:SYMMetry" on page 666
- ":WGEN:MODulation:TYPE" on page 669

:WGEN:MODulation:TYPE

N (see page 776)

Command Syntax

```
:WGEN:MODulation:TYPE <type>
```

```
<type> ::= {AM | FM | FSK}
```

The :WGEN:MODulation:TYPE command selects the modulation type:

- AM (amplitude modulation) — the amplitude of the original carrier signal is modified according to the amplitude of the modulating signal.

  Use the :WGEN:MODulation:AM:FREQuency command to set the modulating signal frequency.

  Use the :WGEN:MODulation:AM:DEPTh command to specify the amount of amplitude modulation.
- FM (frequency modulation) — the frequency of the original carrier signal is modified according to the amplitude of the modulating signal.

  Use the :WGEN:MODulation:FM:FREQuency command to set the modulating signal frequency.

  Use the :WGEN:MODulation:FM:DEViation command to specify the frequency deviation from the original carrier signal frequency.
- FSK (frequency-shift keying modulation) — the output frequency "shifts" between the original carrier frequency and a "hop frequency" at the specified FSK rate.

  The FSK rate specifies a digital square wave modulating signal.

  Use the :WGEN:MODulation:FSKey:FREQuency command to specify the "hop frequency".

  Use the :WGEN:MODulation:FSKey:RATE command to specify the rate at which the output frequency "shifts".

Query Syntax

```
:WGEN:MODulation:TYPE?
```

The :WGEN:MODulation:TYPE? query returns the selected modulation type.

Return Format

```
<type><NL>
```

```
<type> ::= {AM | FM | FSK}
```

See Also

- ":WGEN:MODulation:AM:DEPTh" on page 659
- ":WGEN:MODulation:AM:FREQuency" on page 660
- ":WGEN:MODulation:FM:DEViation" on page 661
- ":WGEN:MODulation:FM:FREQuency" on page 662
- ":WGEN:MODulation:FSKey:FREQuency" on page 663

- ":WGEN:MODulation:FSKey:RATE" on page 664
- ":WGEN:MODulation:FUNCtion" on page 665
- ":WGEN:MODulation:FUNCtion:RAMP:SYMMetry" on page 666
- ":WGEN:MODulation:STATe" on page 668

:WGEN:OUTPut

N (see page 776)

Command Syntax

```
:WGEN:OUTPut <on_off>

<on_off> ::= {{1 | ON} | {0 | OFF}
```

The :WGEN:OUTPut command specifies whether the waveform generator signal output is ON (1) or OFF (0).

Query Syntax

```
:WGEN:OUTPut?
```

The :WGEN:OUTPut? query returns the current state of the waveform generator output setting.

Return Format

```
<on_off><NL>

<on_off> ::= {1 | 0}
```

See Also

- "Introduction to :WGEN Commands" on page 651

:WGEN:OUTPut:LOAD

N (see page 776)

Command Syntax

```
:WGEN:OUTPut:LOAD <impedance>
```

```
<impedance> ::= {ONEMeg | FIFTy}
```

The :WGEN:OUTPut:LOAD command selects the expected output load impedance.

The output impedance of the Gen Out BNC is fixed at 50 ohms. However, the output load selection lets the waveform generator display the correct amplitude and offset levels for the expected output load.

If the actual load impedance is different than the selected value, the displayed amplitude and offset levels will be incorrect.

Query Syntax

```
:WGEN:OUTPut:LOAD?
```

The :WGEN:OUTPut:LOAD? query returns the current expected output load impedance.

Return Format

```
<impedance><NL>
```

```
<impedance> ::= {ONEM | FIFT}
```

See Also

- "Introduction to :WGEN Commands" on page 651

:WGEN:OUTPut:POLarity

N (see page 776)

Command Syntax

```
:WGEN:OUTPut:POLarity <polarity>
```

```
<polarity> ::= {NORMal | INVerted}
```

The :WGEN:OUTPut:POLarity command specifies whether the waveform generator output is inverted..

Query Syntax

```
:WGEN:OUTPut:POLarity?
```

The :WGEN:OUTPut:POLarity? query returns the specified output polarity.

Return Format

```
<polarity><NL>
```

```
<polarity> ::= {NORM | INV}
```

See Also

- "Introduction to :WGEN Commands" on page 651

:WGEN:PERiod

N (see page 776)

Command Syntax

```
:WGEN:PERiod <period>
```

```
<period> ::= period in seconds in NR3 format
```

For all waveforms except Noise and DC, the :WGEN:PERiod command specifies the period of the waveform.

You can also specify the period indirectly using the :WGEN:FREQuency command.

Query Syntax

```
:WGEN:PERiod?
```

The :WGEN:PERiod? query returns the currently set waveform generator period.

Return Format

```
<period><NL>
```

```
<period> ::= period in seconds in NR3 format
```

See Also

- "Introduction to :WGEN Commands" on page 651
- ":WGEN:FUNCtion" on page 653
- ":WGEN:FREQuency" on page 652

:WGEN:RST

N (see page 776)

Command Syntax

```
:WGEN:RST
```

The :WGEN:RST command restores the waveform generator factory default settings (1 kHz sine wave, 500 mVpp, 0 V offset).

See Also

- "Introduction to :WGEN Commands" on page 651
- ":WGEN:FUNCtion" on page 653
- ":WGEN:FREQuency" on page 652

:WGEN:VOLTage

N (see page 776)

Command Syntax

```
:WGEN:VOLTage <amplitude>
```

```
<amplitude> ::= amplitude in volts in NR3 format
```

For all waveforms except DC, the :WGEN:VOLTage command specifies the waveform's amplitude. Use the :WGEN:VOLTage:OFFSet command to specify the offset voltage or DC level.

You can also specify the amplitude and offset indirectly using the :WGEN:VOLTage:HIGH and :WGEN:VOLTage:LOW commands. For example, an amplitude of 5 V and an offset of 1 V is the same as a high-level voltage of 4 V and a low-level voltage of -1 V.

Query Syntax

```
:WGEN:VOLTage?
```

The :WGEN:VOLTage? query returns the currently specified waveform amplitude.

Return Format

```
<amplitude><NL>
```

```
<amplitude> ::= amplitude in volts in NR3 format
```

See Also

- "Introduction to :WGEN Commands" on page 651
- ":WGEN:FUNCtion" on page 653
- ":WGEN:VOLTage:OFFSet" on page 679
- ":WGEN:VOLTage:HIGH" on page 677
- ":WGEN:VOLTage:LOW" on page 678

:WGEN:VOLTage:HIGH

N (see page 776)

Command Syntax

```
:WGEN:VOLTage:HIGH <high>
```

```
<high> ::= high-level voltage in volts, in NR3 format
```

For all waveforms except DC, the :WGEN:VOLTage:HIGH command specifies the waveform's high-level voltage. Use the :WGEN:VOLTage:LOW command to specify the low-level voltage.

You can also specify the high-level and low-level voltages indirectly using the :WGEN:VOLTage and :WGEN:VOLTage:OFFSet commands. For example, a high-level voltage of 4 V and a low-level voltage of -1 V is the same as an amplitude of 5 V and an offset of 1 V.

Query Syntax

```
:WGEN:VOLTage:HIGH?
```

The :WGEN:VOLTage:HIGH? query returns the currently specified waveform high-level voltage.

Return Format

```
<high><NL>
```

```
<high> ::= high-level voltage in volts, in NR3 format
```

See Also

- "Introduction to :WGEN Commands" on page 651
- ":WGEN:FUNCtion" on page 653
- ":WGEN:VOLTage:LOW" on page 678
- ":WGEN:VOLTage" on page 676
- ":WGEN:VOLTage:OFFSet" on page 679

:WGEN:VOLTage:LOW

N (see page 776)

Command Syntax

```
:WGEN:VOLTage:LOW <low>
```

```
<low> ::= low-level voltage in volts, in NR3 format
```

For all waveforms except DC, the :WGEN:VOLTage:LOW command specifies the waveform's low-level voltage. Use the :WGEN:VOLTage:HIGH command to specify the high-level voltage.

You can also specify the high-level and low-level voltages indirectly using the :WGEN:VOLTage and :WGEN:VOLTage:OFFSet commands. For example, a high-level voltage of 4 V and a low-level voltage of -1 V is the same as an amplitude of 5 V and an offset of 1 V.

Query Syntax

```
:WGEN:VOLTage:LOW?
```

The :WGEN:VOLTage:LOW? query returns the currently specified waveform low-level voltage.

Return Format

```
<low><NL>
```

```
<low> ::= low-level voltage in volts, in NR3 format
```

See Also

- "Introduction to :WGEN Commands" on page 651
- ":WGEN:FUNCtion" on page 653
- ":WGEN:VOLTage:LOW" on page 678
- ":WGEN:VOLTage" on page 676
- ":WGEN:VOLTage:OFFSet" on page 679

:WGEN:VOLTage:OFFSet

N (see page 776)

Command Syntax

```
:WGEN:VOLTage:OFFSet <offset>
```

```
<offset> ::= offset in volts in NR3 format
```

The :WGEN:VOLTage:OFFSet command specifies the waveform's offset voltage or the DC level. Use the :WGEN:VOLTage command to specify the amplitude.

You can also specify the amplitude and offset indirectly using the :WGEN:VOLTage:HIGH and :WGEN:VOLTage:LOW commands. For example, an amplitude of 5 V and an offset of 1 V is the same as a high-level voltage of 4 V and a low-level voltage of -1 V.

Query Syntax

```
:WGEN:VOLTage:OFFSet?
```

The :WGEN:VOLTage:OFFSet? query returns the currently specified waveform offset voltage.

Return Format

```
<offset><NL>
```

```
<offset> ::= offset in volts in NR3 format
```

See Also

- "Introduction to :WGEN Commands" on page 651
- ":WGEN:FUNCtion" on page 653
- ":WGEN:VOLTage" on page 676
- ":WGEN:VOLTage:HIGH" on page 677
- ":WGEN:VOLTage:LOW" on page 678

30 :WMEMory<r> Commands

Control reference waveforms.

Table 85 :WMEMory<r> Commands Summary

Command	Query	Options and Query Returns
`:WMEMory<r>:CLEar` (see page 683)	n/a	`<r> ::= 1-2 in NR1 format`

`:WMEMory<r>:DISPlay {{0 | OFF} | {1 | ON}}` (see page 684)	`:WMEMory<r>:DISPlay?` (see page 684)	`<r> ::= 1-2 in NR1 format`
		`{0 | 1}`

`:WMEMory<r>:LABel <string>` (see page 685)	`:WMEMory<r>:LABel?` (see page 685)	`<r> ::= 1-2 in NR1 format`
		`<string> ::= any series of 10 or less ASCII characters enclosed in quotation marks`

`:WMEMory<r>:SAVE <source>` (see page 686)	n/a	`<r> ::= 1-2 in NR1 format`
		`<source> ::= {CHANnel<n> | FUNCtion | MATH}`
		`<n> ::= 1 to (# analog channels) in NR1 format`
		`NOTE: Only ADD or SUBtract math operations can be saved as reference waveforms.`

`:WMEMory<r>:SKEW <skew>` (see page 687)	`:WMEMory<r>:SKEW?` (see page 687)	`<r> ::= 1-2 in NR1 format`
		`<skew> ::= time in seconds in NR3 format`

`:WMEMory<r>:YOFFset <offset>[suffix]` (see page 688)	`:WMEMory<r>:YOFFset?` (see page 688)	`<r> ::= 1-2 in NR1 format`
		`<offset> ::= vertical offset value in NR3 format`
		`[suffix] ::= {V | mV}`

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Table 85 :WMEMory<r> Commands Summary (continued)

Command	Query	Options and Query Returns
:WMEMory<r>:YRANge <range>[suffix] (see page 689)	:WMEMory<r>:YRANge? (see page 689)	<r> ::= 1-2 in NR1 format <range> ::= vertical full-scale range value in NR3 format [suffix] ::= {V | mV}
:WMEMory<r>:YSCale <scale>[suffix] (see page 690)	:WMEMory<r>:YSCale? (see page 690)	<r> ::= 1-2 in NR1 format <scale> ::= vertical units per division value in NR3 format [suffix] ::= {V | mV}

:WMEMory<r>:CLEar

N (see page 776)

Command Syntax

```
:WMEMory<r>:CLEar

<r> ::= 1-2 in NR1 format
```

The :WMEMory<r>:CLEar command clears the specified reference waveform location.

See Also

- Chapter 30, “:WMEMory<r> Commands,” starting on page 681
- ":WMEMory<r>:SAVE" on page 686
- ":WMEMory<r>:DISPlay" on page 684

:WMEMory<r>:DISPlay

N (see page 776)

Command Syntax

```
:WMEMory<r>:DISPlay <on_off>
```

```
<r> ::= 1-2 in NR1 format
```

```
<on_off> ::= {{1 | ON} | {0 | OFF}}
```

The :WMEMory<r>:DISPlay command turns the display of the specified reference waveform on or off.

There are two reference waveform locations, but only one reference waveform can be displayed at a time. That means, if :WMEMory1:DISPlay is ON, sending the :WMEMory2:DISPlay ON command will automatically set :WMEMory1:DISPlay OFF.

Query Syntax

```
:WMEMory<r>:DISPlay?
```

The :WMEMory<r>:DISPlay? query returns the current display setting for the reference waveform.

Return Format

```
<on_off><NL>
```

```
<on_off> ::= {1 | 0}
```

See Also

- Chapter 30, ":WMEMory<r> Commands," starting on page 681
- ":WMEMory<r>:CLEar" on page 683
- ":WMEMory<r>:LABel" on page 685

:WMEMory<r>:LABel

N (see page 776)

Command Syntax

```
:WMEMory<r>:LABel <string>
```

```
<r> ::= 1-2 in NR1 format
```

```
<string> ::= quoted ASCII string
```

NOTE Label strings are 10 characters or less, and may contain any commonly used ASCII characters. Labels with more than 10 characters are truncated to 10 characters. Lower case characters are converted to upper case.

The :WMEMory<r>:LABel command sets the reference waveform label to the string that follows.

Setting a label for a reference waveform also adds the name to the label list in non-volatile memory (replacing the oldest label in the list).

Query Syntax

```
:WMEMory<r>:LABel?
```

The :WMEMory<r>:LABel? query returns the label associated with a particular reference waveform.

Return Format

```
<string><NL>
```

```
<string> ::= quoted ASCII string
```

See Also

- Chapter 30, ":WMEMory<r> Commands," starting on page 681
- ":WMEMory<r>:DISPlay" on page 684

:WMEMory<r>:SAVE

N (see page 776)

Command Syntax

```
:WMEMory<r>:SAVE <source>

<r> ::= 1-2 in NR1 format

<source> ::= {CHANnel<n> | FUNCtion | MATH}

<n> ::= 1 to (# analog channels) in NR1 format
```

The :WMEMory<r>:SAVE command copies the analog channel or math function waveform to the specified reference waveform location.

NOTE Only ADD or SUBtract math operations can be saved as reference waveforms.

See Also

- Chapter 30, ":WMEMory<r> Commands," starting on page 681
- ":WMEMory<r>:DISPlay" on page 684

:WMEMory<r>:SKEW

N (see page 776)

Command Syntax

```
:WMEMory<r>:SKEW <skew>
```

```
<r> ::= 1-2 in NR1 format
```

```
<skew> ::= time in seconds in NR3 format
```

The :WMEMory<r>:SKEW command sets the skew factor for the specified reference waveform.

Query Syntax

```
:WMEMory<r>:SKEW?
```

The :WMEMory<r>:SKEW? query returns the current skew setting for the selected reference waveform.

Return Format

```
<skew><NL>
```

```
<skew> ::= time in seconds in NR3 format
```

See Also

- Chapter 30, ":WMEMory<r> Commands," starting on page 681
- ":WMEMory<r>:DISPlay" on page 684
- ":WMEMory<r>:YOFFset" on page 688
- ":WMEMory<r>:YRANge" on page 689
- ":WMEMory<r>:YSCale" on page 690

:WMEMory<r>:YOFFset

N (see page 776)

Command Syntax

```
:WMEMory<r>:YOFFset <offset> [<suffix>]

<r> ::= 1-2 in NR1 format

<offset> ::= vertical offset value in NR3 format

<suffix> ::= {V | mV}
```

The :WMEMory<r>:YOFFset command sets the value that is represented at center screen for the selected reference waveform.

The range of legal values varies with the value set by the :WMEMory<r>:YRANge or :WMEMory<r>:YSCale commands. If you set the offset to a value outside of the legal range, the offset value is automatically set to the nearest legal value. Legal values are affected by the probe attenuation setting.

Query Syntax

```
:WMEMory<r>:YOFFset?
```

The :WMEMory<r>:YOFFset? query returns the current offset value for the selected reference waveform.

Return Format

```
<offset><NL>

<offset> ::= vertical offset value in NR3 format
```

See Also

- Chapter 30, “:WMEMory<r> Commands,” starting on page 681
- ":WMEMory<r>:DISPlay" on page 684
- ":WMEMory<r>:YRANge" on page 689
- ":WMEMory<r>:YSCale" on page 690
- ":WMEMory<r>:SKEW" on page 687

:WMEMory<r>:YRANge

N (see page 776)

Command Syntax

```
:WMEMory<r>:YRANge <range>[<suffix>]
```

```
<r> ::= 1-2 in NR1 format
```

```
<range> ::= vertical full-scale range value in NR3 format
```

```
<suffix> ::= {V | mV}
```

The :WMEMory<r>:YRANge command defines the full-scale vertical axis of the selected reference waveform.

Legal values for the range are copied from the original source waveform (that is, the analog channel or math function waveform that was originally saved as a reference waveform).

Query Syntax

```
:WMEMory<r>:YRANge?
```

The :WMEMory<r>:YRANge? query returns the current full-scale range setting for the specified reference waveform.

Return Format

```
<range><NL>
```

```
<range> ::= vertical full-scale range value in NR3 format
```

See Also

- Chapter 30, ":WMEMory<r> Commands," starting on page 681
- ":WMEMory<r>:DISPlay" on page 684
- ":WMEMory<r>:YOFFset" on page 688
- ":WMEMory<r>:SKEW" on page 687
- ":WMEMory<r>:YSCale" on page 690

:WMEMory<r>:YSCale

N (see page 776)

Command Syntax

```
:WMEMory<r>:YSCale <scale>[<suffix>]

<r> ::= 1-2 in NR1 format

<scale> ::= vertical units per division in NR3 format

<suffix> ::= {V | mV}
```

The :WMEMory<r>:YSCale command sets the vertical scale, or units per division, of the selected reference waveform.

Legal values for the scale are copied from the original source waveform (that is, the analog channel or math function waveform that was originally saved as a reference waveform).

Query Syntax

```
:WMEMory<r>:YSCale?
```

The :WMEMory<r>:YSCale? query returns the current scale setting for the specified reference waveform.

Return Format

```
<scale><NL>

<scale> ::= vertical units per division in NR3 format
```

See Also

- Chapter 30, “:WMEMory<r> Commands,” starting on page 681
- ":WMEMory<r>:DISPlay" on page 684
- ":WMEMory<r>:YOFFset" on page 688
- ":WMEMory<r>:YRANge" on page 689
- ":WMEMory<r>:SKEW" on page 687

31 Obsolete and Discontinued Commands

Obsolete commands are older forms of commands that are provided to reduce customer rework for existing systems and programs (see"Obsolete Commands" on page 776).

Obsolete Command	Current Command Equivalent	Behavior Differences
ANALog<n>:BWLimit	:CHANnel<n>:BWLimit (see page 201)	
ANALog<n>:COUPling	:CHANnel<n>:COUPling (see page 202)	
ANALog<n>:INVert	:CHANnel<n>:INVert (see page 205)	
ANALog<n>:LABel	:CHANnel<n>:LABel (see page 206)	
ANALog<n>:OFFSet	:CHANnel<n>:OFFSet (see page 207)	
ANALog<n>:PROBe	:CHANnel<n>:PROBe (see page 208)	
ANALog<n>:PMODe	none	
ANALog<n>:RANGe	:CHANnel<n>:RANGe (see page 214)	
:CHANnel:LABel (see page 696)	:CHANnel<n>:LABel (see page 206)	use CHANnel<n>:LABel for analog channels
:CHANnel2:SKEW (see page 697)	:CHANnel<n>:PROBe:SKEW (see page 211)	
:CHANnel<n>:INPut (see page 698)	:CHANnel<n>:IMPedance (see page 204)	
:CHANnel<n>:PMODe (see page 699)	none	

Obsolete Command	Current Command Equivalent	Behavior Differences
:DISPlay:CONNect (see page 700)	:DISPlay:VECTors (see page 236)	
:ERASe (see page 701)	:DISplay:CLEar (see page 229)	
:EXTernal:PMODe (see page 702)	none	
FUNCtion1, FUNCtion2	:FUNCtion Commands (see page 281)	ADD not included
:FUNCtion:SOURce (see page 703)	:FUNCtion:SOURce1 (see page 300)	Obsolete command has ADD, SUBTract, and MULTiply parameters; current command has GOFT parameter.
:FUNCtion:VIEW (see page 704)	:FUNCtion:DISPlay (see page 284)	
:HARDcopy:DESTination (see page 705)	:HARDcopy:FILename (see page 706)	
:HARDcopy:FILename (see page 706)	:RECall:FILename (see page 419) :SAVE:FILename (see page 419)	
:HARDcopy:GRAYscale (see page 707)	:HARDcopy:PALette (see page 311)	
:HARDcopy:IGColors (see page 708)	:HARDcopy:INKSaver (see page 309)	
:HARDcopy:PDRiver (see page 709)	:HARDcopy:APRinter (see page 306)	
:MEASure:LOWer (see page 710)	:MEASure:DEFine:THResholds (see page 345)	MEASure:DEFine:THResholds can define absolute values or percentage
:MEASure:SCRatch (see page 711)	:MEASure:CLEar (see page 343)	
:MEASure:TDELta (see page 712)	:MARKer:XDELta (see page 323)	
:MEASure:THResholds (see page 713)	:MEASure:DEFine:THResholds (see page 345)	MEASure:DEFine:THResholds can define absolute values or percentage
:MEASure:TMAX (see page 714)	:MEASure:XMAX (see page 380)	
:MEASure:TMIN (see page 715)	:MEASure:XMIN (see page 381)	

Obsolete Command	Current Command Equivalent	Behavior Differences
:MEASure:TSTArt (see page 716)	:MARKer:X1Position (see page 319)	
:MEASure:TSTOp (see page 717)	:MARKer:X2Position (see page 321)	
:MEASure:TVOLt (see page 718)	:MEASure:TVALue (see page 368)	TVALue measures additional values such as db, Vs, etc.
:MEASure:UPPer (see page 719)	:MEASure:DEFine:THResholds (see page 345)	MEASure:DEFine:THResholds can define absolute values or percentage
:MEASure:VDELta (see page 720)	:MARKer:YDELta (see page 328)	
:MEASure:VSTArt (see page 721)	:MARKer:Y1Position (see page 326)	
:MEASure:VSTOp (see page 722)	:MARKer:Y2Position (see page 327)	
:MTESt:AMASk:{SAVE | STORe} (see page 723)	:SAVE:MASK[:STARt] (see page 434)	
:MTESt:AVERage (see page 724)	:ACQuire:TYPE AVERage (see page 185)	
:MTESt:AVERage:COUNt (see page 725)	:ACQuire:COUNt (see page 176)	
:MTESt:LOAD (see page 726)	:RECall:MASK[:STARt] (see page 420)	
:MTESt:RUMode (see page 727)	:MTESt:RMODe (see page 402)	
:MTESt:RUMode:SOFailure (see page 728)	:MTESt:RMODe:FACTion:STOP (see page 406)	
:MTESt:{STARt | STOP} (see page 729)	:RUN (see page 156) or :STOP (see page 160)	
:MTESt:TRIGger:SOURce (see page 730)	:TRIGger Commands (see page 565)	There are various commands for setting the source with different types of triggers.
:PRINt? (see page 731)	:DISPlay:DATA? (see page 230)	
:SAVE:IMAGe:AREA (see page 733)	none	

Obsolete Command	Current Command Equivalent	Behavior Differences
:TIMebase:DELay (see page 734)	:TIMebase:POSition (see page 556) or :TIMebase:WINDow:POSition (see page 561)	TIMebase:POSition is position value of main time base; TIMebase:WINDow:POSition is position value of zoomed (delayed) time base window.
:TRIGger:TV:TVMode (see page 735)	:TRIGger:TV:MODE (see page 609)	

Discontinued Commands

Discontinued commands are commands that were used by previous oscilloscopes, but are not supported by the InfiniiVision 1000 X-Series oscilloscopes. Listed below are the Discontinued commands and the nearest equivalent command available (if any).

Discontinued Command	Current Command Equivalent	Comments
ASTore	:DISPlay:PERSistence INFinite (see page 235)	
CHANnel:MATH	:FUNCtion:OPERation (see page 295)	ADD not included
CHANnel<n>:PROTect	:CHANnel<n>:PROTection (see page 213)	Previous form of this command was used to enable/disable 50Ω protection. The new command resets a tripped protect and the query returns the status of TRIPed or NORMal.
DISPlay:INVerse	none	
DISPlay:COLumn	none	
DISPlay:FREeze	none	
DISPlay:GRID	none	
DISPLay:LINE	none	
DISPlay:PIXel	none	
DISPlay:POSition	none	
DISPlay:ROW	none	
DISPlay:TEXT	none	
FUNCtion:MOVE	none	
FUNCtion:PEAKs	none	

Discontinued Command	Current Command Equivalent	Comments
HARDcopy:ADDRess	none	Only parallel printer port is supported. GPIB printing not supported
MASK	none	All commands discontinued, feature not available
SYSTem:KEY	none	
TEST:ALL	*TST (Self Test) (see page 128)	
TRACE subsystem	none	All commands discontinued, feature not available
TRIGger:ADVanced subsystem		Use new GLITch, PATTern, or TV trigger modes
TRIGger:TV:FIELd	:TRIGger:TV:MODE (see page 609)	
TRIGger:TV:TVHFrej		
TRIGger:TV:VIR	none	
VAUToscale	none	

Discontinued Parameters

Some previous oscilloscope queries returned control setting values of OFF and ON. The InfiniiVision 1000 X-Series oscilloscopes only return the enumerated values 0 (for off) and 1 (for on).

:CHANnel:LABel

O (see page 776)

Command Syntax

```
:CHANnel:LABel <source_text><string>
```

```
<source_text> ::= {CHANnel1 | CHANnel2}
```

```
<string> ::= quoted ASCII string
```

The :CHANnel:LABel command sets the source text to the string that follows. Setting a channel will also result in the name being added to the label list.

NOTE The :CHANnel:LABel command is an obsolete command provided for compatibility to previous oscilloscopes. Use the :CHANnel<n>:LABel command (see page 206).

Query Syntax

```
:CHANnel:LABel?
```

The :CHANnel:LABel? query returns the label associated with a particular analog channel.

Return Format

```
<string><NL>
```

```
<string> ::= quoted ASCII string
```

:CHANNel2:SKEW

O (see page 776)

Command Syntax

```
:CHANnel2:SKEW <skew value>

<skew value> ::= skew time in NR3 format

<skew value> ::= -100 ns to +100 ns
```

The :CHANnel2:SKEW command sets the skew between channels 1 and 2. The maximum skew is +/-100 ns. You can use the oscilloscope's analog probe skew control to remove cable delay errors between channel 1 and channel 2.

NOTE The :CHANnel2:SKEW command is an obsolete command provided for compatibility to previous oscilloscopes. Use the :CHANnel<n>:PROBe:SKEW command (see page 211) instead.

NOTE This command is only valid for the two channel oscilloscope models.

Query Syntax

```
:CHANnel2:SKEW?
```

The :CHANnel2:SKEW? query returns the current probe skew setting for the selected channel.

Return Format

```
<skew value><NL>

<skew value> ::= skew value in NR3 format
```

See Also

- "Introduction to :CHANnel<n> Commands" on page 199

:CHANnel<n>:INPut

O (see page 776)

Command Syntax

```
:CHANnel<n>:INPut <impedance>
```

```
<impedance> ::= {ONEMeg | FIFTy}
```

```
<n> ::= 1 to (# analog channels) in NR1 format
```

The :CHANnel<n>:INPut command selects the input impedance setting for the specified channel. The legal values for this command are ONEMeg (1 MΩ) and FIFTy (50Ω).

NOTE **The :CHANnel<n>:INPut command is an obsolete command provided for compatibility to previous oscilloscopes. Use the :CHANnel<n>:IMPedance command (see page 204) instead.**

Query Syntax

```
:CHANnel<n>:INPut?
```

The :CHANnel<n>:INPut? query returns the current input impedance setting for the specified channel.

Return Format

```
<impedance value><NL>
```

```
<impedance value> ::= {ONEM | FIFT}
```

:CHANnel<n>:PMODe

O (see page 776)

Command Syntax

```
:CHANnel<n>:PMODe <pmode value>

<pmode value> ::= {AUTo | MANual}

<n> ::= 1 to (# analog channels) in NR1 format
```

The probe sense mode is controlled internally and cannot be set. If a probe with sense is connected to the specified channel, auto sensing is enabled; otherwise, the mode is manual.

If the PMODe sent matches the oscilloscope's setting, the command will be accepted. Otherwise, a setting conflict error is generated.

NOTE **The :CHANnel<n>:PMODe command is an obsolete command provided for compatibility to previous oscilloscopes.**

Query Syntax

```
:CHANnel<n>:PMODe?
```

The :CHANnel<n>:PMODe? query returns AUT if an autosense probe is attached and MAN otherwise.

Return Format

```
<pmode value><NL>

<pmode value> ::= {AUT | MAN}
```

:DISPlay:CONNect

O (see page 776)

Command Syntax

```
:DISPlay:CONNect <connect>
```

```
<connect> ::= {{ 1 | ON} | {0 | OFF}}
```

The :DISPlay:CONNect command turns vectors on and off. When vectors are turned on, the oscilloscope displays lines connecting sampled data points. When vectors are turned off, only the sampled data is displayed.

NOTE The :DISPlay:CONNEct command is an obsolete command provided for compatibility to previous oscilloscopes. Use the :DISPlay:VECTors command (see page 236) instead.

Query Syntax

```
:DISPlay:CONNect?
```

The :DISPlay:CONNect? query returns the current state of the vectors setting.

Return Format

```
<connect><NL>
```

```
<connect> ::= {1 | 0}
```

See Also

- ":DISPlay:VECTors" on page 236

:ERASe

O (see page 776)

Command Syntax

```
:ERASe
```

The :ERASe command erases the screen.

NOTE The :ERASe command is an obsolete command provided for compatibility to previous oscilloscopes. Use the :DISplay:CLEar command (see page 229) instead.

:EXTernal:PMODe

O (see page 776)

Command Syntax

```
:EXTernal:PMODe <pmode value>
```

```
<pmode value> ::= {AUTo | MANual}
```

The probe sense mode is controlled internally and cannot be set. If a probe with sense is connected to the specified channel, auto sensing is enabled; otherwise, the mode is manual.

If the pmode sent matches the oscilloscope's setting, the command will be accepted. Otherwise, a setting conflict error is generated.

NOTE The :EXTernal:PMODe command is an obsolete command provided for compatibility to previous oscilloscopes.

Query Syntax

```
:EXTernal:PMODe?
```

The :EXTernal:PMODe? query returns AUT if an autosense probe is attached and MAN otherwise.

Return Format

```
<pmode value><NL>
```

```
<pmode value> ::= {AUT | MAN}
```

:FUNCtion:SOURce

O (see page 776)

Command Syntax

```
:FUNCtion:SOURce <value>

<value> ::= {CHANnel<n> | ADD | SUBTract | MULTiply}

<n> ::= 1 to (# analog channels) in NR1 format
```

The :FUNCtion:SOURce command is only used when an FFT (Fast Fourier Transform) operation is selected (see the:FUNCtion:OPERation command for more information about selecting an operation). The :FUNCtion:SOURce command selects the source for function operations. Choose CHANnel<n>, or ADD, SUBT, or MULT to specify the desired source for FFT operations specified by the :FUNCtion:OPERation command.

NOTE The :FUNCtion:SOURce command is an obsolete command provided for compatibility to previous oscilloscopes. Use the :FUNCtion:SOURce1 command (see page 300) instead.

Query Syntax

```
:FUNCtion:SOURce?
```

The :FUNCtion:SOURce? query returns the current source for function operations.

Return Format

```
<value><NL>

<value> ::= {CHAN<n> | ADD | SUBT | MULT}

<n> ::= 1 to (# analog channels) in NR1 format
```

See Also

- "Introduction to :FUNCtion Commands" on page 283
- ":FUNCtion:OPERation" on page 295

:FUNCtion:VIEW

0 (see page 776)

Command Syntax

```
:FUNCtion:VIEW <view>
```

```
<view> ::= {{1 | ON} | (0 | OFF}}
```

The :FUNCtion:VIEW command turns the selected function on or off. When ON is selected, the function performs as specified using the other FUNCtion commands. When OFF is selected, function is neither calculated nor displayed.

NOTE **The :FUNCtion:VIEW command is provided for backward compatibility to previous oscilloscopes. Use the :FUNCtion:DISPlay command (see page 284) instead.**

Query Syntax

```
:FUNCtion:VIEW?
```

The :FUNCtion:VIEW? query returns the current state of the selected function.

Return Format

```
<view><NL>
```

```
<view> ::= {1 | 0}
```

:HARDcopy:DESTination

O (see page 776)

Command Syntax

```
:HARDcopy:DESTination <destination>

<destination> ::= {CENTronics | FLOPpy}
```

The :HARDcopy:DESTination command sets the hardcopy destination.

NOTE

The :HARDcopy:DESTination command is an obsolete command provided for compatibility to previous oscilloscopes. Use the :HARDcopy:FILename command (see page 706) instead.

Query Syntax

```
:HARDcopy:DESTination?
```

The :HARDcopy:DESTination? query returns the selected hardcopy destination.

Return Format

```
<destination><NL>

<destination> ::= {CENT | FLOP}
```

See Also

- "Introduction to :HARDcopy Commands" on page 304

:HARDcopy:FILename

O (see page 776)

Command Syntax

```
:HARDcopy:FILename <string>
```

```
<string> ::= quoted ASCII string
```

The HARDcopy:FILename command sets the output filename for those print formats whose output is a file.

NOTE The :HARDcopy:FILename command is an obsolete command provided for compatibility to previous oscilloscopes. Use the :SAVE:FILename command (see page 428) and :RECall:FILename command (see page 419) instead.

Query Syntax

```
:HARDcopy:FILename?
```

The :HARDcopy:FILename? query returns the current hardcopy output filename.

Return Format

```
<string><NL>
```

```
<string> ::= quoted ASCII string
```

See Also

- "Introduction to :HARDcopy Commands" on page 304

:HARDcopy:GRAYscale

0 (see page 776)

Command Syntax

```
:HARDcopy:GRAYscale <gray>

<gray> ::= {{OFF | 0} | {ON | 1}}
```

The :HARDcopy:GRAYscale command controls whether grayscaling is performed in the hardcopy dump.

NOTE

The :HARDcopy:GRAYscale command is an obsolete command provided for compatibility to previous oscilloscopes. Use the :HARDcopy:PALette command (see page 311) instead. (":HARDcopy:GRAYscale ON" is the same as ":HARDcopy:PALette GRAYscale" and ":HARDcopy:GRAYscale OFF" is the same as ":HARDcopy:PALette COLor".)

Query Syntax

```
:HARDcopy:GRAYscale?
```

The :HARDcopy:GRAYscale? query returns a flag indicating whether grayscaling is performed in the hardcopy dump.

Return Format

```
<gray><NL>

<gray> ::= {0 | 1}
```

See Also

- "Introduction to :HARDcopy Commands" on page 304

:HARDcopy:IGColors

O (see page 776)

Command Syntax

```
:HARDcopy:IGColors <value>
```

```
<value> ::= {{OFF | 0} | {ON | 1}}
```

The HARDcopy:IGColors command controls whether the graticule colors are inverted or not.

NOTE The :HARDcopy:IGColors command is an obsolete command provided for compatibility to previous oscilloscopes. Use the :HARDcopy:INKSaver (see page 309) command instead.

Query Syntax

```
:HARDcopy:IGColors?
```

The :HARDcopy:IGColors? query returns a flag indicating whether graticule colors are inverted or not.

Return Format

```
<value><NL>
```

```
<value> ::= {0 | 1}
```

See Also

- "Introduction to :HARDcopy Commands" on page 304

:HARDcopy:PDRiver

O (see page 776)

Command Syntax

```
:HARDcopy:PDRiver <driver>

<driver> ::= {AP2Xxx | AP21xx | {AP2560 | AP25} | {DJ350 | DJ35} |
              DJ6xx | {DJ630 | DJ63} | DJ6Special | DJ6Photo |
              DJ8Special | DJ8xx | DJ9Vip | OJPRokx50 | DJ9xx | GVIP |
              DJ55xx | {PS470 | PS47} {PS100 | PS10} | CLASer |
              MLASer | LJFastraster | POSTscript}
```

The HARDcopy:PDRiver command sets the hardcopy printer driver used for the selected printer.

If the correct driver for the selected printer can be identified, it will be selected and cannot be changed.

NOTE The :HARDcopy:PDRiver command is an obsolete command provided for compatibility to previous oscilloscopes. Use the :HARDcopy:APRinter (see page 306) command instead.

Query Syntax

```
:HARDcopy:PDRiver?
```

The :HARDcopy:PDRiver? query returns the selected hardcopy printer driver.

Return Format

```
<driver><NL>

<driver> ::= {AP2X | AP21 | AP25 | DJ35 | DJ6 | DJ63 | DJ6S | DJ6P |
              DJ8S | DJ8 | DJ9V | OJPR | DJ9 | GVIP | DJ55 | PS10 |
              PS47 | CLAS | MLAS | LJF | POST}
```

See Also

- "Introduction to :HARDcopy Commands" on page 304

:MEASure:LOWer

O (see page 776)

Command Syntax

```
:MEASure:LOWer <voltage>
```

The :MEASure:LOWer command sets the lower measurement threshold value. This value and the UPPer value represent absolute values when the thresholds are ABSolute and percentage when the thresholds are PERCent as defined by the :MEASure:DEFine THResholds command.

NOTE

The :MEASure:LOWer command is obsolete and is provided for backward compatibility to previous oscilloscopes. Use the :MEASure:DEFine THResholds command (see page 345) instead.

Query Syntax

```
:MEASure:LOWer?
```

The :MEASure:LOWer? query returns the current lower threshold level.

Return Format

```
<voltage><NL>

<voltage> ::= the user-defined lower threshold in volts in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:THResholds" on page 713
- ":MEASure:UPPer" on page 719

:MEASure:SCRatch

0 (see page 776)

Command Syntax

```
:MEASure:SCRatch
```

The :MEASure:SCRatch command clears all selected measurements and markers from the screen.

NOTE The :MEASure:SCRatch command is obsolete and is provided for backward compatibility to previous oscilloscopes. Use the :MEASure:CLEar command (see page 343) instead.

:MEASure:TDELta

O (see page 776)

Query Syntax

```
:MEASure:TDELta?
```

The :MEASure:TDELta? query returns the time difference between the Tstop marker (X2 cursor) and the Tstart marker (X1 cursor).

Tdelta = Tstop - Tstart

Tstart is the time at the start marker (X1 cursor) and Tstop is the time at the stop marker (X2 cursor). No measurement is made when the :MEASure:TDELta? query is received by the oscilloscope. The delta time value that is output is the current value. This is the same value as the front-panel cursors delta X value.

NOTE

The :MEASure:TDELta command is an obsolete command provided for compatibility to previous oscilloscopes. Use the :MARKer:XDELta command (see page 323) instead.

Return Format

```
<value><NL>

<value> ::= time difference between start and stop markers in NR3 format
```

See Also

- "Introduction to :MARKer Commands" on page 316
- "Introduction to :MEASure Commands" on page 339
- ":MARKer:X1Position" on page 319
- ":MARKer:X2Position" on page 321
- ":MARKer:XDELta" on page 323
- ":MEASure:TSTArt" on page 716
- ":MEASure:TSTOp" on page 717

:MEASure:THResholds

O (see page 776)

Command Syntax

```
:MEASure:THResholds {T1090 | T2080 | VOLTage}
```

The :MEASure:THResholds command selects the thresholds used when making time measurements.

NOTE The :MEASure:THResholds command is obsolete and is provided for backward compatibility to previous oscilloscopes. Use the :MEASure:DEFine THResholds command (see page 345) instead.

Query Syntax

```
:MEASure:THResholds?
```

The :MEASure:THResholds? query returns the current thresholds selected when making time measurements.

Return Format

```
{T1090 | T2080 | VOLTage}<NL>

{T1090} uses the 10% and 90% levels of the selected waveform.

{T2080} uses the 20% and 80% levels of the selected waveform.

{VOLTage} uses the upper and lower voltage thresholds set by the
UPPer and LOWer commands on the selected waveform.
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:LOWer" on page 710
- ":MEASure:UPPer" on page 719

:MEASure:TMAX

0 (see page 776)

Command Syntax

```
:MEASure:TMAX [<source>]

<source> ::= {CHANnel<n> | FUNCtion | MATH}

<n> ::= 1 to (# analog channels) in NR1 format
```

The :MEASure:TMAX command installs a screen measurement and starts an X-at-Max-Y measurement on the selected waveform. If the optional source is specified, the current source is modified.

NOTE **The :MEASure:TMAX command is obsolete and is provided for backward compatibility to previous oscilloscopes. Use the :MEASure:XMAX command (see page 380) instead.**

Query Syntax

```
:MEASure:TMAX? [<source>]
```

The :MEASure:TMAX? query returns the horizontal axis value at which the maximum vertical value occurs on the current source. If the optional source is specified, the current source is modified. If all channels are off, the query returns 9.9E+37.

Return Format

```
<value><NL>

<value> ::= time at maximum in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:TMIN" on page 715
- ":MEASure:XMAX" on page 380
- ":MEASure:XMIN" on page 381

:MEASure:TMIN

O (see page 776)

Command Syntax

```
:MEASure:TMIN [<source>]

<source> ::= {CHANnel<n> | FUNCtion | MATH}

<n> ::= 1 to (# analog channels) in NR1 format
```

The :MEASure:TMIN command installs a screen measurement and starts an X-at-Min-Y measurement on the selected waveform. If the optional source is specified, the current source is modified.

NOTE The :MEASure:TMIN command is obsolete and is provided for backward compatibility to previous oscilloscopes. Use the :MEASure:XMIN command (see page 381) instead.

Query Syntax

```
:MEASure:TMIN? [<source>]
```

The :MEASure:TMIN? query returns the horizontal axis value at which the minimum vertical value occurs on the current source. If the optional source is specified, the current source is modified. If all channels are off, the query returns 9.9E+37.

Return Format

```
<value><NL>

<value> ::= time at minimum in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:TMAX" on page 714
- ":MEASure:XMAX" on page 380
- ":MEASure:XMIN" on page 381

:MEASure:TSTArt

O (see page 776)

Command Syntax

```
:MEASure:TSTArt <value> [suffix]
```

```
<value> ::= time at the start marker in seconds
```

```
[suffix] ::= {s | ms | us | ns | ps}
```

The :MEASure:TSTArt command moves the start marker (X1 cursor) to the specified time with respect to the trigger time.

NOTE The short form of this command, TSTA, does not follow the defined Long Form to Short Form Truncation Rules (see page 778). The normal short form "TST" would be the same for both TSTArt and TSTOp, so sending TST for the TSTArt command produces an error.

NOTE The :MEASure:TSTArt command is an obsolete command provided for compatibility to previous oscilloscopes. Use the :MARKer:X1Position command (see page 319) instead.

Query Syntax

```
:MEASure:TSTArt?
```

The :MEASure:TSTArt? query returns the time at the start marker (X1 cursor).

Return Format

```
<value><NL>
```

```
<value> ::= time at the start marker in NR3 format
```

See Also

- "Introduction to :MARKer Commands" on page 316
- "Introduction to :MEASure Commands" on page 339
- ":MARKer:X1Position" on page 319
- ":MARKer:X2Position" on page 321
- ":MARKer:XDELta" on page 323
- ":MEASure:TDELta" on page 712
- ":MEASure:TSTOp" on page 717

:MEASure:TSTOp

O (see page 776)

Command Syntax

```
:MEASure:TSTOp <value> [suffix]
```

```
<value> ::= time at the stop marker in seconds
```

```
[suffix] ::= {s | ms | us | ns | ps}
```

The :MEASure:TSTOp command moves the stop marker (X2 cursor) to the specified time with respect to the trigger time.

NOTE The short form of this command, TSTO, does not follow the defined Long Form to Short Form Truncation Rules (see page 778). The normal short form "TST" would be the same for both TSTArt and TSTOp, so sending TST for the TSTOp command produces an error.

NOTE The :MEASure:TSTOp command is an obsolete command provided for compatibility to previous oscilloscopes. Use the :MARKer:X2Position command (see page 321) instead.

Query Syntax

```
:MEASure:TSTOp?
```

The :MEASure:TSTOp? query returns the time at the stop marker (X2 cursor).

Return Format

```
<value><NL>
```

```
<value> ::= time at the stop marker in NR3 format
```

See Also

- "Introduction to :MARKer Commands" on page 316
- "Introduction to :MEASure Commands" on page 339
- ":MARKer:X1Position" on page 319
- ":MARKer:X2Position" on page 321
- ":MARKer:XDELta" on page 323
- ":MEASure:TDELta" on page 712
- ":MEASure:TSTArt" on page 716

:MEASure:TVOLt

O (see page 776)

Query Syntax

```
:MEASure:TVOLt? <value>, [<slope>]<occurrence>[,<source>]

<value> ::= the voltage level that the waveform must cross.

<slope> ::= direction of the waveform.  A rising slope is indicated by
            a plus sign (+).  A falling edge is indicated by a minus
            sign (-).

<occurrence> ::= the transition to be reported.  If the occurrence
                 number is one, the first crossing is reported.  If
                 the number is two, the second crossing is reported,
                 etc.

<source> ::= {CHANnel<n> | FUNCtion | MATH}

<n> ::= 1 to (# analog channels) in NR1 format
```

When the :MEASure:TVOLt? query is sent, the displayed signal is searched for the specified voltage level and transition. The time interval between the trigger event and this defined occurrence is returned as the response to the query.

The specified voltage can be negative or positive. To specify a negative voltage, use a minus sign (-). The sign of the slope selects a rising (+) or falling (-) edge. If no sign is specified for the slope, it is assumed to be the rising edge.

The magnitude of the occurrence defines the occurrence to be reported. For example, +3 returns the time for the third time the waveform crosses the specified voltage level in the positive direction. Once this voltage crossing is found, the oscilloscope reports the time at that crossing in seconds, with the trigger point (time zero) as the reference.

If the specified crossing cannot be found, the oscilloscope reports +9.9E+37. This value is returned if the waveform does not cross the specified voltage, or if the waveform does not cross the specified voltage for the specified number of times in the direction specified.

If the optional source parameter is specified, the current source is modified.

NOTE **The :MEASure:TVOLt command is obsolete and is provided for backward compatibility to previous oscilloscopes. Use the :MEASure:TVALue command (see page 368).**

Return Format

```
<value><NL>

<value> ::= time in seconds of the specified voltage crossing
            in NR3 format
```

:MEASure:UPPer

O (see page 776)

Command Syntax

```
:MEASure:UPPer <value>
```

The :MEASure:UPPer command sets the upper measurement threshold value. This value and the LOWer value represent absolute values when the thresholds are ABSolute and percentage when the thresholds are PERCent as defined by the :MEASure:DEFine THResholds command.

NOTE The :MEASure:UPPer command is obsolete and is provided for backward compatibility to previous oscilloscopes. Use the :MEASure:DEFine THResholds command (see page 345) instead.

Query Syntax

```
:MEASure:UPPer?
```

The :MEASure:UPPer? query returns the current upper threshold level.

Return Format

```
<value><NL>

<value> ::= the user-defined upper threshold in NR3 format
```

See Also

- "Introduction to :MEASure Commands" on page 339
- ":MEASure:LOWer" on page 710
- ":MEASure:THResholds" on page 713

:MEASure:VDELta

O (see page 776)

Query Syntax

```
:MEASure:VDELta?
```

The :MEASure:VDELta? query returns the voltage difference between vertical marker 1 (Y1 cursor) and vertical marker 2 (Y2 cursor). No measurement is made when the :MEASure:VDELta? query is received by the oscilloscope. The delta value that is returned is the current value. This is the same value as the front-panel cursors delta Y value.

VDELta = value at marker 2 - value at marker 1

NOTE The :MEASure:VDELta command is an obsolete command provided for compatibility to previous oscilloscopes. Use the :MARKer:YDELta command (see page 328) instead.

Return Format

```
<value><NL>

<value> ::= delta V value in NR1 format
```

See Also

- "Introduction to :MARKer Commands" on page 316
- "Introduction to :MEASure Commands" on page 339
- ":MARKer:Y1Position" on page 326
- ":MARKer:Y2Position" on page 327
- ":MARKer:YDELta" on page 328
- ":MEASure:TDELta" on page 712
- ":MEASure:TSTArt" on page 716

:MEASure:VSTArt

O (see page 776)

Command Syntax

```
:MEASure:VSTArt <vstart_argument>

<vstart_argument> ::= value for vertical marker 1
```

The :MEASure:VSTArt command moves the vertical marker (Y1 cursor) to the specified value corresponding to the selected source. The source can be selected by the MARKer:X1Y1source command.

NOTE The short form of this command, VSTA, does not follow the defined Long Form to Short Form Truncation Rules (see page 778). The normal short form, VST, would be the same for both VSTArt and VSTOp, so sending VST for the VSTArt command produces an error.

NOTE The :MEASure:VSTArt command is an obsolete command provided for compatibility to previous oscilloscopes. Use the :MARKer:Y1Position command (see page 326) instead.

Query Syntax

```
:MEASure:VSTArt?
```

The :MEASure:VSTArt? query returns the current value of the Y1 cursor.

Return Format

```
<value><NL>

<value> ::= voltage at voltage marker 1 in NR3 format
```

See Also

- "Introduction to :MARKer Commands" on page 316
- "Introduction to :MEASure Commands" on page 339
- ":MARKer:Y1Position" on page 326
- ":MARKer:Y2Position" on page 327
- ":MARKer:YDELta" on page 328
- ":MARKer:X1Y1source" on page 320
- ":MEASure:SOURce" on page 364
- ":MEASure:TDELta" on page 712
- ":MEASure:TSTArt" on page 716

:MEASure:VSTOp

O (see page 776)

Command Syntax

```
:MEASure:VSTOp <vstop_argument>
```

```
<vstop_argument> ::= value for Y2 cursor
```

The :MEASure:VSTOp command moves the vertical marker 2 (Y2 cursor) to the specified value corresponding to the selected source. The source can be selected by the MARKer:X2Y2source command.

NOTE

The short form of this command, VSTO, does not follow the defined Long Form to Short Form Truncation Rules (see page 778). The normal short form, VST, would be the same for both VSTArt and VSTOp, so sending VST for the VSTOp command produces an error.

NOTE

The :MEASure:VSTOp command is an obsolete command provided for compatibility to previous oscilloscopes. Use the :MARKer:Y2Position command (see page 327) instead.

Query Syntax

```
:MEASure:VSTOp?
```

The :MEASure:VSTOp? query returns the current value of the Y2 cursor.

Return Format

```
<value><NL>
```

```
<value> ::= value of the Y2 cursor in NR3 format
```

See Also

- "Introduction to :MARKer Commands" on page 316
- "Introduction to :MEASure Commands" on page 339
- ":MARKer:Y1Position" on page 326
- ":MARKer:Y2Position" on page 327
- ":MARKer:YDELta" on page 328
- ":MARKer:X2Y2source" on page 322
- ":MEASure:SOURce" on page 364
- ":MEASure:TDELta" on page 712
- ":MEASure:TSTArt" on page 716

:MTESt:AMASk:{SAVE | STORe}

O (see page 776)

Command Syntax

```
:MTESt:AMASk:{SAVE | STORe} "<filename>"
```

The :MTESt:AMASk:SAVE command saves the automask generated mask to a file. If an automask has not been generated, an error occurs.

The <filename> parameter is an MS-DOS compatible name of the file, a maximum of 254 characters long (including the path name, if used). The filename assumes the present working directory if a path does not precede the file name.

NOTE **The :MTESt:AMASk:{SAVE | STORe} command is obsolete and is provided for backward compatibility to previous oscilloscopes. Use the :SAVE:MASK[:STARt] command (see page 434) instead.**

See Also

- "Introduction to :MTESt Commands" on page 385

:MTESt:AVERage

O (see page 776)

Command Syntax

```
:MTESt:AVERage <on_off>
```

```
<on_off> ::= {{1 | ON} | {0 | OFF}}
```

The :MTESt:AVERage command enables or disables averaging. When ON, the oscilloscope acquires multiple data values for each time bucket, and averages them. When OFF, averaging is disabled. To set the number of averages, use the :MTESt:AVERage:COUNt command described next.

NOTE **The :MTESt:AVERage command is obsolete and is provided for backward compatibility to previous oscilloscopes. Use the :ACQuire:TYPE AVERage command (see page 185) instead.**

Query Syntax

```
:MTESt:AVERage?
```

The :MTESt:AVERage? query returns the current setting for averaging.

Return Format

```
<on_off><NL>
```

```
<on_off> ::= {1 | 0}
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:AVERage:COUNt" on page 725

:MTESt:AVERage:COUNt

O (see page 776)

Command Syntax

```
:MTESt:AVERage:COUNt <count>
```

```
<count> ::= an integer from 2 to 65536 in NR1 format
```

The :MTESt:AVERage:COUNt command sets the number of averages for the waveforms. With the AVERage acquisition type, the :MTESt:AVERage:COUNt command specifies the number of data values to be averaged for each time bucket before the acquisition is considered complete for that time bucket.

NOTE **The :MTESt:AVERage:COUNt command is obsolete and is provided for backward compatibility to previous oscilloscopes. Use the :ACQuire:COUNt command (see page 176) instead.**

Query Syntax

```
:MTESt:AVERage:COUNt?
```

The :MTESt:AVERage:COUNt? query returns the currently selected count value.

Return Format

```
<count><NL>
```

```
<count> ::= an integer from 2 to 65536 in NR1 format
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:AVERage" on page 724

:MTESt:LOAD

0 (see page 776)

Command Syntax

```
:MTESt:LOAD "<filename>"
```

The :MTESt:LOAD command loads the specified mask file.

The <filename> parameter is an MS-DOS compatible name of the file, a maximum of 254 characters long (including the path name, if used).

NOTE The :MTESt:LOAD command is obsolete and is provided for backward compatibility to previous oscilloscopes. Use the :RECall:MASK[:STARt] command (see page 420) instead.

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:AMASk:{SAVE | STORe}" on page 723

:MTESt:RUMode

O (see page 776)

Command Syntax

```
:MTESt:RUMode {FORever | TIME,<seconds> | {WAVeforms,<wfm_count>}}

<seconds> ::= from 1 to 86400 in NR3 format

<wfm_count> ::= number of waveforms in NR1 format
                from 1 to 1,000,000,000
```

The :MTESt:RUMode command determines the termination conditions for the mask test. The choices are FORever, TIME, or WAVeforms.

- FORever — runs the Mask Test until the test is turned off.
- TIME — sets the amount of time in seconds that a mask test will run before it terminates. The <seconds> parameter is a real number from 1 to 86400 seconds.
- WAVeforms — sets the maximum number of waveforms that are required before the mask test terminates. The <wfm_count> parameter indicates the number of waveforms that are to be acquired; it is an integer from 1 to 1,000,000,000.

NOTE The :MTESt:RUMode command is obsolete and is provided for backward compatibility to previous oscilloscopes. Use the :MTESt:RMODe command (see page 402) instead.

Query Syntax

```
:MTESt:RUMode?
```

The :MTESt:RUMode? query returns the currently selected termination condition and value.

Return Format

```
{FOR | TIME,<seconds> | {WAV,<wfm_count>}}<NL>

<seconds> ::= from 1 to 86400 in NR3 format

<wfm_count> ::= number of waveforms in NR1 format
                from 1 to 1,000,000,000
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:RUMode:SOFailure" on page 728

:MTESt:RUMode:SOFailure

O (see page 776)

Command Syntax

```
:MTESt:RUMode:SOFailure <on_off>
```

```
<on_off> ::= {{1 | ON} | {0 | OFF}}
```

The :MTESt:RUMode:SOFailure command enables or disables the Stop On Failure run until criteria. When a mask test is run and a mask violation is detected, the mask test is stopped and the acquisition system is stopped.

NOTE The :MTESt:RUMode:SOFailure command is obsolete and is provided for backward compatibility to previous oscilloscopes. Use the :MTESt:RMODe:FACTion:STOP command (see page 406) instead.

Query Syntax

```
:MTESt:RUMode:SOFailure?
```

The :MTESt:RUMode:SOFailure? query returns the current state of the Stop on Failure control.

Return Format

```
<on_off><NL>
```

```
<on_off> ::= {1 | 0}
```

See Also

- "Introduction to :MTESt Commands" on page 385
- ":MTESt:RUMode" on page 727

:MTESt:{STARt | STOP}

O (see page 776)

Command Syntax

```
:MTESt:{STARt | STOP}
```

The :MTESt:{STARt | STOP} command starts or stops the acquisition system.

NOTE

The :MTESt:STARt and :MTESt:STOP commands are obsolete and are provided for backward compatibility to previous oscilloscopes. Use the :RUN command (see page 156) and :STOP command (see page 160) instead.

See Also

- "Introduction to :MTESt Commands" on page 385

:MTESt:TRIGger:SOURce

O (see page 776)

Command Syntax

```
:MTESt:TRIGger:SOURce <source>

<source> ::= CHANnel<n>

<n> ::= 1 to (# analog channels) in NR1 format
```

The :MTESt:TRIGger:SOURce command sets the channel to use as the trigger.

NOTE The :MTESt:TRIGger:SOURce command is obsolete and is provided for backward compatibility to previous oscilloscopes. Use the trigger source commands (see page 565) instead.

Query Syntax

```
:MTESt:TRIGger:SOURce?
```

The :MTESt:TRIGger:SOURce? query returns the currently selected trigger source.

Return Format

```
<source> ::= CHAN<n>

<n> ::= 1 to (# analog channels) in NR1 format
```

See Also

- "Introduction to :MTESt Commands" on page 385

:PRINt?

O (see page 776)

Query Syntax

```
:PRINt? [<options>]

<options> ::= [<print option>][,..,<print option>]

<print option> ::= {COLor | GRAYscale | BMP8bit | BMP}
```

The :PRINt? query pulls image data back over the bus for storage.

NOTE The :PRINT command is an obsolete command provided for compatibility to previous oscilloscopes. Use the :DISPlay:DATA command (see page 230) instead.

Print Option	:PRINt command	:PRINt? query	Query Default
COLor	Sets palette=COLor		
GRAYscale	Sets palette=GRAYscale		palette=COLor
PRINter0,1	Causes the USB printer #0,1 to be selected as destination (if connected)	Not used	N/A
BMP8bit	Sets print format to 8-bit BMP	Selects 8-bit BMP formatting for query	N/A
BMP	Sets print format to BMP	Selects BMP formatting for query	N/A
FACTors	Selects outputting of additional settings information for :PRINT	Not used	N/A
NOFactors	Deselects outputting of additional settings information for :PRINT	Not used	N/A

Old Print Option:	Is Now:
HIRes	COLor
LORes	GRAYscale
PARallel	PRINter0
DISK	invalid
PCL	invalid

NOTE The PRINt? query is not a core command.

See Also

- "Introduction to Root (:) Commands" on page 133
- "Introduction to :HARDcopy Commands" on page 304
- ":HARDcopy:FACTors" on page 307
- ":HARDcopy:GRAYscale" on page 707
- ":DISPlay:DATA" on page 230

:SAVE:IMAGe:AREA

O (see page 776)

Query Syntax

```
:SAVE:IMAGe:AREA?
```

The :SAVE:IMAGe:AREA? query returns the selected image area.

When saving images, this query returns SCR (screen). When saving setups or waveform data, this query returns GRAT (graticule) even though graticule images are not saved.

Return Format

```
<area><NL>

<area> ::= {GRAT | SCR}
```

See Also

- "Introduction to :SAVE Commands" on page 426
- ":SAVE:IMAGe[:STARt]" on page 429
- ":SAVE:IMAGe:FACTors" on page 430
- ":SAVE:IMAGe:FORMat" on page 431
- ":SAVE:IMAGe:INKSaver" on page 432
- ":SAVE:IMAGe:PALette" on page 433

:TIMebase:DELay

O (see page 776)

Command Syntax

```
:TIMebase:DELay <delay_value>

<delay_value> ::= time in seconds from trigger to the delay reference
                  point on the screen.

The valid range for delay settings depends on the time/division
setting for the main time base.
```

The :TIMebase:DELay command sets the main time base delay. This delay is the time between the trigger event and the delay reference point on the screen. The delay reference point is set with the :TIMebase:REFerence command (see page 558).

NOTE The :TIMebase:DELay command is obsolete and is provided for backward compatibility to previous oscilloscopes. Use the :TIMebase:POSition command (see page 556) instead.

Query Syntax

```
:TIMebase:DELay?
```

The :TIMebase:DELay query returns the current delay value.

Return Format

```
<delay_value><NL>

<delay_value> ::= time from trigger to display reference in seconds
                  in NR3 format.
```

Example Code

```
  ' TIMEBASE_DELAY - Sets the time base delay.  This delay
  ' is the internal time between the trigger event and the
  ' onscreen delay reference point.

  ' Set time base delay to 0.0.
  myScope.WriteString ":TIMEBASE:DELAY 0.0"
```

See complete example programs at: Chapter 36, “Programming Examples,” starting on page 785

:TRIGger:TV:TVMode

O (see page 776)

Command Syntax

```
:TRIGger:TV:TVMode <mode>

<mode> ::= {FIEld1 | FIEld2 | AFIelds | ALINes | LINE | VERTical
           | LFIeld1 | LFIeld2 | LALTernate | LVERtical}
```

The :TRIGger:TV:MODE command selects the TV trigger mode and field. The LVERtical parameter is only available when :TRIGger:TV:STANdard is GENeric. The LALTernate parameter is not available when :TRIGger:TV:STANdard is GENeric (see page 612).

Old forms for <mode> are accepted:

<mode>	Old Forms Accepted
FIEld1	F1
FIEld2	F2
AFIeld	ALLFields, ALLFLDS
ALINes	ALLLines
LFIeld1	LINEF1, LINEFIELD1
LFIeld2	LINEF2, LINEFIELD2
LALTernate	LINEAlt
LVERtical	LINEVert

NOTE The :TRIGger:TV:TVMode command is an obsolete command provided for compatibility to previous oscilloscopes. Use the :TRIGger:TV:MODE command (see page 609) instead.

Query Syntax

```
:TRIGger:TV:TVMode?
```

The :TRIGger:TV:TVMode? query returns the TV trigger mode.

Return Format

```
<value><NL>

<value> ::= {FIE1 | FIE2 | AFI | ALIN | LINE | VERT | LFI1 | LFI2
            | LALT | LVER}
```

32 Error Messages

-440, Query UNTERMINATED after indefinite response

-430, Query DEADLOCKED

-420, Query UNTERMINATED

-410, Query INTERRUPTED

-400, Query error

-340, Calibration failed

-330, Self-test failed

-321, Out of memory

-320, Storage fault

-315, Configuration memory lost

-314, Save/recall memory lost

-313, Calibration memory lost

-311, Memory error

-310, System error

-300, Device specific error

-278, Macro header not found

-277, Macro redefinition not allowed

-276, Macro recursion error

-273, Illegal macro label

-272, Macro execution error

-258, Media protected

-257, File name error

-256, File name not found

-255, Directory full

-254, Media full

-253, Corrupt media

-252, Missing media

-251, Missing mass storage

-250, Mass storage error

-241, Hardware missing

This message can occur when a feature is unavailable or unlicensed.

For example, some serial bus decode commands are only available when the serial decode options are licensed.

-240, Hardware error

-231, Data questionable

-230, Data corrupt or stale

-224, Illegal parameter value

-223, Too much data

-222, Data out of range

-221, Settings conflict

-220, Parameter error

-200, Execution error

-183, Invalid inside macro definition

-181, Invalid outside macro definition

-178, Expression data not allowed

-171, Invalid expression

-170, Expression error

-168, Block data not allowed

-161, Invalid block data

-158, String data not allowed

-151, Invalid string data

-150, String data error

-148, Character data not allowed

-138, Suffix not allowed

-134, Suffix too long

-131, Invalid suffix

-128, Numeric data not allowed

-124, Too many digits

-123, Exponent too large

-121, Invalid character in number

-120, Numeric data error

-114, Header suffix out of range

-113, Undefined header

-112, Program mnemonic too long

-109, Missing parameter

-108, Parameter not allowed

-105, GET not allowed

-104, Data type error

-103, Invalid separator

-102, Syntax error

-101, Invalid character

-100, Command error

+10, Software Fault Occurred

+100, File Exists

+101, End-Of-File Found

+102, Read Error

+103, Write Error

+104, Illegal Operation

+105, Print Canceled

+106, Print Initialization Failed

+107, Invalid Trace File

+108, Compression Error

+109, No Data For Operation

A remote operation wants some information, but there is no information available. For example, you may request a stored TIFF image using the :DISPlay:DATA? query, but there may be no image stored.

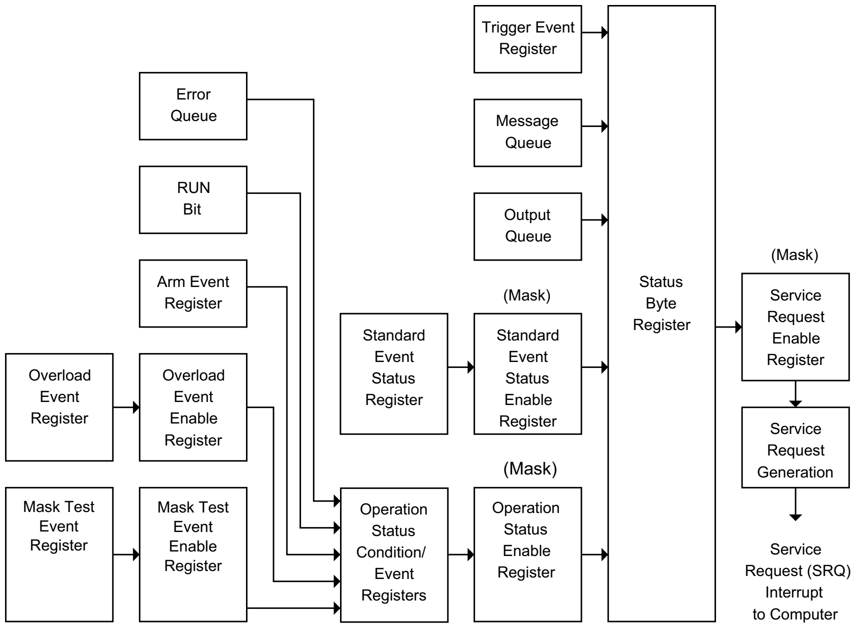
+112, Unknown File Type

+113, Directory Not Supported

33 Status Reporting

IEEE 488.2 defines data structures, commands, and common bit definitions for status reporting (for example, the Status Byte Register and the Standard Event Status Register). There are also instrument-defined structures and bits (for example, the Operation Status Event Register and the Overload Event Register).

An overview of the oscilloscope's status reporting structure is shown in the following block diagram. The status reporting structure allows monitoring specified events in the oscilloscope. The ability to monitor and report these events allows determination of such things as the status of an operation, the availability and reliability of the measured data, and more.


Trigger Event Register
Error Queue
Message Queue
RUN Bit
Output Queue
(Mask)
Arm Event Register
(Mask)
Status Byte Register
Service Request Enable Register
Standard Event Status Register
Standard Event Status Enable Register
Overload Event Register
Overload Event Enable Register
Service Request Generation
(Mask)
Mask Test Event Register
Mask Test Event Enable Register
Operation Status Condition/ Event Registers
Operation Status Enable Register
Service Request (SRQ) Interrupt to Computer

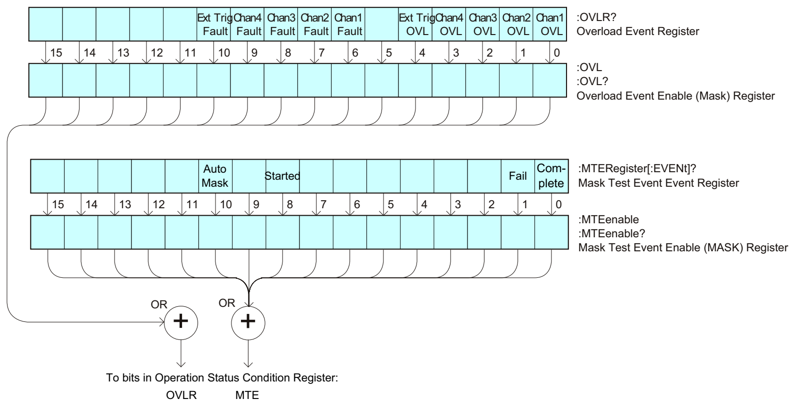
- To monitor an event, first clear the event; then, enable the event. All of the events are cleared when you initialize the instrument.
- To allow a service request (SRQ) interrupt to an external controller, enable at least one bit in the Status Byte Register (by setting, or unmasking, the bit in the Service Request Enable register).

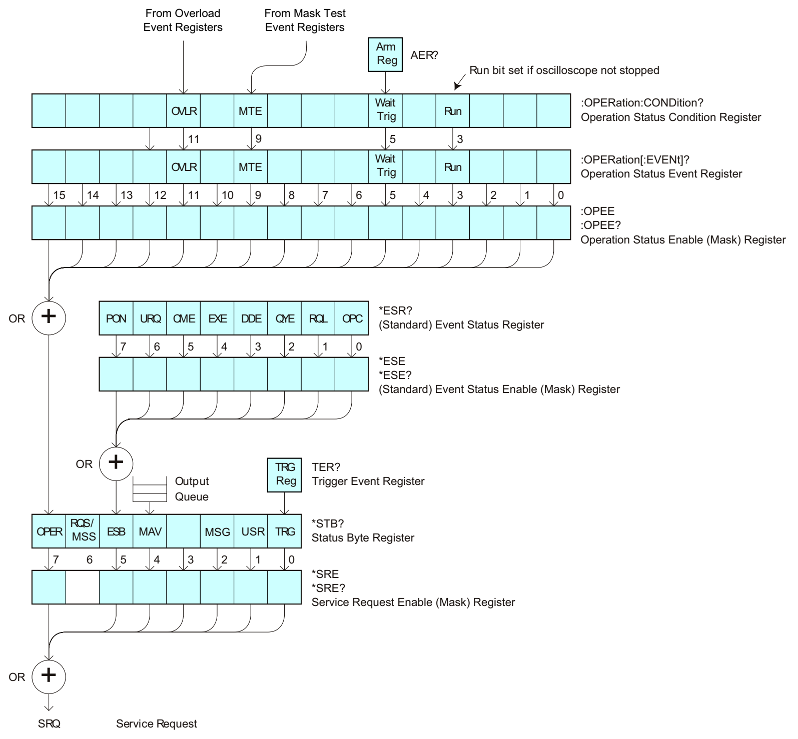
The Status Byte Register, the Standard Event Status Register group, and the Output Queue are defined as the Standard Status Data Structure Model in IEEE 488.2-1987.

The bits in the status byte act as summary bits for the data structures residing behind them. In the case of queues, the summary bit is set if the queue is not empty. For registers, the summary bit is set if any enabled bit in the event register is set. The events are enabled with the corresponding event enable register. Events captured by an event register remain set until the register is read or cleared. Registers are read with their associated commands. The *CLS command clears all event registers and all queues except the output queue. If you send *CLS immediately after a program message terminator, the output queue is also cleared.

Status Reporting Data Structures

The following figure shows how the status register bits are masked and logically OR'ed to generate service requests (SRQ) on particular events.




From Overload Event Registers
From Mask Test Event Registers
Arm Reg
AER?
Run bit set if oscilloscope not stopped
OVLR
MTE
Wait Trig
Run
:OPERation:CONDition?
Operation Status Condition Register
11 9 5 3
:OPERation[:EVENt]?
Operation Status Event Register
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
:OPEE
:OPEE?
Operation Status Enable (Mask) Register
OR
PON URQ CME EXE DDE QYE RQL OPC
*ESR?
(Standard) Event Status Register
7 6 5 4 3 2 1 0
*ESE
*ESE?
(Standard) Event Status Enable (Mask) Register
OR
Output Queue
TRG Reg
TER?
Trigger Event Register
OPER
RQS/ MSS
ESB
MAV
MSG
USR
TRG
*STB?
Status Byte Register
7 6 5 4 3 2 1 0
*SRE
*SRE?
Service Request Enable (Mask) Register
OR
SRQ
Service Request

The status register bits are described in more detail in the following tables:

- Table 41
- Table 39

- Table 46
- Table 47
- Table 49
- Table 44

The status registers picture above shows how the different status reporting data structures work together. To make it possible for any of the Standard Event Status Register bits to generate a summary bit, the bits must be enabled. These bits are enabled by using the *ESE common command to set the corresponding bit in the Standard Event Status Enable Register.

To generate a service request (SRQ) interrupt to an external controller, at least one bit in the Status Byte Register must be enabled. These bits are enabled by using the *SRE common command to set the corresponding bit in the Service Request Enable Register. These enabled bits can then set RQS and MSS (bit 6) in the Status Byte Register.

Status Byte Register (STB)

The Status Byte Register is the summary-level register in the status reporting structure. It contains summary bits that monitor activity in the other status registers and queues. The Status Byte Register is a live register. That is, its summary bits are set and cleared by the presence and absence of a summary bit from other event registers or queues.

If the Status Byte Register is to be used with the Service Request Enable Register to set bit 6 (RQS/MSS) and to generate an SRQ, at least one of the summary bits must be enabled, then set. Also, event bits in all other status registers must be specifically enabled to generate the summary bit that sets the associated summary bit in the Status Byte Register.

The Status Byte Register can be read using either the *STB? Common Command or the programming interface serial poll command. Both commands return the decimal-weighted sum of all set bits in the register. The difference between the two methods is that the serial poll command reads bit 6 as the Request Service (RQS) bit and clears the bit which clears the SRQ interrupt. The *STB? command reads bit 6 as the Master Summary Status (MSS) and does not clear the bit or have any affect on the SRQ interrupt. The value returned is the total bit weights of all of the bits that are set at the present time.

The use of bit 6 can be confusing. This bit was defined to cover all possible computer interfaces, including a computer that could not do a serial poll. The important point to remember is that, if you are using an SRQ interrupt to an external computer, the serial poll command clears bit 6. Clearing bit 6 allows the oscilloscope to generate another SRQ interrupt when another enabled event occurs.

No other bits in the Status Byte Register are cleared by either the *STB? query or the serial poll, except the Message Available bit (bit 4). If there are no other messages in the Output Queue, bit 4 (MAV) can be cleared as a result of reading the response to the *STB? command.

If bit 4 (weight = 16) and bit 5 (weight = 32) are set, the program prints the sum of the two weights. Since these bits were not enabled to generate an SRQ, bit 6 (weight = 64) is not set.

The following example uses the *STB? query to read the contents of the oscilloscope's Status Byte Register.

```
myScope.WriteString "*STB?"
varQueryResult = myScope.ReadNumber
MsgBox "Status Byte Register, Read: 0x" + Hex(varQueryResult)
```

The next program prints 0xD1 and clears bit 6 (RQS) and bit 4 (MAV) of the Status Byte Register. The difference in the output value between this example and the previous one is the value of bit 6 (weight = 64). Bit 6 is set when the first enabled summary bit is set and is cleared when the Status Byte Register is read by the serial poll command.

Example The following example uses the resource session object's ReadSTB method to read the contents of the oscilloscope's Status Byte Register.

```
varQueryResult = myScope.IO.ReadSTB
MsgBox "Status Byte Register, Serial Poll: 0x" + Hex(varQueryResult)
```

NOTE

Use Serial Polling to Read Status Byte Register. Serial polling is the preferred method to read the contents of the Status Byte Register because it resets bit 6 and allows the next enabled event that occurs to generate a new SRQ interrupt.

Service Request Enable Register (SRE)

Setting the Service Request Enable Register bits enable corresponding bits in the Status Byte Register. These enabled bits can then set RQS and MSS (bit 6) in the Status Byte Register.

Bits are set in the Service Request Enable Register using the *SRE command and the bits that are set are read with the *SRE? query.

Example The following example sets bit 4 (MAV) and bit 5 (ESB) in the Service Request Enable Register.

```
myScope.WriteString "*SRE " + CStr(CInt("&H30"))
```

This example uses the decimal parameter value of 48, the string returned by CStr(CInt("&H30")), to enable the oscilloscope to generate an SRQ interrupt under the following conditions:

- When one or more bytes in the Output Queue set bit 4 (MAV).
- When an enabled event in the Standard Event Status Register generates a summary bit that sets bit 5 (ESB).

Trigger Event Register (TER)

This register sets the TRG bit in the status byte when a trigger event occurs.

The TER event register stays set until it is cleared by reading the register or using the *CLS command. If your application needs to detect multiple triggers, the TER event register must be cleared after each one.

If you are using the Service Request to interrupt a program or controller operation, you must clear the event register each time the trigger bit is set.

Output Queue

The output queue stores the oscilloscope-to-controller responses that are generated by certain instrument commands and queries. The output queue generates the Message Available summary bit when the output queue contains one or more bytes. This summary bit sets the MAV bit (bit 4) in the Status Byte Register.

When using the Keysight VISA COM library, the output queue may be read with the FormattedIO488 object's ReadString, ReadNumber, ReadList, or ReadIEEEBlock methods.

Message Queue

The message queue contains the text of the last message written to the advisory line on the screen of the oscilloscope. The length of the oscilloscope's message queue is 1. Note that messages sent with the :SYSTem:DSP command do not set the MSG status bit in the Status Byte Register.

(Standard) Event Status Register (ESR)

The (Standard) Event Status Register (ESR) monitors the following oscilloscope status events:

- PON - Power On
- URQ - User Request
- CME - Command Error
- EXE - Execution Error
- DDE - Device Dependent Error
- QYE - Query Error
- RQC - Request Control
- OPC - Operation Complete

When one of these events occur, the event sets the corresponding bit in the register. If the bits are enabled in the Standard Event Status Enable Register, the bits set in this register generate a summary bit to set bit 5 (ESB) in the Status Byte Register.

You can read the contents of the Standard Event Status Register and clear the register by sending the *ESR? query. The value returned is the total bit weights of all of the bits that are set at the present time.

Example The following example uses the *ESR query to read the contents of the Standard Event Status Register.

```
myScope.WriteString "*ESR?"
varQueryResult = myScope.ReadNumber
MsgBox "Standard Event Status Register: 0x" + Hex(varQueryResult)
```

If bit 4 (weight = 16) and bit 5 (weight = 32) are set, the program prints the sum of the two weights.

(Standard) Event Status Enable Register (ESE)

To allow any of the (Standard) Event Status Register (ESR) bits to generate a summary bit, you must first enable that bit. Enable the bit by using the *ESE (Event Status Enable) common command to set the corresponding bit in the (Standard) Event Status Enable Register (ESE).

Set bits are read with the *ESE? query.

Example Suppose your application requires an interrupt whenever any type of error occurs. The error related bits in the (Standard) Event Status Register are bits 2 through 5 (hexadecimal value 0x3C). Therefore, you can enable any of these bits to generate the summary bit by sending:

```
myScope.WriteString "*ESE " + CStr(CInt("&H3C"))
```

Whenever an error occurs, it sets one of these bits in the (Standard) Event Status Register. Because all the error related bits are enabled, a summary bit is generated to set bit 5 (ESB) in the Status Byte Register.

If bit 5 (ESB) in the Status Byte Register is enabled (via the *SRE command), an SRQ service request interrupt is sent to the controller PC.

NOTE

Disabled (Standard) Event Status Register bits respond but do not generate a summary bit. (Standard) Event Status Register bits that are not enabled still respond to their corresponding conditions (that is, they are set if the corresponding event occurs). However, because they are not enabled, they do not generate a summary bit to the Status Byte Register.

Error Queue

As errors are detected, they are placed in an error queue. This queue is first in, first out. If the error queue overflows, the last error in the queue is replaced with error 350, Queue overflow. Any time the queue overflows, the least recent errors remain in the queue, and the most recent error is discarded. The length of the oscilloscope's error queue is 30 (29 positions for the error messages, and 1 position for the Queue overflow message).

The error queue is read with the :SYSTem:ERRor? query. Executing this query reads and removes the oldest error from the head of the queue, which opens a position at the tail of the queue for a new error. When all the errors have been read from the queue, subsequent error queries return "0, No error".

The error queue is cleared when:

- the instrument is powered up,
- the instrument receives the *CLS common command, or
- the last item is read from the error queue.

Operation Status Event Register (:OPERegister[:EVENt])

The Operation Status Event Register register hosts these bits:

Name	Location	Description
RUN bit	bit 3	Is set whenever the instrument goes from a stop state to a single or running state.
WAIT TRIG bit	bit 5	Is set by the Trigger Armed Event Register and indicates that the trigger is armed.
MTE bit	bit 9	Comes from the Mask Test Event Registers.
OVLR bit	bit 11	Is set whenever a 50Ω input overload occurs.

If any of these bits are set, the OPER bit (bit 7) of the Status Byte Register is set. The Operation Status Event Register is read and cleared with the :OPERegister[:EVENt]? query. The register output is enabled or disabled using the mask value supplied with the OPEE command.

Operation Status Condition Register (:OPERegister:CONDition)

The Operation Status Condition Register register hosts these bits:

Name	Location	Description
RUN bit	bit 3	Is set whenever the instrument is not stopped.
WAIT TRIG bit	bit 5	Is set by the Trigger Armed Event Register and indicates that the trigger is armed.
MTE bit	bit 9	Comes from the Mask Test Event Registers.
OVLR bit	bit 11	Is set whenever a 50Ω input overload occurs.

The :OPERegister:CONDition? query returns the value of the Operation Status Condition Register.

Arm Event Register (AER)

This register sets bit 5 (Wait Trig bit) in the Operation Status Register and the OPER bit (bit 7) in the Status Byte Register when the instrument becomes armed.

The ARM event register stays set until it is cleared by reading the register with the AER? query or using the *CLS command. If your application needs to detect multiple triggers, the ARM event register must be cleared after each one.

If you are using the Service Request to interrupt a program or controller operation when the trigger bit is set, then you must clear the event register after each time it has been set.

Overload Event Register (:OVLRegister)

The Overload Event Register register hosts these bits:

Name	Location	Description
Channel 1 Fault	bit 6	Fault has occurred on Channel 1 input.
Channel 2 Fault	bit 7	Fault has occurred on Channel 2 input.
Channel 3 Fault	bit 8	Fault has occurred on Channel 3 input.
Channel 4 Fault	bit 9	Fault has occurred on Channel 4 input.
External Trigger Fault	bit 10	Fault has occurred on External Trigger input.

Mask Test Event Event Register (:MTERegister[:EVENt])

The Mask Test Event Event Register register hosts these bits:

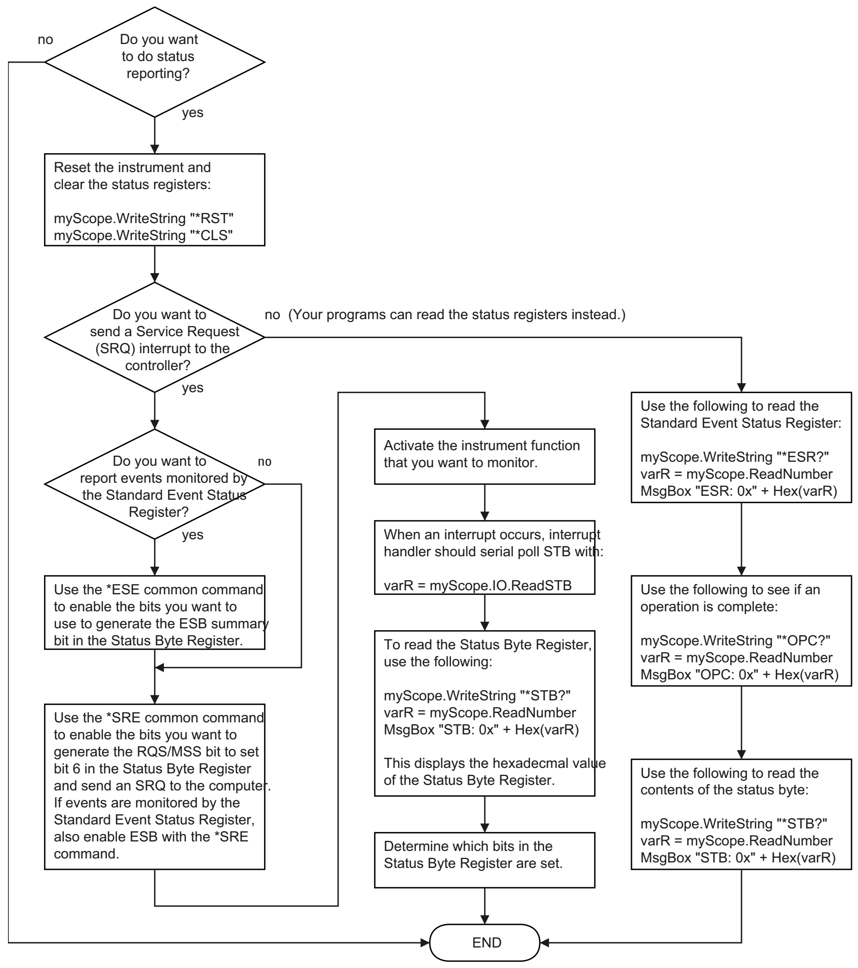
Name	Location	Description
Complete	bit 0	Is set when the mask test is complete.
Fail	bit 1	Is set when there is a mask test failure.
Started	bit 8	Is set when mask testing is started.
Auto Mask	bit 10	Is set when auto mask creation is completed.

The :MTERegister[:EVENt]? query returns the value of, and clears, the Mask Test Event Event Register.

Clearing Registers and Queues

The *CLS common command clears all event registers and all queues except the output queue. If *CLS is sent immediately after a program message terminator, the output queue is also cleared.

Status Reporting Decision Chart



Do you want to do status reporting?

Reset the instrument and clear the status registers:

```
myScope.WriteString "*RST"
myScope.WriteString "*CLS"
```

Do you want to send a Service Request (SRQ) interrupt to the controller?

Do you want to report events monitored by the Standard Event Status Register?

Use the *ESE common command to enable the bits you want to use to generate the ESB summary bit in the Status Byte Register.

Use the *SRE common command to enable the bits you want to generate the RQS/MSS bit to set bit 6 in the Status Byte Register and send an SRQ to the computer. If events are monitored by the Standard Event Status Register, also enable ESB with the *SRE command.

Activate the instrument function that you want to monitor.

When an interrupt occurs, interrupt handler should serial poll STB with:

```
varR = myScope.IO.ReadSTB
```

To read the Status Byte Register, use the following:

```
myScope.WriteString "*STB?"
varR = myScope.ReadNumber
MsgBox "STB: 0x" + Hex(varR)
```

This displays the hexadecmal value of the Status Byte Register.

Determine which bits in the Status Byte Register are set.

Use the following to read the Standard Event Status Register:

```
myScope.WriteString "*ESR?"
varR = myScope.ReadNumber
MsgBox "ESR: 0x" + Hex(varR)
```

Use the following to see if an operation is complete:

```
myScope.WriteString "*OPC?"
varR = myScope.ReadNumber
MsgBox "OPC: 0x" + Hex(varR)
```

Use the following to read the contents of the status byte:

```
myScope.WriteString "*STB?"
varR = myScope.ReadNumber
MsgBox "STB: 0x" + Hex(varR)
```

34 Synchronizing Acquisitions

When remotely controlling an oscilloscope with programming commands, it is often necessary to know when the oscilloscope has finished the previous operation and is ready for the next command. The most common example is when an acquisition is started using the :DIGitize, :RUN, or :SINGle commands. Before a measurement result can be queried, the acquisition must complete. Too often fixed delays are used to accomplish this wait, but fixed delays often use excessive time or the time may not be long enough. A better solution is to use synchronous commands and status to know when the oscilloscope is ready for the next request.

Synchronization in the Programming Flow

Most remote programming follows these three general steps:

1 Set up the oscilloscope and device under test (see page 766).

2 Acquire a waveform (see page 766).

3 Retrieve results (see page 766).

Set Up the Oscilloscope

Before making changes to the oscilloscope setup, it is best to make sure it is stopped using the :STOP command followed by the *OPC? query.

NOTE **It is not necessary to use *OPC?, hard coded waits, or status checking when setting up the oscilloscope. After the oscilloscope is configured, it is ready for an acquisition.**

Acquire a Waveform

When acquiring a waveform there are two possible methods used to wait for the acquisition to complete. These methods are blocking and polling. The table below details when each method should be chosen and why.

	Blocking Wait	Polling Wait
Use When	You know the oscilloscope *will* trigger based on the oscilloscope setup and device under test.	You know the oscilloscope *may or may not* trigger on the oscilloscope setup and device under test.
Advantages	No need for polling. Fastest method.	Remote interface will not timeout No need for device clear if no trigger.
Disadvantages	Remote interface may timeout. Device clear only way to get control of oscilloscope if there is no trigger.	Slower method. Requires polling loop. Requires known maximum wait time.
Implementation Details	See "Blocking Synchronization" on page 767.	See "Polling Synchronization With Timeout" on page 768.

Retrieve Results

Once the acquisition is complete, it is safe to retrieve measurements and statistics.

Blocking Synchronization

Use the :DIGitize command to start the acquisition. This blocks subsequent queries until the acquisition and processing is complete. For example:

```
'
' Synchronizing acquisition using blocking.
' ===================================================================

Option Explicit

Public myMgr As VisaComLib.ResourceManager
Public myScope As VisaComLib.FormattedIO488
Public varQueryResult As Variant
Public strQueryResult As String

Sub Main()

  On Error GoTo VisaComError

  ' Create the VISA COM I/O resource.
  Set myMgr = New VisaComLib.ResourceManager
  Set myScope = New VisaComLib.FormattedIO488
  Set myScope.IO = myMgr.Open("TCPIP0::130.29.69.12::inst0::INSTR")
  myScope.IO.Clear   ' Clear the interface.

  ' Set up.
  ' -----------------------------------------------------------------
  myScope.WriteString ":TRIGger:MODE EDGE"
  myScope.WriteString ":TRIGger:EDGE:LEVel 2"
  myScope.WriteString ":TIMebase:SCALe 5e-8"

  ' Acquire.
  ' -----------------------------------------------------------------
  myScope.WriteString ":DIGitize"

  ' Get results.
  ' -----------------------------------------------------------------
  myScope.WriteString ":MEASure:RISetime"
  myScope.WriteString ":MEASure:RISetime?"
  varQueryResult = myScope.ReadNumber   ' Read risetime.
  Debug.Print "Risetime: " + _
      FormatNumber(varQueryResult * 1000000000, 1) + " ns"

  Exit Sub

VisaComError:
  MsgBox "VISA COM Error:" + vbCrLf + Err.Description

End Sub
```

Polling Synchronization With Timeout

This example requires a timeout value so the operation can abort if an acquisition does not occur within the timeout period:

```
'
' Synchronizing acquisition using polling.
' ===================================================================

Option Explicit

Public myMgr As VisaComLib.ResourceManager
Public myScope As VisaComLib.FormattedIO488
Public varQueryResult As Variant
Public strQueryResult As String

Private Declare Sub Sleep Lib "kernel32" (ByVal dwMilliseconds As Long)

Sub Main()

  On Error GoTo VisaComError

  ' Create the VISA COM I/O resource.
  Set myMgr = New VisaComLib.ResourceManager
  Set myScope = New VisaComLib.FormattedIO488
  Set myScope.IO = myMgr.Open("TCPIP0::130.29.69.12::inst0::INSTR")
  myScope.IO.Clear   ' Clear the interface.

  ' Set up.
  ' -----------------------------------------------------------------
  ' Set up the trigger and horizontal scale.
  myScope.WriteString ":TRIGger:MODE EDGE"
  myScope.WriteString ":TRIGger:EDGE:LEVel 2"
  myScope.WriteString ":TIMebase:SCALe 5e-8"

  ' Stop acquisitions and wait for the operation to complete.
  myScope.WriteString ":STOP"
  myScope.WriteString "*OPC?"
  strQueryResult = myScope.ReadString

  ' Acquire.
  ' -----------------------------------------------------------------
  ' Start a single acquisition.
  myScope.WriteString ":SINGle"

  ' Oscilloscope is armed and ready, enable DUT here.
  Debug.Print "Oscilloscope is armed and ready, enable DUT."

  ' Look for RUN bit = stopped (acquisition complete).
  Dim lngTimeout As Long   ' Max millisecs to wait for single-shot.
  Dim lngElapsed As Long
  lngTimeout = 10000   ' 10 seconds.
  lngElapsed = 0

  Do While lngElapsed <= lngTimeout
```

```
    myScope.WriteString ":OPERegister:CONDition?"
    varQueryResult = myScope.ReadNumber
    ' Mask RUN bit (bit 3, &H8).
    If (varQueryResult And &H8) = 0 Then
      Exit Do
    Else
      Sleep 100   ' Small wait to prevent excessive queries.
      lngElapsed = lngElapsed + 100
    End If
  Loop

  ' Get results.
  ' -----------------------------------------------------------------
  If lngElapsed < lngTimeout Then
    myScope.WriteString ":MEASure:RISetime"
    myScope.WriteString ":MEASure:RISetime?"
    varQueryResult = myScope.ReadNumber   ' Read risetime.
    Debug.Print "Risetime: " + _
        FormatNumber(varQueryResult * 1000000000, 1) + " ns"
  Else
    Debug.Print "Timeout waiting for single-shot trigger."
  End If

  Exit Sub

VisaComError:
  MsgBox "VISA COM Error:" + vbCrLf + Err.Description

End Sub
```

Synchronizing with a Single-Shot Device Under Test (DUT)

The examples in "Blocking Synchronization" on page 767 and "Polling Synchronization With Timeout" on page 768 assume the DUT is continually running and therefore the oscilloscope will have more than one opportunity to trigger. With a single shot DUT, there is only one opportunity for the oscilloscope to trigger, so it is necessary for the oscilloscope to be armed and ready before the DUT is enabled.

NOTE **The blocking :DIGitize command cannot be used for a single shot DUT because once the :DIGitize command is issued, the oscilloscope is blocked from any further commands until the acquisition is complete.**

This example is the same "Polling Synchronization With Timeout" on page 768 with the addition of checking for the armed event status.

```
'
' Synchronizing single-shot acquisition using polling.
' ===================================================================

Option Explicit

Public myMgr As VisaComLib.ResourceManager
Public myScope As VisaComLib.FormattedIO488
Public varQueryResult As Variant
Public strQueryResult As String

Private Declare Sub Sleep Lib "kernel32" (ByVal dwMilliseconds As Long)

Sub Main()

  On Error GoTo VisaComError

  ' Create the VISA COM I/O resource.
  Set myMgr = New VisaComLib.ResourceManager
  Set myScope = New VisaComLib.FormattedIO488
  Set myScope.IO = myMgr.Open("TCPIP0::130.29.69.12::inst0::INSTR")
  myScope.IO.Clear   ' Clear the interface.

  ' Set up.
  ' -----------------------------------------------------------------
  ' Set up the trigger and horizontal scale.
  myScope.WriteString ":TRIGger:MODE EDGE"
  myScope.WriteString ":TRIGger:EDGE:LEVel 2"
  myScope.WriteString ":TIMebase:SCALe 5e-8"

  ' Stop acquisitions and wait for the operation to complete.
  myScope.WriteString ":STOP"
  myScope.WriteString "*OPC?"
  strQueryResult = myScope.ReadString

  ' Acquire.
  ' -----------------------------------------------------------------
  ' Start a single acquisition.
  myScope.WriteString ":SINGle"

  ' Wait until the trigger system is armed.
  Do
    Sleep 100   ' Small wait to prevent excessive queries.
    myScope.WriteString ":AER?"
    varQueryResult = myScope.ReadNumber
  Loop Until varQueryResult = 1

  ' Oscilloscope is armed and ready, enable DUT here.
  Debug.Print "Oscilloscope is armed and ready, enable DUT."

  ' Now, look for RUN bit = stopped (acquisition complete).
  Dim lngTimeout As Long   ' Max millisecs to wait for single-shot.
  Dim lngElapsed As Long
  lngTimeout = 10000   ' 10 seconds.
  lngElapsed = 0

  Do While lngElapsed <= lngTimeout
    myScope.WriteString ":OPERegister:CONDition?"
    varQueryResult = myScope.ReadNumber
    ' Mask RUN bit (bit 3, &H8).
    If (varQueryResult And &H8) = 0 Then
      Exit Do
    Else
      Sleep 100   ' Small wait to prevent excessive queries.
      lngElapsed = lngElapsed + 100
    End If
  Loop

  ' Get results.
  ' -----------------------------------------------------------------
  If lngElapsed < lngTimeout Then
    myScope.WriteString ":MEASure:RISetime"
    myScope.WriteString ":MEASure:RISetime?"
    varQueryResult = myScope.ReadNumber   ' Read risetime.
    Debug.Print "Risetime: " + _
        FormatNumber(varQueryResult * 1000000000, 1) + " ns"
  Else
    Debug.Print "Timeout waiting for single-shot trigger."
  End If

  Exit Sub

VisaComError:
  MsgBox "VISA COM Error:" + vbCrLf + Err.Description

End Sub
```

Synchronization with an Averaging Acquisition

When averaging, it is necessary to know when the average count has been reached. The :SINGle command does not average.

If it is known that a trigger will occur, a :DIGitize will acquire the complete number of averages, but if the number of averages is large, a timeout on the connection can occur.

The example below polls during the :DIGitize to prevent a timeout on the connection.

```
'
' Synchronizing in averaging acquisition mode.
' ===================================================================

Option Explicit

Public myMgr As VisaComLib.ResourceManager
Public myScope As VisaComLib.FormattedIO488
Public varQueryResult As Variant
Public strQueryResult As String

Private Declare Sub Sleep Lib "kernel32" (ByVal dwMilliseconds As Long)

Sub Main()

  On Error GoTo VisaComError

  ' Create the VISA COM I/O resource.
  Set myMgr = New VisaComLib.ResourceManager
  Set myScope = New VisaComLib.FormattedIO488
  Set myScope.IO = myMgr.Open("TCPIP0::130.29.69.12::inst0::INSTR")
  myScope.IO.Clear   ' Clear the interface.
  myScope.IO.Timeout = 5000

  ' Set up.
  ' -----------------------------------------------------------------
  ' Set up the trigger and horizontal scale.
  myScope.WriteString ":TRIGger:SWEep NORMal"
  myScope.WriteString ":TRIGger:MODE EDGE"
  myScope.WriteString ":TRIGger:EDGE:LEVel 2"
  myScope.WriteString ":TIMebase:SCALe 5e-8"

  ' Stop acquisitions and wait for the operation to complete.
  myScope.WriteString ":STOP"
  myScope.WriteString "*OPC?"
  strQueryResult = myScope.ReadString

  ' Set up average acquisition mode.
  Dim lngAverages As Long
  lngAverages = 256
  myScope.WriteString ":ACQuire:COUNt " + CStr(lngAverages)
  myScope.WriteString ":ACQuire:TYPE AVERage"
  ' Save *ESE (Standard Event Status Enable register) mask
  ' (so it can be restored later).
  Dim varInitialESE As Variant
  myScope.WriteString "*ESE?"
  varInitialESE = myScope.ReadNumber

  ' Set *ESE mask to allow only OPC (Operation Complete) bit.
  myScope.WriteString "*ESE " + CStr(CInt("&H01"))

  ' Acquire using :DIGitize.  Set up OPC bit to be set when the
  ' operation is complete.
  ' -----------------------------------------------------------------
  myScope.WriteString ":DIGitize"
  myScope.WriteString "*OPC"

  ' Assume the oscilloscope will trigger, if not put a check here.

  ' Wait until OPC becomes true (bit 5 of Status Byte register, STB,
  ' from Standard Event Status register, ESR, is set).  STB can be
  ' read during :DIGitize without generating a timeout.
  Do
    Sleep 4000   ' Poll more often than the timeout setting.
    varQueryResult = myScope.IO.ReadSTB
  Loop While (varQueryResult And &H20) = 0

  ' Clear ESR and restore previously saved *ESE mask.
  myScope.WriteString "*ESR?"   ' Clear ESR by reading it.
  varQueryResult = myScope.ReadNumber
  myScope.WriteString "*ESE " + CStr(varInitialESE)

  ' Get results.
  ' -----------------------------------------------------------------
  myScope.WriteString ":WAVeform:COUNt?"
  varQueryResult = myScope.ReadNumber
  Debug.Print "Averaged waveforms: " + CStr(varQueryResult)

  myScope.WriteString ":MEASure:RISetime"
  myScope.WriteString ":MEASure:RISetime?"
  varQueryResult = myScope.ReadNumber   ' Read risetime.
  Debug.Print "Risetime: " + _
      FormatNumber(varQueryResult * 1000000000, 1) + " ns"

  Exit Sub

VisaComError:
  MsgBox "VISA COM Error:" + vbCrLf + Err.Description

End Sub
```

35 More About Oscilloscope Commands

KEYSIGHT TECHNOLOGIES

Command Classifications

To help you use existing programs with your oscilloscope, or use current programs with the next generation of Keysight InfiniiVision oscilloscopes, commands are classified by the following categories:

- "Core Commands" on page 776
- "Non-Core Commands" on page 776
- "Obsolete Commands" on page 776

C Core Commands

Core commands are a common set of commands that provide basic oscilloscope functionality on this oscilloscope and future Keysight InfiniiVision oscilloscopes. Core commands are unlikely to be modified in the future. If you restrict your programs to core commands, the programs should work across product offerings in the future, assuming appropriate programming methods are employed.

N Non-Core Commands

Non-core commands are commands that provide specific features, but are not universal across all Keysight InfiniiVision oscilloscope models. Non-core commands may be modified or deleted in the future. With a command structure as complex as the one for your oscilloscope, some evolution over time is inevitable. Keysight's intent is to continue to expand command subsystems, such as the rich and evolving trigger feature set.

O Obsolete Commands

Obsolete commands are older forms of commands that are provided to reduce customer rework for existing systems and programs. Generally, these commands are mapped onto some of the Core and Non-core commands, but may not strictly have the same behavior as the new command. None of the obsolete commands are guaranteed to remain functional in future products. New systems and programs should use the Core (and Non-core) commands. Obsolete commands are listed in:

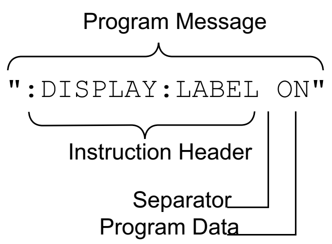
- Chapter 31, “Obsolete and Discontinued Commands,” starting on page 691

Valid Command/Query Strings

- "Program Message Syntax" on page 777
- "Duplicate Mnemonics" on page 781
- "Tree Traversal Rules and Multiple Commands" on page 781

Program Message Syntax

To program the instrument remotely, you must understand the command format and structure expected by the instrument. The IEEE 488.2 syntax rules govern how individual elements such as headers, separators, program data, and terminators may be grouped together to form complete instructions. Syntax definitions are also given to show how query responses are formatted. The following figure shows the main syntactical parts of a typical program statement.



Instructions (both commands and queries) normally appear as a string embedded in a statement of your host language, such as Visual Basic or C/C++. The only time a parameter is not meant to be expressed as a string is when the instruction's syntax definition specifies <block data>, such as <learn string>. There are only a few instructions that use block data.

Program messages can have long or short form commands (and data in some cases — see "Long Form to Short Form Truncation Rules" on page 778), and upper and/or lower case ASCII characters may be used. (Query responses, however, are always returned in upper case.)

Instructions are composed of two main parts:

- The header, which specifies the command or query to be sent.
- The program data, which provide additional information needed to clarify the meaning of the instruction.

Instruction Header

The instruction header is one or more mnemonics separated by colons (:) that represent the operation to be performed by the instrument.

":DISPlay:LABel ON" is a command. Queries are indicated by adding a question mark (?) to the end of the header, for example, ":DISPlay:LABel?". Many instructions can be used as either commands or queries, depending on whether or not you have included the question mark. The command and query forms of an instruction usually have different program data. Many queries do not use any program data.

There are three types of headers:

- "Simple Command Headers" on page 779
- "Compound Command Headers" on page 779
- "Common Command Headers" on page 779

White Space (Separator) White space is used to separate the instruction header from the program data. If the instruction does not require any program data parameters, you do not need to include any white space. White space is defined as one or more space characters. ASCII defines a space to be character 32 (in decimal).

Program Data Program data are used to clarify the meaning of the command or query. They provide necessary information, such as whether a function should be on or off, or which waveform is to be displayed. Each instruction's syntax definition shows the program data, as well as the values they accept. "Program Data Syntax Rules" on page 780 describes all of the general rules about acceptable values.

When there is more than one data parameter, they are separated by commas(,). Spaces can be added around the commas to improve readability.

Program Message Terminator The program instructions within a data message are executed after the program message terminator is received. The terminator may be either an NL (New Line) character, an EOI (End-Or-Identify) asserted in the programming interface, or a combination of the two. Asserting the EOI sets the EOI control line low on the last byte of the data message. The NL character is an ASCII linefeed (decimal 10).

NOTE **New Line Terminator Functions.** The NL (New Line) terminator has the same function as an EOS (End Of String) and EOT (End Of Text) terminator.

Long Form to Short Form Truncation Rules

To get the short form of a command/keyword:

- When the command/keyword is longer than four characters, use the first four characters of the command/keyword unless the fourth character is a vowel; when the fourth character is a vowel, use the first three characters of the command/keyword.
- When the command/keyword is four or fewer characters, use all of the characters.

Long Form	Short form
RANGe	RANG
PATTern	PATT

Long Form	Short form
TIMebase	TIM
DELay	DEL
TYPE	TYPE

In the oscilloscope programmer's documentation, the short form of a command is indicated by uppercase characters.

Programs written in long form are easily read and are almost self-documenting. The short form syntax conserves the amount of controller memory needed for program storage and reduces I/O activity.

Simple Command Headers

Simple command headers contain a single mnemonic. :AUToscale and :DIGitize are examples of simple command headers typically used in the oscilloscope. The syntax is:

```
<program mnemonic><terminator>
```

Simple command headers must occur at the beginning of a program message; if not, they must be preceded by a colon.

When program data must be included with the simple command header (for example, :DIGitize CHANnel1), white space is added to separate the data from the header. The syntax is:

```
<program mnemonic><separator><program data><terminator>
```

Compound Command Headers

Compound command headers are a combination of two or more program mnemonics. The first mnemonic selects the subsystem, and the second mnemonic selects the function within that subsystem. The mnemonics within the compound message are separated by colons. For example, to execute a single function within a subsystem:

```
:<subsystem>:<function><separator><program data><terminator>
```

For example, :CHANnel1:BWLimit ON

Common Command Headers

Common command headers control IEEE 488.2 functions within the instrument (such as clear status). Their syntax is:

```
*<command header><terminator>
```

No space or separator is allowed between the asterisk (*) and the command header. *CLS is an example of a common command header.

Program Data Syntax Rules

Program data is used to convey a parameter information related to the command header. At least one space must separate the command header or query header from the program data.

```
<program mnemonic><separator><data><terminator>
```

When a program mnemonic or query has multiple program data, a comma separates sequential program data.

```
<program mnemonic><separator><data>,<data><terminator>
```

For example, :MEASure:DELay CHANnel1,CHANnel2 has two program data: CHANnel1 and CHANnel2.

Two main types of program data are used in commands: character and numeric.

Character Program Data Character program data is used to convey parameter information as alpha or alphanumeric strings. For example, the :TIMebase:MODE command can be set to normal, zoomed (delayed), XY, or ROLL. The character program data in this case may be MAIN, WINDow, XY, or ROLL. The command :TIMebase:MODE WINDow sets the time base mode to zoomed.

The available mnemonics for character program data are always included with the command's syntax definition.

When sending commands, you may either the long form or short form (if one exists). Uppercase and lowercase letters may be mixed freely.

When receiving query responses, uppercase letters are used exclusively.

Numeric Program Data Some command headers require program data to be expressed numerically. For example, :TIMebase:RANGe requires the desired full scale range to be expressed numerically.

For numeric program data, you have the option of using exponential notation or using suffix multipliers to indicate the numeric value. The following numbers are all equal:

```
28 = 0.28E2 = 280e-1 = 28000m = 0.028K = 28e-3K.
```

When a syntax definition specifies that a number is an integer, that means that the number should be whole. Any fractional part will be ignored, truncating the number. Numeric data parameters accept fractional values are called real numbers.

All numbers must be strings of ASCII characters. Thus, when sending the number 9, you would send a byte representing the ASCII code for the character 9 (which is 57). A three-digit number like 102 would take up three bytes (ASCII codes 49, 48, and 50). This is handled automatically when you include the entire instruction in a string.

Duplicate Mnemonics

Identical function mnemonics can be used in more than one subsystem. For example, the function mnemonic RANGe may be used to change the vertical range or to change the horizontal range:

```
:CHANnel1:RANGe .4
```

Sets the vertical range of channel 1 to 0.4 volts full scale.

```
:TIMebase:RANGe 1
```

Sets the horizontal time base to 1 second full scale.

:CHANnel1 and :TIMebase are subsystem selectors and determine which range is being modified.

Tree Traversal Rules and Multiple Commands

Command headers are created by traversing down the command tree. A legal command header would be :TIMebase:RANGe. This is referred to as a *compound header*. A compound header is a header made of two or more mnemonics separated by colons. The mnemonic created contains no spaces.

The following rules apply to traversing the tree:

- A leading colon (<NL> or EOI true on the last byte) places the parser at the root of the command tree. A leading colon is a colon that is the first character of a program header. Executing a subsystem command lets you access that subsystem until a leading colon or a program message terminator (<NL>) or EOI true is found.
- In the command tree, use the last mnemonic in the compound header as the reference point (for example, RANGe). Then find the last colon above that mnemonic (TIMebase:). That is the point where the parser resides. Any command below that point can be sent within the current program message without sending the mnemonics which appear above them (for example, POSition).

The output statements in the examples are written using the Keysight VISA COM library in Visual Basic. The quoted string is placed on the bus, followed by a carriage return and linefeed (CRLF).

To execute more than one function within the same subsystem, separate the functions with a semicolon (;):

```
:<subsystem>:<function><separator><data>;<function><separator><data><ter
minator>
```

For example:

```
myScope.WriteString ":TIMebase:RANGe 0.5;POSition 0"
```

NOTE

The colon between TIMebase and RANGe is necessary because TIMebase:RANGe is a compound command. The semicolon between the RANGe command and the POSition command is the required program message unit separator. The POSition command does not need TIMebase preceding it because the TIMebase:RANGe command sets the parser to the TIMebase node in the tree.

Example 2: Program Message Terminator Sets Parser Back to Root

```
myScope.WriteString ":TIMebase:REFerence CENTer;POSition 0.00001"
```

or

```
myScope.WriteString ":TIMebase:REFerence CENTer"
myScope.WriteString ":TIMebase:POSition 0.00001"
```

NOTE

In the first line of example 2, the subsystem selector is implied for the POSition command in the compound command. The POSition command must be in the same program message as the REFerence command because the program message terminator places the parser back at the root of the command tree.

A second way to send these commands is by placing TIMebase: before the POSition command as shown in the second part of example 2. The space after POSition is required.

Example 3: Selecting Multiple Subsystems

You can send multiple program commands and program queries for different subsystems on the same line by separating each command with a semicolon. The colon following the semicolon enables you to enter a new subsystem. For example:

```
<program mnemonic><data>;:<program mnemonic><data><terminator>
```

For example:

```
myScope.WriteString ":TIMebase:REFerence CENTer;:DISPlay:VECTors ON"
```

NOTE

The leading colon before DISPlay:VECTors ON tells the parser to go back to the root of the command tree. The parser can then see the DISPlay:VECTors ON command. The space between REFerence and CENter is required; so is the space between VECTors and ON.

Multiple commands may be any combination of compound and simple commands.

Query Return Values

Command headers immediately followed by a question mark (?) are queries. Queries are used to get results of measurements made by the instrument or to find out how the instrument is currently configured.

After receiving a query, the instrument interrogates the requested function and places the answer in its output queue. The answer remains in the output queue until it is read or another command is issued.

When read, the answer is transmitted across the bus to the designated listener (typically a controller). For example, the query :TIMebase:RANGe? places the current time base setting in the output queue. When using the Keysight VISA COM library in Visual Basic, the controller statements:

```
Dim strQueryResult As String
myScope.WriteString ":TIMebase:RANGe?"
strQueryResult = myScope.ReadString
```

pass the value across the bus to the controller and place it in the variable strQueryResult.

NOTE **Read Query Results Before Sending Another Command.** Sending another command or query before reading the result of a query clears the output buffer (the current response) and places a Query INTERRUPTED error in the error queue.

Infinity Representation The representation of infinity is +9.9E+37. This is also the value returned when a measurement cannot be made.

All Oscilloscope Commands Are Sequential

IEEE 488.2 makes the distinction between sequential and overlapped commands:

- *Sequential commands* finish their task before the execution of the next command starts.
- *Overlapped commands* run concurrently. Commands following an overlapped command may be started before the overlapped command is completed.

All of the oscilloscope commands are sequential.

36 Programming Examples

Example programs are ASCII text files that can be cut from the help file and pasted into your favorite text editor.

VISA COM Examples

- "VISA COM Example in Visual Basic" on page 786
- "VISA COM Example in C#" on page 795
- "VISA COM Example in Visual Basic .NET" on page 804
- "VISA COM Example in Python" on page 812

VISA COM Example in Visual Basic

To run this example in Visual Basic for Applications (VBA):

1. Start the application that provides Visual Basic for Applications (for example, Microsoft Excel).
2. Press ALT+F11 to launch the Visual Basic editor.
3. Reference the Keysight VISA COM library:
   a. Choose **Tools > References...** from the main menu.
   b. In the References dialog, check the "VISA COM 5.5 Type Library".
   c. Click **OK**.
4. Choose **Insert > Module**.
5. Cut-and-paste the code that follows into the editor.
6. Edit the program to use the VISA address of your oscilloscope, and save the changes.
7. Run the program.

```
'
' Keysight VISA COM Example in Visual Basic
' -------------------------------------------------------------------
' This program illustrates a few commonly-used programming
' features of your Keysight oscilloscope.
' -------------------------------------------------------------------

Option Explicit

Public myMgr As VisaComLib.ResourceManager
Public myScope As VisaComLib.FormattedIO488
Public varQueryResult As Variant
Public strQueryResult As String

' For Sleep subroutine.
Private Declare Sub Sleep Lib "kernel32" (ByVal dwMilliseconds As Long)

'
' Main Program
' -------------------------------------------------------------------

Sub Main()
```

```
  On Error GoTo VisaComError

  ' Create the VISA COM I/O resource.
  Set myMgr = New VisaComLib.ResourceManager
  Set myScope = New VisaComLib.FormattedIO488
  Set myScope.IO = _
      myMgr.Open("USB0::0x0957::0x17A6::US50210029::0::INSTR")
  myScope.IO.Clear   ' Clear the interface.
  myScope.IO.Timeout = 10000   ' Set I/O communication timeout.

  ' Initialize - start from a known state.
  Initialize

  ' Capture data.
  Capture

  ' Analyze the captured waveform.
  Analyze

  Exit Sub

VisaComError:
  MsgBox "VISA COM Error:" + vbCrLf + Err.Description
  End

End Sub

'
' Initialize the oscilloscope to a known state.
' --------------------------------------------------------------------

Private Sub Initialize()

  On Error GoTo VisaComError

  ' Get and display the device's *IDN? string.
  strQueryResult = DoQueryString("*IDN?")
  Debug.Print "Identification string: " + strQueryResult

  ' Clear status and load the default setup.
  DoCommand "*CLS"
  DoCommand "*RST"

  Exit Sub

VisaComError:
  MsgBox "VISA COM Error:" + vbCrLf + Err.Description
  End

End Sub

'
' Capture the waveform.
' --------------------------------------------------------------------

Private Sub Capture()
```

```
On Error GoTo VisaComError

' Use auto-scale to automatically configure oscilloscope.
' -----------------------------------------------------------------
DoCommand ":AUToscale"

' Set trigger mode (EDGE, PULSe, PATTern, etc., and input source.
DoCommand ":TRIGger:MODE EDGE"
Debug.Print "Trigger mode: " + _
    DoQueryString(":TRIGger:MODE?")

' Set EDGE trigger parameters.
DoCommand ":TRIGger:EDGE:SOURCe CHANnel1"
Debug.Print "Trigger edge source: " + _
    DoQueryString(":TRIGger:EDGE:SOURce?")

DoCommand ":TRIGger:EDGE:LEVel 1.5"
Debug.Print "Trigger edge level: " + _
    DoQueryString(":TRIGger:EDGE:LEVel?")

DoCommand ":TRIGger:EDGE:SLOPe POSitive"
Debug.Print "Trigger edge slope: " + _
    DoQueryString(":TRIGger:EDGE:SLOPe?")

' Save oscilloscope configuration.
' -----------------------------------------------------------------
varQueryResult = DoQueryIEEEBlock_UI1(":SYSTem:SETup?")

' Output setup string to a file:
Dim strPath As String
strPath = "c:\scope\config\setup.dat"
Dim hFile As Long
hFile = FreeFile
Open strPath For Binary Access Write Lock Write As hFile
Put hFile, , varQueryResult   ' Write data.
Close hFile   ' Close file.
Debug.Print "Setup bytes saved: " + CStr(LenB(varQueryResult))

' Change settings with individual commands:
' -----------------------------------------------------------------

' Set vertical scale and offset.
DoCommand ":CHANnel1:SCALe 0.05"
Debug.Print "Channel 1 vertical scale: " + _
    DoQueryString(":CHANnel1:SCALe?")

DoCommand ":CHANnel1:OFFSet -1.5"
Debug.Print "Channel 1 vertical offset: " + _
    DoQueryString(":CHANnel1:OFFSet?")

' Set horizontal scale and offset.
DoCommand ":TIMebase:SCALe 0.0002"
Debug.Print "Timebase scale: " + _
    DoQueryString(":TIMebase:SCALe?")

DoCommand ":TIMebase:POSition 0.0"
Debug.Print "Timebase position: " + _
```

```
        DoQueryString(":TIMebase:POSition?")

    ' Set the acquisition type (NORMal, PEAK, AVERage, or HRESolution).
    DoCommand ":ACQuire:TYPE NORMal"
    Debug.Print "Acquire type: " + _
        DoQueryString(":ACQuire:TYPE?")

    ' Or, configure by loading a previously saved setup.
    ' -----------------------------------------------------------------
    Dim varSetupString As Variant
    strPath = "c:\scope\config\setup.dat"
    Open strPath For Binary Access Read As hFile   ' Open file for input.
    Get hFile, , varSetupString   ' Read data.
    Close hFile   ' Close file.
    ' Write learn string back to oscilloscope using ":SYSTem:SETup"
    ' command:
    DoCommandIEEEBlock ":SYSTem:SETup", varSetupString
    Debug.Print "Setup bytes restored: " + CStr(LenB(varSetupString))

    ' Capture an acquisition using :DIGitize.
    ' -----------------------------------------------------------------
    DoCommand ":DIGitize CHANnel1"

    Exit Sub

  VisaComError:
    MsgBox "VISA COM Error:" + vbCrLf + Err.Description
    End

  End Sub

  '
  ' Analyze the captured waveform.
  ' -------------------------------------------------------------------

  Private Sub Analyze()

    On Error GoTo VisaComError

    ' Make a couple of measurements.
    ' -----------------------------------------------------------------
    DoCommand ":MEASure:SOURce CHANnel1"
    Debug.Print "Measure source: " + _
        DoQueryString(":MEASure:SOURce?")

    DoCommand ":MEASure:FREQuency"
    varQueryResult = DoQueryNumber(":MEASure:FREQuency?")
    MsgBox "Frequency:" + vbCrLf + _
        FormatNumber(varQueryResult / 1000, 4) + " kHz"

    DoCommand ":MEASure:VAMPlitude"
    varQueryResult = DoQueryNumber(":MEASure:VAMPlitude?")
    MsgBox "Vertical amplitude:" + vbCrLf + _
        FormatNumber(varQueryResult, 4) + " V"


    ' Download the screen image.
```

```
' -----------------------------------------------------------------
' Get screen image.
DoCommand ":HARDcopy:INKSaver OFF"
Dim byteData() As Byte
byteData = DoQueryIEEEBlock_UI1(":DISPlay:DATA? PNG, COLor")

' Save screen image to a file.
Dim strPath As String
strPath = "c:\scope\data\screen.png"
If Len(Dir(strPath)) Then
  Kill strPath   ' Remove file if it exists.
End If

Dim hFile As Long
hFile = FreeFile
Open strPath For Binary Access Write Lock Write As hFile
Put hFile, , byteData   ' Write data.
Close hFile   ' Close file.
MsgBox "Screen image (" + CStr(UBound(byteData) + 1) + _
    " bytes) written to " + strPath


' Download waveform data.
' -----------------------------------------------------------------

' Set the waveform points mode.
DoCommand ":WAVeform:POINts:MODE RAW"
Debug.Print "Waveform points mode: " + _
    DoQueryString(":WAVeform:POINts:MODE?")

' Get the number of waveform points available.
Debug.Print "Waveform points available: " + _
    DoQueryString(":WAVeform:POINts?")

' Set the waveform source.
DoCommand ":WAVeform:SOURce CHANnel1"
Debug.Print "Waveform source: " + _
    DoQueryString(":WAVeform:SOURce?")

' Choose the format of the data returned (WORD, BYTE, ASCII):
DoCommand ":WAVeform:FORMat BYTE"
Debug.Print "Waveform format: " + _
    DoQueryString(":WAVeform:FORMat?")

' Display the waveform settings:
Dim Preamble()
Dim intFormat As Integer
Dim intType As Integer
Dim lngPoints As Long
Dim lngCount As Long
Dim dblXIncrement As Double
Dim dblXOrigin As Double
Dim lngXReference As Long
Dim sngYIncrement As Single
Dim sngYOrigin As Single
Dim lngYReference As Long
```

```
Preamble() = DoQueryNumbers(":WAVeform:PREamble?")

intFormat = Preamble(0)
intType = Preamble(1)
lngPoints = Preamble(2)
lngCount = Preamble(3)
dblXIncrement = Preamble(4)
dblXOrigin = Preamble(5)
lngXReference = Preamble(6)
sngYIncrement = Preamble(7)
sngYOrigin = Preamble(8)
lngYReference = Preamble(9)

If intFormat = 0 Then
  Debug.Print "Waveform format: BYTE"
ElseIf intFormat = 1 Then
  Debug.Print "Waveform format: WORD"
ElseIf intFormat = 4 Then
  Debug.Print "Waveform format: ASCii"
End If

If intType = 0 Then
  Debug.Print "Acquisition type: NORMal"
ElseIf intType = 1 Then
  Debug.Print "Acquisition type: PEAK"
ElseIf intType = 2 Then
  Debug.Print "Acquisition type: AVERage"
ElseIf intType = 3 Then
  Debug.Print "Acquisition type: HRESolution"
End If

Debug.Print "Waveform points: " + _
    FormatNumber(lngPoints, 0)

Debug.Print "Waveform average count: " + _
    FormatNumber(lngCount, 0)

Debug.Print "Waveform X increment: " + _
    Format(dblXIncrement, "Scientific")

Debug.Print "Waveform X origin: " + _
    Format(dblXOrigin, "Scientific")

Debug.Print "Waveform X reference: " + _
    FormatNumber(lngXReference, 0)

Debug.Print "Waveform Y increment: " + _
    Format(sngYIncrement, "Scientific")

Debug.Print "Waveform Y origin: " + _
    FormatNumber(sngYOrigin, 0)

Debug.Print "Waveform Y reference: " + _
    FormatNumber(lngYReference, 0)

' Get the waveform data
varQueryResult = DoQueryIEEEBlock_UI1(":WAVeform:DATA?")
```

```
  Debug.Print "Number of data values: " + _
      CStr(UBound(varQueryResult) + 1)

  ' Set up output file:
  strPath = "c:\scope\data\waveform_data.csv"

  ' Open file for output.
  Open strPath For Output Access Write Lock Write As hFile

  ' Output waveform data in CSV format.
  Dim lngDataValue As Long
  Dim lngI As Long

  For lngI = 0 To UBound(varQueryResult)
    lngDataValue = varQueryResult(lngI)

    ' Write time value, voltage value.
    Print #hFile, _
        FormatNumber(dblXOrigin + (lngI * dblXIncrement), 9) + _
        ", " + _
        FormatNumber(((lngDataValue - lngYReference) * _
        sngYIncrement) + sngYOrigin)

  Next lngI

  ' Close output file.
  Close hFile   ' Close file.
  MsgBox "Waveform format BYTE data written to " + _
      "c:\scope\data\waveform_data.csv."

  Exit Sub

VisaComError:
  MsgBox "VISA COM Error:" + vbCrLf + Err.Description
  End

End Sub

Private Sub DoCommand(command As String)

  On Error GoTo VisaComError

  myScope.WriteString command
  CheckInstrumentErrors

  Exit Sub

VisaComError:
  MsgBox "VISA COM Error: " + vbCrLf + CStr(Err.Number) + ", " + _
      Err.Source + ", " + _
      Err.Description, vbExclamation, "VISA COM Error"
  End

End Sub

Private Sub DoCommandIEEEBlock(command As String, data As Variant)
```

```
  On Error GoTo VisaComError

  Dim strErrors As String

  myScope.WriteIEEEBlock command, data
  CheckInstrumentErrors

  Exit Sub

VisaComError:
  MsgBox "VISA COM Error: " + vbCrLf + CStr(Err.Number) + ", " + _
      Err.Source + ", " + _
      Err.Description, vbExclamation, "VISA COM Error"
  End

End Sub

Private Function DoQueryString(query As String) As String

  On Error GoTo VisaComError

  myScope.WriteString query
  DoQueryString = myScope.ReadString
  CheckInstrumentErrors

  Exit Function

VisaComError:
  MsgBox "VISA COM Error: " + vbCrLf + CStr(Err.Number) + ", " + _
      Err.Source + ", " + _
      Err.Description, vbExclamation, "VISA COM Error"
  End

End Function

Private Function DoQueryNumber(query As String) As Variant

  On Error GoTo VisaComError

  myScope.WriteString query
  DoQueryNumber = myScope.ReadNumber
  CheckInstrumentErrors

  Exit Function

VisaComError:
  MsgBox "VISA COM Error: " + vbCrLf + CStr(Err.Number) + ", " + _
      Err.Source + ", " + _
      Err.Description, vbExclamation, "VISA COM Error"
  End

End Function

Private Function DoQueryNumbers(query As String) As Variant()

  On Error GoTo VisaComError
  Dim strErrors As String

  myScope.WriteString query
  DoQueryNumbers = myScope.ReadList
  CheckInstrumentErrors

  Exit Function

VisaComError:
  MsgBox "VISA COM Error: " + vbCrLf + CStr(Err.Number) + ", " + _
      Err.Source + ", " + _
      Err.Description, vbExclamation, "VISA COM Error"
  End

End Function

Private Function DoQueryIEEEBlock_UI1(query As String) As Variant

  On Error GoTo VisaComError

  myScope.WriteString query
  DoQueryIEEEBlock_UI1 = myScope.ReadIEEEBlock(BinaryType_UI1)
  CheckInstrumentErrors

  Exit Function

VisaComError:
  MsgBox "VISA COM Error: " + vbCrLf + CStr(Err.Number) + ", " + _
      Err.Source + ", " + _
      Err.Description, vbExclamation, "VISA COM Error"
  End

End Function

Private Sub CheckInstrumentErrors()

  On Error GoTo VisaComError

  Dim strErrVal As String
  Dim strOut As String

  myScope.WriteString ":SYSTem:ERRor?"   ' Query any errors data.
  strErrVal = myScope.ReadString         ' Read: Errnum,"Error String".
  While Val(strErrVal) <> 0              ' End if find: 0,"No Error".
    strOut = strOut + "INST Error: " + strErrVal
    myScope.WriteString ":SYSTem:ERRor?"   ' Request error message.
    strErrVal = myScope.ReadString         ' Read error message.
  Wend

  If Not strOut = "" Then
    MsgBox strOut, vbExclamation, "INST Error Messages"
    myScope.FlushWrite (False)
    myScope.FlushRead

  End If

  Exit Sub
```

```
VisaComError:
  MsgBox "VISA COM Error: " + vbCrLf + Err.Description

End Sub
```

VISA COM Example in C#

To compile and run this example in Microsoft Visual Studio 2008:

1. Open Visual Studio.
2. Create a new Visual C#, Windows, Console Application project.
3. Cut-and-paste the code that follows into the C# source file.
4. Edit the program to use the VISA address of your oscilloscope.
5. Add a reference to the VISA COM 5.5 Type Library:
   a. Right-click the project you wish to modify (not the solution) in the Solution Explorer window of the Microsoft Visual Studio environment.
   b. Choose **Add Reference...**.
   c. In the Add Reference dialog, select the **COM** tab.
   d. Select **VISA COM 5.5 Type Library**; then click **OK**.
6. Build and run the program.

For more information, see the VISA COM Help that comes with Keysight IO Libraries Suite 16.

```
/*
 * Keysight VISA COM Example in C#
 * -------------------------------------------------------------------
 * This program illustrates a few commonly used programming
 * features of your Keysight oscilloscope.
 * -------------------------------------------------------------------
 */

using System;
using System.IO;
using System.Text;
using Ivi.Visa.Interop;
using System.Runtime.InteropServices;

namespace InfiniiVision
{
  class VisaComInstrumentApp
  {
    private static VisaComInstrument myScope;

    public static void Main(string[] args)
    {
      try
      {
        myScope = new
```

```
          VisaComInstrument("USB0::0x0957::0x17A6::US50210029::0::INSTR"
);
        myScope.SetTimeoutSeconds(10);

        // Initialize - start from a known state.
        Initialize();

        // Capture data.
        Capture();

        // Analyze the captured waveform.
        Analyze();
      }
      catch (System.ApplicationException err)
      {
        Console.WriteLine("*** VISA COM Error : " + err.Message);
      }
      catch (System.SystemException err)
      {
        Console.WriteLine("*** System Error Message : " + err.Message);
      }
      catch (System.Exception err)
      {
        System.Diagnostics.Debug.Fail("Unexpected Error");
        Console.WriteLine("*** Unexpected Error : " + err.Message);
      }
      finally
      {
        myScope.Close();
      }
    }

    /*
     * Initialize the oscilloscope to a known state.
     * --------------------------------------------------------------
     */
    private static void Initialize()
    {
      string strResults;

      // Get and display the device's *IDN? string.
      strResults = myScope.DoQueryString("*IDN?");
      Console.WriteLine("*IDN? result is: {0}", strResults);

      // Clear status and load the default setup.
      myScope.DoCommand("*CLS");
      myScope.DoCommand("*RST");
    }

    /*
     * Capture the waveform.
     * --------------------------------------------------------------
     */
    private static void Capture()
    {
      // Use auto-scale to automatically configure oscilloscope.
      myScope.DoCommand(":AUToscale");
      // Set trigger mode (EDGE, PULSe, PATTern, etc., and input source.
      myScope.DoCommand(":TRIGger:MODE EDGE");
      Console.WriteLine("Trigger mode: {0}",
          myScope.DoQueryString(":TRIGger:MODE?"));

      // Set EDGE trigger parameters.
      myScope.DoCommand(":TRIGger:EDGE:SOURCe CHANnel1");
      Console.WriteLine("Trigger edge source: {0}",
          myScope.DoQueryString(":TRIGger:EDGE:SOURce?"));

      myScope.DoCommand(":TRIGger:EDGE:LEVel 1.5");
      Console.WriteLine("Trigger edge level: {0}",
          myScope.DoQueryString(":TRIGger:EDGE:LEVel?"));

      myScope.DoCommand(":TRIGger:EDGE:SLOPe POSitive");
      Console.WriteLine("Trigger edge slope: {0}",
          myScope.DoQueryString(":TRIGger:EDGE:SLOPe?"));

      // Save oscilloscope configuration.
      byte[] ResultsArray;   // Results array.
      int nLength;   // Number of bytes returned from instrument.
      string strPath;

      // Query and read setup string.
      ResultsArray = myScope.DoQueryIEEEBlock(":SYSTem:SETup?");
      nLength = ResultsArray.Length;

      // Write setup string to file.
      strPath = "c:\\scope\\config\\setup.stp";
      FileStream fStream = File.Open(strPath, FileMode.Create);
      fStream.Write(ResultsArray, 0, nLength);
      fStream.Close();
      Console.WriteLine("Setup bytes saved: {0}", nLength);

      // Change settings with individual commands:

      // Set vertical scale and offset.
      myScope.DoCommand(":CHANnel1:SCALe 0.05");
      Console.WriteLine("Channel 1 vertical scale: {0}",
          myScope.DoQueryString(":CHANnel1:SCALe?"));

      myScope.DoCommand(":CHANnel1:OFFSet -1.5");
      Console.WriteLine("Channel 1 vertical offset: {0}",
          myScope.DoQueryString(":CHANnel1:OFFSet?"));

      // Set horizontal scale and offset.
      myScope.DoCommand(":TIMebase:SCALe 0.0002");
      Console.WriteLine("Timebase scale: {0}",
          myScope.DoQueryString(":TIMebase:SCALe?"));

      myScope.DoCommand(":TIMebase:POSition 0.0");
      Console.WriteLine("Timebase position: {0}",
          myScope.DoQueryString(":TIMebase:POSition?"));

      // Set the acquisition type (NORMal, PEAK, AVERage, or HRESolution
).
```

```
  myScope.DoCommand(":ACQuire:TYPE NORMal");
  Console.WriteLine("Acquire type: {0}",
      myScope.DoQueryString(":ACQuire:TYPE?"));

  // Or, configure by loading a previously saved setup.
  byte[] DataArray;
  int nBytesWritten;

  // Read setup string from file.
  strPath = "c:\\scope\\config\\setup.stp";
  DataArray = File.ReadAllBytes(strPath);
  nBytesWritten = DataArray.Length;

  // Restore setup string.
  myScope.DoCommandIEEEBlock(":SYSTem:SETup", DataArray);
  Console.WriteLine("Setup bytes restored: {0}", nBytesWritten);

  // Capture an acquisition using :DIGitize.
  myScope.DoCommand(":DIGitize CHANnel1");
}

/*
 * Analyze the captured waveform.
 * --------------------------------------------------------------
 */
private static void Analyze()
{
  byte[] ResultsArray;   // Results array.
  int nLength;   // Number of bytes returned from instrument.
  string strPath;

  // Make a couple of measurements.
  // ------------------------------------------------------------
  myScope.DoCommand(":MEASure:SOURce CHANnel1");
  Console.WriteLine("Measure source: {0}",
      myScope.DoQueryString(":MEASure:SOURce?"));

  double fResult;
  myScope.DoCommand(":MEASure:FREQuency");
  fResult = myScope.DoQueryNumber(":MEASure:FREQuency?");
  Console.WriteLine("Frequency: {0:F4} kHz", fResult / 1000);

  myScope.DoCommand(":MEASure:VAMPlitude");
  fResult = myScope.DoQueryNumber(":MEASure:VAMPlitude?");
  Console.WriteLine("Vertical amplitude: {0:F2} V", fResult);

  // Download the screen image.
  // ------------------------------------------------------------
  myScope.DoCommand(":HARDcopy:INKSaver OFF");

  // Get the screen data.
  ResultsArray =
      myScope.DoQueryIEEEBlock(":DISPlay:DATA? PNG, COLor");
  nLength = ResultsArray.Length;

  // Store the screen data to a file.
  strPath = "c:\\scope\\data\\screen.png";
```

```
FileStream fStream = File.Open(strPath, FileMode.Create);
fStream.Write(ResultsArray, 0, nLength);
fStream.Close();
Console.WriteLine("Screen image ({0} bytes) written to {1}",
    nLength, strPath);

// Download waveform data.
// --------------------------------------------------------------

// Set the waveform points mode.
myScope.DoCommand(":WAVeform:POINts:MODE RAW");
Console.WriteLine("Waveform points mode: {0}",
    myScope.DoQueryString(":WAVeform:POINts:MODE?"));

// Get the number of waveform points available.
Console.WriteLine("Waveform points available: {0}",
    myScope.DoQueryString(":WAVeform:POINts?"));

// Set the waveform source.
myScope.DoCommand(":WAVeform:SOURce CHANnel1");
Console.WriteLine("Waveform source: {0}",
    myScope.DoQueryString(":WAVeform:SOURce?"));

// Choose the format of the data returned (WORD, BYTE, ASCII):
myScope.DoCommand(":WAVeform:FORMat BYTE");
Console.WriteLine("Waveform format: {0}",
    myScope.DoQueryString(":WAVeform:FORMat?"));

// Display the waveform settings:
double[] fResultsArray;
fResultsArray = myScope.DoQueryNumbers(":WAVeform:PREamble?");

double fFormat = fResultsArray[0];
if (fFormat == 0.0)
{
  Console.WriteLine("Waveform format: BYTE");
}
else if (fFormat == 1.0)
{
  Console.WriteLine("Waveform format: WORD");
}
else if (fFormat == 2.0)
{
  Console.WriteLine("Waveform format: ASCii");
}

double fType = fResultsArray[1];
if (fType == 0.0)
{
  Console.WriteLine("Acquire type: NORMal");
}
else if (fType == 1.0)
{
  Console.WriteLine("Acquire type: PEAK");
}
else if (fType == 2.0)
{
        Console.WriteLine("Acquire type: AVERage");
      }
      else if (fType == 3.0)
      {
        Console.WriteLine("Acquire type: HRESolution");
      }

      double fPoints = fResultsArray[2];
      Console.WriteLine("Waveform points: {0:e}", fPoints);

      double fCount = fResultsArray[3];
      Console.WriteLine("Waveform average count: {0:e}", fCount);

      double fXincrement = fResultsArray[4];
      Console.WriteLine("Waveform X increment: {0:e}", fXincrement);

      double fXorigin = fResultsArray[5];
      Console.WriteLine("Waveform X origin: {0:e}", fXorigin);

      double fXreference = fResultsArray[6];
      Console.WriteLine("Waveform X reference: {0:e}", fXreference);

      double fYincrement = fResultsArray[7];
      Console.WriteLine("Waveform Y increment: {0:e}", fYincrement);

      double fYorigin = fResultsArray[8];
      Console.WriteLine("Waveform Y origin: {0:e}", fYorigin);

      double fYreference = fResultsArray[9];
      Console.WriteLine("Waveform Y reference: {0:e}", fYreference);

      // Read waveform data.
      ResultsArray = myScope.DoQueryIEEEBlock(":WAVeform:DATA?");
      nLength = ResultsArray.Length;
      Console.WriteLine("Number of data values: {0}", nLength);

      // Set up output file:
      strPath = "c:\\scope\\data\\waveform_data.csv";
      if (File.Exists(strPath)) File.Delete(strPath);

      // Open file for output.
      StreamWriter writer = File.CreateText(strPath);

      // Output waveform data in CSV format.
      for (int i = 0; i < nLength - 1; i++)
        writer.WriteLine("{0:f9}, {1:f6}",
            fXorigin + ((float)i * fXincrement),
            (((float)ResultsArray[i] - fYreference)
            * fYincrement) + fYorigin);

      // Close output file.
      writer.Close();
      Console.WriteLine("Waveform format BYTE data written to {0}",
          strPath);
    }
  }
```

```
class VisaComInstrument
{
  private ResourceManagerClass m_ResourceManager;
  private FormattedIO488Class m_IoObject;
  private string m_strVisaAddress;

  // Constructor.
  public VisaComInstrument(string strVisaAddress)
  {
    // Save VISA address in member variable.
    m_strVisaAddress = strVisaAddress;

    // Open the default VISA COM IO object.
    OpenIo();

    // Clear the interface.
    m_IoObject.IO.Clear();
  }

  public void DoCommand(string strCommand)
  {
    // Send the command.
    m_IoObject.WriteString(strCommand, true);

    // Check for inst errors.
    CheckInstrumentErrors(strCommand);
  }

  public void DoCommandIEEEBlock(string strCommand,
      byte[] DataArray)
  {
    // Send the command to the device.
    m_IoObject.WriteIEEEBlock(strCommand, DataArray, true);

    // Check for inst errors.
    CheckInstrumentErrors(strCommand);
  }

  public string DoQueryString(string strQuery)
  {
    // Send the query.
    m_IoObject.WriteString(strQuery, true);

    // Get the result string.
    string strResults;
    strResults = m_IoObject.ReadString();

    // Check for inst errors.
    CheckInstrumentErrors(strQuery);

    // Return results string.
    return strResults;
  }

  public double DoQueryNumber(string strQuery)
  {
    // Send the query.
    m_IoObject.WriteString(strQuery, true);

    // Get the result number.
    double fResult;
    fResult = (double)m_IoObject.ReadNumber(
      IEEEASCIIType.ASCIIType_R8, true);

    // Check for inst errors.
    CheckInstrumentErrors(strQuery);

    // Return result number.
    return fResult;
  }

  public double[] DoQueryNumbers(string strQuery)
  {
    // Send the query.
    m_IoObject.WriteString(strQuery, true);

    // Get the result numbers.
    double[] fResultsArray;
    fResultsArray = (double[])m_IoObject.ReadList(
      IEEEASCIIType.ASCIIType_R8, ",;");

    // Check for inst errors.
    CheckInstrumentErrors(strQuery);

    // Return result numbers.
    return fResultsArray;
  }

  public byte[] DoQueryIEEEBlock(string strQuery)
  {
    // Send the query.
    m_IoObject.WriteString(strQuery, true);

    // Get the results array.
    System.Threading.Thread.Sleep(2000); // Delay before reading.
    byte[] ResultsArray;
    ResultsArray = (byte[])m_IoObject.ReadIEEEBlock(
      IEEEBinaryType.BinaryType_UI1, false, true);

    // Check for inst errors.
    CheckInstrumentErrors(strQuery);

    // Return results array.
    return ResultsArray;
  }

  private void CheckInstrumentErrors(string strCommand)
  {
    // Check for instrument errors.
    string strInstrumentError;
    bool bFirstError = true;

    do   // While not "0,No error".
    {
      m_IoObject.WriteString(":SYSTem:ERRor?", true);
      strInstrumentError = m_IoObject.ReadString();

      if (!strInstrumentError.ToString().StartsWith("+0,"))
      {
        if (bFirstError)
        {
          Console.WriteLine("ERROR(s) for command '{0}': ",
            strCommand);
          bFirstError = false;
        }
        Console.Write(strInstrumentError);
      }
    } while (!strInstrumentError.ToString().StartsWith("+0,"));
  }

  private void OpenIo()
  {
    m_ResourceManager = new ResourceManagerClass();
    m_IoObject = new FormattedIO488Class();

    // Open the default VISA COM IO object.
    try
    {
      m_IoObject.IO =
        (IMessage)m_ResourceManager.Open(m_strVisaAddress,
        AccessMode.NO_LOCK, 0, "");
    }
    catch (Exception e)
    {
      Console.WriteLine("An error occurred: {0}", e.Message);
    }
  }

  public void SetTimeoutSeconds(int nSeconds)
  {
    m_IoObject.IO.Timeout = nSeconds * 1000;
  }

  public void Close()
  {
    try
    {
      m_IoObject.IO.Close();
    }
    catch { }

    try
    {
      Marshal.ReleaseComObject(m_IoObject);
    }
    catch { }

    try
    {
      Marshal.ReleaseComObject(m_ResourceManager);
    }
```

```
      catch { }
    }
  }
}
```

VISA COM Example in Visual Basic .NET

To compile and run this example in Microsoft Visual Studio 2008:

1 Open Visual Studio.

2 Create a new Visual Basic, Windows, Console Application project.

3 Cut-and-paste the code that follows into the Visual Basic .NET source file.

4 Edit the program to use the VISA address of your oscilloscope.

5 Add a reference to the VISA COM 5.5 Type Library:

   a Right-click the project you wish to modify (not the solution) in the Solution Explorer window of the Microsoft Visual Studio environment.

   b Choose **Add Reference...**.

   c In the Add Reference dialog, select the **COM** tab.

   d Select **VISA COM 5.5 Type Library**; then click **OK**.

   e Right-click the project you wish to modify (not the solution) in the Solution Explorer window of the Microsoft Visual Studio environment and choose **Properties**; then, select "InfiniiVision.VisaComInstrumentApp" as the **Startup object**.

6 Build and run the program.

For more information, see the VISA COM Help that comes with Keysight IO Libraries Suite 16.

```
'
' Keysight VISA COM Example in Visual Basic .NET
' -------------------------------------------------------------------
' This program illustrates a few commonly used programming
' features of your Keysight oscilloscope.
' -------------------------------------------------------------------

Imports System
Imports System.IO
Imports System.Text
Imports Ivi.Visa.Interop
Imports System.Runtime.InteropServices

Namespace InfiniiVision
  Class VisaComInstrumentApp
    Private Shared myScope As VisaComInstrument

    Public Shared Sub Main(ByVal args As String())
      Try
        myScope = New _
          VisaComInstrument("USB0::0x0957::0x17A6::US50210029::0::INSTR"
)
        mySceope.SetTimeoutSeconds(10)

        ' Initialize - start from a known state.
        Initialize()

        ' Capture data.
        Capture()

        ' Analyze the captured waveform.
        Analyze()

      Catch err As System.ApplicationException
        Console.WriteLine("*** VISA Error Message : " + err.Message)
      Catch err As System.SystemException
        Console.WriteLine("*** System Error Message : " + err.Message)
      Catch err As System.Exception
        System.Diagnostics.Debug.Fail("Unexpected Error")
        Console.WriteLine("*** Unexpected Error : " + err.Message)
      Finally
        myScope.Close()
      End Try
    End Sub

    ' Initialize the oscilloscope to a known state.
    ' --------------------------------------------------------------

    Private Shared Sub Initialize()
      Dim strResults As String

      ' Get and display the device's *IDN? string.
      strResults = myScope.DoQueryString("*IDN?")
      Console.WriteLine("*IDN? result is: {0}", strResults)

      ' Clear status and load the default setup.
      myScope.DoCommand("*CLS")
      myScope.DoCommand("*RST")

    End Sub

    ' Capture the waveform.
    ' --------------------------------------------------------------

    Private Shared Sub Capture()

      ' Use auto-scale to automatically configure oscilloscope.
      myScope.DoCommand(":AUToscale")

      ' Set trigger mode (EDGE, PULSe, PATTern, etc., and input source.
      myScope.DoCommand(":TRIGger:MODE EDGE")
      Console.WriteLine("Trigger mode: {0}", _
          myScope.DoQueryString(":TRIGger:MODE?"))

      ' Set EDGE trigger parameters.
      myScope.DoCommand(":TRIGger:EDGE:SOURCe CHANnel1")
      Console.WriteLine("Trigger edge source: {0}", _
          myScope.DoQueryString(":TRIGger:EDGE:SOURce?"))
      myScope.DoCommand(":TRIGger:EDGE:LEVel 1.5")
      Console.WriteLine("Trigger edge level: {0}", _
          myScope.DoQueryString(":TRIGger:EDGE:LEVel?"))

      myScope.DoCommand(":TRIGger:EDGE:SLOPe POSitive")
      Console.WriteLine("Trigger edge slope: {0}", _
          myScope.DoQueryString(":TRIGger:EDGE:SLOPe?"))

      ' Save oscilloscope configuration.
      Dim ResultsArray As Byte()   ' Results array.
      Dim nLength As Integer   ' Number of bytes returned from inst.
      Dim strPath As String
      Dim fStream As FileStream

      ' Query and read setup string.
      ResultsArray = myScope.DoQueryIEEEBlock(":SYSTem:SETup?")
      nLength = ResultsArray.Length

      ' Write setup string to file.
      strPath = "c:\scope\config\setup.stp"
      fStream = File.Open(strPath, FileMode.Create)
      fStream.Write(ResultsArray, 0, nLength)
      fStream.Close()
      Console.WriteLine("Setup bytes saved: {0}", nLength)

      ' Change settings with individual commands:

      ' Set vertical scale and offset.
      myScope.DoCommand(":CHANnel1:SCALe 0.05")
      Console.WriteLine("Channel 1 vertical scale: {0}", _
          myScope.DoQueryString(":CHANnel1:SCALe?"))

      myScope.DoCommand(":CHANnel1:OFFSet -1.5")
      Console.WriteLine("Channel 1 vertical offset: {0}", _
          myScope.DoQueryString(":CHANnel1:OFFSet?"))

      ' Set horizontal scale and offset.
      myScope.DoCommand(":TIMebase:SCALe 0.0002")
      Console.WriteLine("Timebase scale: {0}", _
          myScope.DoQueryString(":TIMebase:SCALe?"))

      myScope.DoCommand(":TIMebase:POSition 0.0")
      Console.WriteLine("Timebase position: {0}", _
          myScope.DoQueryString(":TIMebase:POSition?"))

      ' Set the acquisition type (NORMal, PEAK, AVERage, or HRESolution)
.
      myScope.DoCommand(":ACQuire:TYPE NORMal")
      Console.WriteLine("Acquire type: {0}", _
          myScope.DoQueryString(":ACQuire:TYPE?"))

      ' Or, configure by loading a previously saved setup.
      Dim DataArray As Byte()
      Dim nBytesWritten As Integer

      ' Read setup string from file.
```

```
      strPath = "c:\scope\config\setup.stp"
      DataArray = File.ReadAllBytes(strPath)
      nBytesWritten = DataArray.Length

      ' Restore setup string.
      myScope.DoCommandIEEEBlock(":SYSTem:SETup", DataArray)
      Console.WriteLine("Setup bytes restored: {0}", nBytesWritten)

      ' Capture an acquisition using :DIGitize.
      myScope.DoCommand(":DIGitize CHANnel1")

    End Sub

    ' Analyze the captured waveform.
    ' --------------------------------------------------------------

    Private Shared Sub Analyze()

      Dim fResult As Double
      Dim ResultsArray As Byte()    ' Results array.
      Dim nLength As Integer    ' Number of bytes returned from inst.
      Dim strPath As String

      ' Make a couple of measurements.
      ' ------------------------------------------------------------
      myScope.DoCommand(":MEASure:SOURce CHANnel1")
      Console.WriteLine("Measure source: {0}", _
          myScope.DoQueryString(":MEASure:SOURce?"))

      myScope.DoCommand(":MEASure:FREQuency")
      fResult = myScope.DoQueryNumber(":MEASure:FREQuency?")
      Console.WriteLine("Frequency: {0:F4} kHz", fResult / 1000)

      myScope.DoCommand(":MEASure:VAMPlitude")
      fResult = myScope.DoQueryNumber(":MEASure:VAMPlitude?")
      Console.WriteLine("Vertical amplitude: {0:F2} V", fResult)

      ' Download the screen image.
      ' ------------------------------------------------------------
      myScope.DoCommand(":HARDcopy:INKSaver OFF")

      ' Get the screen data.
      ResultsArray = myScope.DoQueryIEEEBlock(":DISPlay:DATA? PNG, COLor
")
      nLength = ResultsArray.Length

      ' Store the screen data to a file.
      strPath = "c:\scope\data\screen.png"
      Dim fStream As FileStream
      fStream = File.Open(strPath, FileMode.Create)
      fStream.Write(ResultsArray, 0, nLength)
      fStream.Close()
      Console.WriteLine("Screen image ({0} bytes) written to {1}", _
          nLength, strPath)

      ' Download waveform data.
      ' ------------------------------------------------------------
      ' Set the waveform points mode.
      myScope.DoCommand(":WAVeform:POINts:MODE RAW")
      Console.WriteLine("Waveform points mode: {0}", _
          myScope.DoQueryString(":WAVeform:POINts:MODE?"))

      ' Get the number of waveform points available.
      Console.WriteLine("Waveform points available: {0}", _
          myScope.DoQueryString(":WAVeform:POINts?"))

      ' Set the waveform source.
      myScope.DoCommand(":WAVeform:SOURce CHANnel1")
      Console.WriteLine("Waveform source: {0}", _
          myScope.DoQueryString(":WAVeform:SOURce?"))

      ' Choose the format of the data returned (WORD, BYTE, ASCII):
      myScope.DoCommand(":WAVeform:FORMat BYTE")
      Console.WriteLine("Waveform format: {0}", _
          myScope.DoQueryString(":WAVeform:FORMat?"))

      ' Display the waveform settings:
      Dim fResultsArray As Double()
      fResultsArray = myScope.DoQueryNumbers(":WAVeform:PREamble?")

      Dim fFormat As Double = fResultsArray(0)
      If fFormat = 0 Then
        Console.WriteLine("Waveform format: BYTE")
      ElseIf fFormat = 1 Then
        Console.WriteLine("Waveform format: WORD")
      ElseIf fFormat = 2 Then
        Console.WriteLine("Waveform format: ASCii")
      End If

      Dim fType As Double = fResultsArray(1)
      If fType = 0 Then
        Console.WriteLine("Acquire type: NORMal")
      ElseIf fType = 1 Then
        Console.WriteLine("Acquire type: PEAK")
      ElseIf fType = 2 Then
        Console.WriteLine("Acquire type: AVERage")
      ElseIf fType = 3 Then
        Console.WriteLine("Acquire type: HRESolution")
      End If

      Dim fPoints As Double = fResultsArray(2)
      Console.WriteLine("Waveform points: {0:e}", fPoints)

      Dim fCount As Double = fResultsArray(3)
      Console.WriteLine("Waveform average count: {0:e}", fCount)

      Dim fXincrement As Double = fResultsArray(4)
      Console.WriteLine("Waveform X increment: {0:e}", fXincrement)

      Dim fXorigin As Double = fResultsArray(5)
      Console.WriteLine("Waveform X origin: {0:e}", fXorigin)

      Dim fXreference As Double = fResultsArray(6)
```

```
    Console.WriteLine("Waveform X reference: {0:e}", fXreference)

    Dim fYincrement As Double = fResultsArray(7)
    Console.WriteLine("Waveform Y increment: {0:e}", fYincrement)

    Dim fYorigin As Double = fResultsArray(8)
    Console.WriteLine("Waveform Y origin: {0:e}", fYorigin)

    Dim fYreference As Double = fResultsArray(9)
    Console.WriteLine("Waveform Y reference: {0:e}", fYreference)

    ' Get the waveform data.
    ResultsArray = myScope.DoQueryIEEEBlock(":WAVeform:DATA?")
    nLength = ResultsArray.Length
    Console.WriteLine("Number of data values: {0}", nLength)

    ' Set up output file:
    strPath = "c:\scope\data\waveform_data.csv"
    If File.Exists(strPath) Then
      File.Delete(strPath)
    End If

    ' Open file for output.
    Dim writer As StreamWriter = File.CreateText(strPath)

    ' Output waveform data in CSV format.
    For index As Integer = 0 To nLength - 1
      ' Write time value, voltage value.
      writer.WriteLine("{0:f9}, {1:f6}", _
          fXorigin + (CSng(index) * fXincrement), _
          ((CSng(ResultsArray(index)) - fYreference) _
          * fYincrement) + fYorigin)
    Next

    ' Close output file.
    writer.Close()
    Console.WriteLine("Waveform format BYTE data written to {0}", _
        strPath)

  End Sub

End Class

Class VisaComInstrument
  Private m_ResourceManager As ResourceManagerClass
  Private m_IoObject As FormattedIO488Class
  Private m_strVisaAddress As String

  ' Constructor.
  Public Sub New(ByVal strVisaAddress As String)

    ' Save VISA address in member variable.
    m_strVisaAddress = strVisaAddress

    ' Open the default VISA COM IO object.
    OpenIo()
    ' Clear the interface.
    m_IoObject.IO.Clear()

  End Sub

  Public Sub DoCommand(ByVal strCommand As String)

    ' Send the command.
    m_IoObject.WriteString(strCommand, True)

    ' Check for inst errors.
    CheckInstrumentErrors(strCommand)

  End Sub

  Public Sub DoCommandIEEEBlock(ByVal strCommand As String, _
      ByVal DataArray As Byte())

    ' Send the command to the device.
    m_IoObject.WriteIEEEBlock(strCommand, DataArray, True)

    ' Check for inst errors.
    CheckInstrumentErrors(strCommand)

  End Sub

  Public Function DoQueryString(ByVal strQuery As String) As String
    ' Send the query.
    m_IoObject.WriteString(strQuery, True)

    ' Get the result string.
    Dim strResults As String
    strResults = m_IoObject.ReadString()

    ' Check for inst errors.
    CheckInstrumentErrors(strQuery)

    ' Return results string.
    Return strResults
  End Function

  Public Function DoQueryNumber(ByVal strQuery As String) As Double
    ' Send the query.
    m_IoObject.WriteString(strQuery, True)

    ' Get the result number.
    Dim fResult As Double
    fResult = _
        CDbl(m_IoObject.ReadNumber(IEEEASCIIType.ASCIIType_R8, True))

    ' Check for inst errors.
    CheckInstrumentErrors(strQuery)

    ' Return result number.
    Return fResult
  End Function
```

```
Public Function DoQueryNumbers(ByVal strQuery As String) As _
    Double()
  ' Send the query.
  m_IoObject.WriteString(strQuery, True)

  ' Get the result numbers.
  Dim fResultsArray As Double()
  fResultsArray = _
      m_IoObject.ReadList(IEEEASCIIType.ASCIIType_R8, ",;")

  ' Check for inst errors.
  CheckInstrumentErrors(strQuery)

  ' Return result numbers.
  Return fResultsArray
End Function

Public _
    Function DoQueryIEEEBlock(ByVal strQuery As String) As Byte()
  ' Send the query.
  m_IoObject.WriteString(strQuery, True)

  ' Get the results array.
  System.Threading.Thread.Sleep(2000) ' Delay before reading data.
  Dim ResultsArray As Byte()
  ResultsArray = _
      m_IoObject.ReadIEEEBlock(IEEEBinaryType.BinaryType_UI1, _
      False, True)

  ' Check for inst errors.
  CheckInstrumentErrors(strQuery)

  ' Return results array.
  Return ResultsArray
End Function

Private Sub CheckInstrumentErrors(ByVal strCommand As String)
  ' Check for instrument errors.
  Dim strInstrumentError As String
  Dim bFirstError As Boolean = True
  Do   ' While not "0,No error".
    m_IoObject.WriteString(":SYSTem:ERRor?", True)
    strInstrumentError = m_IoObject.ReadString()

    If Not strInstrumentError.ToString().StartsWith("+0,") Then
      If bFirstError Then
        Console.WriteLine("ERROR(s) for command '{0}': ", _
            strCommand)
        bFirstError = False
      End If
      Console.Write(strInstrumentError)
    End If
  Loop While Not strInstrumentError.ToString().StartsWith("+0,")
End Sub

Private Sub OpenIo()
  m_ResourceManager = New ResourceManagerClass()
```

```
      m_IoObject = New FormattedIO488Class()

      ' Open the default VISA COM IO object.
      Try
        m_IoObject.IO = _
            DirectCast(m_ResourceManager.Open(m_strVisaAddress, _
                AccessMode.NO_LOCK, 0, ""), IMessage)
      Catch e As Exception
        Console.WriteLine("An error occurred: {0}", e.Message)
      End Try
    End Sub

    Public Sub SetTimeoutSeconds(ByVal nSeconds As Integer)
      m_IoObject.IO.Timeout = nSeconds * 1000
    End Sub

    Public Sub Close()
      Try
        m_IoObject.IO.Close()
      Catch
      End Try

      Try
        Marshal.ReleaseComObject(m_IoObject)
      Catch
      End Try

      Try
        Marshal.ReleaseComObject(m_ResourceManager)
      Catch
      End Try
    End Sub
  End Class
End Namespace
```

VISA COM Example in Python

You can use the Python programming language with the "comtypes" package to control Keysight oscilloscopes.

The Python language and "comtypes" package can be downloaded from the web at http://www.python.org/ and http://starship.python.net/crew/theller/comtypes/, respectively.

To run this example with Python and "comtypes":

1 Cut-and-paste the code that follows into a file named "example.py".
2 Edit the program to use the VISA address of your oscilloscope.
3 If "python.exe" can be found via your PATH environment variable, open a Command Prompt window; then, change to the folder that contains the "example.py" file, and enter:

```
python example.py
```

```
#
# Keysight VISA COM Example in Python using "comtypes"
# *********************************************************
# This program illustrates a few commonly used programming
# features of your Keysight oscilloscope.
# *********************************************************

# Import Python modules.
# ---------------------------------------------------------
import string
import time
import sys
import array

from comtypes.client import GetModule
from comtypes.client import CreateObject

# Run GetModule once to generate comtypes.gen.VisaComLib.
if not hasattr(sys, "frozen"):
 GetModule("C:\Program Files (x86)\IVI Foundation\VISA\VisaCom\
GlobMgr.dll")

import comtypes.gen.VisaComLib as VisaComLib


# Global variables (booleans: 0 = False, 1 = True).
# ---------------------------------------------------------


# =========================================================
# Initialize:
# =========================================================
def initialize():
 # Get and display the device's *IDN? string.
 idn_string = do_query_string("*IDN?")
 print "Identification string '%s'" % idn_string

 # Clear status and load the default setup.
 do_command("*CLS")
 do_command("*RST")


# =========================================================
# Capture:
# =========================================================
def capture():

 # Use auto-scale to automatically set up oscilloscope.
 print "Autoscale."
 do_command(":AUToscale")

 # Set trigger mode.
 do_command(":TRIGger:MODE EDGE")
 qresult = do_query_string(":TRIGger:MODE?")
 print "Trigger mode: %s" % qresult

 # Set EDGE trigger parameters.
```

```
  do_command(":TRIGger:EDGE:SOURCe CHANnel1")
  qresult = do_query_string(":TRIGger:EDGE:SOURce?")
  print "Trigger edge source: %s" % qresult

  do_command(":TRIGger:EDGE:LEVel 1.5")
  qresult = do_query_string(":TRIGger:EDGE:LEVel?")
  print "Trigger edge level: %s" % qresult

  do_command(":TRIGger:EDGE:SLOPe POSitive")
  qresult = do_query_string(":TRIGger:EDGE:SLOPe?")
  print "Trigger edge slope: %s" % qresult

  # Save oscilloscope setup.
  setup_bytes = do_query_ieee_block(":SYSTem:SETup?")
  nLength = len(setup_bytes)
  f = open("c:\scope\config\setup.stp", "wb")
  f.write(bytearray(setup_bytes))
  f.close()
  print "Setup bytes saved: %d" % nLength

  # Change oscilloscope settings with individual commands:

  # Set vertical scale and offset.
  do_command(":CHANnel1:SCALe 0.05")
  qresult = do_query_number(":CHANnel1:SCALe?")
  print "Channel 1 vertical scale: %f" % qresult

  do_command(":CHANnel1:OFFSet -1.5")
  qresult = do_query_number(":CHANnel1:OFFSet?")
  print "Channel 1 offset: %f" % qresult

  # Set horizontal scale and offset.
  do_command(":TIMebase:SCALe 0.0002")
  qresult = do_query_string(":TIMebase:SCALe?")
  print "Timebase scale: %s" % qresult

  do_command(":TIMebase:POSition 0.0")
  qresult = do_query_string(":TIMebase:POSition?")
  print "Timebase position: %s" % qresult

  # Set the acquisition type.
  do_command(":ACQuire:TYPE NORMal")
  qresult = do_query_string(":ACQuire:TYPE?")
  print "Acquire type: %s" % qresult

  # Or, configure by loading a previously saved setup.
  f = open("c:\scope\config\setup.stp", "rb")
  setup_bytes = f.read()
  f.close()
  do_command_ieee_block(":SYSTem:SETup", array.array('B', setup_bytes))
  print "Setup bytes restored: %d" % len(setup_bytes)

  # Capture an acquisition using :DIGitize.
  do_command(":DIGitize CHANnel1")


# =========================================================
# Analyze:
# =========================================================
def analyze():

  # Make measurements.
  # -------------------------------------------------------
  do_command(":MEASure:SOURce CHANnel1")
  qresult = do_query_string(":MEASure:SOURce?")
  print "Measure source: %s" % qresult

  do_command(":MEASure:FREQuency")
  qresult = do_query_string(":MEASure:FREQuency?")
  print "Measured frequency on channel 1: %s" % qresult

  do_command(":MEASure:VAMPlitude")
  qresult = do_query_string(":MEASure:VAMPlitude?")
  print "Measured vertical amplitude on channel 1: %s" % qresult

  # Download the screen image.
  # -------------------------------------------------------
  do_command(":HARDcopy:INKSaver OFF")

  image_bytes = do_query_ieee_block(":DISPlay:DATA? PNG, COLor")
  nLength = len(image_bytes)
  f = open("c:\scope\data\screen.png", "wb")
  f.write(bytearray(image_bytes))
  f.close()
  print "Screen image written to c:\scope\data\screen.png."

  # Download waveform data.
  # -------------------------------------------------------

  # Set the waveform points mode.
  do_command(":WAVeform:POINts:MODE RAW")
  qresult = do_query_string(":WAVeform:POINts:MODE?")
  print "Waveform points mode: %s" % qresult

  # Get the number of waveform points available.
  do_command(":WAVeform:POINts 10240")
  qresult = do_query_string(":WAVeform:POINts?")
  print "Waveform points available: %s" % qresult

  # Set the waveform source.
  do_command(":WAVeform:SOURce CHANnel1")
  qresult = do_query_string(":WAVeform:SOURce?")
  print "Waveform source: %s" % qresult

  # Choose the format of the data returned:
  do_command(":WAVeform:FORMat BYTE")
  print "Waveform format: %s" % do_query_string(":WAVeform:FORMat?")

  # Display the waveform settings from preamble:
  wav_form_dict = {
    0 : "BYTE",
    1 : "WORD",
    4 : "ASCii",
  }
```

```
acq_type_dict = {
 0 : "NORMal",
 1 : "PEAK",
 2 : "AVERage",
 3 : "HRESolution",
}

(
 wav_form,
 acq_type,
 wfmpts,
 avgcnt,
 x_increment,
 x_origin,
 x_reference,
 y_increment,
 y_origin,
 y_reference
) = do_query_numbers(":WAVeform:PREamble?")

print "Waveform format: %s" % wav_form_dict[wav_form]
print "Acquire type: %s" % acq_type_dict[acq_type]
print "Waveform points desired: %d" % wfmpts
print "Waveform average count: %d" % avgcnt
print "Waveform X increment: %1.12f" % x_increment
print "Waveform X origin: %1.9f" % x_origin
print "Waveform X reference: %d" % x_reference   # Always 0.
print "Waveform Y increment: %f" % y_increment
print "Waveform Y origin: %f" % y_origin
print "Waveform Y reference: %d" % y_reference   # Always 125.

# Get numeric values for later calculations.
x_increment = do_query_number(":WAVeform:XINCrement?")
x_origin = do_query_number(":WAVeform:XORigin?")
y_increment = do_query_number(":WAVeform:YINCrement?")
y_origin = do_query_number(":WAVeform:YORigin?")
y_reference = do_query_number(":WAVeform:YREFerence?")

# Get the waveform data.
data_bytes = do_query_ieee_block(":WAVeform:DATA?")
nLength = len(data_bytes)
print "Number of data values: %d" % nLength

# Open file for output.
strPath = "c:\scope\data\waveform_data.csv"
f = open(strPath, "w")

# Output waveform data in CSV format.
for i in xrange(0, nLength - 1):
 time_val = x_origin + (i * x_increment)
 voltage = (data_bytes[i] - y_reference) * y_increment + y_origin
 f.write("%E, %f\n" % (time_val, voltage))

# Close output file.
f.close()
print "Waveform format BYTE data written to %s." % strPath
```

```
# =========================================================
# Send a command and check for errors:
# =========================================================
def do_command(command):
 myScope.WriteString("%s" % command, True)
 check_instrument_errors(command)


# =========================================================
# Send a command and check for errors:
# =========================================================
def do_command_ieee_block(command, data):
 myScope.WriteIEEEBlock(command, data, True)
 check_instrument_errors(command)


# =========================================================
# Send a query, check for errors, return string:
# =========================================================
def do_query_string(query):
 myScope.WriteString("%s" % query, True)
 result = myScope.ReadString()
 check_instrument_errors(query)
 return result


# =========================================================
# Send a query, check for errors, return string:
# =========================================================
def do_query_ieee_block(query):
 myScope.WriteString("%s" % query, True)
 result = myScope.ReadIEEEBlock(VisaComLib.BinaryType_UI1, \
   False, True)
 check_instrument_errors(query)
 return result


# =========================================================
# Send a query, check for errors, return values:
# =========================================================
def do_query_number(query):
 myScope.WriteString("%s" % query, True)
 result = myScope.ReadNumber(VisaComLib.ASCIIType_R8, True)
 check_instrument_errors(query)
 return result


# =========================================================
# Send a query, check for errors, return values:
# =========================================================
def do_query_numbers(query):
 myScope.WriteString("%s" % query, True)
 result = myScope.ReadList(VisaComLib.ASCIIType_R8, ",;")
 check_instrument_errors(query)
 return result
```

```
# =========================================================
# Check for instrument errors:
# =========================================================
def check_instrument_errors(command):

 while True:
  myScope.WriteString(":SYSTem:ERRor?", True)
  error_string = myScope.ReadString()
  if error_string:   # If there is an error string value.

   if error_string.find("+0,", 0, 3) == -1:   # Not "No error".
    print "ERROR: %s, command: '%s'" % (error_string, command)
    print "Exited because of error."
    sys.exit(1)

   else:   # "No error"
    break

  else:   # :SYSTem:ERRor? should always return string.
   print "ERROR: :SYSTem:ERRor? returned nothing, command: '%s'" \
     % command
   print "Exited because of error."
   sys.exit(1)


# =========================================================
# Main program:
# =========================================================
rm = CreateObject("VISA.GlobalRM", \
 interface=VisaComLib.IResourceManager)
myScope = CreateObject("VISA.BasicFormattedIO", \
 interface=VisaComLib.IFormattedIO488)
myScope.IO = \
 rm.Open("USB0::0x2A8D::0x1797::CN56240004::0::INSTR")

# Clear the interface.
myScope.IO.Clear
print "Interface cleared."

# Set the Timeout to 15 seconds.
myScope.IO.Timeout = 15000   # 15 seconds.
print "Timeout set to 15000 milliseconds."

# Initialize the oscilloscope, capture data, and analyze.
initialize()
capture()
analyze()

print "End of program"
```

VISA Examples

- "VISA Example in C" on page 819
- "VISA Example in Visual Basic" on page 828
- "VISA Example in C#" on page 838
- "VISA Example in Visual Basic .NET" on page 849
- "VISA Example in Python (PyVISA 1.5 and older)" on page 859
- "VISA Example in Python (PyVISA 1.6 and newer)" on page 865

VISA Example in C

To compile and run this example in Microsoft Visual Studio 2008:

1. Open Visual Studio.
2. Create a new Visual C++, Win32, Win32 Console Application project.
3. In the Win32 Application Wizard, click **Next >**. Then, check **Empty project**, and click **Finish**.
4. Cut-and-paste the code that follows into a file named "example.c" in the project directory.
5. In Visual Studio 2008, right-click the Source Files folder, choose **Add > Add Existing Item...**, select the example.c file, and click **Add**.
6. Edit the program to use the VISA address of your oscilloscope.
7. Choose **Project > Properties...**. In the Property Pages dialog, update these project settings:
   a. Under Configuration Properties, Linker, Input, add "visa32.lib" to the Additional Dependencies field.
   b. Under Configuration Properties, C/C++, Code Generation, select Multi-threaded DLL for the Runtime Library field.
   c. Click **OK** to close the Property Pages dialog.
8. Add the include files and library files search paths:
   a. Choose **Tools > Options...**.
   b. In the Options dialog, under Projects and Solutions, select **VC++ Directories**.
   c. Show directories for **Include files**, and add the include directory (for example, Program Files (x86)\IVI Foundation\VISA\WinNT\Include).
   d. Show directories for **Library files**, and add the library files directory (for example, Program Files (x86)\IVI Foundation\VISA\WinNT\lib\msc).
   e. Click **OK** to close the Options dialog.
9. Build and run the program.

```
/*
 * Keysight VISA Example in C
 * ------------------------------------------------------------------
 * This program illustrates a few commonly-used programming
 * features of your Keysight oscilloscope.
 */

#include <stdio.h>            /* For printf(). */
#include <string.h>           /* For strcpy(), strcat(). */
#include <time.h>             /* For clock(). */
#include <visa.h>             /* Keysight VISA routines. */

#define VISA_ADDRESS "USB0::0x0957::0x17A6::US50210029::0::INSTR"
#define IEEEBLOCK_SPACE 5000000

/* Function prototypes */
void initialize(void);          /* Initialize to known state. */
void capture(void);             /* Capture the waveform. */
void analyze(void);             /* Analyze the captured waveform. */

void do_command(char *command);        /* Send command. */
int do_command_ieeeblock(char *command); /* Command w/IEEE block. */
void do_query_string(char *query);     /* Query for string. */
void do_query_number(char *query);     /* Query for number. */
void do_query_numbers(char *query);     /* Query for numbers. */
int do_query_ieeeblock(char *query);   /* Query for IEEE block. */
void check_instrument_errors();        /* Check for inst errors. */
void error_handler();                  /* VISA error handler. */

/* Global variables */
ViSession defaultRM, vi;        /* Device session ID. */
ViStatus err;                   /* VISA function return value. */
char str_result[256] = {0};     /* Result from do_query_string(). */
double num_result;              /* Result from do_query_number(). */
unsigned char ieeeblock_data[IEEEBLOCK_SPACE];   /* Result from
                                   do_query_ieeeblock(). */
double dbl_results[10];         /* Result from do_query_numbers(). */

/* Main Program
 * --------------------------------------------------------------- */
void main(void)
{
  /* Open the default resource manager session. */
  err = viOpenDefaultRM(&defaultRM);
  if (err != VI_SUCCESS) error_handler();

  /* Open the session using the oscilloscope's VISA address. */
  err = viOpen(defaultRM, VISA_ADDRESS, VI_NULL, VI_NULL, &vi);
  if (err != VI_SUCCESS) error_handler();

/* Set the I/O timeout to fifteen seconds. */
err = viSetAttribute(vi, VI_ATTR_TMO_VALUE, 15000);
  if (err != VI_SUCCESS) error_handler();

  /* Initialize - start from a known state. */
  initialize();
  /* Capture data. */
  capture();

  /* Analyze the captured waveform. */
  analyze();

  /* Close the vi session and the resource manager session. */
  viClose(vi);
  viClose(defaultRM);
}

/* Initialize the oscilloscope to a known state.
 * --------------------------------------------------------------- */
void initialize (void)
{
  /* Clear the interface. */
  err = viClear(vi);
  if (err != VI_SUCCESS) error_handler();

  /* Get and display the device's *IDN? string. */
  do_query_string("*IDN?");
  printf("Oscilloscope *IDN? string: %s\n", str_result);

  /* Clear status and load the default setup. */
  do_command("*CLS");
  do_command("*RST");
}

/* Capture the waveform.
 * --------------------------------------------------------------- */
void capture (void)
{
  int num_bytes;
  FILE *fp;

  /* Use auto-scale to automatically configure oscilloscope. */
  do_command(":AUToscale");

  /* Set trigger mode (EDGE, PULSe, PATTern, etc., and input source. */
  do_command(":TRIGger:MODE EDGE");
  do_query_string(":TRIGger:MODE?");
  printf("Trigger mode: %s\n", str_result);

  /* Set EDGE trigger parameters. */
  do_command(":TRIGger:EDGE:SOURCe CHANnel1");
  do_query_string(":TRIGger:EDGE:SOURce?");
  printf("Trigger edge source: %s\n", str_result);

  do_command(":TRIGger:EDGE:LEVel 1.5");
  do_query_string(":TRIGger:EDGE:LEVel?");
  printf("Trigger edge level: %s\n", str_result);

  do_command(":TRIGger:EDGE:SLOPe POSitive");
  do_query_string(":TRIGger:EDGE:SLOPe?");
  printf("Trigger edge slope: %s\n", str_result);

  /* Save oscilloscope configuration. */
  /* Read system setup. */
  num_bytes = do_query_ieeeblock(":SYSTem:SETup?");
  printf("Read setup string query (%d bytes).\n", num_bytes);

  /* Write setup string to file. */
  fp = fopen ("c:\\scope\\config\\setup.stp", "wb");
  num_bytes = fwrite(ieeeblock_data, sizeof(unsigned char), num_bytes,
    fp);
  fclose (fp);
  printf("Wrote setup string (%d bytes) to ", num_bytes);
  printf("c:\\scope\\config\\setup.stp.\n");

  /* Change settings with individual commands:

  /* Set vertical scale and offset. */
  do_command(":CHANnel1:SCALe 0.05");
  do_query_string(":CHANnel1:SCALe?");
  printf("Channel 1 vertical scale: %s\n", str_result);

  do_command(":CHANnel1:OFFSet -1.5");
  do_query_string(":CHANnel1:OFFSet?");
  printf("Channel 1 offset: %s\n", str_result);

  /* Set horizontal scale and offset. */
  do_command(":TIMebase:SCALe 0.0002");
  do_query_string(":TIMebase:SCALe?");
  printf("Timebase scale: %s\n", str_result);

  do_command(":TIMebase:POSition 0.0");
  do_query_string(":TIMebase:POSition?");
  printf("Timebase position: %s\n", str_result);

  /* Set the acquisition type (NORMal, PEAK, AVERage, or HRESolution). *
/
  do_command(":ACQuire:TYPE NORMal");
  do_query_string(":ACQuire:TYPE?");
  printf("Acquire type: %s\n", str_result);

  /* Or, configure by loading a previously saved setup. */

  /* Read setup string from file. */
  fp = fopen ("c:\\scope\\config\\setup.stp", "rb");
  num_bytes = fread (ieeeblock_data, sizeof(unsigned char),
    IEEEBLOCK_SPACE, fp);
  fclose (fp);
  printf("Read setup string (%d bytes) from file ", num_bytes);
  printf("c:\\scope\\config\\setup.stp.\n");

  /* Restore setup string. */
  num_bytes = do_command_ieeeblock(":SYSTem:SETup", num_bytes);
  printf("Restored setup string (%d bytes).\n", num_bytes);

  /* Capture an acquisition using :DIGitize. */
  do_command(":DIGitize CHANnel1");
}
```

```
/* Analyze the captured waveform.
 * -------------------------------------------------------------- */
void analyze (void)
{
  double wav_format;
  double acq_type;
  double wav_points;
  double avg_count;
  double x_increment;
  double x_origin;
  double x_reference;
  double y_increment;
  double y_origin;
  double y_reference;

  FILE *fp;
  int num_bytes;   /* Number of bytes returned from instrument. */
  int i;

  /* Make a couple of measurements.
   * ------------------------------------------------------------ */
  do_command(":MEASure:SOURce CHANnel1");
  do_query_string(":MEASure:SOURce?");
  printf("Measure source: %s\n", str_result);

  do_command(":MEASure:FREQuency");
  do_query_number(":MEASure:FREQuency?");
  printf("Frequency: %.4f kHz\n", num_result / 1000);

  do_command(":MEASure:VAMPlitude");
  do_query_number(":MEASure:VAMPlitude?");
  printf("Vertical amplitude: %.2f V\n", num_result);

  /* Download the screen image.
   * ------------------------------------------------------------ */
  do_command(":HARDcopy:INKSaver OFF");

  /* Read screen image. */
  num_bytes = do_query_ieeeblock(":DISPlay:DATA? PNG, COLor");
  printf("Screen image bytes: %d\n", num_bytes);

  /* Write screen image bytes to file. */
  fp = fopen ("c:\\scope\\data\\screen.png", "wb");
  num_bytes = fwrite(ieeeblock_data, sizeof(unsigned char), num_bytes,
    fp);
  fclose (fp);
  printf("Wrote screen image (%d bytes) to ", num_bytes);
  printf("c:\\scope\\data\\screen.png.\n");

  /* Download waveform data.
   * ------------------------------------------------------------ */

  /* Set the waveform points mode. */
  do_command(":WAVeform:POINts:MODE RAW");
  do_query_string(":WAVeform:POINts:MODE?");
  printf("Waveform points mode: %s\n", str_result);
```

```
/* Get the number of waveform points available. */
do_query_string(":WAVeform:POINts?");
printf("Waveform points available: %s\n", str_result);

/* Set the waveform source. */
do_command(":WAVeform:SOURce CHANnel1");
do_query_string(":WAVeform:SOURce?");
printf("Waveform source: %s\n", str_result);

/* Choose the format of the data returned (WORD, BYTE, ASCII): */
do_command(":WAVeform:FORMat BYTE");
do_query_string(":WAVeform:FORMat?");
printf("Waveform format: %s\n", str_result);

/* Display the waveform settings: */
do_query_numbers(":WAVeform:PREamble?");

wav_format = dbl_results[0];
if (wav_format == 0.0)
{
  printf("Waveform format: BYTE\n");
}
else if (wav_format == 1.0)
{
  printf("Waveform format: WORD\n");
}
else if (wav_format == 2.0)
{
  printf("Waveform format: ASCii\n");
}

acq_type = dbl_results[1];
if (acq_type == 0.0)
{
  printf("Acquire type: NORMal\n");
}
else if (acq_type == 1.0)
{
  printf("Acquire type: PEAK\n");
}
else if (acq_type == 2.0)
{
  printf("Acquire type: AVERage\n");
}
else if (acq_type == 3.0)
{
  printf("Acquire type: HRESolution\n");
}

wav_points = dbl_results[2];
printf("Waveform points: %e\n", wav_points);

avg_count = dbl_results[3];
printf("Waveform average count: %e\n", avg_count);

x_increment = dbl_results[4];
printf("Waveform X increment: %e\n", x_increment);
```

```
  x_origin = dbl_results[5];
  printf("Waveform X origin: %e\n", x_origin);

  x_reference = dbl_results[6];
  printf("Waveform X reference: %e\n", x_reference);

  y_increment = dbl_results[7];
  printf("Waveform Y increment: %e\n", y_increment);

  y_origin = dbl_results[8];
  printf("Waveform Y origin: %e\n", y_origin);

  y_reference = dbl_results[9];
  printf("Waveform Y reference: %e\n", y_reference);

  /* Read waveform data. */
  num_bytes = do_query_ieeeblock(":WAVeform:DATA?");
  printf("Number of data values: %d\n", num_bytes);

  /* Open file for output. */
  fp = fopen("c:\\scope\\data\\waveform_data.csv", "wb");

  /* Output waveform data in CSV format. */
  for (i = 0; i < num_bytes - 1; i++)
  {
    /* Write time value, voltage value. */
    fprintf(fp, "%9f, %6f\n",
      x_origin + ((float)i * x_increment),
      (((float)ieeeblock_data[i] - y_reference) * y_increment)
      + y_origin);
  }

  /* Close output file. */
   fclose(fp);
   printf("Waveform format BYTE data written to ");
   printf("c:\\scope\\data\\waveform_data.csv.\n");
}

/* Send a command to the instrument.
 * ------------------------------------------------------------------ */
void do_command(command)
char *command;
{
  char message[80];

  strcpy(message, command);
  strcat(message, "\n");
  err = viPrintf(vi, message);
  if (err != VI_SUCCESS) error_handler();

  check_instrument_errors();
}

/* Command with IEEE definite-length block.
 * ------------------------------------------------------------------ */
int do_command_ieeeblock(command, num_bytes)
```

```
char *command;
int num_bytes;
{
  char message[80];
  int data_length;

  strcpy(message, command);
  strcat(message, " #8%08d");
  err = viPrintf(vi, message, num_bytes);
  if (err != VI_SUCCESS) error_handler();

  err = viBufWrite(vi, ieeeblock_data, num_bytes, &data_length);
  if (err != VI_SUCCESS) error_handler();

  check_instrument_errors();

  return(data_length);
}

/* Query for a string result.
 * --------------------------------------------------------------- */
void do_query_string(query)
char *query;
{
  char message[80];

  strcpy(message, query);
  strcat(message, "\n");

  err = viPrintf(vi, message);
  if (err != VI_SUCCESS) error_handler();

  err = viScanf(vi, "%t", str_result);
  if (err != VI_SUCCESS) error_handler();

  check_instrument_errors();
}

/* Query for a number result.
 * --------------------------------------------------------------- */
void do_query_number(query)
char *query;
{
  char message[80];

  strcpy(message, query);
  strcat(message, "\n");

  err = viPrintf(vi, message);
  if (err != VI_SUCCESS) error_handler();

  err = viScanf(vi, "%lf", &num_result);
  if (err != VI_SUCCESS) error_handler();

  check_instrument_errors();
}
```

```
/* Query for numbers result.
 * ------------------------------------------------------------------ */
void do_query_numbers(query)
char *query;
{
  char message[80];

  strcpy(message, query);
  strcat(message, "\n");

  err = viPrintf(vi, message);
  if (err != VI_SUCCESS) error_handler();

  err = viScanf(vi, "%,10lf\n", dbl_results);
  if (err != VI_SUCCESS) error_handler();

  check_instrument_errors();
}

/* Query for an IEEE definite-length block result.
 * ------------------------------------------------------------------ */
int do_query_ieeeblock(query)
char *query;
{
  char message[80];
  int data_length;

  strcpy(message, query);
  strcat(message, "\n");
  err = viPrintf(vi, message);
  if (err != VI_SUCCESS) error_handler();

  data_length = IEEEBLOCK_SPACE;
  err = viScanf(vi, "%#b\n", &data_length, ieeeblock_data);
  if (err != VI_SUCCESS) error_handler();

  if (data_length == IEEEBLOCK_SPACE )
  {
    printf("IEEE block buffer full: ");
    printf("May not have received all data.\n");
  }

  check_instrument_errors();

  return(data_length);
}

/* Check for instrument errors.
 * ------------------------------------------------------------------ */
void check_instrument_errors()
{
  char str_err_val[256] = {0};
  char str_out[800] = "";

  err = viQueryf(vi, ":SYSTem:ERRor?\n", "%t", str_err_val);
  if (err != VI_SUCCESS) error_handler();
  while(strncmp(str_err_val, "+0,No error", 3) != 0 )
  {
    strcat(str_out, ", ");
    strcat(str_out, str_err_val);
    err = viQueryf(vi, ":SYSTem:ERRor?\n", "%t", str_err_val);
    if (err != VI_SUCCESS) error_handler();
  }

  if (strcmp(str_out, "") != 0)
  {
    printf("INST Error%s\n", str_out);
    err = viFlush(vi, VI_READ_BUF);
    if (err != VI_SUCCESS) error_handler();
    err = viFlush(vi, VI_WRITE_BUF);
    if (err != VI_SUCCESS) error_handler();
  }
}

/* Handle VISA errors.
 * --------------------------------------------------------------- */
void error_handler()
{
  char err_msg[1024] = {0};

  viStatusDesc(vi, err, err_msg);
  printf("VISA Error: %s\n", err_msg);
  if (err < VI_SUCCESS)
  {
    exit(1);
  }
}
```

VISA Example in Visual Basic

To run this example in Visual Basic for Applications:

1 Start the application that provides Visual Basic for Applications (for example, Microsoft Excel).

2 Press ALT+F11 to launch the Visual Basic editor.

3 Add the visa32.bas file to your project:

   a Choose **File > Import File...**.

   b Navigate to the header file, visa32.bas (installed with Keysight IO Libraries Suite and found in the Program Files (x86)\IVI Foundation\VISA\WinNT\Include), select it, and click **Open**.

4 Choose **Insert > Module**.

5 Cut-and-paste the code that follows into the editor.

6 Edit the program to use the VISA address of your oscilloscope, and save the changes.

7 Run the program.

```
'
' Keysight VISA Example in Visual Basic
' -------------------------------------------------------------------
' This program illustrates a few commonly-used programming
' features of your Keysight oscilloscope.
' -------------------------------------------------------------------

Option Explicit

Public err As Long   ' Error returned by VISA function calls.
Public drm As Long   ' Session to Default Resource Manager.
Public vi As Long    ' Session to instrument.

' Declare variables to hold numeric values returned by
' viVScanf/viVQueryf.
Public dblQueryResult As Double
Public Const ByteArraySize = 5000000
Public retCount As Long
Public byteArray(ByteArraySize) As Byte
Public paramsArray(2) As Long
Public Const DblArraySize = 20
Public dblArray(DblArraySize) As Double

' Declare fixed length string variable to hold string value returned
' by viVScanf/viVQueryf.
Public strQueryResult As String * 200

' For Sleep subroutine.
Private Declare Sub Sleep Lib "kernel32" (ByVal dwMilliseconds As Long)

'
' Main Program
' -------------------------------------------------------------------

Sub Main()

  ' Open the default resource manager session.
  err = viOpenDefaultRM(drm)
  If (err <> VI_SUCCESS) Then HandleVISAError drm

  ' Open the session using the oscilloscope's VISA address.
  err = viOpen(drm, _
      "USB0::0x0957::0x17A6::US50210029::0::INSTR", 0, 15000, vi)
  If (err <> VI_SUCCESS) Then HandleVISAError drm

  ' Set the I/O timeout to ten seconds.
  err = viSetAttribute(vi, VI_ATTR_TMO_VALUE, 10000)
  If (err <> VI_SUCCESS) Then HandleVISAError vi

  ' Initialize - start from a known state.
  Initialize

  ' Capture data.
  Capture

  ' Analyze the captured waveform.
  Analyze
  ' Close the vi session and the resource manager session.
  err = viClose(vi)
  err = viClose(drm)

End Sub

'
' Initialize the oscilloscope to a known state.
' --------------------------------------------------------------------

Private Sub Initialize()

  ' Clear the interface.
  err = viClear(vi)
  If Not (err = VI_SUCCESS) Then HandleVISAError vi

  ' Get and display the device's *IDN? string.
  strQueryResult = DoQueryString("*IDN?")
  MsgBox "*IDN? string: " + strQueryResult, vbOKOnly, "*IDN? Result"

  ' Clear status and load the default setup.
  DoCommand "*CLS"
  DoCommand "*RST"

End Sub

'
' Capture the waveform.
' --------------------------------------------------------------------

Private Sub Capture()

  ' Use auto-scale to automatically configure oscilloscope.
  ' ------------------------------------------------------------------
  DoCommand ":AUToscale"

  ' Set trigger mode (EDGE, PULSe, PATTern, etc., and input source.
  DoCommand ":TRIGger:MODE EDGE"
  Debug.Print "Trigger mode: " + _
      DoQueryString(":TRIGger:MODE?")

  ' Set EDGE trigger parameters.
  DoCommand ":TRIGger:EDGE:SOURCe CHANnel1"
  Debug.Print "Trigger edge source: " + _
      DoQueryString(":TRIGger:EDGE:SOURce?")

  DoCommand ":TRIGger:EDGE:LEVel 1.5"
  Debug.Print "Trigger edge level: " + _
      DoQueryString(":TRIGger:EDGE:LEVel?")

  DoCommand ":TRIGger:EDGE:SLOPe POSitive"
  Debug.Print "Trigger edge slope: " + _
      DoQueryString(":TRIGger:EDGE:SLOPe?")

  ' Save oscilloscope configuration.
  ' ------------------------------------------------------------------
```

```
Dim lngSetupStringSize As Long
lngSetupStringSize = DoQueryIEEEBlock_Bytes(":SYSTem:SETup?")
Debug.Print "Setup bytes saved: " + CStr(lngSetupStringSize)

' Output setup string to a file:
Dim strPath As String
strPath = "c:\scope\config\setup.dat"
If Len(Dir(strPath)) Then
  Kill strPath   ' Remove file if it exists.
End If

' Open file for output.
Dim hFile As Long
hFile = FreeFile
Open strPath For Binary Access Write Lock Write As hFile
Dim lngI As Long
For lngI = 0 To lngSetupStringSize - 1
  Put hFile, , byteArray(lngI)   ' Write data.
Next lngI
Close hFile   ' Close file.

' Change settings with individual commands:
' -----------------------------------------------------------------

' Set vertical scale and offset.
DoCommand ":CHANnel1:SCALe 0.05"
Debug.Print "Channel 1 vertical scale: " + _
    DoQueryString(":CHANnel1:SCALe?")

DoCommand ":CHANnel1:OFFSet -1.5"
Debug.Print "Channel 1 vertical offset: " + _
    DoQueryString(":CHANnel1:OFFSet?")

' Set horizontal scale and position.
DoCommand ":TIMebase:SCALe 0.0002"
Debug.Print "Timebase scale: " + _
    DoQueryString(":TIMebase:SCALe?")

DoCommand ":TIMebase:POSition 0.0"
Debug.Print "Timebase position: " + _
    DoQueryString(":TIMebase:POSition?")

' Set the acquisition type (NORMal, PEAK, AVERage, or HRESolution).
DoCommand ":ACQuire:TYPE NORMal"
Debug.Print "Acquire type: " + _
    DoQueryString(":ACQuire:TYPE?")

' Or, configure by loading a previously saved setup.
' -----------------------------------------------------------------
strPath = "c:\scope\config\setup.dat"
Open strPath For Binary Access Read As hFile   ' Open file for input.
Dim lngSetupFileSize As Long
lngSetupFileSize = LOF(hFile)  ' Length of file.
Get hFile, , byteArray   ' Read data.
Close hFile   ' Close file.
' Write learn string back to oscilloscope using ":SYSTem:SETup"
' command:
  Dim lngRestored As Long
  lngRestored = DoCommandIEEEBlock(":SYSTem:SETup", lngSetupFileSize)
  Debug.Print "Setup bytes restored: " + CStr(lngRestored)

  ' Capture an acquisition using :DIGitize.
  ' -----------------------------------------------------------------
  DoCommand ":DIGitize CHANnel1"

End Sub

'
' Analyze the captured waveform.
' -------------------------------------------------------------------

Private Sub Analyze()

  ' Make a couple of measurements.
  ' -----------------------------------------------------------------
  DoCommand ":MEASure:SOURce CHANnel1"
  Debug.Print "Measure source: " + _
      DoQueryString(":MEASure:SOURce?")

  DoCommand ":MEASure:FREQuency"
  dblQueryResult = DoQueryNumber(":MEASure:FREQuency?")
  MsgBox "Frequency:" + vbCrLf + _
      FormatNumber(dblQueryResult / 1000, 4) + " kHz"

  DoCommand ":MEASure:VAMPlitude"
  dblQueryResult = DoQueryNumber(":MEASure:VAMPlitude?")
  MsgBox "Vertical amplitude:" + vbCrLf + _
      FormatNumber(dblQueryResult, 4) + " V"


  ' Download the screen image.
  ' -----------------------------------------------------------------
  DoCommand ":HARDcopy:INKSaver OFF"

  ' Get screen image.
  Dim lngBlockSize As Long
  lngBlockSize = DoQueryIEEEBlock_Bytes(":DISPlay:DATA? PNG, COLor")
  Debug.Print "Screen image bytes: " + CStr(lngBlockSize)

  ' Save screen image to a file:
  Dim strPath As String
  strPath = "c:\scope\data\screen.png"
  If Len(Dir(strPath)) Then
    Kill strPath   ' Remove file if it exists.
  End If
  Dim hFile As Long
  hFile = FreeFile
  Open strPath For Binary Access Write Lock Write As hFile
  Dim lngI As Long
  For lngI = 0 To lngBlockSize - 1
    Put hFile, , byteArray(lngI)   ' Write data.
  Next lngI
  Close hFile   ' Close file.
  MsgBox "Screen image written to " + strPath
```

```
' Download waveform data.
' -----------------------------------------------------------------

' Set the waveform points mode.
DoCommand ":WAVeform:POINts:MODE RAW"
Debug.Print "Waveform points mode: " + _
    DoQueryString(":WAVeform:POINts:MODE?")

' Get the number of waveform points available.
Debug.Print "Waveform points available: " + _
    DoQueryString(":WAVeform:POINts?")

' Set the waveform source.
DoCommand ":WAVeform:SOURce CHANnel1"
Debug.Print "Waveform source: " + _
    DoQueryString(":WAVeform:SOURce?")

' Choose the format of the data returned (WORD, BYTE, ASCII):
DoCommand ":WAVeform:FORMat BYTE"
Debug.Print "Waveform format: " + _
    DoQueryString(":WAVeform:FORMat?")

' Display the waveform settings:
Dim intFormat As Integer
Dim intType As Integer
Dim lngPoints As Long
Dim lngCount As Long
Dim dblXIncrement As Double
Dim dblXOrigin As Double
Dim lngXReference As Long
Dim sngYIncrement As Single
Dim lngYOrigin As Long
Dim lngYReference As Long
Dim strOutput As String

Dim lngNumNumbers As Long
lngNumNumbers = DoQueryNumbers(":WAVeform:PREamble?")

intFormat = dblArray(0)
intType = dblArray(1)
lngPoints = dblArray(2)
lngCount = dblArray(3)
dblXIncrement = dblArray(4)
dblXOrigin = dblArray(5)
lngXReference = dblArray(6)
sngYIncrement = dblArray(7)
lngYOrigin = dblArray(8)
lngYReference = dblArray(9)

If intFormat = 0 Then
  Debug.Print "Waveform format: BYTE"
ElseIf intFormat = 1 Then
  Debug.Print "Waveform format: WORD"
ElseIf intFormat = 2 Then
  Debug.Print "Waveform format: ASCii"
```

```
End If

If intType = 0 Then
  Debug.Print "Acquisition type: NORMal"
ElseIf intType = 1 Then
  Debug.Print "Acquisition type: PEAK"
ElseIf intType = 2 Then
  Debug.Print "Acquisition type: AVERage"
ElseIf intType = 3 Then
  Debug.Print "Acquisition type: HRESolution"
End If

Debug.Print "Waveform points: " + _
    FormatNumber(lngPoints, 0)

Debug.Print "Waveform average count: " + _
    FormatNumber(lngCount, 0)

Debug.Print "Waveform X increment: " + _
    Format(dblXIncrement, "Scientific")

Debug.Print "Waveform X origin: " + _
    Format(dblXOrigin, "Scientific")

Debug.Print "Waveform X reference: " + _
    FormatNumber(lngXReference, 0)

Debug.Print "Waveform Y increment: " + _
    Format(sngYIncrement, "Scientific")

Debug.Print "Waveform Y origin: " + _
    FormatNumber(lngYOrigin, 0)

Debug.Print "Waveform Y reference: " + _
    FormatNumber(lngYReference, 0)

' Get the waveform data
Dim lngNumBytes As Long
lngNumBytes = DoQueryIEEEBlock_Bytes(":WAVeform:DATA?")
Debug.Print "Number of data values: " + CStr(lngNumBytes)

' Set up output file:
strPath = "c:\scope\data\waveform_data.csv"

' Open file for output.
Open strPath For Output Access Write Lock Write As hFile

' Output waveform data in CSV format.
Dim lngDataValue As Long

For lngI = 0 To lngNumBytes - 1
  lngDataValue = CLng(byteArray(lngI))

  ' Write time value, voltage value.
  Print #hFile, _
      FormatNumber(dblXOrigin + (lngI * dblXIncrement), 9) + _
      ", " + _
```

```
        FormatNumber(((lngDataValue - lngYReference) _
        * sngYIncrement) + lngYOrigin)

  Next lngI

  ' Close output file.
  Close hFile   ' Close file.
  MsgBox "Waveform format BYTE data written to " + _
      "c:\scope\data\waveform_data.csv."

End Sub

Private Sub DoCommand(command As String)

  err = viVPrintf(vi, command + vbLf, 0)
  If (err <> VI_SUCCESS) Then HandleVISAError vi

  CheckInstrumentErrors

End Sub

Private Function DoCommandIEEEBlock(command As String, _
    lngBlockSize As Long)

  retCount = lngBlockSize

  Dim strCommandAndLength As String
  strCommandAndLength = command + " %#" + _
      Format(lngBlockSize) + "b"

  err = viVPrintf(vi, strCommandAndLength + vbLf, paramsArray(1))
  If (err <> VI_SUCCESS) Then HandleVISAError vi

  DoCommandIEEEBlock = retCount

  CheckInstrumentErrors

End Function

Private Function DoQueryString(query As String) As String

  Dim strResult As String * 200

  err = viVPrintf(vi, query + vbLf, 0)
  If (err <> VI_SUCCESS) Then HandleVISAError vi

  err = viVScanf(vi, "%t", strResult)
  If (err <> VI_SUCCESS) Then HandleVISAError vi

  DoQueryString = strResult

  CheckInstrumentErrors

End Function

Private Function DoQueryNumber(query As String) As Variant
```

```
  Dim dblResult As Double

  err = viVPrintf(vi, query + vbLf, 0)
  If (err <> VI_SUCCESS) Then HandleVISAError vi

  err = viVScanf(vi, "%lf" + vbLf, VarPtr(dblResult))
  If (err <> VI_SUCCESS) Then HandleVISAError vi

  DoQueryNumber = dblResult

  CheckInstrumentErrors

End Function

Private Function DoQueryNumbers(query As String) As Long

  Dim dblResult As Double

  ' Send query.
  err = viVPrintf(vi, query + vbLf, 0)
  If (err <> VI_SUCCESS) Then HandleVISAError vi

  ' Set up paramsArray for multiple parameter query returning array.
  paramsArray(0) = VarPtr(retCount)
  paramsArray(1) = VarPtr(dblArray(0))

  ' Set retCount to max number of elements array can hold.
  retCount = DblArraySize

  ' Read numbers.
  err = viVScanf(vi, "%,#lf" + vbLf, paramsArray(0))
  If (err <> VI_SUCCESS) Then HandleVISAError vi

  ' retCount is now actual number of values returned by query.
  DoQueryNumbers = retCount

  CheckInstrumentErrors

End Function

Private Function DoQueryIEEEBlock_Bytes(query As String) As Long

  ' Send query.
  err = viVPrintf(vi, query + vbLf, 0)
  If (err <> VI_SUCCESS) Then HandleVISAError vi

  ' Set up paramsArray for multiple parameter query returning array.
  paramsArray(0) = VarPtr(retCount)
  paramsArray(1) = VarPtr(byteArray(0))

  ' Set retCount to max number of elements array can hold.
  retCount = ByteArraySize

  ' Get unsigned integer bytes.
  err = viVScanf(vi, "%#b" + vbLf, paramsArray(0))
  If (err <> VI_SUCCESS) Then HandleVISAError vi
  err = viFlush(vi, VI_READ_BUF)
  If (err <> VI_SUCCESS) Then HandleVISAError vi

  err = viFlush(vi, VI_WRITE_BUF)
  If (err <> VI_SUCCESS) Then HandleVISAError vi

  ' retCount is now actual number of bytes returned by query.
  DoQueryIEEEBlock_Bytes = retCount

  CheckInstrumentErrors

End Function

Private Sub CheckInstrumentErrors()

  On Error GoTo ErrorHandler

  Dim strErrVal As String * 200
  Dim strOut As String

  err = viVPrintf(vi, ":SYSTem:ERRor?" + vbLf, 0)   ' Query any errors.
  If (err <> VI_SUCCESS) Then HandleVISAError vi

  err = viVScanf(vi, "%t", strErrVal)   ' Read: Errnum,"Error String".
  If (err <> VI_SUCCESS) Then HandleVISAError vi

  While Val(strErrVal) <> 0             ' End if find: 0,"No Error".
    strOut = strOut + "INST Error: " + strErrVal

    err = viVPrintf(vi, ":SYSTem:ERRor?" + vbLf, 0)   ' Request error.
    If (err <> VI_SUCCESS) Then HandleVISAError vi

    err = viVScanf(vi, "%t", strErrVal)   ' Read error message.
    If (err <> VI_SUCCESS) Then HandleVISAError vi

  Wend

  If Not strOut = "" Then
    MsgBox strOut, vbExclamation, "INST Error Messages"

    err = viFlush(vi, VI_READ_BUF)
    If (err <> VI_SUCCESS) Then HandleVISAError vi

    err = viFlush(vi, VI_WRITE_BUF)
    If (err <> VI_SUCCESS) Then HandleVISAError vi

  End If

  Exit Sub

ErrorHandler:

  MsgBox "*** Error : " + Error, vbExclamation
  End

End Sub
```

```
Private Sub HandleVISAError(session As Long)

  Dim strVisaErr As String * 200
  Call viStatusDesc(session, err, strVisaErr)
  MsgBox "*** VISA Error : " + strVisaErr, vbExclamation

  ' If the error is not a warning, close the session.
  If err < VI_SUCCESS Then
    If session <> 0 Then Call viClose(session)
    End
  End If

End Sub
```

VISA Example in C#

To compile and run this example in Microsoft Visual Studio 2008:

1 Open Visual Studio.

2 Create a new Visual C#, Windows, Console Application project.

3 Cut-and-paste the code that follows into the C# source file.

4 Edit the program to use the VISA address of your oscilloscope.

5 Add Keysight's VISA header file to your project:

   a Right-click the project you wish to modify (not the solution) in the Solution Explorer window of the Microsoft Visual Studio environment.

   b Click **Add** and then click **Add Existing Item...**

   c Navigate to the header file, visa32.cs (installed with Keysight IO Libraries Suite and found in the Program Files (x86)\IVI Foundation\VISA\WinNT\Include directory), select it, but *do not click the Open button*.

   d Click the down arrow to the right of the **Add** button, and choose **Add as Link**.

   You should now see the file underneath your project in the Solution Explorer. It will have a little arrow icon in its lower left corner, indicating that it is a link.

6 Build and run the program.

For more information, see the tutorial on using VISA in Microsoft .NET in the VISA Help that comes with Keysight IO Libraries Suite 17.

```
/*
 * Keysight VISA Example in C#
 * -------------------------------------------------------------------
 * This program illustrates a few commonly used programming
 * features of your Keysight oscilloscope.
 * -------------------------------------------------------------------
 */

using System;
using System.IO;
using System.Text;
```

```
namespace InfiniiVision
{
  class VisaInstrumentApp
  {
    private static VisaInstrument myScope;

    public static void Main(string[] args)
    {
      try
      {
        myScope = new
          VisaInstrument("USB0::0x0957::0x17A6::US50210029::0::INSTR");
        myScope.SetTimeoutSeconds(10);

        // Initialize - start from a known state.
        Initialize();

        // Capture data.
        Capture();

        // Analyze the captured waveform.
        Analyze();

      }
      catch (System.ApplicationException err)
      {
        Console.WriteLine("*** VISA Error Message : " + err.Message);
      }
      catch (System.SystemException err)
      {
        Console.WriteLine("*** System Error Message : " + err.Message);
      }
      catch (System.Exception err)
      {
        System.Diagnostics.Debug.Fail("Unexpected Error");
        Console.WriteLine("*** Unexpected Error : " + err.Message);
      }
      finally
      {
        myScope.Close();
      }
    }

    /*
     * Initialize the oscilloscope to a known state.
     * --------------------------------------------------------------
     */
    private static void Initialize()
    {
      StringBuilder strResults;

      // Get and display the device's *IDN? string.
      strResults = myScope.DoQueryString("*IDN?");
      Console.WriteLine("*IDN? result is: {0}", strResults);

      // Clear status and load the default setup.
      myScope.DoCommand("*CLS");
      myScope.DoCommand("*RST");
    }

    /*
     * Capture the waveform.
     * --------------------------------------------------------------
     */
    private static void Capture()
    {
      // Use auto-scale to automatically configure oscilloscope.
      myScope.DoCommand(":AUToscale");

      // Set trigger mode (EDGE, PULSe, PATTern, etc., and input source.
      myScope.DoCommand(":TRIGger:MODE EDGE");
      Console.WriteLine("Trigger mode: {0}",
          myScope.DoQueryString(":TRIGger:MODE?"));

      // Set EDGE trigger parameters.
      myScope.DoCommand(":TRIGger:EDGE:SOURCe CHANnel1");
      Console.WriteLine("Trigger edge source: {0}",
          myScope.DoQueryString(":TRIGger:EDGE:SOURce?"));

      myScope.DoCommand(":TRIGger:EDGE:LEVel 1.5");
      Console.WriteLine("Trigger edge level: {0}",
          myScope.DoQueryString(":TRIGger:EDGE:LEVel?"));

      myScope.DoCommand(":TRIGger:EDGE:SLOPe POSitive");
      Console.WriteLine("Trigger edge slope: {0}",
          myScope.DoQueryString(":TRIGger:EDGE:SLOPe?"));

      // Save oscilloscope configuration.
      byte[] ResultsArray;   // Results array.
      int nLength;   // Number of bytes returned from instrument.
      string strPath;

      // Query and read setup string.
      nLength = myScope.DoQueryIEEEBlock(":SYSTem:SETup?",
        out ResultsArray);

      // Write setup string to file.
      strPath = "c:\\scope\\config\\setup.stp";
      FileStream fStream = File.Open(strPath, FileMode.Create);
      fStream.Write(ResultsArray, 0, nLength);
      fStream.Close();
      Console.WriteLine("Setup bytes saved: {0}", nLength);

      // Change settings with individual commands:

      // Set vertical scale and offset.
      myScope.DoCommand(":CHANnel1:SCALe 0.05");
      Console.WriteLine("Channel 1 vertical scale: {0}",
          myScope.DoQueryString(":CHANnel1:SCALe?"));

      myScope.DoCommand(":CHANnel1:OFFSet -1.5");
      Console.WriteLine("Channel 1 vertical offset: {0}",
          myScope.DoQueryString(":CHANnel1:OFFSet?"));
      // Set horizontal scale and position.
      myScope.DoCommand(":TIMebase:SCALe 0.0002");
      Console.WriteLine("Timebase scale: {0}",
          myScope.DoQueryString(":TIMebase:SCALe?"));

      myScope.DoCommand(":TIMebase:POSition 0.0");
      Console.WriteLine("Timebase position: {0}",
          myScope.DoQueryString(":TIMebase:POSition?"));

      // Set the acquisition type (NORMal, PEAK, AVERage, or HRESolution
).
      myScope.DoCommand(":ACQuire:TYPE NORMal");
      Console.WriteLine("Acquire type: {0}",
          myScope.DoQueryString(":ACQuire:TYPE?"));

      // Or, configure by loading a previously saved setup.
      byte[] DataArray;
      int nBytesWritten;

      // Read setup string from file.
      strPath = "c:\\scope\\config\\setup.stp";
      DataArray = File.ReadAllBytes(strPath);

      // Restore setup string.
      nBytesWritten = myScope.DoCommandIEEEBlock(":SYSTem:SETup",
        DataArray);
      Console.WriteLine("Setup bytes restored: {0}", nBytesWritten);

      // Capture an acquisition using :DIGitize.
      myScope.DoCommand(":DIGitize CHANnel1");
    }

    /*
     * Analyze the captured waveform.
     * --------------------------------------------------------------
     */
    private static void Analyze()
    {
      byte[] ResultsArray;   // Results array.
      int nLength;   // Number of bytes returned from instrument.
      string strPath;

      // Make a couple of measurements.
      // --------------------------------------------------------------
      myScope.DoCommand(":MEASure:SOURce CHANnel1");
      Console.WriteLine("Measure source: {0}",
          myScope.DoQueryString(":MEASure:SOURce?"));

      double fResult;
      myScope.DoCommand(":MEASure:FREQuency");
      fResult = myScope.DoQueryNumber(":MEASure:FREQuency?");
      Console.WriteLine("Frequency: {0:F4} kHz", fResult / 1000);

      myScope.DoCommand(":MEASure:VAMPlitude");
      fResult = myScope.DoQueryNumber(":MEASure:VAMPlitude?");
      Console.WriteLine("Vertical amplitude: {0:F2} V", fResult);
```

```
// Download the screen image.
// -----------------------------------------------------------
myScope.DoCommand(":HARDcopy:INKSaver OFF");

// Get the screen data.
nLength = myScope.DoQueryIEEEBlock(":DISPlay:DATA? PNG, COLor",
    out ResultsArray);

// Store the screen data to a file.
strPath = "c:\\scope\\data\\screen.png";
FileStream fStream = File.Open(strPath, FileMode.Create);
fStream.Write(ResultsArray, 0, nLength);
fStream.Close();
Console.WriteLine("Screen image ({0} bytes) written to {1}",
    nLength, strPath);

// Download waveform data.
// -----------------------------------------------------------

// Set the waveform points mode.
myScope.DoCommand(":WAVeform:POINts:MODE RAW");
Console.WriteLine("Waveform points mode: {0}",
    myScope.DoQueryString(":WAVeform:POINts:MODE?"));

// Get the number of waveform points available.
myScope.DoCommand(":WAVeform:POINts 10240");
Console.WriteLine("Waveform points available: {0}",
    myScope.DoQueryString(":WAVeform:POINts?"));

// Set the waveform source.
myScope.DoCommand(":WAVeform:SOURce CHANnel1");
Console.WriteLine("Waveform source: {0}",
    myScope.DoQueryString(":WAVeform:SOURce?"));

// Choose the format of the data returned (WORD, BYTE, ASCII):
myScope.DoCommand(":WAVeform:FORMat BYTE");
Console.WriteLine("Waveform format: {0}",
    myScope.DoQueryString(":WAVeform:FORMat?"));

// Display the waveform settings:
double[] fResultsArray;
fResultsArray = myScope.DoQueryNumbers(":WAVeform:PREamble?");

double fFormat = fResultsArray[0];
if (fFormat == 0.0)
{
  Console.WriteLine("Waveform format: BYTE");
}
else if (fFormat == 1.0)
{
  Console.WriteLine("Waveform format: WORD");
}
else if (fFormat == 2.0)
{
  Console.WriteLine("Waveform format: ASCii");
}
```

```
double fType = fResultsArray[1];
if (fType == 0.0)
{
  Console.WriteLine("Acquire type: NORMal");
}
else if (fType == 1.0)
{
  Console.WriteLine("Acquire type: PEAK");
}
else if (fType == 2.0)
{
  Console.WriteLine("Acquire type: AVERage");
}
else if (fType == 3.0)
{
  Console.WriteLine("Acquire type: HRESolution");
}

double fPoints = fResultsArray[2];
Console.WriteLine("Waveform points: {0:e}", fPoints);

double fCount = fResultsArray[3];
Console.WriteLine("Waveform average count: {0:e}", fCount);

double fXincrement = fResultsArray[4];
Console.WriteLine("Waveform X increment: {0:e}", fXincrement);

double fXorigin = fResultsArray[5];
Console.WriteLine("Waveform X origin: {0:e}", fXorigin);

double fXreference = fResultsArray[6];
Console.WriteLine("Waveform X reference: {0:e}", fXreference);

double fYincrement = fResultsArray[7];
Console.WriteLine("Waveform Y increment: {0:e}", fYincrement);

double fYorigin = fResultsArray[8];
Console.WriteLine("Waveform Y origin: {0:e}", fYorigin);

double fYreference = fResultsArray[9];
Console.WriteLine("Waveform Y reference: {0:e}", fYreference);

// Read waveform data.
nLength = myScope.DoQueryIEEEBlock(":WAVeform:DATA?",
    out ResultsArray);
Console.WriteLine("Number of data values: {0}", nLength);

// Set up output file:
strPath = "c:\\scope\\data\\waveform_data.csv";
if (File.Exists(strPath)) File.Delete(strPath);

// Open file for output.
StreamWriter writer = File.CreateText(strPath);

// Output waveform data in CSV format.
for (int i = 0; i < nLength - 1; i++)
```

```
        writer.WriteLine("{0:f9}, {1:f6}",
            fXorigin + ((float)i * fXincrement),
            (((float)ResultsArray[i] - fYreference) *
            fYincrement) + fYorigin);

      // Close output file.
      writer.Close();
      Console.WriteLine("Waveform format BYTE data written to {0}",
          strPath);
    }
  }

  class VisaInstrument
  {
    private int m_nResourceManager;
    private int m_nSession;
    private string m_strVisaAddress;

    // Constructor.
    public VisaInstrument(string strVisaAddress)
    {
      // Save VISA address in member variable.
      m_strVisaAddress = strVisaAddress;

      // Open the default VISA resource manager.
      OpenResourceManager();

      // Open a VISA resource session.
      OpenSession();

      // Clear the interface.
      int nViStatus;
      nViStatus = visa32.viClear(m_nSession);
    }

    public void DoCommand(string strCommand)
    {
      // Send the command.
      VisaSendCommandOrQuery(strCommand);

      // Check for inst errors.
      CheckInstrumentErrors(strCommand);
    }

    public int DoCommandIEEEBlock(string strCommand,
      byte[] DataArray)
    {
      // Send the command to the device.
      string strCommandAndLength;
      int nViStatus, nLength, nBytesWritten;

      nLength = DataArray.Length;
      strCommandAndLength = String.Format("{0} #8%08d",
        strCommand);

      // Write first part of command to formatted I/O write buffer.
      nViStatus = visa32.viPrintf(m_nSession, strCommandAndLength,
        nLength);
      CheckVisaStatus(nViStatus);

      // Write the data to the formatted I/O write buffer.
      nViStatus = visa32.viBufWrite(m_nSession, DataArray, nLength,
        out nBytesWritten);
      CheckVisaStatus(nViStatus);

      // Check for inst errors.
      CheckInstrumentErrors(strCommand);

      return nBytesWritten;
    }

    public StringBuilder DoQueryString(string strQuery)
    {
      // Send the query.
      VisaSendCommandOrQuery(strQuery);

      // Get the result string.
      StringBuilder strResults = new StringBuilder(1000);
      strResults = VisaGetResultString();

      // Check for inst errors.
      CheckInstrumentErrors(strQuery);

      // Return string results.
      return strResults;
    }

    public double DoQueryNumber(string strQuery)
    {
      // Send the query.
      VisaSendCommandOrQuery(strQuery);

      // Get the result string.
      double fResults;
      fResults = VisaGetResultNumber();

      // Check for inst errors.
      CheckInstrumentErrors(strQuery);

      // Return string results.
      return fResults;
    }

    public double[] DoQueryNumbers(string strQuery)
    {
      // Send the query.
      VisaSendCommandOrQuery(strQuery);

      // Get the result string.
      double[] fResultsArray;
      fResultsArray = VisaGetResultNumbers();

      // Check for inst errors.
      CheckInstrumentErrors(strQuery);
      // Return string results.
      return fResultsArray;
    }

    public int DoQueryIEEEBlock(string strQuery,
      out byte[] ResultsArray)
    {
      // Send the query.
      VisaSendCommandOrQuery(strQuery);

      // Get the result string.
      int length;   // Number of bytes returned from instrument.
      length = VisaGetResultIEEEBlock(out ResultsArray);

      // Check for inst errors.
      CheckInstrumentErrors(strQuery);

      // Return string results.
      return length;
    }

    private void VisaSendCommandOrQuery(string strCommandOrQuery)
    {
      // Send command or query to the device.
      string strWithNewline;
      strWithNewline = String.Format("{0}\n", strCommandOrQuery);
      int nViStatus;
      nViStatus = visa32.viPrintf(m_nSession, strWithNewline);
      CheckVisaStatus(nViStatus);
    }

    private StringBuilder VisaGetResultString()
    {
      StringBuilder strResults = new StringBuilder(1000);

      // Read return value string from the device.
      int nViStatus;
      nViStatus = visa32.viScanf(m_nSession, "%1000t", strResults);
      CheckVisaStatus(nViStatus);

      return strResults;
    }

    private double VisaGetResultNumber()
    {
      double fResults = 0;

      // Read return value string from the device.
      int nViStatus;
      nViStatus = visa32.viScanf(m_nSession, "%lf", out fResults);
      CheckVisaStatus(nViStatus);

      return fResults;
    }

    private double[] VisaGetResultNumbers()
```

```
{
  double[] fResultsArray;
  fResultsArray = new double[10];

  // Read return value string from the device.
  int nViStatus;
  nViStatus = visa32.viScanf(m_nSession, "%,10lf\n",
      fResultsArray);
  CheckVisaStatus(nViStatus);

  return fResultsArray;
}

private int VisaGetResultIEEEBlock(out byte[] ResultsArray)
{
  // Results array, big enough to hold a PNG.
  ResultsArray = new byte[300000];
  int length;   // Number of bytes returned from instrument.

  // Set the default number of bytes that will be contained in
  // the ResultsArray to 300,000 (300kB).
  length = 300000;

  // Read return value string from the device.
  int nViStatus;
  nViStatus = visa32.viScanf(m_nSession, "%#b", ref length,
    ResultsArray);
  CheckVisaStatus(nViStatus);

  // Write and read buffers need to be flushed after IEEE block?
  nViStatus = visa32.viFlush(m_nSession, visa32.VI_WRITE_BUF);
  CheckVisaStatus(nViStatus);

  nViStatus = visa32.viFlush(m_nSession, visa32.VI_READ_BUF);
  CheckVisaStatus(nViStatus);

  return length;
}

private void CheckInstrumentErrors(string strCommand)
{
  // Check for instrument errors.
  StringBuilder strInstrumentError = new StringBuilder(1000);
  bool bFirstError = true;

  do   // While not "0,No error"
  {
    VisaSendCommandOrQuery(":SYSTem:ERRor?");
    strInstrumentError = VisaGetResultString();

    if (!strInstrumentError.ToString().StartsWith("+0,"))
    {
      if (bFirstError)
      {
        Console.WriteLine("ERROR(s) for command '{0}': ",
          strCommand);
        bFirstError = false;
```

```
          }
          Console.Write(strInstrumentError);
        }
      } while (!strInstrumentError.ToString().StartsWith("+0,"));
    }

    private void OpenResourceManager()
    {
      int nViStatus;
      nViStatus =
        visa32.viOpenDefaultRM(out this.m_nResourceManager);
      if (nViStatus < visa32.VI_SUCCESS)
        throw new
          ApplicationException("Failed to open Resource Manager");
    }

    private void OpenSession()
    {
      int nViStatus;
      nViStatus = visa32.viOpen(this.m_nResourceManager,
        this.m_strVisaAddress, visa32.VI_NO_LOCK,
        visa32.VI_TMO_IMMEDIATE, out this.m_nSession);
      CheckVisaStatus(nViStatus);
    }

    public void SetTimeoutSeconds(int nSeconds)
    {
      int nViStatus;
      nViStatus = visa32.viSetAttribute(this.m_nSession,
        visa32.VI_ATTR_TMO_VALUE, nSeconds * 1000);
      CheckVisaStatus(nViStatus);
    }

    public void CheckVisaStatus(int nViStatus)
    {
      // If VISA error, throw exception.
      if (nViStatus < visa32.VI_SUCCESS)
      {
        StringBuilder strError = new StringBuilder(256);
        visa32.viStatusDesc(this.m_nResourceManager, nViStatus,
          strError);
        throw new ApplicationException(strError.ToString());
      }
    }

    public void Close()
    {
      if (m_nSession != 0)
        visa32.viClose(m_nSession);
      if (m_nResourceManager != 0)
        visa32.viClose(m_nResourceManager);
    }
  }
}
```

VISA Example in Visual Basic .NET

To compile and run this example in Microsoft Visual Studio 2008:

1 Open Visual Studio.

2 Create a new Visual Basic, Windows, Console Application project.

3 Cut-and-paste the code that follows into the Visual Basic .NET source file.

4 Edit the program to use the VISA address of your oscilloscope.

5 Add Keysight's VISA header file to your project:

   a Right-click the project you wish to modify (not the solution) in the Solution Explorer window of the Microsoft Visual Studio environment.

   b Choose **Add** and then choose **Add Existing Item...**

   c Navigate to the header file, visa32.vb (installed with Keysight IO Libraries Suite and found in the Program Files (x86)\IVI Foundation\VISA\WinNT\Include directory), select it, but *do not click the Open button*.

   d Click the down arrow to the right of the **Add** button, and choose **Add as Link**.

   You should now see the file underneath your project in the Solution Explorer. It will have a little arrow icon in its lower left corner, indicating that it is a link.

   e Right-click the project again and choose **Properties**; then, select "InfiniiVision.VisaInstrumentApp" as the **Startup object**.

6 Build and run the program.

For more information, see the tutorial on using VISA in Microsoft .NET in the VISA Help that comes with Keysight IO Libraries Suite 17.

```
'
' Keysight VISA Example in Visual Basic .NET
' -------------------------------------------------------------------
' This program illustrates a few commonly-used programming
' features of your Keysight oscilloscope.
' -------------------------------------------------------------------

Imports System
Imports System.IO
Imports System.Text

Namespace InfiniiVision
  Class VisaInstrumentApp
    Private Shared myScope As VisaInstrument

    Public Shared Sub Main(ByVal args As String())
      Try
        myScope = _
          New VisaInstrument("USB0::0x0957::0x17A6::US50210029::0::INSTR
")
        myScope.SetTimeoutSeconds(10)
        ' Initialize - start from a known state.
        Initialize()

        ' Capture data.
        Capture()

        ' Analyze the captured waveform.
        Analyze()

      Catch err As System.ApplicationException
        Console.WriteLine("*** VISA Error Message : " + err.Message)
      Catch err As System.SystemException
        Console.WriteLine("*** System Error Message : " + err.Message)
      Catch err As System.Exception
        Debug.Fail("Unexpected Error")
        Console.WriteLine("*** Unexpected Error : " + err.Message)
      End Try
    End Sub

    '
    ' Initialize the oscilloscope to a known state.
    ' --------------------------------------------------------------

    Private Shared Sub Initialize()
      Dim strResults As StringBuilder

      ' Get and display the device's *IDN? string.
      strResults = myScope.DoQueryString("*IDN?")
      Console.WriteLine("*IDN? result is: {0}", strResults)

      ' Clear status and load the default setup.
      myScope.DoCommand("*CLS")
      myScope.DoCommand("*RST")

    End Sub

    '
    ' Capture the waveform.
    ' --------------------------------------------------------------

    Private Shared Sub Capture()

      ' Use auto-scale to automatically configure oscilloscope.
      myScope.DoCommand(":AUToscale")

      ' Set trigger mode (EDGE, PULSe, PATTern, etc., and input source.
      myScope.DoCommand(":TRIGger:MODE EDGE")
      Console.WriteLine("Trigger mode: {0}", _
          myScope.DoQueryString(":TRIGger:MODE?"))

      ' Set EDGE trigger parameters.
      myScope.DoCommand(":TRIGger:EDGE:SOURCe CHANnel1")
      Console.WriteLine("Trigger edge source: {0}", _
          myScope.DoQueryString(":TRIGger:EDGE:SOURce?"))

      myScope.DoCommand(":TRIGger:EDGE:LEVel 1.5")
      Console.WriteLine("Trigger edge level: {0}", _
          myScope.DoQueryString(":TRIGger:EDGE:LEVel?"))

      myScope.DoCommand(":TRIGger:EDGE:SLOPe POSitive")
      Console.WriteLine("Trigger edge slope: {0}", _
          myScope.DoQueryString(":TRIGger:EDGE:SLOPe?"))

      ' Save oscilloscope configuration.
      Dim ResultsArray As Byte()   ' Results array.
      Dim nLength As Integer   ' Number of bytes returned from inst.
      Dim strPath As String
      Dim fStream As FileStream

      ' Query and read setup string.
      nLength = myScope.DoQueryIEEEBlock(":SYSTem:SETup?", _
          ResultsArray)

      ' Write setup string to file.
      strPath = "c:\scope\config\setup.stp"
      fStream = File.Open(strPath, FileMode.Create)
      fStream.Write(ResultsArray, 0, nLength)
      fStream.Close()
      Console.WriteLine("Setup bytes saved: {0}", nLength)

      ' Change settings with individual commands:

      ' Set vertical scale and offset.
      myScope.DoCommand(":CHANnel1:SCALe 0.05")
      Console.WriteLine("Channel 1 vertical scale: {0}", _
          myScope.DoQueryString(":CHANnel1:SCALe?"))

      myScope.DoCommand(":CHANnel1:OFFSet -1.5")
      Console.WriteLine("Channel 1 vertical offset: {0}", _
          myScope.DoQueryString(":CHANnel1:OFFSet?"))

      ' Set horizontal scale and position.
      myScope.DoCommand(":TIMebase:SCALe 0.0002")
      Console.WriteLine("Timebase scale: {0}", _
          myScope.DoQueryString(":TIMebase:SCALe?"))

      myScope.DoCommand(":TIMebase:POSition 0.0")
      Console.WriteLine("Timebase position: {0}", _
          myScope.DoQueryString(":TIMebase:POSition?"))

      ' Set the acquisition type (NORMal, PEAK, AVERage, or HRESolution)
.
      myScope.DoCommand(":ACQuire:TYPE NORMal")
      Console.WriteLine("Acquire type: {0}", _
          myScope.DoQueryString(":ACQuire:TYPE?"))

      ' Or, configure by loading a previously saved setup.
      Dim DataArray As Byte()
      Dim nBytesWritten As Integer

      ' Read setup string from file.
      strPath = "c:\scope\config\setup.stp"
      DataArray = File.ReadAllBytes(strPath)
```

```
  ' Restore setup string.
  nBytesWritten = myScope.DoCommandIEEEBlock(":SYSTem:SETup", _
      DataArray)
  Console.WriteLine("Setup bytes restored: {0}", nBytesWritten)

  ' Capture an acquisition using :DIGitize.
  myScope.DoCommand(":DIGitize CHANnel1")

End Sub

'
' Analyze the captured waveform.
' --------------------------------------------------------------

Private Shared Sub Analyze()

  Dim fResult As Double
  Dim ResultsArray As Byte()    ' Results array.
  Dim nLength As Integer    ' Number of bytes returned from inst.
  Dim strPath As String

  ' Make a couple of measurements.
  ' ------------------------------------------------------------
  myScope.DoCommand(":MEASure:SOURce CHANnel1")
  Console.WriteLine("Measure source: {0}", _
      myScope.DoQueryString(":MEASure:SOURce?"))

  myScope.DoCommand(":MEASure:FREQuency")
  fResult = myScope.DoQueryNumber(":MEASure:FREQuency?")
  Console.WriteLine("Frequency: {0:F4} kHz", fResult / 1000)

  myScope.DoCommand(":MEASure:VAMPlitude")
  fResult = myScope.DoQueryNumber(":MEASure:VAMPlitude?")
  Console.WriteLine("Vertical amplitude: {0:F2} V", fResult)

  ' Download the screen image.
  ' ------------------------------------------------------------
  myScope.DoCommand(":HARDcopy:INKSaver OFF")

  ' Get the screen data.
  nLength = myScope.DoQueryIEEEBlock(":DISPlay:DATA? PNG, COLor", _
      ResultsArray)

  ' Store the screen data to a file.
  strPath = "c:\scope\data\screen.png"
  Dim fStream As FileStream
  fStream = File.Open(strPath, FileMode.Create)
  fStream.Write(ResultsArray, 0, nLength)
  fStream.Close()
  Console.WriteLine("Screen image ({0} bytes) written to {1}", _
      nLength, strPath)

  ' Download waveform data.
  ' ------------------------------------------------------------

  ' Set the waveform points mode.
  myScope.DoCommand(":WAVeform:POINts:MODE RAW")
```

```
Console.WriteLine("Waveform points mode: {0}", _
    myScope.DoQueryString(":WAVeform:POINts:MODE?"))

' Get the number of waveform points available.
myScope.DoCommand(":WAVeform:POINts 10240")
Console.WriteLine("Waveform points available: {0}", _
    myScope.DoQueryString(":WAVeform:POINts?"))

' Set the waveform source.
myScope.DoCommand(":WAVeform:SOURce CHANnel1")
Console.WriteLine("Waveform source: {0}", _
    myScope.DoQueryString(":WAVeform:SOURce?"))

' Choose the format of the data returned (WORD, BYTE, ASCII):
myScope.DoCommand(":WAVeform:FORMat BYTE")
Console.WriteLine("Waveform format: {0}", _
    myScope.DoQueryString(":WAVeform:FORMat?"))

' Display the waveform settings:
Dim fResultsArray As Double()
fResultsArray = myScope.DoQueryNumbers(":WAVeform:PREamble?")

Dim fFormat As Double = fResultsArray(0)
If fFormat = 0 Then
  Console.WriteLine("Waveform format: BYTE")
ElseIf fFormat = 1 Then
  Console.WriteLine("Waveform format: WORD")
ElseIf fFormat = 2 Then
  Console.WriteLine("Waveform format: ASCii")
End If

Dim fType As Double = fResultsArray(1)
If fType = 0 Then
  Console.WriteLine("Acquire type: NORMal")
ElseIf fType = 1 Then
  Console.WriteLine("Acquire type: PEAK")
ElseIf fType = 2 Then
  Console.WriteLine("Acquire type: AVERage")
ElseIf fType = 3 Then
  Console.WriteLine("Acquire type: HRESolution")
End If

Dim fPoints As Double = fResultsArray(2)
Console.WriteLine("Waveform points: {0:e}", fPoints)

Dim fCount As Double = fResultsArray(3)
Console.WriteLine("Waveform average count: {0:e}", fCount)

Dim fXincrement As Double = fResultsArray(4)
Console.WriteLine("Waveform X increment: {0:e}", fXincrement)

Dim fXorigin As Double = fResultsArray(5)
Console.WriteLine("Waveform X origin: {0:e}", fXorigin)

Dim fXreference As Double = fResultsArray(6)
Console.WriteLine("Waveform X reference: {0:e}", fXreference)
```

```
    Dim fYincrement As Double = fResultsArray(7)
    Console.WriteLine("Waveform Y increment: {0:e}", fYincrement)

    Dim fYorigin As Double = fResultsArray(8)
    Console.WriteLine("Waveform Y origin: {0:e}", fYorigin)

    Dim fYreference As Double = fResultsArray(9)
    Console.WriteLine("Waveform Y reference: {0:e}", fYreference)

    ' Get the waveform data.
    nLength = myScope.DoQueryIEEEBlock(":WAVeform:DATA?", _
        ResultsArray)
    Console.WriteLine("Number of data values: {0}", nLength)

    ' Set up output file:
    strPath = "c:\scope\data\waveform_data.csv"
    If File.Exists(strPath) Then
      File.Delete(strPath)
    End If

    ' Open file for output.
    Dim writer As StreamWriter = File.CreateText(strPath)

    ' Output waveform data in CSV format.
    For index As Integer = 0 To nLength - 1
      ' Write time value, voltage value.
      writer.WriteLine("{0:f9}, {1:f6}", _
          fXorigin + (CSng(index) * fXincrement), _
          ((CSng(ResultsArray(index)) - fYreference) _
          * fYincrement) + fYorigin)
    Next

    ' Close output file.
    writer.Close()
    Console.WriteLine("Waveform format BYTE data written to {0}", _
        strPath)

  End Sub

End Class

Class VisaInstrument
  Private m_nResourceManager As Integer
  Private m_nSession As Integer
  Private m_strVisaAddress As String

  ' Constructor.
  Public Sub New(ByVal strVisaAddress As String)
    ' Save VISA address in member variable.
    m_strVisaAddress = strVisaAddress

    ' Open the default VISA resource manager.
    OpenResourceManager()

    ' Open a VISA resource session.
    OpenSession()
    ' Clear the interface.
    Dim nViStatus As Integer
    nViStatus = visa32.viClear(m_nSession)
  End Sub

  Public Sub DoCommand(ByVal strCommand As String)
    ' Send the command.
    VisaSendCommandOrQuery(strCommand)

    ' Check for inst errors.
    CheckInstrumentErrors(strCommand)

  End Sub

  Public Function DoCommandIEEEBlock(ByVal strCommand As String, _
      ByVal DataArray As Byte()) As Integer

    ' Send the command to the device.
    Dim strCommandAndLength As String
    Dim nViStatus As Integer
    Dim nLength As Integer
    Dim nBytesWritten As Integer

    nLength = DataArray.Length
    strCommandAndLength = [String].Format("{0} #8{1:D8}", _
        strCommand, nLength)

    ' Write first part of command to formatted I/O write buffer.
    nViStatus = visa32.viPrintf(m_nSession, strCommandAndLength)
    CheckVisaStatus(nViStatus)

    ' Write the data to the formatted I/O write buffer.
    nViStatus = visa32.viBufWrite(m_nSession, DataArray, nLength, _
        nBytesWritten)
    CheckVisaStatus(nViStatus)

    ' Check for inst errors.
    CheckInstrumentErrors(strCommand)

    Return nBytesWritten
  End Function

  Public Function DoQueryString(ByVal strQuery As String) _
    As StringBuilder
    ' Send the query.
    VisaSendCommandOrQuery(strQuery)

    ' Get the result string.
    Dim strResults As New StringBuilder(1000)
    strResults = VisaGetResultString()

    ' Check for inst errors.
    CheckInstrumentErrors(strQuery)

    ' Return string results.
    Return strResults
  End Function
```

```
Public Function DoQueryNumber(ByVal strQuery As String) As Double
  ' Send the query.
  VisaSendCommandOrQuery(strQuery)

  ' Get the result string.
  Dim fResults As Double
  fResults = VisaGetResultNumber()

  ' Check for inst errors.
  CheckInstrumentErrors(strQuery)

  ' Return string results.
  Return fResults
End Function

Public Function DoQueryNumbers(ByVal strQuery As String) _
    As Double()
  ' Send the query.
  VisaSendCommandOrQuery(strQuery)

  ' Get the result string.
  Dim fResultsArray As Double()
  fResultsArray = VisaGetResultNumbers()

  ' Check for instrument errors (another command and result).
  CheckInstrumentErrors(strQuery)

  ' Return string results.
  Return fResultsArray
End Function

Public Function DoQueryIEEEBlock(ByVal strQuery As String, _
    ByRef ResultsArray As Byte()) As Integer
  ' Send the query.
  VisaSendCommandOrQuery(strQuery)

  ' Get the result string.
  System.Threading.Thread.Sleep(2000) ' Delay before reading data.
  Dim length As Integer
  ' Number of bytes returned from instrument.
  length = VisaGetResultIEEEBlock(ResultsArray)

  ' Check for inst errors.
  CheckInstrumentErrors(strQuery)

  ' Return string results.
  Return length
End Function

Private Sub VisaSendCommandOrQuery(ByVal strCommandOrQuery _
     As String)
  ' Send command or query to the device.
  Dim strWithNewline As String
  strWithNewline = [String].Format("{0}" & Chr(10) & "", _
      strCommandOrQuery)
  Dim nViStatus As Integer
```

```
    nViStatus = visa32.viPrintf(m_nSession, strWithNewline)
    CheckVisaStatus(nViStatus)
  End Sub

  Private Function VisaGetResultString() As StringBuilder
    Dim strResults As New StringBuilder(1000)

    ' Read return value string from the device.
    Dim nViStatus As Integer
    nViStatus = visa32.viScanf(m_nSession, "%1000t", strResults)
    CheckVisaStatus(nViStatus)

    Return strResults
  End Function

  Private Function VisaGetResultNumber() As Double
    Dim fResults As Double = 0

    ' Read return value string from the device.
    Dim nViStatus As Integer
    nViStatus = visa32.viScanf(m_nSession, "%lf", fResults)
    CheckVisaStatus(nViStatus)

    Return fResults
  End Function

  Private Function VisaGetResultNumbers() As Double()
    Dim fResultsArray As Double()
    fResultsArray = New Double(9) {}

    ' Read return value string from the device.
    Dim nViStatus As Integer
    nViStatus = visa32.viScanf(m_nSession, _
        "%,10lf" & Chr(10) & "", fResultsArray)
    CheckVisaStatus(nViStatus)

    Return fResultsArray
  End Function

  Private Function VisaGetResultIEEEBlock(ByRef ResultsArray _
      As Byte()) As Integer
    ' Results array, big enough to hold a PNG.
    ResultsArray = New Byte(299999) {}
    Dim length As Integer
    ' Number of bytes returned from instrument.
    ' Set the default number of bytes that will be contained in
    ' the ResultsArray to 300,000 (300kB).
    length = 300000

    ' Read return value string from the device.
    Dim nViStatus As Integer
    nViStatus = visa32.viScanf(m_nSession, "%#b", length, _
        ResultsArray)
    CheckVisaStatus(nViStatus)

    ' Write and read buffers need to be flushed after IEEE block?
    nViStatus = visa32.viFlush(m_nSession, visa32.VI_WRITE_BUF)
    CheckVisaStatus(nViStatus)

    nViStatus = visa32.viFlush(m_nSession, visa32.VI_READ_BUF)
    CheckVisaStatus(nViStatus)

    Return length
  End Function

  Private Sub CheckInstrumentErrors(ByVal strCommand As String)
    ' Check for instrument errors.
    Dim strInstrumentError As New StringBuilder(1000)
    Dim bFirstError As Boolean = True
    Do   ' While not "0,No error"
      VisaSendCommandOrQuery(":SYSTem:ERRor?")
      strInstrumentError = VisaGetResultString()

      If Not strInstrumentError.ToString().StartsWith("+0,") Then
        If bFirstError Then
          Console.WriteLine("ERROR(s) for command '{0}': ", _
              strCommand)
          bFirstError = False
        End If
        Console.Write(strInstrumentError)
      End If
    Loop While Not strInstrumentError.ToString().StartsWith("+0,")
  End Sub

  Private Sub OpenResourceManager()
    Dim nViStatus As Integer
    nViStatus = visa32.viOpenDefaultRM(Me.m_nResourceManager)
    If nViStatus < visa32.VI_SUCCESS Then
      Throw New  _
          ApplicationException("Failed to open Resource Manager")
    End If
  End Sub

  Private Sub OpenSession()
    Dim nViStatus As Integer
    nViStatus = visa32.viOpen(Me.m_nResourceManager, _
        Me.m_strVisaAddress, visa32.VI_NO_LOCK, _
        visa32.VI_TMO_IMMEDIATE, Me.m_nSession)
    CheckVisaStatus(nViStatus)
  End Sub

  Public Sub SetTimeoutSeconds(ByVal nSeconds As Integer)
    Dim nViStatus As Integer
    nViStatus = visa32.viSetAttribute(Me.m_nSession, _
        visa32.VI_ATTR_TMO_VALUE, nSeconds * 1000)
    CheckVisaStatus(nViStatus)
  End Sub

  Public Sub CheckVisaStatus(ByVal nViStatus As Integer)
    ' If VISA error, throw exception.
    If nViStatus < visa32.VI_SUCCESS Then
      Dim strError As New StringBuilder(256)
      visa32.viStatusDesc(Me.m_nResourceManager, nViStatus, strError)
      Throw New ApplicationException(strError.ToString())
      End If
    End Sub

    Public Sub Close()
      If m_nSession <> 0 Then
        visa32.viClose(m_nSession)
      End If
      If m_nResourceManager <> 0 Then
        visa32.viClose(m_nResourceManager)
      End If
    End Sub
  End Class
End Namespace
```

VISA Example in Python (PyVISA 1.5 and older)

You can use the Python programming language with the PyVISA package to control Keysight Infiniium Series oscilloscopes.

The Python language and PyVISA package can be downloaded from the web at http://www.python.org/ and http://pyvisa.sourceforge.net/, respectively.

To run this example with Python and PyVISA:

1 Cut-and-paste the code that follows into a file named "example.py".

2 Edit the program to use the VISA address of your oscilloscope.

3 If "python.exe" can be found via your PATH environment variable, open a Command Prompt window; then, change to the folder that contains the "example.py" file, and enter:

```
python example.py
```

```
# *********************************************************
# This program illustrates a few commonly-used programming
# features of your Keysight oscilloscope.
# *********************************************************

# Import modules.
# ---------------------------------------------------------
import visa
import string
import struct
import sys

# Global variables (booleans: 0 = False, 1 = True).
# ---------------------------------------------------------
debug = 0


# =========================================================
# Initialize:
# =========================================================
def initialize():

 # Get and display the device's *IDN? string.
```

```
  idn_string = do_query_string("*IDN?")
  print "Identification string: '%s'" % idn_string

  # Clear status and load the default setup.
  do_command("*CLS")
  do_command("*RST")


# =========================================================
# Capture:
# =========================================================
def capture():

  # Use auto-scale to automatically set up oscilloscope.
  print "Autoscale."
  do_command(":AUToscale")

  # Set trigger mode.
  do_command(":TRIGger:MODE EDGE")
  qresult = do_query_string(":TRIGger:MODE?")
  print "Trigger mode: %s" % qresult

  # Set EDGE trigger parameters.
  do_command(":TRIGger:EDGE:SOURce CHANnel1")
  qresult = do_query_string(":TRIGger:EDGE:SOURce?")
  print "Trigger edge source: %s" % qresult

  do_command(":TRIGger:EDGE:LEVel 1.5")
  qresult = do_query_string(":TRIGger:EDGE:LEVel?")
  print "Trigger edge level: %s" % qresult

  do_command(":TRIGger:EDGE:SLOPe POSitive")
  qresult = do_query_string(":TRIGger:EDGE:SLOPe?")
  print "Trigger edge slope: %s" % qresult

  # Save oscilloscope setup.
  sSetup = do_query_string(":SYSTem:SETup?")
  sSetup = get_definite_length_block_data(sSetup)

  f = open("setup.stp", "wb")
  f.write(sSetup)
  f.close()
  print "Setup bytes saved: %d" % len(sSetup)

  # Change oscilloscope settings with individual commands:

  # Set vertical scale and offset.
  do_command(":CHANnel1:SCALe 0.05")
  qresult = do_query_values(":CHANnel1:SCALe?")[0]
  print "Channel 1 vertical scale: %f" % qresult

  do_command(":CHANnel1:OFFSet -1.5")
  qresult = do_query_values(":CHANnel1:OFFSet?")[0]
  print "Channel 1 offset: %f" % qresult

  # Set horizontal scale and offset.
  do_command(":TIMebase:SCALe 0.0002")
```

```
 qresult = do_query_string(":TIMebase:SCALe?")
 print "Timebase scale: %s" % qresult

 do_command(":TIMebase:POSition 0.0")
 qresult = do_query_string(":TIMebase:POSition?")
 print "Timebase position: %s" % qresult

 # Set the acquisition type.
 do_command(":ACQuire:TYPE NORMal")
 qresult = do_query_string(":ACQuire:TYPE?")
 print "Acquire type: %s" % qresult

 # Or, set up oscilloscope by loading a previously saved setup.
 sSetup = ""
 f = open("setup.stp", "rb")
 sSetup = f.read()
 f.close()
 do_command(":SYSTem:SETup #8%08d%s" % (len(sSetup), sSetup), hide_param
s=True)
 print "Setup bytes restored: %d" % len(sSetup)

 # Capture an acquisition using :DIGitize.
 do_command(":DIGitize CHANnel1")


# =========================================================
# Analyze:
# =========================================================
def analyze():

 # Make measurements.
 # --------------------------------------------------------
 do_command(":MEASure:SOURce CHANnel1")
 qresult = do_query_string(":MEASure:SOURce?")
 print "Measure source: %s" % qresult

 do_command(":MEASure:FREQuency")
 qresult = do_query_string(":MEASure:FREQuency?")
 print "Measured frequency on channel 1: %s" % qresult

 do_command(":MEASure:VAMPlitude")
 qresult = do_query_string(":MEASure:VAMPlitude?")
 print "Measured vertical amplitude on channel 1: %s" % qresult

 # Download the screen image.
 # --------------------------------------------------------
 do_command(":HARDcopy:INKSaver OFF")

 sDisplay = do_query_string(":DISPlay:DATA? PNG, COLor")
 sDisplay = get_definite_length_block_data(sDisplay)

 # Save display data values to file.
 f = open("screen_image.png", "wb")
 f.write(sDisplay)
 f.close()
 print "Screen image written to screen_image.png."
```

```
# Download waveform data.
# --------------------------------------------------------

# Set the waveform points mode.
do_command(":WAVeform:POINts:MODE RAW")
qresult = do_query_string(":WAVeform:POINts:MODE?")
print "Waveform points mode: %s" % qresult

# Get the number of waveform points available.
do_command(":WAVeform:POINts 10240")
qresult = do_query_string(":WAVeform:POINts?")
print "Waveform points available: %s" % qresult

# Set the waveform source.
do_command(":WAVeform:SOURce CHANnel1")
qresult = do_query_string(":WAVeform:SOURce?")
print "Waveform source: %s" % qresult

# Choose the format of the data returned:
do_command(":WAVeform:FORMat BYTE")
print "Waveform format: %s" % do_query_string(":WAVeform:FORMat?")

# Display the waveform settings from preamble:
wav_form_dict = {
 0 : "BYTE",
 1 : "WORD",
 4 : "ASCii",
}
acq_type_dict = {
 0 : "NORMal",
 1 : "PEAK",
 2 : "AVERage",
 3 : "HRESolution",
}

preamble_string = do_query_string(":WAVeform:PREamble?")
(
 wav_form, acq_type, wfmpts, avgcnt, x_increment, x_origin,
 x_reference, y_increment, y_origin, y_reference
) = string.split(preamble_string, ",")

print "Waveform format: %s" % wav_form_dict[int(wav_form)]
print "Acquire type: %s" % acq_type_dict[int(acq_type)]
print "Waveform points desired: %s" % wfmpts
print "Waveform average count: %s" % avgcnt
print "Waveform X increment: %s" % x_increment
print "Waveform X origin: %s" % x_origin
print "Waveform X reference: %s" % x_reference   # Always 0.
print "Waveform Y increment: %s" % y_increment
print "Waveform Y origin: %s" % y_origin
print "Waveform Y reference: %s" % y_reference

# Get numeric values for later calculations.
x_increment = do_query_values(":WAVeform:XINCrement?")[0]
x_origin = do_query_values(":WAVeform:XORigin?")[0]
y_increment = do_query_values(":WAVeform:YINCrement?")[0]
y_origin = do_query_values(":WAVeform:YORigin?")[0]
```

```
 y_reference = do_query_values(":WAVeform:YREFerence?")[0]

 # Get the waveform data.
 sData = do_query_string(":WAVeform:DATA?")
 sData = get_definite_length_block_data(sData)

 # Unpack unsigned byte data.
 values = struct.unpack("%dB" % len(sData), sData)
 print "Number of data values: %d" % len(values)

 # Save waveform data values to CSV file.
 f = open("waveform_data.csv", "w")

 for i in xrange(0, len(values) - 1):
  time_val = x_origin + (i * x_increment)
  voltage = ((values[i] - y_reference) * y_increment) + y_origin
  f.write("%E, %f\n" % (time_val, voltage))

 f.close()
 print "Waveform format BYTE data written to waveform_data.csv."


# =========================================================
# Send a command and check for errors:
# =========================================================
def do_command(command, hide_params=False):

 if hide_params:
  (header, data) = string.split(command, " ", 1)
  if debug:
   print "\nCmd = '%s'" % header
 else:
  if debug:
   print "\nCmd = '%s'" % command

 InfiniiVision.write("%s\n" % command)

 if hide_params:
  check_instrument_errors(header)
 else:
  check_instrument_errors(command)


# =========================================================
# Send a query, check for errors, return string:
# =========================================================
def do_query_string(query):
 if debug:
  print "Qys = '%s'" % query
 result = InfiniiVision.ask("%s\n" % query)
 check_instrument_errors(query)
 return result


# =========================================================
# Send a query, check for errors, return values:
# =========================================================
def do_query_values(query):
 if debug:
  print "Qyv = '%s'" % query
 results = InfiniiVision.ask_for_values("%s\n" % query)
 check_instrument_errors(query)
 return results


# =========================================================
# Check for instrument errors:
# =========================================================
def check_instrument_errors(command):

 while True:
  error_string = InfiniiVision.ask(":SYSTem:ERRor?\n")
  if error_string:   # If there is an error string value.

   if error_string.find("+0,", 0, 3) == -1:   # Not "No error".

    print "ERROR: %s, command: '%s'" % (error_string, command)
    print "Exited because of error."
    sys.exit(1)

   else:   # "No error"
    break

  else:   # :SYSTem:ERRor? should always return string.
   print "ERROR: :SYSTem:ERRor? returned nothing, command: '%s'" % comma
nd
   print "Exited because of error."
   sys.exit(1)


# =========================================================
# Returns data from definite-length block.
# =========================================================
def get_definite_length_block_data(sBlock):

 # First character should be "#".
 pound = sBlock[0:1]
 if pound != "#":
  print "PROBLEM: Invalid binary block format, pound char is '%s'." % po
und
  print "Exited because of problem."
  sys.exit(1)

 # Second character is number of following digits for length value.
 digits = sBlock[1:2]

 # Get the data out of the block and return it.
 sData = sBlock[int(digits) + 2:]

 return sData


# =========================================================
# Main program:
```

```
# =========================================================

InfiniiVision = visa.instrument("USB0::0x2A8D::0x1797::CN56240004::0::IN
STR")
InfiniiVision.timeout = 15
InfiniiVision.term_chars = ""
InfiniiVision.clear()

# Initialize the oscilloscope, capture data, and analyze.
initialize()
capture()
analyze()

print "End of program."
```

VISA Example in Python (PyVISA 1.6 and newer)

You can use the Python programming language with the PyVISA package to control Keysight Infiniium Series oscilloscopes.

The Python language and PyVISA package can be downloaded from the web at http://www.python.org/ and http://pyvisa.readthedocs.org/, respectively.

To run this example with Python and PyVISA:

1 Cut-and-paste the code that follows into a file named "example.py".
2 Edit the program to use the VISA address of your oscilloscope.
3 If "python.exe" can be found via your PATH environment variable, open a Command Prompt window; then, change to the folder that contains the "example.py" file, and enter:

```
python example.py
```

```
# *********************************************************
# This program illustrates a few commonly-used programming
# features of your Keysight oscilloscope.
# *********************************************************

# Import modules.
# ---------------------------------------------------------
import visa
import string
import struct
import sys

# Global variables (booleans: 0 = False, 1 = True).
# ---------------------------------------------------------
debug = 0


# =========================================================
# Initialize:
# =========================================================
def initialize():
 # Get and display the device's *IDN? string.
 idn_string = do_query_string("*IDN?")
 print "Identification string: '%s'" % idn_string

 # Clear status and load the default setup.
 do_command("*CLS")
 do_command("*RST")


# =========================================================
# Capture:
# =========================================================
def capture():

 # Use auto-scale to automatically set up oscilloscope.
 print "Autoscale."
 do_command(":AUToscale")

 # Set trigger mode.
 do_command(":TRIGger:MODE EDGE")
 qresult = do_query_string(":TRIGger:MODE?")
 print "Trigger mode: %s" % qresult

 # Set EDGE trigger parameters.
 do_command(":TRIGger:EDGE:SOURce CHANnel1")
 qresult = do_query_string(":TRIGger:EDGE:SOURce?")
 print "Trigger edge source: %s" % qresult

 do_command(":TRIGger:EDGE:LEVel 1.5")
 qresult = do_query_string(":TRIGger:EDGE:LEVel?")
 print "Trigger edge level: %s" % qresult

 do_command(":TRIGger:EDGE:SLOPe POSitive")
 qresult = do_query_string(":TRIGger:EDGE:SLOPe?")
 print "Trigger edge slope: %s" % qresult

 # Save oscilloscope setup.
 sSetup = do_query_ieee_block(":SYSTem:SETup?")

 f = open("setup.stp", "wb")
 f.write(sSetup)
 f.close()
 print "Setup bytes saved: %d" % len(sSetup)

 # Change oscilloscope settings with individual commands:

 # Set vertical scale and offset.
 do_command(":CHANnel1:SCALe 0.05")
 qresult = do_query_string(":CHANnel1:SCALe?")
 print "Channel 1 vertical scale: %s" % qresult

 do_command(":CHANnel1:OFFSet -1.5")
 qresult = do_query_string(":CHANnel1:OFFSet?")
 print "Channel 1 offset: %s" % qresult

 # Set horizontal scale and offset.
 do_command(":TIMebase:SCALe 0.0002")
```

```
 qresult = do_query_string(":TIMebase:SCALe?")
 print "Timebase scale: %s" % qresult

 do_command(":TIMebase:POSition 0.0")
 qresult = do_query_string(":TIMebase:POSition?")
 print "Timebase position: %s" % qresult

 # Set the acquisition type.
 do_command(":ACQuire:TYPE NORMal")
 qresult = do_query_string(":ACQuire:TYPE?")
 print "Acquire type: %s" % qresult

 # Or, set up oscilloscope by loading a previously saved setup.
 sSetup = ""
 f = open("setup.stp", "rb")
 sSetup = f.read()
 f.close()
 do_command_ieee_block(":SYSTem:SETup", sSetup)
 print "Setup bytes restored: %d" % len(sSetup)

 # Capture an acquisition using :DIGitize.
 do_command(":DIGitize CHANnel1")


# =========================================================
# Analyze:
# =========================================================
def analyze():

 # Make measurements.
 # --------------------------------------------------------
 do_command(":MEASure:SOURce CHANnel1")
 qresult = do_query_string(":MEASure:SOURce?")
 print "Measure source: %s" % qresult

 do_command(":MEASure:FREQuency")
 qresult = do_query_string(":MEASure:FREQuency?")
 print "Measured frequency on channel 1: %s" % qresult

 do_command(":MEASure:VAMPlitude")
 qresult = do_query_string(":MEASure:VAMPlitude?")
 print "Measured vertical amplitude on channel 1: %s" % qresult

 # Download the screen image.
 # --------------------------------------------------------
 do_command(":HARDcopy:INKSaver OFF")

 sDisplay = do_query_ieee_block(":DISPlay:DATA? PNG, COLor")

 # Save display data values to file.
 f = open("screen_image.png", "wb")
 f.write(sDisplay)
 f.close()
 print "Screen image written to screen_image.png."

 # Download waveform data.
 # --------------------------------------------------------
 # Set the waveform points mode.
 do_command(":WAVeform:POINts:MODE RAW")
 qresult = do_query_string(":WAVeform:POINts:MODE?")
 print "Waveform points mode: %s" % qresult

 # Get the number of waveform points available.
 do_command(":WAVeform:POINts 10240")
 qresult = do_query_string(":WAVeform:POINts?")
 print "Waveform points available: %s" % qresult

 # Set the waveform source.
 do_command(":WAVeform:SOURce CHANnel1")
 qresult = do_query_string(":WAVeform:SOURce?")
 print "Waveform source: %s" % qresult

 # Choose the format of the data returned:
 do_command(":WAVeform:FORMat BYTE")
 print "Waveform format: %s" % do_query_string(":WAVeform:FORMat?")

 # Display the waveform settings from preamble:
 wav_form_dict = {
  0 : "BYTE",
  1 : "WORD",
  4 : "ASCii",
 }
 acq_type_dict = {
  0 : "NORMal",
  1 : "PEAK",
  2 : "AVERage",
  3 : "HRESolution",
 }

 preamble_string = do_query_string(":WAVeform:PREamble?")
 (
  wav_form, acq_type, wfmpts, avgcnt, x_increment, x_origin,
  x_reference, y_increment, y_origin, y_reference
 ) = string.split(preamble_string, ",")

 print "Waveform format: %s" % wav_form_dict[int(wav_form)]
 print "Acquire type: %s" % acq_type_dict[int(acq_type)]
 print "Waveform points desired: %s" % wfmpts
 print "Waveform average count: %s" % avgcnt
 print "Waveform X increment: %s" % x_increment
 print "Waveform X origin: %s" % x_origin
 print "Waveform X reference: %s" % x_reference   # Always 0.
 print "Waveform Y increment: %s" % y_increment
 print "Waveform Y origin: %s" % y_origin
 print "Waveform Y reference: %s" % y_reference

 # Get numeric values for later calculations.
 x_increment = do_query_number(":WAVeform:XINCrement?")
 x_origin = do_query_number(":WAVeform:XORigin?")
 y_increment = do_query_number(":WAVeform:YINCrement?")
 y_origin = do_query_number(":WAVeform:YORigin?")
 y_reference = do_query_number(":WAVeform:YREFerence?")
```

```
 # Get the waveform data.
 sData = do_query_ieee_block(":WAVeform:DATA?")

 # Unpack unsigned byte data.
 values = struct.unpack("%dB" % len(sData), sData)
 print "Number of data values: %d" % len(values)

 # Save waveform data values to CSV file.
 f = open("waveform_data.csv", "w")

 for i in xrange(0, len(values) - 1):
  time_val = x_origin + (i * x_increment)
  voltage = ((values[i] - y_reference) * y_increment) + y_origin
  f.write("%E, %f\n" % (time_val, voltage))

 f.close()
 print "Waveform format BYTE data written to waveform_data.csv."


# =========================================================
# Send a command and check for errors:
# =========================================================
def do_command(command, hide_params=False):

 if hide_params:
  (header, data) = string.split(command, " ", 1)
  if debug:
   print "\nCmd = '%s'" % header
 else:
  if debug:
   print "\nCmd = '%s'" % command

 InfiniiVision.write("%s" % command)

 if hide_params:
  check_instrument_errors(header)
 else:
  check_instrument_errors(command)


# =========================================================
# Send a command and binary values and check for errors:
# =========================================================
def do_command_ieee_block(command, values):
 if debug:
  print "Cmb = '%s'" % command
 InfiniiVision.write_binary_values("%s " % command, values, datatype='c'
)
 check_instrument_errors(command)


# =========================================================
# Send a query, check for errors, return string:
# =========================================================
def do_query_string(query):
 if debug:
  print "Qys = '%s'" % query
 result = InfiniiVision.query("%s" % query)
 check_instrument_errors(query)
 return result


# =========================================================
# Send a query, check for errors, return floating-point value:
# =========================================================
def do_query_number(query):
 if debug:
  print "Qyn = '%s'" % query
 results = InfiniiVision.query("%s" % query)
 check_instrument_errors(query)
 return float(results)


# =========================================================
# Send a query, check for errors, return binary values:
# =========================================================
def do_query_ieee_block(query):
 if debug:
  print "Qys = '%s'" % query
 result = InfiniiVision.query_binary_values("%s" % query, datatype='s')
 check_instrument_errors(query)
 return result[0]


# =========================================================
# Check for instrument errors:
# =========================================================
def check_instrument_errors(command):

 while True:
  error_string = InfiniiVision.query(":SYSTem:ERRor?")
  if error_string:   # If there is an error string value.

   if error_string.find("+0,", 0, 3) == -1:   # Not "No error".

    print "ERROR: %s, command: '%s'" % (error_string, command)
    print "Exited because of error."
    sys.exit(1)

   else:   # "No error"
    break

  else:   # :SYSTem:ERRor? should always return string.
   print "ERROR: :SYSTem:ERRor? returned nothing, command: '%s'" % comma
nd
   print "Exited because of error."
   sys.exit(1)


# =========================================================
# Main program:
# =========================================================

rm = visa.ResourceManager()
```

```
InfiniiVision= rm.open_resource("USB0::0x2A8D::0x1797::CN56240004::0::IN
STR")

InfiniiVision.timeout = 15000
InfiniiVision.clear()

# Initialize the oscilloscope, capture data, and analyze.
initialize()
capture()
analyze()

print "End of program."
```

SICL Examples

- "SICL Example in C" on page 872
- "SICL Example in Visual Basic" on page 881

SICL Example in C

To compile and run this example in Microsoft Visual Studio 2008:

1 Open Visual Studio.

2 Create a new Visual C++, Win32, Win32 Console Application project.

3 In the Win32 Application Wizard, click **Next >**. Then, check **Empty project**, and click **Finish**.

4 Cut-and-paste the code that follows into a file named "example.c" in the project directory.

5 In Visual Studio 2008, right-click the Source Files folder, choose **Add > Add Existing Item...**, select the example.c file, and click **Add**.

6 Edit the program to use the SICL address of your oscilloscope.

7 Choose **Project > Properties...**. In the Property Pages dialog, update these project settings:

   a Under Configuration Properties, Linker, Input, add "sicl32.lib" to the Additional Dependencies field.

   b Under Configuration Properties, C/C++, Code Generation, select Multi-threaded DLL for the Runtime Library field.

   c Click **OK** to close the Property Pages dialog.

8 Add the include files and library files search paths:

   a Choose **Tools > Options...**.

   b In the Options dialog, select **VC++ Directories** under Projects and Solutions.

   c Show directories for **Include files**, and add the include directory (for example, Program Files\Agilent\IO Libraries Suite\include).

   d Show directories for **Library files**, and add the library files directory (for example, Program Files\Agilent\IO Libraries Suite\lib).

   e Click **OK** to close the Options dialog.

9 Build and run the program.

```
/*
 * Keysight SICL Example in C
 * ------------------------------------------------------------------
 * This program illustrates a few commonly-used programming
 * features of your Keysight oscilloscope.
 */

#include <stdio.h>            /* For printf(). */
```

```
#include <string.h>           /* For strcpy(), strcat(). */
#include <time.h>             /* For clock(). */
#include <sicl.h>             /* Keysight SICL routines. */

#define SICL_ADDRESS      "usb0[2391::6054::US50210029::0]"
#define TIMEOUT           5000
#define IEEEBLOCK_SPACE   100000

/* Function prototypes */
void initialize(void);          /* Initialize to known state. */
void capture(void);             /* Capture the waveform. */
void analyze(void);             /* Analyze the captured waveform. */

void do_command(char *command);        /* Send command. */
int do_command_ieeeblock(char *command); /* Command w/IEEE block. */
void do_query_string(char *query);     /* Query for string. */
void do_query_number(char *query);     /* Query for number. */
void do_query_numbers(char *query);    /* Query for numbers. */
int do_query_ieeeblock(char *query);   /* Query for IEEE block. */
void check_instrument_errors();        /* Check for inst errors. */

/* Global variables */
INST id;                        /* Device session ID. */
char str_result[256] = {0};     /* Result from do_query_string(). */
double num_result;              /* Result from do_query_number(). */
unsigned char ieeeblock_data[IEEEBLOCK_SPACE];   /* Result from
                                   do_query_ieeeblock(). */
double dbl_results[10];         /* Result from do_query_numbers(). */

/* Main Program
 * --------------------------------------------------------------- */
void main(void)
{
  /* Install a default SICL error handler that logs an error message
   * and exits.  On Windows 98SE or Windows Me, view messages with
   * the SICL Message Viewer.  For Windows 2000 or XP, use the Event
   * Viewer.
   */
  ionerror(I_ERROR_EXIT);

  /* Open a device session using the SICL_ADDRESS */
  id = iopen(SICL_ADDRESS);

  if (id == 0)
  {
    printf ("Oscilloscope iopen failed!\n");
  }
  else
  {
    printf ("Oscilloscope session opened!\n");
  }

  /* Initialize - start from a known state. */
  initialize();

  /* Capture data. */
  capture();
  /* Analyze the captured waveform. */
  analyze();

  /* Close the device session to the instrument. */
  iclose(id);
  printf ("Program execution is complete...\n");

  /* For WIN16 programs, call _siclcleanup before exiting to release
   * resources allocated by SICL for this application.  This call is
   * a no-op for WIN32 programs.
   */
  _siclcleanup();
}

/* Initialize the oscilloscope to a known state.
 * --------------------------------------------------------------- */
void initialize (void)
{
  /* Set the I/O timeout value for this session to 5 seconds. */
  itimeout(id, TIMEOUT);

  /* Clear the interface. */
  iclear(id);

  /* Get and display the device's *IDN? string. */
  do_query_string("*IDN?");
  printf("Oscilloscope *IDN? string: %s\n", str_result);

  /* Clear status and load the default setup. */
  do_command("*CLS");
  do_command("*RST");
}

/* Capture the waveform.
 * --------------------------------------------------------------- */
void capture (void)
{
  int num_bytes;
  FILE *fp;

  /* Use auto-scale to automatically configure oscilloscope.
   * ------------------------------------------------------------- */
  do_command(":AUToscale");

  /* Set trigger mode (EDGE, PULSe, PATTern, etc., and input source. */
  do_command(":TRIGger:MODE EDGE");
  do_query_string(":TRIGger:MODE?");
  printf("Trigger mode: %s\n", str_result);

  /* Set EDGE trigger parameters. */
  do_command(":TRIGger:EDGE:SOURCe CHANnel1");
  do_query_string(":TRIGger:EDGE:SOURce?");
  printf("Trigger edge source: %s\n", str_result);

  do_command(":TRIGger:EDGE:LEVel 1.5");
  do_query_string(":TRIGger:EDGE:LEVel?");
  printf("Trigger edge level: %s\n", str_result);

  do_command(":TRIGger:EDGE:SLOPe POSitive");
  do_query_string(":TRIGger:EDGE:SLOPe?");
  printf("Trigger edge slope: %s\n", str_result);

  /* Save oscilloscope configuration.
   * ------------------------------------------------------------- */

  /* Read system setup. */
  num_bytes = do_query_ieeeblock(":SYSTem:SETup?");
  printf("Read setup string query (%d bytes).\n", num_bytes);

  /* Write setup string to file. */
  fp = fopen ("c:\\scope\\config\\setup.stp", "wb");
  num_bytes = fwrite(ieeeblock_data, sizeof(unsigned char), num_bytes,
    fp);
  fclose (fp);
  printf("Wrote setup string (%d bytes) to ", num_bytes);
  printf("c:\\scope\\config\\setup.stp.\n");

  /* Change settings with individual commands:
   * ------------------------------------------------------------- */

  /* Set vertical scale and offset. */
  do_command(":CHANnel1:SCALe 0.05");
  do_query_string(":CHANnel1:SCALe?");
  printf("Channel 1 vertical scale: %s\n", str_result);

  do_command(":CHANnel1:OFFSet -1.5");
  do_query_string(":CHANnel1:OFFSet?");
  printf("Channel 1 offset: %s\n", str_result);

  /* Set horizontal scale and position. */
  do_command(":TIMebase:SCALe 0.0002");
  do_query_string(":TIMebase:SCALe?");
  printf("Timebase scale: %s\n", str_result);

  do_command(":TIMebase:POSition 0.0");
  do_query_string(":TIMebase:POSition?");
  printf("Timebase position: %s\n", str_result);

  /* Set the acquisition type (NORMal, PEAK, AVERage, or HRESolution). *
/
  do_command(":ACQuire:TYPE NORMal");
  do_query_string(":ACQuire:TYPE?");
  printf("Acquire type: %s\n", str_result);

  /* Or, configure by loading a previously saved setup.
  * ------------------------------------------------------------- */

  /* Read setup string from file. */
  fp = fopen ("c:\\scope\\config\\setup.stp", "rb");
  num_bytes = fread (ieeeblock_data, sizeof(unsigned char),
    IEEEBLOCK_SPACE, fp);
  fclose (fp);
  printf("Read setup string (%d bytes) from file ", num_bytes);
```

```
    printf("c:\\scope\\config\\setup.stp.\n");

    /* Restore setup string. */
    num_bytes = do_command_ieeeblock(":SYSTem:SETup", num_bytes);
    printf("Restored setup string (%d bytes).\n", num_bytes);

    /* Capture an acquisition using :DIGitize.
     * ----------------------------------------------------------------- */
    do_command(":DIGitize CHANnel1");
  }

  /* Analyze the captured waveform.
   * ------------------------------------------------------------------- */
  void analyze (void)
  {
    double wav_format;
    double acq_type;
    double wav_points;
    double avg_count;
    double x_increment;
    double x_origin;
    double x_reference;
    double y_increment;
    double y_origin;
    double y_reference;

    FILE *fp;
    int num_bytes;   /* Number of bytes returned from instrument. */
    int i;

    /* Make a couple of measurements.
     * ----------------------------------------------------------------- */
    do_command(":MEASure:SOURce CHANnel1");
    do_query_string(":MEASure:SOURce?");
    printf("Measure source: %s\n", str_result);

    do_command(":MEASure:FREQuency");
    do_query_number(":MEASure:FREQuency?");
    printf("Frequency: %.4f kHz\n", num_result / 1000);

    do_command(":MEASure:VAMPlitude");
    do_query_number(":MEASure:VAMPlitude?");
    printf("Vertical amplitude: %.2f V\n", num_result);

    /* Download the screen image.
     * ----------------------------------------------------------------- */
    do_command(":HARDcopy:INKSaver OFF");

    /* Read screen image. */
    num_bytes = do_query_ieeeblock(":DISPlay:DATA? PNG, COLor");
    printf("Screen image bytes: %d\n", num_bytes);

    /* Write screen image bytes to file. */
    fp = fopen ("c:\\scope\\data\\screen.png", "wb");
    num_bytes = fwrite(ieeeblock_data, sizeof(unsigned char), num_bytes,
      fp);
    fclose (fp);
```

```
printf("Wrote screen image (%d bytes) to ", num_bytes);
printf("c:\\scope\\data\\screen.png.\n");

/* Download waveform data.
 * -------------------------------------------------------------- */

/* Set the waveform points mode. */
do_command(":WAVeform:POINts:MODE RAW");
do_query_string(":WAVeform:POINts:MODE?");
printf("Waveform points mode: %s\n", str_result);

/* Get the number of waveform points available. */
do_command(":WAVeform:POINts 10240");
do_query_string(":WAVeform:POINts?");
printf("Waveform points available: %s\n", str_result);

/* Set the waveform source. */
do_command(":WAVeform:SOURce CHANnel1");
do_query_string(":WAVeform:SOURce?");
printf("Waveform source: %s\n", str_result);

/* Choose the format of the data returned (WORD, BYTE, ASCII): */
do_command(":WAVeform:FORMat BYTE");
do_query_string(":WAVeform:FORMat?");
printf("Waveform format: %s\n", str_result);

/* Display the waveform settings: */
do_query_numbers(":WAVeform:PREamble?");

wav_format = dbl_results[0];
if (wav_format == 0.0)
{
  printf("Waveform format: BYTE\n");
}
else if (wav_format == 1.0)
{
  printf("Waveform format: WORD\n");
}
else if (wav_format == 2.0)
{
  printf("Waveform format: ASCii\n");
}

acq_type = dbl_results[1];
if (acq_type == 0.0)
{
  printf("Acquire type: NORMal\n");
}
else if (acq_type == 1.0)
{
  printf("Acquire type: PEAK\n");
}
else if (acq_type == 2.0)
{
  printf("Acquire type: AVERage\n");
}
else if (acq_type == 3.0)
```

```
  {
    printf("Acquire type: HRESolution\n");
  }

  wav_points = dbl_results[2];
  printf("Waveform points: %e\n", wav_points);

  avg_count = dbl_results[3];
  printf("Waveform average count: %e\n", avg_count);

  x_increment = dbl_results[4];
  printf("Waveform X increment: %e\n", x_increment);

  x_origin = dbl_results[5];
  printf("Waveform X origin: %e\n", x_origin);

  x_reference = dbl_results[6];
  printf("Waveform X reference: %e\n", x_reference);

  y_increment = dbl_results[7];
  printf("Waveform Y increment: %e\n", y_increment);

  y_origin = dbl_results[8];
  printf("Waveform Y origin: %e\n", y_origin);

  y_reference = dbl_results[9];
  printf("Waveform Y reference: %e\n", y_reference);

  /* Read waveform data. */
  num_bytes = do_query_ieeeblock(":WAVeform:DATA?");
  printf("Number of data values: %d\n", num_bytes);

  /* Open file for output. */
  fp = fopen("c:\\scope\\data\\waveform_data.csv", "wb");

  /* Output waveform data in CSV format. */
  for (i = 0; i < num_bytes - 1; i++)
  {
    /* Write time value, voltage value. */
    fprintf(fp, "%9f, %6f\n",
      x_origin + ((float)i * x_increment),
      (((float)ieeeblock_data[i] - y_reference) * y_increment)
      + y_origin);
  }

  /* Close output file. */
   fclose(fp);
   printf("Waveform format BYTE data written to ");
   printf("c:\\scope\\data\\waveform_data.csv.\n");
}

/* Send a command to the instrument.
 * -------------------------------------------------------------- */
void do_command(command)
char *command;
{
  char message[80];
  strcpy(message, command);
  strcat(message, "\n");
  iprintf(id, message);

  check_instrument_errors();
}

/* Command with IEEE definite-length block.
 * ------------------------------------------------------------------ */
int do_command_ieeeblock(command, num_bytes)
char *command;
int num_bytes;
{
  char message[80];
  int data_length;

  strcpy(message, command);
  strcat(message, " #8%08d");
  iprintf(id, message, num_bytes);
  ifwrite(id, ieeeblock_data, num_bytes, 1, &data_length);

  check_instrument_errors();

  return(data_length);
}

/* Query for a string result.
 * ------------------------------------------------------------------ */
void do_query_string(query)
char *query;
{
  char message[80];

  strcpy(message, query);
  strcat(message, "\n");
  iprintf(id, message);

  iscanf(id, "%t\n", str_result);

  check_instrument_errors();
}

/* Query for a number result.
 * ------------------------------------------------------------------ */
void do_query_number(query)
char *query;
{
  char message[80];

  strcpy(message, query);
  strcat(message, "\n");
  iprintf(id, message);

  iscanf(id, "%lf", &num_result);

  check_instrument_errors();
```

```
}

/* Query for numbers result.
 * ------------------------------------------------------------------ */
void do_query_numbers(query)
char *query;
{
  char message[80];

  strcpy(message, query);
  strcat(message, "\n");
  iprintf(id, message);

  iscanf(id, "%,10lf\n", dbl_results);

  check_instrument_errors();
}

/* Query for an IEEE definite-length block result.
 * ------------------------------------------------------------------ */
int do_query_ieeeblock(query)
char *query;
{
  char message[80];
  int data_length;

  strcpy(message, query);
  strcat(message, "\n");
  iprintf(id, message);

  data_length = IEEEBLOCK_SPACE;
  iscanf(id, "%#b", &data_length, ieeeblock_data);

  if (data_length == IEEEBLOCK_SPACE )
  {
    printf("IEEE block buffer full: ");
    printf("May not have received all data.\n");
  }

  check_instrument_errors();

  return(data_length);
}

/* Check for instrument errors.
 * ------------------------------------------------------------------ */
void check_instrument_errors()
{
  char str_err_val[256] = {0};
  char str_out[800] = "";

  ipromptf(id, ":SYSTem:ERRor?\n", "%t", str_err_val);
  while(strncmp(str_err_val, "+0,No error", 3) != 0 )
  {
    strcat(str_out, ", ");
    strcat(str_out, str_err_val);
    ipromptf(id, ":SYSTem:ERRor?\n", "%t", str_err_val);
  }

  if (strcmp(str_out, "") != 0)
  {
    printf("INST Error%s\n", str_out);
    iflush(id, I_BUF_READ | I_BUF_WRITE);
  }
}
```

SICL Example in Visual Basic

To run this example in Visual Basic for Applications:

1. Start the application that provides Visual Basic for Applications (for example, Microsoft Excel).
2. Press ALT+F11 to launch the Visual Basic editor.
3. Add the sicl32.bas file to your project:
   a. Choose **File > Import File...**.
   b. Navigate to the header file, sicl32.bas (installed with Keysight IO Libraries Suite and found in the Program Files\Agilent\IO Libraries Suite\include directory), select it, and click **Open**.
4. Choose **Insert > Module**.
5. Cut-and-paste the code that follows into the editor.
6. Edit the program to use the SICL address of your oscilloscope, and save the changes.
7. Run the program.

```
'
' Keysight SICL Example in Visual Basic
' -------------------------------------------------------------------
' This program illustrates a few commonly-used programming
' features of your Keysight oscilloscope.
' -------------------------------------------------------------------

Option Explicit

Public id As Integer   ' Session to instrument.

' Declare variables to hold numeric values returned by
' ivscanf/ifread.
Public dblQueryResult As Double
Public Const ByteArraySize = 5000000
Public retCount As Long
Public byteArray(ByteArraySize) As Byte

' Declare fixed length string variable to hold string value returned
' by ivscanf.
Public strQueryResult As String * 200

' For Sleep subroutine.
```

```
Private Declare Sub Sleep Lib "kernel32" (ByVal dwMilliseconds As Long)

'
' Main Program
' -------------------------------------------------------------------

Sub Main()

  On Error GoTo ErrorHandler

  ' Open a device session using the SICL_ADDRESS.
  id = iopen("usb0[2391::6054::US50210029::0]")
  Call itimeout(id, 5000)

  ' Initialize - start from a known state.
  Initialize

  ' Capture data.
  Capture

  ' Analyze the captured waveform.
  Analyze

  ' Close the vi session and the resource manager session.
  Call iclose(id)

  Exit Sub

ErrorHandler:

  MsgBox "*** Error : " + Error, vbExclamation
  End

End Sub

'
' Initialize the oscilloscope to a known state.
' -------------------------------------------------------------------

Private Sub Initialize()

  On Error GoTo ErrorHandler

  ' Clear the interface.
  Call iclear(id)

  ' Get and display the device's *IDN? string.
  strQueryResult = DoQueryString("*IDN?")
  MsgBox "Result is: " + RTrim(strQueryResult), vbOKOnly, "*IDN? Result"

  ' Clear status and load the default setup.
  DoCommand "*CLS"
  DoCommand "*RST"

  Exit Sub

ErrorHandler:
  MsgBox "*** Error : " + Error, vbExclamation
  End

End Sub

'
' Capture the waveform.
' ---------------------------------------------------------------------

Private Sub Capture()

  On Error GoTo ErrorHandler

  ' Use auto-scale to automatically configure oscilloscope.
  ' -------------------------------------------------------------------
  DoCommand ":AUToscale"

  ' Set trigger mode (EDGE, PULSe, PATTern, etc., and input source.
  DoCommand ":TRIGger:MODE EDGE"
  Debug.Print "Trigger mode: " + _
      DoQueryString(":TRIGger:MODE?")

  ' Set EDGE trigger parameters.
  DoCommand ":TRIGger:EDGE:SOURCe CHANnel1"
  Debug.Print "Trigger edge source: " + _
      DoQueryString(":TRIGger:EDGE:SOURce?")

  DoCommand ":TRIGger:EDGE:LEVel 1.5"
  Debug.Print "Trigger edge level: " + _
      DoQueryString(":TRIGger:EDGE:LEVel?")

  DoCommand ":TRIGger:EDGE:SLOPe POSitive"
  Debug.Print "Trigger edge slope: " + _
      DoQueryString(":TRIGger:EDGE:SLOPe?")

  ' Save oscilloscope configuration.
  ' -------------------------------------------------------------------
  Dim lngSetupStringSize As Long
  lngSetupStringSize = DoQueryIEEEBlock_Bytes(":SYSTem:SETup?")
  Debug.Print "Setup bytes saved: " + CStr(lngSetupStringSize)

  ' Output setup string to a file:
  Dim strPath As String
  strPath = "c:\scope\config\setup.dat"
  If Len(Dir(strPath)) Then
    Kill strPath   ' Remove file if it exists.
  End If

  ' Open file for output.
  Dim hFile As Long
  hFile = FreeFile
  Open strPath For Binary Access Write Lock Write As hFile
  Dim lngI As Long
  For lngI = 0 To lngSetupStringSize - 1
    Put hFile, , byteArray(lngI)   ' Write data.
  Next lngI
  Close hFile   ' Close file.

  ' Change settings with individual commands:
  ' -----------------------------------------------------------------

  ' Set vertical scale and offset.
  DoCommand ":CHANnel1:SCALe 0.05"
  Debug.Print "Channel 1 vertical scale: " + _
      DoQueryString(":CHANnel1:SCALe?")

  DoCommand ":CHANnel1:OFFSet -1.5"
  Debug.Print "Channel 1 vertical offset: " + _
      DoQueryString(":CHANnel1:OFFSet?")

  ' Set horizontal scale and position.
  DoCommand ":TIMebase:SCALe 0.0002"
  Debug.Print "Timebase scale: " + _
      DoQueryString(":TIMebase:SCALe?")

  DoCommand ":TIMebase:POSition 0.0"
  Debug.Print "Timebase position: " + _
      DoQueryString(":TIMebase:POSition?")

  ' Set the acquisition type (NORMal, PEAK, AVERage, or HRESolution).
  DoCommand ":ACQuire:TYPE NORMal"
  Debug.Print "Acquire type: " + _
      DoQueryString(":ACQuire:TYPE?")

  ' Or, configure by loading a previously saved setup.
  ' -----------------------------------------------------------------
  strPath = "c:\scope\config\setup.dat"
  Open strPath For Binary Access Read As hFile   ' Open file for input.
  Dim lngSetupFileSize As Long
  lngSetupFileSize = LOF(hFile)  ' Length of file.
  Get hFile, , byteArray   ' Read data.
  Close hFile   ' Close file.
  ' Write setup string back to oscilloscope using ":SYSTem:SETup"
  ' command:
  Dim lngRestored As Long
  lngRestored = DoCommandIEEEBlock(":SYSTem:SETup", lngSetupFileSize)
  Debug.Print "Setup bytes restored: " + CStr(lngRestored)

  ' Capture an acquisition using :DIGitize.
  ' -----------------------------------------------------------------
  DoCommand ":DIGitize CHANnel1"

  Exit Sub

ErrorHandler:

  MsgBox "*** Error : " + Error, vbExclamation
  End

End Sub

'
' Analyze the captured waveform.
' ---------------------------------------------------------------------

Private Sub Analyze()

  On Error GoTo ErrorHandler

  ' Make a couple of measurements.
  ' -------------------------------------------------------------------
  DoCommand ":MEASure:SOURce CHANnel1"
  Debug.Print "Measure source: " + _
      DoQueryString(":MEASure:SOURce?")

  DoCommand ":MEASure:FREQuency"
  dblQueryResult = DoQueryNumber(":MEASure:FREQuency?")
  MsgBox "Frequency:" + vbCrLf + _
      FormatNumber(dblQueryResult / 1000, 4) + " kHz"

  DoCommand ":MEASure:VAMPlitude"
  dblQueryResult = DoQueryNumber(":MEASure:VAMPlitude?")
  MsgBox "Vertical amplitude:" + vbCrLf + _
      FormatNumber(dblQueryResult, 4) + " V"

  ' Download the screen image.
  ' -------------------------------------------------------------------
  DoCommand ":HARDcopy:INKSaver OFF"

  ' Get screen image.
  Dim lngBlockSize As Long
  lngBlockSize = DoQueryIEEEBlock_Bytes(":DISPlay:DATA? PNG, COLor")
  Debug.Print "Screen image bytes: " + CStr(lngBlockSize)

  ' Save screen image to a file:
  Dim strPath As String
  strPath = "c:\scope\data\screen.png"
  If Len(Dir(strPath)) Then
    Kill strPath   ' Remove file if it exists.
  End If
  Dim hFile As Long
  hFile = FreeFile
  Open strPath For Binary Access Write Lock Write As hFile
  Dim lngI As Long
  ' Skip past header.
  For lngI = CInt(Chr(byteArray(1))) + 2 To lngBlockSize - 1
    Put hFile, , byteArray(lngI)   ' Write data.
  Next lngI
  Close hFile   ' Close file.
  MsgBox "Screen image written to " + strPath

  ' Download waveform data.
  ' -------------------------------------------------------------------

  ' Set the waveform points mode.
  DoCommand ":WAVeform:POINts:MODE RAW"
  Debug.Print "Waveform points mode: " + _
      DoQueryString(":WAVeform:POINts:MODE?")

  ' Get the number of waveform points available.
```

```
DoCommand ":WAVeform:POINts 10240"
Debug.Print "Waveform points available: " + _
    DoQueryString(":WAVeform:POINts?")

' Set the waveform source.
DoCommand ":WAVeform:SOURce CHANnel1"
Debug.Print "Waveform source: " + _
    DoQueryString(":WAVeform:SOURce?")

' Choose the format of the data returned (WORD, BYTE, ASCII):
DoCommand ":WAVeform:FORMat BYTE"
Debug.Print "Waveform format: " + _
    DoQueryString(":WAVeform:FORMat?")

' Display the waveform settings:
Dim Preamble() As Double
Dim intFormat As Integer
Dim intType As Integer
Dim lngPoints As Long
Dim lngCount As Long
Dim dblXIncrement As Double
Dim dblXOrigin As Double
Dim lngXReference As Long
Dim sngYIncrement As Single
Dim sngYOrigin As Single
Dim lngYReference As Long

Preamble() = DoQueryNumbers(":WAVeform:PREamble?")

intFormat = Preamble(0)
intType = Preamble(1)
lngPoints = Preamble(2)
lngCount = Preamble(3)
dblXIncrement = Preamble(4)
dblXOrigin = Preamble(5)
lngXReference = Preamble(6)
sngYIncrement = Preamble(7)
sngYOrigin = Preamble(8)
lngYReference = Preamble(9)

If intFormat = 0 Then
  Debug.Print "Waveform format: BYTE"
ElseIf intFormat = 1 Then
  Debug.Print "Waveform format: WORD"
ElseIf intFormat = 2 Then
  Debug.Print "Waveform format: ASCii"
End If

If intType = 0 Then
  Debug.Print "Acquisition type: NORMal"
ElseIf intType = 1 Then
  Debug.Print "Acquisition type: PEAK"
ElseIf intType = 2 Then
  Debug.Print "Acquisition type: AVERage"
ElseIf intType = 3 Then
  Debug.Print "Acquisition type: HRESolution"
End If
```

```
Debug.Print "Waveform points: " + _
    FormatNumber(lngPoints, 0)

Debug.Print "Waveform average count: " + _
    FormatNumber(lngCount, 0)

Debug.Print "Waveform X increment: " + _
    Format(dblXIncrement, "Scientific")

Debug.Print "Waveform X origin: " + _
    Format(dblXOrigin, "Scientific")

Debug.Print "Waveform X reference: " + _
    FormatNumber(lngXReference, 0)

Debug.Print "Waveform Y increment: " + _
    Format(sngYIncrement, "Scientific")

Debug.Print "Waveform Y origin: " + _
    FormatNumber(sngYOrigin, 0)

Debug.Print "Waveform Y reference: " + _
    FormatNumber(lngYReference, 0)

' Get the waveform data
Dim lngNumBytes As Long
lngNumBytes = DoQueryIEEEBlock_Bytes(":WAVeform:DATA?")
Debug.Print "Number of data values: " + _
    CStr(lngNumBytes - CInt(Chr(byteArray(1))) - 2)

' Set up output file:
strPath = "c:\scope\data\waveform_data.csv"

' Open file for output.
Open strPath For Output Access Write Lock Write As hFile

' Output waveform data in CSV format.
Dim lngDataValue As Long

' Skip past header.
For lngI = CInt(Chr(byteArray(1))) + 2 To lngNumBytes - 2
  lngDataValue = CLng(byteArray(lngI))

  ' Write time value, voltage value.
  Print #hFile, _
      FormatNumber(dblXOrigin + (lngI * dblXIncrement), 9) + _
      ", " + _
      FormatNumber(((lngDataValue - lngYReference) * _
      sngYIncrement) + sngYOrigin)

Next lngI

' Close output file.
Close hFile   ' Close file.
MsgBox "Waveform format BYTE data written to " + _
    "c:\scope\data\waveform_data.csv."
  Exit Sub

ErrorHandler:

  MsgBox "*** Error : " + Error, vbExclamation
  End

End Sub

Private Sub DoCommand(command As String)

  On Error GoTo ErrorHandler

  Call ivprintf(id, command + vbLf)

  CheckInstrumentErrors

  Exit Sub

ErrorHandler:

  MsgBox "*** Error : " + Error, vbExclamation
  End

End Sub

Private Function DoCommandIEEEBlock(command As String, _
    lngBlockSize As Long)

  On Error GoTo ErrorHandler

  ' Send command part.
  Call ivprintf(id, command + " ")

  ' Write definite-length block bytes.
  Call ifwrite(id, byteArray(), lngBlockSize, vbNull, retCount)

  ' retCount is now actual number of bytes written.
  DoCommandIEEEBlock = retCount

  CheckInstrumentErrors

  Exit Function

ErrorHandler:

  MsgBox "*** Error : " + Error, vbExclamation
  End

End Function

Private Function DoQueryString(query As String) As String

  Dim actual As Long

  On Error GoTo ErrorHandler
  Dim strResult As String * 200

  Call ivprintf(id, query + vbLf)
  Call ivscanf(id, "%200t", strResult)
  DoQueryString = strResult

  CheckInstrumentErrors

  Exit Function

ErrorHandler:

  MsgBox "*** Error : " + Error, vbExclamation
  End

End Function

Private Function DoQueryNumber(query As String) As Double

  On Error GoTo ErrorHandler

  Dim dblResult As Double

  Call ivprintf(id, query + vbLf)
  Call ivscanf(id, "%lf" + vbLf, dblResult)
  DoQueryNumber = dblResult

  CheckInstrumentErrors

  Exit Function

ErrorHandler:

  MsgBox "*** Error : " + Error, vbExclamation
  End

End Function

Private Function DoQueryNumbers(query As String) As Double()

  On Error GoTo ErrorHandler

  Dim dblResults(10) As Double

  Call ivprintf(id, query + vbLf)
  Call ivscanf(id, "%,10lf" + vbLf, dblResults)
  DoQueryNumbers = dblResults

  CheckInstrumentErrors

  Exit Function

ErrorHandler:

  MsgBox "*** Error : " + Error, vbExclamation
  End
```

```
End Function

Private Function DoQueryIEEEBlock_Bytes(query As String) As Long

  On Error GoTo ErrorHandler

  ' Send query.
  Call ivprintf(id, query + vbLf)

  ' Read definite-length block bytes.
  Sleep 2000   ' Delay before reading data.
  Call ifread(id, byteArray(), ByteArraySize, vbNull, retCount)

  ' Get number of block length digits.
  Dim intLengthDigits As Integer
  intLengthDigits = CInt(Chr(byteArray(1)))

  ' Get block length from those digits.
  Dim strBlockLength As String
  strBlockLength = ""
  Dim i As Integer
  For i = 2 To intLengthDigits + 1
    strBlockLength = strBlockLength + Chr(byteArray(i))
  Next

  ' Return number of bytes in block plus header.
  DoQueryIEEEBlock_Bytes = CLng(strBlockLength) + intLengthDigits + 2

  CheckInstrumentErrors

  Exit Function

ErrorHandler:

  MsgBox "*** Error : " + Error, vbExclamation
  End

End Function

Private Sub CheckInstrumentErrors()

  On Error GoTo ErrorHandler

  Dim strErrVal As String * 200
  Dim strOut As String

  Call ivprintf(id, ":SYSTem:ERRor?" + vbLf)   ' Query any errors data.
  Call ivscanf(id, "%200t", strErrVal)   ' Read: Errnum,"Error String".
  While Val(strErrVal) <> 0             ' End if find: +0,"No Error".
    strOut = strOut + "INST Error: " + strErrVal
    Call ivprintf(id, ":SYSTem:ERRor?" + vbLf)   ' Request error message
.
    Call ivscanf(id, "%200t", strErrVal)   ' Read error message.
  Wend

  If Not strOut = "" Then
```

```
    MsgBox strOut, vbExclamation, "INST Error Messages"
    Call iflush(id, I_BUF_READ Or I_BUF_WRITE)

  End If

  Exit Sub

ErrorHandler:

  MsgBox "*** Error : " + Error, vbExclamation
  End

End Sub
```

SCPI.NET Examples

These programming examples show how to use the SCPI.NET drivers that come with Keysight's free Command Expert software.

While you can write code manually using SCPI.NET drivers (as described in this section), you can also use the Command Expert software to:

- Connect to instruments and control them interactively using SCPI command sets.
- Quickly prototype and test command sequences.
- Generate C#, VB.NET, or C/C++ code for command sequences.
- Find, download, and install SCPI command sets.
- Browse command trees, search for commands, and view command descriptions.

The Command Expert suite also comes with Add-ons for easy instrument control and measurement data retrieval in NI LabVIEW, Microsoft Excel, Keysight VEE, and Keysight SystemVue.

For more information on Keysight Command Expert, and to download the software, see: http://www.keysight.com/find/commandexpert

- "SCPI.NET Example in C#" on page 892
- "SCPI.NET Example in Visual Basic .NET" on page 898
- "SCPI.NET Example in IronPython" on page 904

SCPI.NET Example in C#

To compile and run this example in Microsoft Visual Studio 2008:

1. Install the Keysight Command Expert software and the command set for the oscilloscope.
2. Open Visual Studio.
3. Create a new Visual C#, Windows, Console Application project.
4. Cut-and-paste the code that follows into the C# source file.
5. Edit the program to use the address of your oscilloscope.
6. Add a reference to the SCPI.NET driver:
    a. Right-click the project you wish to modify (not the solution) in the Solution Explorer window of the Microsoft Visual Studio environment.
    b. Choose **Add Reference...**.
    c. In the Add Reference dialog, select the **Browse** tab, and navigate to the ScpiNetDrivers folder.

- Windows XP: C:\Documents and Settings\All Users\Agilent\Command Expert\ScpiNetDrivers
- Windows 7: C:\ProgramData\Keysight\Command Expert\ScpiNetDrivers

d Select the .dll file for your oscilloscope, for example **AgInfiniiVision2000X_02_35.dll**; then, click **OK**.

7 Build and run the program.

For more information, see the SCPI.NET driver help that comes with Keysight Command Expert.

```
/*
 * Keysight SCPI.NET Example in C#
 * -------------------------------------------------------------------
 * This program illustrates a few commonly used programming
 * features of your Keysight oscilloscope.
 * -------------------------------------------------------------------
 */

using System;
using System.IO;
using System.Text;
using Agilent.CommandExpert.ScpiNet.AgInfiniiVision2000X_02_35;

namespace InfiniiVision
{
  class ScpiNetInstrumentApp
  {
    private static AgInfiniiVision2000X myScope;

    static void Main(string[] args)
    {
      try
      {
        string strScopeAddress;
        strScopeAddress =
          "USB0::0x2A8D::0x1797::CN56240004::0::INSTR";
        Console.WriteLine("Connecting to oscilloscope...");
        Console.WriteLine();
        myScope = new AgInfiniiVision2000X(strScopeAddress);
        myScope.Transport.DefaultTimeout.Set(10000);

        // Initialize - start from a known state.
        Initialize();

        // Capture data.
        Capture();

        // Analyze the captured waveform.
        Analyze();

        Console.WriteLine("Press any key to exit");
        Console.ReadKey();
      }
      catch (System.ApplicationException err)
      {
        Console.WriteLine("*** SCPI.NET Error : " + err.Message);
      }
      catch (System.SystemException err)
      {
        Console.WriteLine("*** System Error Message : " + err.Message);
      }
      catch (System.Exception err)
      {
        System.Diagnostics.Debug.Fail("Unexpected Error");
        Console.WriteLine("*** Unexpected Error : " + err.Message);
      }
      finally
      {
        //myScope.Dispose();
      }

    }

    /*
     * Initialize the oscilloscope to a known state.
     * --------------------------------------------------------------
     */
    private static void Initialize()
    {
      string strResults;

      // Get and display the device's *IDN? string.
      myScope.SCPI.IDN.Query(out strResults);
      Console.WriteLine("*IDN? result is: {0}", strResults);

      // Clear status and load the default setup.
      myScope.SCPI.CLS.Command();
      myScope.SCPI.RST.Command();
    }

    /*
     * Capture the waveform.
     * --------------------------------------------------------------
     */
    private static void Capture()
    {
      string strResults;
      double fResult;

      // Use auto-scale to automatically configure oscilloscope.
      myScope.SCPI.AUToscale.Command(null, null, null, null, null);

      // Set trigger mode.
      myScope.SCPI.TRIGger.MODE.Command("EDGE");
      myScope.SCPI.TRIGger.MODE.Query(out strResults);
      Console.WriteLine("Trigger mode: {0}", strResults);

      // Set EDGE trigger parameters.
      myScope.SCPI.TRIGger.EDGE.SOURce.Command("CHANnel1");
      myScope.SCPI.TRIGger.EDGE.SOURce.Query(out strResults);
      Console.WriteLine("Trigger edge source: {0}", strResults);
```

```
myScope.SCPI.TRIGger.EDGE.LEVel.Command(1.5, "CHANnel1");
myScope.SCPI.TRIGger.EDGE.LEVel.Query("CHANnel1", out fResult);
Console.WriteLine("Trigger edge level: {0:F2}", fResult);

myScope.SCPI.TRIGger.EDGE.SLOPe.Command("POSitive");
myScope.SCPI.TRIGger.EDGE.SLOPe.Query(out strResults);
Console.WriteLine("Trigger edge slope: {0}", strResults);

// Save oscilloscope configuration.
string[] strResultsArray;   // Results array.
int nLength;   // Number of bytes returned from instrument.
string strPath;

// Query and read setup string.
myScope.SCPI.SYSTem.SETup.Query(out strResultsArray);
nLength = strResultsArray.Length;

// Write setup string to file.
strPath = "c:\\scope\\config\\setup.stp";
File.WriteAllLines(strPath, strResultsArray);
Console.WriteLine("Setup bytes saved: {0}", nLength);


// Change settings with individual commands:

// Set vertical scale and offset.
myScope.SCPI.CHANnel.SCALe.Command(1, 0.05);
myScope.SCPI.CHANnel.SCALe.Query(1, out fResult);
Console.WriteLine("Channel 1 vertical scale: {0:F4}", fResult);

myScope.SCPI.CHANnel.OFFSet.Command(1, -1.5);
myScope.SCPI.CHANnel.OFFSet.Query(1, out fResult);
Console.WriteLine("Channel 1 vertical offset: {0:F4}", fResult);

// Set horizontal scale and offset.
myScope.SCPI.TIMebase.SCALe.Command(0.0002);
myScope.SCPI.TIMebase.SCALe.Query(out fResult);
Console.WriteLine("Timebase scale: {0:F4}", fResult);

myScope.SCPI.TIMebase.POSition.Command(0.0);
myScope.SCPI.TIMebase.POSition.Query(out fResult);
Console.WriteLine("Timebase position: {0:F2}", fResult);

// Set the acquisition type.
myScope.SCPI.ACQuire.TYPE.Command("NORMal");
myScope.SCPI.ACQuire.TYPE.Query(out strResults);
Console.WriteLine("Acquire type: {0}", strResults);

// Or, configure by loading a previously saved setup.
int nBytesWritten;

strPath = "c:\\scope\\config\\setup.stp";
strResultsArray = File.ReadAllLines(strPath);
nBytesWritten = strResultsArray.Length;

// Restore setup string.
```

```
      myScope.SCPI.SYSTem.SETup.Command(strResultsArray);
      Console.WriteLine("Setup bytes restored: {0}", nBytesWritten);

      // Capture an acquisition using :DIGitize.
      myScope.SCPI.DIGitize.Command("CHANnel1", null, null, null, null);
    }

    /*
     * Analyze the captured waveform.
     * --------------------------------------------------------------
     */
    private static void Analyze()
    {
      string strResults, source1, source2;
      double fResult;

      // Make a couple of measurements.
      // -------------------------------------------------------------
      myScope.SCPI.MEASure.SOURce.Command("CHANnel1", null);
      myScope.SCPI.MEASure.SOURce.Query(out source1, out source2);
      Console.WriteLine("Measure source: {0}", source1);

      myScope.SCPI.MEASure.FREQuency.Command("CHANnel1");
      myScope.SCPI.MEASure.FREQuency.Query("CHANnel1", out fResult);
      Console.WriteLine("Frequency: {0:F4} kHz", fResult / 1000);

      // Use direct command/query when commands not in command set.
      myScope.Transport.Command.Invoke(":MEASure:VAMPlitude CHANnel1");
      myScope.Transport.Query.Invoke(":MEASure:VAMPlitude? CHANnel1",
        out strResults);
      Console.WriteLine("Vertical amplitude: {0} V", strResults);

      // Download the screen image.
      // -------------------------------------------------------------
      myScope.SCPI.HARDcopy.INKSaver.Command(false);

      // Get the screen data.
      byte[] byteResultsArray;   // Results array.
      myScope.SCPI.DISPlay.DATA.QueryNewFormatCommandList("PNG", "COLor"
,
        out byteResultsArray);
      int nLength;   // Number of bytes returned from instrument.
      nLength = byteResultsArray.Length;

      // Store the screen data to a file.
      string strPath;
      strPath = "c:\\scope\\data\\screen.png";
      FileStream fStream = File.Open(strPath, FileMode.Create);
      fStream.Write(byteResultsArray, 0, nLength);
      fStream.Close();
      Console.WriteLine("Screen image ({0} bytes) written to {1}",
          nLength, strPath);

      // Download waveform data.
      // -------------------------------------------------------------

      // Set the waveform points mode.
```

```
myScope.SCPI.WAVeform.POINts.MODE.Command("RAW");
myScope.SCPI.WAVeform.POINts.MODE.Query(out strResults);
Console.WriteLine("Waveform points mode: {0}", strResults);

// Get the number of waveform points available.
myScope.SCPI.WAVeform.POINts.CommandPoints("10000");
int nPointsAvail;
myScope.SCPI.WAVeform.POINts.Query(out nPointsAvail);
Console.WriteLine("Waveform points available: {0}", nPointsAvail);

// Set the waveform source.
myScope.SCPI.WAVeform.SOURce.Command("CHANnel1");
myScope.SCPI.WAVeform.SOURce.Query(out strResults);
Console.WriteLine("Waveform source: {0}", strResults);

// Choose the format of the data returned (WORD, BYTE, ASCII):
myScope.SCPI.WAVeform.FORMat.Command("BYTE");
myScope.SCPI.WAVeform.FORMat.Query(out strResults);
Console.WriteLine("Waveform format: {0}", strResults);

// Display the waveform settings:
int nFormat, nType;
double dblXincrement, dblXorigin, dblYincrement, dblYorigin;
long nPoints, nCount, nXreference, nYreference;
myScope.SCPI.WAVeform.PREamble.Query(
  out nFormat,
  out nType,
  out nPoints,
  out nCount,
  out dblXincrement,
  out dblXorigin,
  out nXreference,
  out dblYincrement,
  out dblYorigin,
  out nYreference);

if (nFormat == 0)
{
  Console.WriteLine("Waveform format: BYTE");
}
else if (nFormat == 1)
{
  Console.WriteLine("Waveform format: WORD");
}
else if (nFormat == 2)
{
  Console.WriteLine("Waveform format: ASCii");
}

if (nType == 0)
{
  Console.WriteLine("Acquire type: NORMal");
}
else if (nType == 1)
{
  Console.WriteLine("Acquire type: PEAK");
}
```

```
        else if (nType == 2)
        {
          Console.WriteLine("Acquire type: AVERage");
        }
        else if (nType == 3)
        {
          Console.WriteLine("Acquire type: HRESolution");
        }

        Console.WriteLine("Waveform points: {0:e}", nPoints);
        Console.WriteLine("Waveform average count: {0:e}", nCount);
        Console.WriteLine("Waveform X increment: {0:e}", dblXincrement);
        Console.WriteLine("Waveform X origin: {0:e}", dblXorigin);
        Console.WriteLine("Waveform X reference: {0:e}", nXreference);
        Console.WriteLine("Waveform Y increment: {0:e}", dblYincrement);
        Console.WriteLine("Waveform Y origin: {0:e}", dblYorigin);
        Console.WriteLine("Waveform Y reference: {0:e}", nYreference);

        // Read waveform data.
        myScope.SCPI.WAVeform.DATA.QueryBYTE(out byteResultsArray);
        nLength = byteResultsArray.Length;
        Console.WriteLine("Number of data values: {0}", nLength);

        // Set up output file:
        strPath = "c:\\scope\\data\\waveform_data.csv";
        if (File.Exists(strPath)) File.Delete(strPath);

        // Open file for output.
        StreamWriter writer = File.CreateText(strPath);

        // Output waveform data in CSV format.
        for (int i = 0; i < nLength - 1; i++)
          writer.WriteLine("{0:f9}, {1:f6}",
              dblXorigin + ((float)i * dblXincrement),
              (((float)byteResultsArray[i] - nYreference)
              * dblYincrement) + dblYorigin);

        // Close output file.
        writer.Close();
        Console.WriteLine("Waveform format BYTE data written to {0}",
            strPath);
      }
    }
  }
```

SCPI.NET Example in Visual Basic .NET

To compile and run this example in Microsoft Visual Studio 2008:

1 Install the Keysight Command Expert software and the command set for the oscilloscope.
2 Open Visual Studio.
3 Create a new Visual Basic, Windows, Console Application project.
4 Cut-and-paste the code that follows into the Visual Basic .NET source file.

5 Edit the program to use the VISA address of your oscilloscope.

6 Add a reference to the SCPI.NET 3.0 driver:

   a Right-click the project you wish to modify (not the solution) in the Solution Explorer window of the Microsoft Visual Studio environment.

   b Choose **Add Reference...**.

   c In the Add Reference dialog, select the **Browse** tab, and navigate to the ScpiNetDrivers folder.

      - Windows XP: C:\Documents and Settings\All Users\Agilent\Command Expert\ScpiNetDrivers
      - Windows 7: C:\ProgramData\Keysight\Command Expert\ScpiNetDrivers

   d Select the .dll file for your oscilloscope, for example **AgInfiniiVision2000X_02_35.dll**; then, click **OK**.

   e Right-click the project you wish to modify (not the solution) in the Solution Explorer window of the Microsoft Visual Studio environment and choose **Properties**; then, select "InfiniiVision.ScpiNetInstrumentApp" as the **Startup object**.

7 Build and run the program.

For more information, see the SCPI.NET driver help that comes with Keysight Command Expert.

```
'
' Keysight SCPI.NET Example in Visual Basic .NET
' -------------------------------------------------------------------
' This program illustrates a few commonly used programming
' features of your Keysight oscilloscope.
' -------------------------------------------------------------------

Imports System
Imports System.IO
Imports System.Text
Imports Agilent.CommandExpert.ScpiNet.AgInfiniiVision2000X_02_35

Namespace InfiniiVision
  Class ScpiNetInstrumentApp
    Private Shared myScope As AgInfiniiVision2000X

    Public Shared Sub Main(ByVal args As String())
      Try
        Dim strScopeAddress As String
        strScopeAddress = _
          "USB0::0x2A8D::0x1797::CN56240004::0::INSTR"
        Console.WriteLine("Connecting to oscilloscope...")
        Console.WriteLine()
        myScope = New AgInfiniiVision2000X(strScopeAddress)
        myScope.Transport.DefaultTimeout.[Set](10000)

        ' Initialize - start from a known state.
        Initialize()
        ' Capture data.
        Capture()

        ' Analyze the captured waveform.
        Analyze()

        Console.WriteLine("Press any key to exit")
        Console.ReadKey()
      Catch err As System.ApplicationException
        Console.WriteLine("*** SCPI.NET Error : " & err.Message)
      Catch err As System.SystemException
        Console.WriteLine("*** System Error Message : " & err.Message)
      Catch err As System.Exception
        System.Diagnostics.Debug.Fail("Unexpected Error")
        Console.WriteLine("*** Unexpected Error : " & err.Message)
        'myScope.Dispose();
      Finally
      End Try

    End Sub

    ' Initialize the oscilloscope to a known state.
    ' --------------------------------------------------------------

    Private Shared Sub Initialize()
      Dim strResults As String

      ' Get and display the device's *IDN? string.
      myScope.SCPI.IDN.Query(strResults)
      Console.WriteLine("*IDN? result is: {0}", strResults)

      ' Clear status and load the default setup.
      myScope.SCPI.CLS.Command()
      myScope.SCPI.RST.Command()
    End Sub

    ' Capture the waveform.
    ' --------------------------------------------------------------

    Private Shared Sub Capture()
      Dim strResults As String
      Dim fResult As Double

      ' Use auto-scale to automatically configure oscilloscope.
      myScope.SCPI.AUToscale.Command(Nothing, Nothing, Nothing, _
                                     Nothing, Nothing)

      ' Set trigger mode.
      myScope.SCPI.TRIGger.MODE.Command("EDGE")
      myScope.SCPI.TRIGger.MODE.Query(strResults)
      Console.WriteLine("Trigger mode: {0}", strResults)

      ' Set EDGE trigger parameters.
      myScope.SCPI.TRIGger.EDGE.SOURce.Command("CHANnel1")
      myScope.SCPI.TRIGger.EDGE.SOURce.Query(strResults)
      Console.WriteLine("Trigger edge source: {0}", strResults)
```

```
myScope.SCPI.TRIGger.EDGE.LEVel.Command(1.5, "CHANnel1")
myScope.SCPI.TRIGger.EDGE.LEVel.Query("CHANnel1", fResult)
Console.WriteLine("Trigger edge level: {0:F2}", fResult)

myScope.SCPI.TRIGger.EDGE.SLOPe.Command("POSitive")
myScope.SCPI.TRIGger.EDGE.SLOPe.Query(strResults)
Console.WriteLine("Trigger edge slope: {0}", strResults)

' Save oscilloscope configuration.
Dim strResultsArray As String()
' Results array.
Dim nLength As Integer
' Number of bytes returned from instrument.
Dim strPath As String

' Query and read setup string.
myScope.SCPI.SYSTem.SETup.Query(strResultsArray)
nLength = strResultsArray.Length

' Write setup string to file.
strPath = "c:\scope\config\setup.stp"
File.WriteAllLines(strPath, strResultsArray)
Console.WriteLine("Setup bytes saved: {0}", nLength)


' Change settings with individual commands:

' Set vertical scale and offset.
myScope.SCPI.CHANnel.SCALe.Command(1, 0.05)
myScope.SCPI.CHANnel.SCALe.Query(1, fResult)
Console.WriteLine("Channel 1 vertical scale: {0:F4}", fResult)

myScope.SCPI.CHANnel.OFFSet.Command(1, -1.5)
myScope.SCPI.CHANnel.OFFSet.Query(1, fResult)
Console.WriteLine("Channel 1 vertical offset: {0:F4}", fResult)

' Set horizontal scale and offset.
myScope.SCPI.TIMebase.SCALe.Command(0.0002)
myScope.SCPI.TIMebase.SCALe.Query(fResult)
Console.WriteLine("Timebase scale: {0:F4}", fResult)

myScope.SCPI.TIMebase.POSition.Command(0.0)
myScope.SCPI.TIMebase.POSition.Query(fResult)
Console.WriteLine("Timebase position: {0:F2}", fResult)

' Set the acquisition type.
myScope.SCPI.ACQuire.TYPE.Command("NORMal")
myScope.SCPI.ACQuire.TYPE.Query(strResults)
Console.WriteLine("Acquire type: {0}", strResults)

' Or, configure by loading a previously saved setup.
Dim nBytesWritten As Integer

strPath = "c:\scope\config\setup.stp"
strResultsArray = File.ReadAllLines(strPath)
nBytesWritten = strResultsArray.Length
```

```
          ' Restore setup string.
          myScope.SCPI.SYSTem.SETup.Command(strResultsArray)
          Console.WriteLine("Setup bytes restored: {0}", nBytesWritten)

          ' Capture an acquisition using :DIGitize.
          myScope.SCPI.DIGitize.Command("CHANnel1", Nothing, Nothing, _
                                        Nothing, Nothing)
        End Sub

        ' Analyze the captured waveform.
        ' --------------------------------------------------------------

        Private Shared Sub Analyze()
          Dim strResults As String, source1 As String, source2 As String
          Dim fResult As Double

          ' Make a couple of measurements.
          ' ------------------------------------------------------------
          myScope.SCPI.MEASure.SOURce.Command("CHANnel1", Nothing)
          myScope.SCPI.MEASure.SOURce.Query(source1, source2)
          Console.WriteLine("Measure source: {0}", source1)

          myScope.SCPI.MEASure.FREQuency.Command("CHANnel1")
          myScope.SCPI.MEASure.FREQuency.Query("CHANnel1", fResult)
          Console.WriteLine("Frequency: {0:F4} kHz", fResult / 1000)

          ' Use direct command/query when commands not in command set.
          myScope.Transport.Command.Invoke(":MEASure:VAMPlitude CHANnel1")
          myScope.Transport.Query.Invoke(":MEASure:VAMPlitude? CHANnel1", _
                                         strResults)
          Console.WriteLine("Vertical amplitude: {0} V", strResults)

          ' Download the screen image.
          ' ------------------------------------------------------------
          myScope.SCPI.HARDcopy.INKSaver.Command(False)

          ' Get the screen data.
          Dim byteResultsArray As Byte()
          ' Results array.
          myScope.SCPI.DISPlay.DATA.QueryNewFormatCommandList("PNG", "COLor"
    , byteResultsArray)
          Dim nLength As Integer
          ' Number of bytes returned from instrument.
          nLength = byteResultsArray.Length

          ' Store the screen data to a file.
          Dim strPath As String
          strPath = "c:\scope\data\screen.png"
          Dim fStream As FileStream = File.Open(strPath, FileMode.Create)
          fStream.Write(byteResultsArray, 0, nLength)
          fStream.Close()
          Console.WriteLine("Screen image ({0} bytes) written to {1}", _
                            nLength, strPath)

          ' Download waveform data.
          ' ------------------------------------------------------------
```

```
' Set the waveform points mode.
myScope.SCPI.WAVeform.POINts.MODE.Command("RAW")
myScope.SCPI.WAVeform.POINts.MODE.Query(strResults)
Console.WriteLine("Waveform points mode: {0}", strResults)

' Get the number of waveform points available.
myScope.SCPI.WAVeform.POINts.CommandPoints("10000")
Dim nPointsAvail As Integer
myScope.SCPI.WAVeform.POINts.Query(nPointsAvail)
Console.WriteLine("Waveform points available: {0}", nPointsAvail)


' Set the waveform source.
myScope.SCPI.WAVeform.SOURce.Command("CHANnel1")
myScope.SCPI.WAVeform.SOURce.Query(strResults)
Console.WriteLine("Waveform source: {0}", strResults)

' Choose the format of the data returned (WORD, BYTE, ASCII):
myScope.SCPI.WAVeform.FORMat.Command("BYTE")
myScope.SCPI.WAVeform.FORMat.Query(strResults)
Console.WriteLine("Waveform format: {0}", strResults)

' Display the waveform settings:
Dim nFormat As Integer, nType As Integer
Dim dblXincrement As Double, dblXorigin As Double, _
  dblYincrement As Double, dblYorigin As Double
Dim nPoints As Long, nCount As Long, nXreference As Long, _
  nYreference As Long
myScope.SCPI.WAVeform.PREamble.Query(nFormat, nType, nPoints, _
  nCount, dblXincrement, dblXorigin, nXreference, _
  dblYincrement, dblYorigin, nYreference)

If nFormat = 0 Then
  Console.WriteLine("Waveform format: BYTE")
ElseIf nFormat = 1 Then
  Console.WriteLine("Waveform format: WORD")
ElseIf nFormat = 2 Then
  Console.WriteLine("Waveform format: ASCii")
End If

If nType = 0 Then
  Console.WriteLine("Acquire type: NORMal")
ElseIf nType = 1 Then
  Console.WriteLine("Acquire type: PEAK")
ElseIf nType = 2 Then
  Console.WriteLine("Acquire type: AVERage")
ElseIf nType = 3 Then
  Console.WriteLine("Acquire type: HRESolution")
End If

Console.WriteLine("Waveform points: {0:e}", nPoints)
Console.WriteLine("Waveform average count: {0:e}", nCount)
Console.WriteLine("Waveform X increment: {0:e}", dblXincrement)
Console.WriteLine("Waveform X origin: {0:e}", dblXorigin)
Console.WriteLine("Waveform X reference: {0:e}", nXreference)
Console.WriteLine("Waveform Y increment: {0:e}", dblYincrement)
Console.WriteLine("Waveform Y origin: {0:e}", dblYorigin)
```

```
            Console.WriteLine("Waveform Y reference: {0:e}", nYreference)

            ' Read waveform data.
            myScope.SCPI.WAVeform.DATA.QueryBYTE(byteResultsArray)
            nLength = byteResultsArray.Length
            Console.WriteLine("Number of data values: {0}", nLength)

            ' Set up output file:
            strPath = "c:\scope\data\waveform_data.csv"
            If File.Exists(strPath) Then
              File.Delete(strPath)
            End If

            ' Open file for output.
            Dim writer As StreamWriter = File.CreateText(strPath)

            ' Output waveform data in CSV format.
            For i As Integer = 0 To nLength - 2
              writer.WriteLine("{0:f9}, {1:f6}", _
                dblXorigin + (CSng(i) * dblXincrement), _
                ((CSng(byteResultsArray(i)) - nYreference) * _
                 dblYincrement) + dblYorigin)
            Next

            ' Close output file.
            writer.Close()
            Console.WriteLine("Waveform format BYTE data written to {0}", _
                              strPath)
        End Sub
    End Class
End Namespace
```

SCPI.NET Example in IronPython

You can also control Keysight oscilloscopes using the SCPI.NET library and Python programming language on the .NET platform using:

- IronPython (http://ironpython.codeplex.com/) which is an implementation of the Python programming language running under .NET.

To run this example with IronPython:

1. Install the Keysight Command Expert software and the command set for the oscilloscope.
2. Cut-and-paste the code that follows into a file named "example.py".
3. Edit the program to use the address of your oscilloscope.
4. If the IronPython "ipy.exe" can be found via your PATH environment variable, open a Command Prompt window; then, change to the folder that contains the "example.py" file, and enter:

   ```
   ipy example.py
   ```

```
#
# Keysight SCPI.NET Example in IronPython
```

```
# *********************************************************
# This program illustrates a few commonly used programming
# features of your Keysight oscilloscope.
# *********************************************************

# Import Python modules.
# ---------------------------------------------------------
import sys
sys.path.append("C:\Python27\Lib")   # Python Standard Library.
sys.path.append("C:\ProgramData\Keysight\Command Expert\ScpiNetDrivers")
import string

# Import .NET modules.
# ---------------------------------------------------------
from System import *
from System.IO import *
from System.Text import *
from System.Runtime.InteropServices import *
import clr
clr.AddReference("AgInfiniiVision2000X_02_35")
from Agilent.CommandExpert.ScpiNet.AgInfiniiVision2000X_02_35 import *


# =========================================================
# Initialize:
# =========================================================
def initialize():

 # Get and display the device's *IDN? string.
 idn_string = scope.SCPI.IDN.Query()
 print "Identification string '%s'" % idn_string

 # Clear status and load the default setup.
 scope.SCPI.CLS.Command()
 scope.SCPI.RST.Command()


# =========================================================
# Capture:
# =========================================================
def capture():

 # Use auto-scale to automatically set up oscilloscope.
 print "Autoscale."
 scope.SCPI.AUToscale.Command(None, None, None, None, None)

 # Set trigger mode.
 scope.SCPI.TRIGger.MODE.Command("EDGE")
 qresult = scope.SCPI.TRIGger.MODE.Query()
 print "Trigger mode: %s" % qresult

 # Set EDGE trigger parameters.
 scope.SCPI.TRIGger.EDGE.SOURce.Command("CHANnel1")
 qresult = scope.SCPI.TRIGger.EDGE.SOURce.Query()
 print "Trigger edge source: %s" % qresult

 scope.SCPI.TRIGger.EDGE.LEVel.Command(1.5, "CHANnel1")
 qresult = scope.SCPI.TRIGger.EDGE.LEVel.Query("CHANnel1")
 print "Trigger edge level: %s" % qresult

 scope.SCPI.TRIGger.EDGE.SLOPe.Command("POSitive")
 qresult = scope.SCPI.TRIGger.EDGE.SLOPe.Query()
 print "Trigger edge slope: %s" % qresult

 # Save oscilloscope setup.
 setup_lines = scope.SCPI.SYSTem.SETup.Query()
 nLength = len(setup_lines)
 File.WriteAllLines("setup.stp", setup_lines)
 print "Setup lines saved: %d" % nLength

 # Change oscilloscope settings with individual commands:

 # Set vertical scale and offset.
 scope.SCPI.CHANnel.SCALe.Command(1, 0.05)
 qresult = scope.SCPI.CHANnel.SCALe.Query(1)
 print "Channel 1 vertical scale: %f" % qresult

 scope.SCPI.CHANnel.OFFSet.Command(1, -1.5)
 qresult = scope.SCPI.CHANnel.OFFSet.Query(1)
 print "Channel 1 offset: %f" % qresult

 # Set horizontal scale and offset.
 scope.SCPI.TIMebase.SCALe.Command(0.0002)
 qresult = scope.SCPI.TIMebase.SCALe.Query()
 print "Timebase scale: %f" % qresult

 scope.SCPI.TIMebase.POSition.Command(0.0)
 qresult = scope.SCPI.TIMebase.POSition.Query()
 print "Timebase position: %f" % qresult

 # Set the acquisition type.
 scope.SCPI.ACQuire.TYPE.Command("NORMal")
 qresult = scope.SCPI.ACQuire.TYPE.Query()
 print "Acquire type: %s" % qresult

 # Or, set up oscilloscope by loading a previously saved setup.
 setup_lines = File.ReadAllLines("setup.stp")
 scope.SCPI.SYSTem.SETup.Command(setup_lines)
 print "Setup lines restored: %d" % len(setup_lines)

 # Capture an acquisition using :DIGitize.
 scope.SCPI.DIGitize.Command("CHANnel1", None, None, None, None)


# ==========================================================
# Analyze:
# ==========================================================
def analyze():

 # Make measurements.
 # --------------------------------------------------------
 scope.SCPI.MEASure.SOURce.Command("CHANnel1", None)
 (source1, source2) = scope.SCPI.MEASure.SOURce.Query()
 print "Measure source: %s" % source1
 scope.SCPI.MEASure.FREQuency.Command("CHANnel1")
 qresult = scope.SCPI.MEASure.FREQuency.Query("CHANnel1")
 print "Measured frequency on channel 1: %f" % qresult

 # Use direct command/query when commands not in command set.
 scope.Transport.Command.Invoke(":MEASure:VAMPlitude CHANnel1")
 qresult = scope.Transport.Query.Invoke(":MEASure:VAMPlitude? CHANnel1")
 print "Measured vertical amplitude on channel 1: %s" % qresult

 # Download the screen image.
 # --------------------------------------------------------
 scope.SCPI.HARDcopy.INKSaver.Command(False)

 image_bytes = scope.SCPI.DISPlay.DATA.QueryNewFormatCommandList("PNG",
"COLor")
 nLength = len(image_bytes)
 fStream = File.Open("screen_image.png", FileMode.Create)
 fStream.Write(image_bytes, 0, nLength)
 fStream.Close()
 print "Screen image written to screen_image.png."

 # Download waveform data.
 # --------------------------------------------------------

 # Set the waveform points mode.
 scope.SCPI.WAVeform.POINts.MODE.Command("RAW")
 qresult = scope.SCPI.WAVeform.POINts.MODE.Query()
 print "Waveform points mode: %s" % qresult

 # Get the number of waveform points available.
 scope.SCPI.WAVeform.POINts.CommandPoints("10000")
 qresult = scope.SCPI.WAVeform.POINts.Query()
 print "Waveform points available: %s" % qresult

 # Set the waveform source.
 scope.SCPI.WAVeform.SOURce.Command("CHANnel1")
 qresult = scope.SCPI.WAVeform.SOURce.Query()
 print "Waveform source: %s" % qresult

 # Choose the format of the data returned:
 scope.SCPI.WAVeform.FORMat.Command("BYTE")
 qresult = scope.SCPI.WAVeform.FORMat.Query()
 print "Waveform format: %s" % qresult

 # Display the waveform settings from preamble:
 wav_form_dict = {
  0 : "BYTE",
  1 : "WORD",
  4 : "ASCii",
 }
 acq_type_dict = {
  0 : "NORMal",
  1 : "PEAK",
  2 : "AVERage",
  3 : "HRESolution",
 }
 (
  wav_form, acq_type, wfmpts, avgcnt, x_increment, x_origin,
  x_reference, y_increment, y_origin, y_reference
 ) = scope.SCPI.WAVeform.PREamble.Query()

 print "Waveform format: %s" % wav_form_dict[int(wav_form)]
 print "Acquire type: %s" % acq_type_dict[int(acq_type)]
 print "Waveform points desired: %s" % wfmpts
 print "Waveform average count: %s" % avgcnt
 print "Waveform X increment: %s" % x_increment
 print "Waveform X origin: %s" % x_origin
 print "Waveform X reference: %s" % x_reference   # Always 0.
 print "Waveform Y increment: %s" % y_increment
 print "Waveform Y origin: %s" % y_origin
 print "Waveform Y reference: %s" % y_reference

 # Get numeric values for later calculations.
 x_increment = scope.SCPI.WAVeform.XINCrement.Query()
 x_origin = scope.SCPI.WAVeform.XORigin.Query()
 y_increment = scope.SCPI.WAVeform.YINCrement.Query()
 y_origin = scope.SCPI.WAVeform.YORigin.Query()
 y_reference = scope.SCPI.WAVeform.YREFerence.Query()

 # Get the waveform data.
 data_bytes = scope.SCPI.WAVeform.DATA.QueryBYTE()
 nLength = len(data_bytes)
 print "Number of data values: %d" % nLength

 # Open file for output.
 strPath = "waveform_data.csv"
 writer = File.CreateText(strPath)

 # Output waveform data in CSV format.
 for i in xrange(0, nLength - 1):
  time_val = x_origin + i * x_increment
  voltage = (data_bytes[i] - y_reference) * y_increment + y_origin
  writer.WriteLine("%E, %f" % (time_val, voltage))

 # Close output file.
 writer.Close()
 print "Waveform format BYTE data written to %s." % strPath


# =========================================================
# Main program:
# =========================================================
addr = "USB0::0x2A8D::0x1797::CN56240004::0::INSTR"
scope = AgInfiniiVision2000X(addr)
scope.Transport.DefaultTimeout.Set(10000)

# Initialize the oscilloscope, capture data, and analyze.
initialize()
capture()
analyze()

print "End of program."
```

```
# Wait for a key press before exiting.
print "Press any key to exit..."
Console.ReadKey(True)
```

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