TELEDYNE TEST TOOLS
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Programming Guide

T3DSO1000(A) and T3DSO2000 Digital Oscilloscopes Programming Guide

Version Declaration

This chapter indicates the modifications of commands in the most recent release of the programming guide version.

Introduction

Manual version 1.3 describes all the currently available commands. Some of the commands vary between the oscilloscope series, and these will be annotated in the description of command.

The following are the main revisions:

- ❿Delete the **Table of Commands & Queries,** and all the instructions are classified according to the functional modules.
- ❿Removed incorrect instructions, added instructions for GEN and DIGITAL modules.
- ❿Add two new communication features: Telnet and Socket, visible in “Programming Overview-Remote Control”.
- ❿Detailed programming instances for instructions (WF?/SCDP) to make it easier to understand.
- ❿Support obtaining waveform data of Digital channel and Math.

Content

Programming Overview

This chapter introduces how to build communication between the instrument and the PC. It also introduces how to configure a system for remote instrument control. By using USB and LAN interfaces, in combination with NI-VISA and programming languages, users can remotely control the instruments. Through LAN interface, VXI-11, Sockets and Telnet protocols can be used to communicate with the instruments.

Establishing Communications

Install NI-VISA

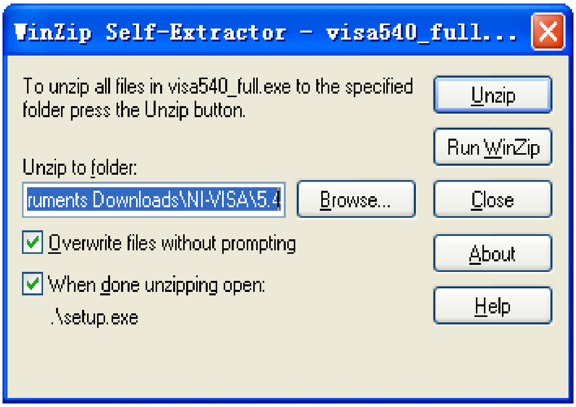
Before programming, you need to install the National Instruments NI-VISA library, which you can download from the National Instruments web site. Currently, NI-VISA is packaged in two versions: a full version and a Run-Time Engine version. The full version includes the NI device drivers and a tool named NI MAX which is a user interface to control and test remotely connected devices. The Run-Time Engine is recommended, as it is a much smaller download than the full version and includes the necessary tools for basic communication to instruments.

For example, you can get the NI-VISA 5.4 full version from:
http://www.ni.com/download/ni-visa-5.4/4230/en/.

You also can download NI-VISA Run-Time Engine 5.4 to your PC and install it as the default selection. Its installation process is similar with the full version.

After you downloaded the file, follow these steps to install NI-VISA (The full version of NI-VISA 5.4 is used in this example. Newer versions are likely, and should be compatible with Teledyne Test Tools instrumentation. Download the latest version available for the operating system being used by the controlling computer):

a. Double click the visa540_full.exe, dialog shown as below:


WinZip Self-Extractor - visa540_full...

To unzip all files in visa540_full.exe to the specified folder press the Unzip button.

Unzip to folder:

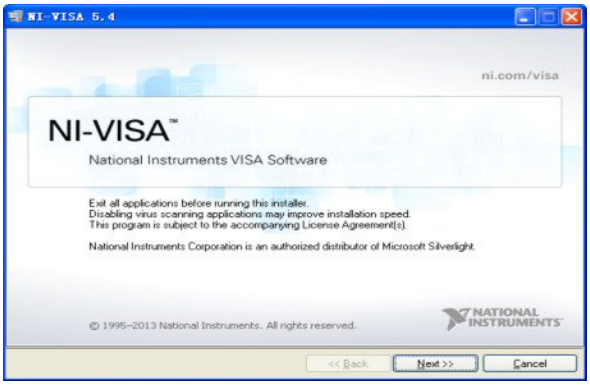
ruments Downloads\NI-VISA\5.4

✓ Overwrite files without prompting

✓ When done unzipping open:

.\setup.exe

b. Click Unzip, the installation process will automatically launch after unzipping files. If your computer needs to install .NET Framework 4, it may auto start.


NI-VISA 5.4

ni.com/visa

NI-VISA™

National Instruments VISA Software

Exit all applications before running this installer.
Disabling virus scanning applications may improve installation speed.
This program is subject to the accompanying License Agreement(s).

National Instruments Corporation is an authorized distributor of Microsoft Silverlight.

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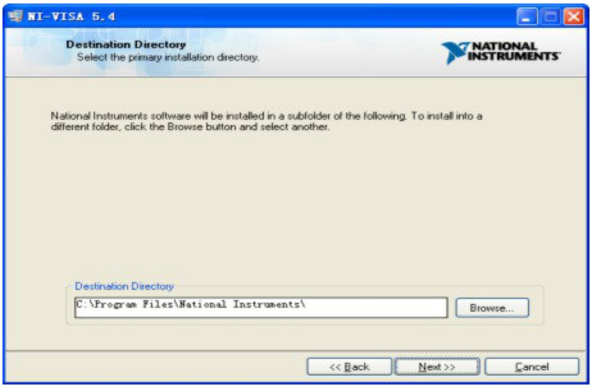
c. The NI-VISA installing dialog is shown above. Click Next to start the installation process.

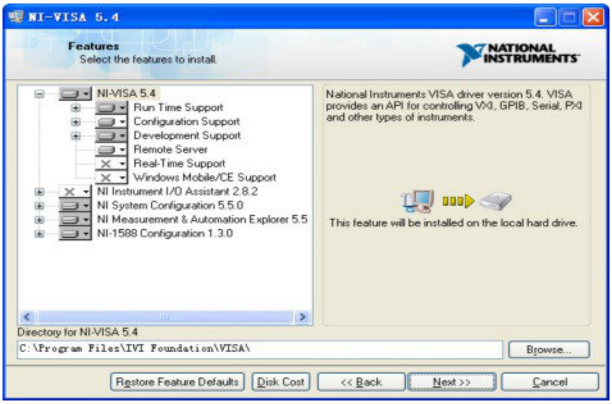

NI-VISA 5.4

Destination Directory
Select the primary installation directory.

National Instruments software will be installed in a subfolder of the following. To install into a different folder, click the Browse button and select another.

Destination Directory
C:\Program Files\National Instruments\

d. Set the install path, default path is “C:\Program Files\National Instruments\”, you can change it. Click Next, dialog shown as above.


NI-VISA 5.4

Features
Select the features to install.

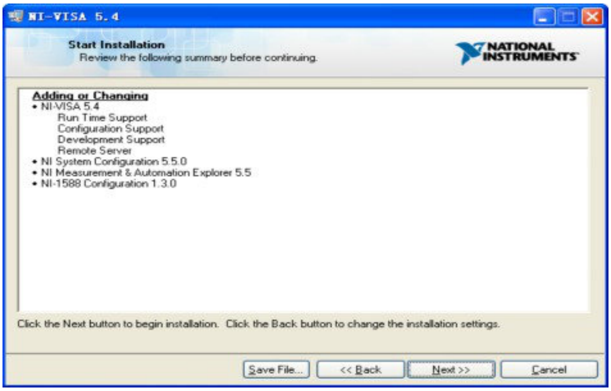
NI-VISA 5.4
Run Time Support
Configuration Support
Development Support
Remote Server
Real-Time Support
Windows Mobile/CE Support
NI Instrument I/O Assistant 2.8.2
NI System Configuration 5.5.0
NI Measurement & Automation Explorer 5.5
NI-1588 Configuration 1.3.0

National Instruments VISA driver version 5.4. VISA provides an API for controlling VXI, GPIB, Serial, PXI and other types of instruments.

This feature will be installed on the local hard drive.

Directory for NI-VISA 5.4
C:\Program Files\IVI Foundation\VISA\

e. Click Next twice, in the License Agreement dialog, select the “I accept the above 2 License Agreement(s).”,and click Next, dialog shown as below:

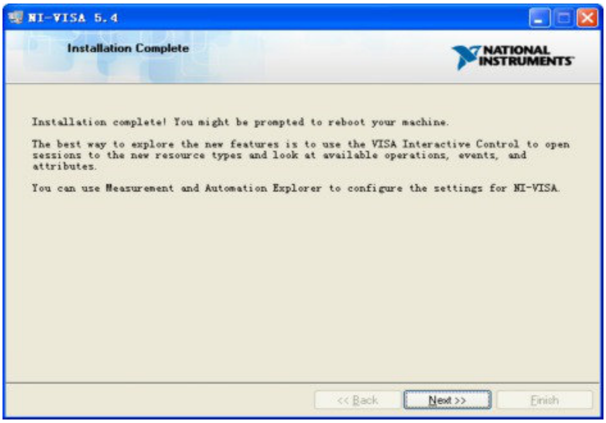


Start Installation
Review the following summary before continuing.

Adding or Changing
• NI-VISA 5.4
  Run Time Support
  Configuration Support
  Development Support
  Remote Server
• NI System Configuration 5.5.0
• NI Measurement & Automation Explorer 5.5
• NI-1588 Configuration 1.3.0

Click the Next button to begin installation. Click the Back button to change the installation settings.

f. Click Next to begin installation.



Installation Complete

Installation complete! You might be prompted to reboot your machine.

The best way to explore the new features is to use the VISA Interactive Control to open sessions to the new resource types and look at available operations, events, and attributes.

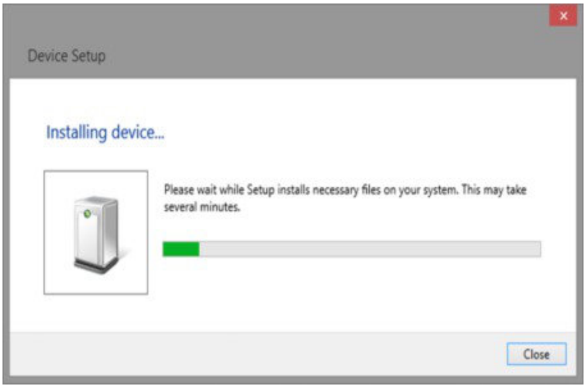
You can use Measurement and Automation Explorer to configure the settings for NI-VISA.

g. Now the installation is complete. Reboot your PC.

Connect the Instrument

Depending on the specific model, your oscilloscope may be able to communicate with a PC through the USB or LAN interface.

Connect the instrument and the USB Host interface of the PC using a USB cable. Assuming your PC is already turned on, turn on your oscilloscope, and then the PC will display the "Device Setup" screen as it automatically installs the device driver as shown below.



Installing device...

Please wait while Setup installs necessary files on your system. This may take several minutes.

Wait for the installation to complete and then proceed to the next step.

Remote Control

User-defined Programming

Users can use SCPI commands via a computer to program and control the digital oscilloscope. For details, refer to the introductions in "Programming Examples".

Send SCPI Commands via NI-MAX

NI-Measurement and Automation eXplorer (NI-MAX) is a program created and maintained by National Instruments. It provides a basic remote control interface for VXI, LAN, USB, GPIB, and Serial communications. It is a utility that enables you to send commands one-at-a-time and also retrieve data from connected devices. It is a great tool for troubleshooting and testing command sequences. The oscilloscopes can be controlled remotely by sending SCPI commands via NI-MAX.

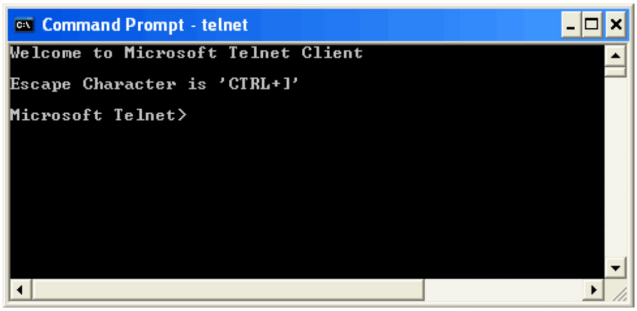
Using SCPI with Telnet

Telnet provides a means of communicating with the oscilloscopes over a LAN connection. The Telnet protocol sends SCPI commands to the oscilloscopes from a PC and is similar to communicating with the oscilloscopes over USB. It sends and receives information interactively: one command at a time. Windows operating systems use a command prompt style interface for the Telnet client. The steps are as follows:

1. On your PC, click Start > All Programs > Accessories > Command Prompt.

2. At the command prompt, type in *telnet*.

3. Press the Enter key. The Telnet display screen will be displayed.

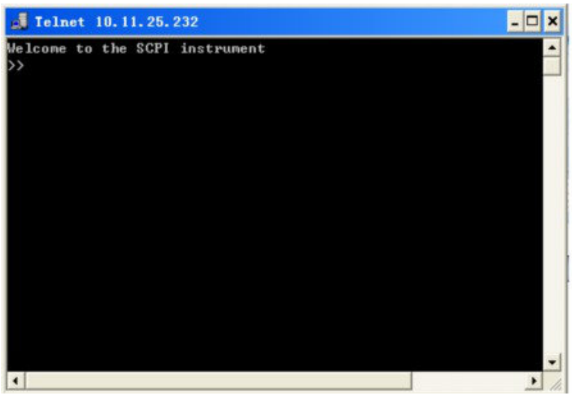


```
Command Prompt - telnet
Welcome to Microsoft Telnet Client

Escape Character is 'CTRL+]'

Microsoft Telnet>
```

4. At the Telnet command line, type:

open XXX.XXX.XXX.XXX 5024

Where *XXX.XXX.XXX.XXX* is the instrument's IP address and 5024 is the port. You should see a response similar to the following:



```
Telnet 10.11.25.232
Welcome to the SCPI instrument
>>
```

5. At the SCPI> prompt, input the SCPI commands such as **IDN?* to return the company name, model number, serial number, and firmware version number.

6. To exit the SCPI> session, press the Ctrl+] keys simultaneously.

7. Type *quit* at the prompt or close the Telnet window to close the connection to the instrument and exit Telnet.

Using SCPI with Sockets

Socket API can be used to control the T3DSO series via LAN without installing any other libraries. This can reduce the complexity of programming.

SOCKET ADDRESS	IP address + port number
IP ADDRESS	T3DSO IP address
PORT NUMBER	5024

Please see section "Examples of Using Sockets" for the details.

Introduction to the SCPI Language

About Commands & Queries

This section lists and describes the remote control commands and queries recognized by the instrument. All commands and queries can be executed in either local or remote state.

The description for each command or query, with syntax and other information, begins on a new page. The name (header) is given in both long and short form at the top of the page, and the subject is indicated as a command or query or both.

The commands are given in long format for the "**COMMAND SYNTAX**" and "**QUERY SYNTAX**" sections and they are used in a short form for the "**EXAMPLE**" .

Queries perform actions such as obtaining information, and are recognized by the question mark (?) following the header.

Description

In the description, a brief explanation of the function performed is given. This is followed by a presentation of the formal syntax, with the header given in upper case characters and the short form derived from it. Where applicable, the syntax of the query is given with the format of its response.

Usage

The commands and queries listed here can be used for the T3DSO1000(A) and T3DSO2000 Digital Oscilloscope Series.

Command Notation

The following notations are used in the commands:

< >	Angular brackets enclose words that are used as placeholders, of which there are two types: the header path and the data parameter of a command.
:=	A colon followed by an equals sign separates a placeholder from the description of the type and range of values that may be used in a command instead of the placeholder.
{ }	Braces enclose a list of choices, one of which one must be made.
[ ]	Square brackets enclose optional items.
…	An ellipsis indicates that the items both to its left and right may be repeated for a number of times.

As an example, consider the syntax notation for the command to set the vertical input sensitivity:

```
<channel>:VOLT_DIV <v_gain>
<channel>:={C1,C2,C3,C4}
<v_gain>:= 2 mV to 10 V
```

The first line shows the formal appearance of the command, with <channel> denoting the placeholder for the header path and <v_gain> the placeholder for the data parameter specifying the desired vertical gain value. The second line indicates that one of four channels must be chosen for the header path. And the third explains that the actual vertical gain can be set to any value between 2mV and 10V.

Commands & Queries

This chapter introduces each command subsystem of the Teledyne Test Tools Digital Oscilloscope Series command set. The contents of this chapter are shown as below:

COMMON (*) Commands

The IEEE 488.2 standard defines some general commands for querying the basic information of an instrument or performing common basic operations. These commands usually start with *, and the command key length is 3 characters.

***IDN?** (Identification Number)
***OPC** (Operation Complete)
***RST** (Reset)

COMMON (*)

*IDN?

Query

DESCRIPTION

The *IDN? query identifies the instrument type and software version. The response consists of four different fields providing information on the manufacturer, the scope model, the serial number and the firmware revision.

QUERY SYNTAX

*IDN?

RESPONSE FORMAT

Teledyne Test Tools,<model>,<serial number>,<firmware>
<model>:= the model number of the instrument.
<serial number>:= A 14-digit decimal code.
<firmware>:= the software revision of the instrument

EXAMPLE

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

Response message:
Teledyne Test Tools, T3DSO1204 ,NDS1EBAC0L0098,7.6.1.15

COMMON (*)

*OPC

Command/Query

DESCRIPTION

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

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.

COMMAND SYNTAX

*OPC

QUERY SYNTAX

*OPC?

RESPONSE FORMAT

*OPC 1

COMMON (*)

*RST

Command

DESCRIPTION

The *RST command initiates a device reset. This is the same as pressing **[Default]** on the front panel.

COMMAND SYNTAX

*RST

EXAMPLE

This example resets the oscilloscope.
Command message:
**RST*

COMM_HEADER Commands

CHDR

COMM_HEADER

COMM_HEADER | CHDR

Command/ Query

DESCRIPTION

The COMM_HEADER command controls the way the oscilloscope formats response to queries. This command does not affect the interpretation of messages sent to the oscilloscope. Headers can be sent in their long or short form regardless of the CHDR setting.

Examples of the three response formats to "C1:VDIV?":

CHDR	RESPONSE
LONG	C1:VOLT_DIV 1.00E+01V
SHORT	C1:VDIV 1.00E+01V
OFF	1.00E+01

COMMAND SYNTAX

COMM_HEADER <mode>
<mode>:={SHORT,LONG,OFF}

• SHORT — response starts with the short form of the header word.
• LONG — response starts with the long form of the header word.
• OFF — header is omitted from the response and units in numbers are suppressed.

Note:
Default is the SHORT response format.

QUERY SYNTAX

COMM_HEADER?

RESPONSE FORMAT

COMM_HEADER <mode>

EXAMPLE

The following command sets the response header format to SHORT.
Command message:
CHDR SHORT

ACQUIRE Commands

The ACQUIRE subsystem controls the way in which waveforms are acquired. These commands set the parameters for acquiring and storing data.

ARM
STOP
ACQW
AVGA
MSIZ
SAST?
SARA?
SANU?
SXSA
XYDS

ACQUIRE

ARM_ACQUISITION | ARM

Command

DESCRIPTION

The ARM_ACQUISITION command starts a new signal acquisition.

COMMAND SYNTAX

ARM_ACQUISITION

EXAMPLE

The following steps show the effect of ARM.

Note:
INR bit 13 (8192) = Trigger is ready.
INR bit 0 (1) = New Signal Acquired.

Step 1: Set the trigger mode to single, and input a signal which can be triggered. Once triggered, you can see the state of acquisition changes to stop. Send the query.

Query message:
INR?

Response message:
INR 8193(trigger ready)

Step 2: Send the query again to clear the register.

Query message:
INR?

Response message:
INR 0

Step 3; Now, send the command to start a new signal acquisition.

Command message:
ARM

Step 4: Send the query to see the effect of ARM.

Query message:
INR?

Response message:
INR 8193

RELATED COMMANDS

STOP
TRMD
INR?

ACQUIRE

STOP
Command

DESCRIPTION

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

COMMAND SYNTAX

STOP

EXAMPLE

The following command stops the acquisition process.
Command message:
STOP

RELATED COMMANDS

ARM
TRMD

ACQUIRE

ACQUIRE_WAY | ACQW

Command /Query

DESCRIPTION

The ACQUIRE_WAY command specifies the acquisition mode.

The ACQUIRE_WAY? query returns the current acquisition mode.

COMMAND SYNTAX

ACQUIRE_WAY <mode>[,<time>]

<mode>:={SAMPLING,PEAK_DETECT,AVERAGE,HIGH_RES}

<time>:={4,16,32,64,128,256,512,…}

- SAMPLING — sets the oscilloscope in the normal mode.
- PEAK_DETECT — sets the oscilloscope in the peak detect mode.
- AVERAGE — sets the oscilloscope in the averaging mode.
- HIGH_RES — sets the oscilloscope in the enhanced resolution mode (also known as smoothing). This is essentially a digital boxcar filter and is used to reduce noise at slower sweep speeds.

Note:

- The [HIGH_RES] option is valid for T3DSO models. See models on page 14.
- <time>:={4,16,32,64,128,256,512,…} when <mode> = AVERAGE.

Options vary from models. See the data sheet or the acquire menu of the oscilloscope.

QUERY SYNTAX

ACQUIRE_WAY?

RESPONSE FORMAT

ACQUIRE_WAY <mode>[,<time>]

EXAMPLE

The following command sets the acquisition mode to average mode and also sets the average time to 16.
Command message:
ACQW AVERAGE,16

RELATED COMMANDS

AVGA

ACQUIRE

AVERAGE_ACQUIRE | AVGA

Command /Query

DESCRIPTION

The AVERAGE_ACQUIRE command selects the average times of average acquisition.

The AVERAGE_ACQUIRE? query returns the currently selected count value for average mode.

COMMAND SYNTAX

AVERAGE_ACQUIRE <time>

<time>:= {4,16,32,64,128,256,…}

Note:
Options of <time> vary from models. See the data sheet or the acquire menu of the oscilloscope for details.

QUERY SYNTAX

AVERAGE_ACQUIRE?

RESPONSE FORMAT

AVERAGE_ACQUIRE <time>

EXAMPLE

The following command turns the average times of average acquisition to 16.
Command message:
AVGA 16

RELATED COMMANDS

ACQW

ACQUIRE

MEMORY_SIZE | MSIZ

Command /Query

DESCRIPTION

The MEMORY_SIZE command sets the maximum depth of memory.

The MEMORY_SIZE? query returns the maximum depth of memory.

COMMAND SYNTAX

MEMORY_SIZE <size>

<size>:={7K,70K,700K,7M} for non-interleaved mode. Non-interleaved means a single channel is active per A/D converter. Most oscilloscopes feature two channels per A/D converter. .

<size>:={14K,140K,1.4M,14M} for interleave mode. Interleave mode means multiple active channels per A/D converter.

Note:
Options of <size> vary from models. See the data sheet or the acquire menu of the oscilloscope for details.

QUERY SYNTAX

MEMORY_SIZE?

RESPONSE FORMAT

MEMORY_SIZE <size>

EXAMPLE

The following command sets the maximum depth of memory to 14M in interleave mode.
Command message:
MSIZ 14M

ACQUIRE — SAMPLE_STATUS? | SAST?

Query

DESCRIPTION

The SAST? query returns the acquisition status of the scope.

QUERY SYNTAX

SAST?

RESPONSE FORMAT

SAST <status>

EXAMPLE

The following query returns the acquisition status of the scope.
Query message:
SAST?

Response message:
SAST Trig'd

ACQUIRE

SAMPLE_RATE? | SARA?

Query

DESCRIPTION

The SARA? query returns the sample rate of the scope.

QUERY SYNTAX

SARA?
DI:SARA?

- DI — digital.

RESPONSE FORMAT

SARA <value>
DI:SARA <value>

Model	Format of <value>
T3DSO1000(A)	Numerical value in E-notation with SI unit, such as 5.00E+08Sa/s.
T3DSO2000	Numerical value with measurement unit and physical unit, such as 1.00GSa/s.

EXAMPLE

- The following query returns the sample rate of the analog channel.

Query message:
SARA?

Response message:
SARA 5.00E+05Sa/s

- The following query returns the sample rate of the digital channel.

Query message:
DI:SARA?

Response message:
DI:SARA 5.00E+05Sa/s

Note:
The table shows the availability of "DI:SARA?" in each digital oscilloscope series.

Model	Valid?
T3DSO2000	yes
T3DSO1000(A)	yes

ACQUIRE SAMPLE_NUM? | SANU?

Query

DESCRIPTION

The SANU? query returns the number of data points that the hardware will acquire from the input signal. The number of points acquired is based on the horizontal scale and memory/acquisition depth selections and cannot be directly set.

QUERY SYNTAX

SANU? <channel>

<channel>:={C1,C2,C3,C4}

RESPONSE FORMAT

SANU <value>

Model	Format of <value>
T3DSO1000(A)	Numerical value in E-notation with SI unit, such as 7.00E+05pts.
T3DSO2000	Numerical value with measurement unit and physical unit, such as 28Mpts.

EXAMPLE

The following query returns the number of sampled points available from last acquisition from Channel 2.

Query message:

SANU? C2

Response message:

SANU 7.00E+05pts

ACQUIRE — SINXX_SAMPLE | SXSA

Command/Query

DESCRIPTION

The SINXX_SAMPLE command sets the way of interpolation.

The SINXX_SAMPLE? query returns the way of interpolation.

COMMAND SYNTAX

SINXX_SAMPLE <state>

<state>:={ON,OFF}
- ON — sine interpolation.
- OFF — linear interpolation.

QUERY SYNTAX

SINXX_SAMPLE?

RESPONSE FORMAT

SINXX_SAMPLE <state>

EXAMPLE

The following command sets the way of the interpolation to sine interpolation. Command message:
SXSA ON

ACQUIRE

XY_DISPLAY | XYDS

Command /Query

DESCRIPTION

The XY_DISPLAY command enables or disables the display of XY mode. XY mode plots the voltage data of both channels with respect to one-another. For example, channel 1 vs. channel 2. This can be used to create Lissajous curves. The standard display mode plots voltage data vs. time.

The XY_DISPLAY? query returns whether the XY format display is enabled.

COMMAND SYNTAX

XY_DISPLAY <state>

<state>:={ON,OFF}

QUERY SYNTAX

X Y _ D I S P L A Y ?

RESPONSE FORMAT

XY_DISPLAY <state>

EXAMPLE

The following command enables the XY format.
Command message:
XYDS ON

AUTOSET Commands

The AUTOSET subsystem commands control the function of automatic waveform setting. The oscilloscope will automatically adjust the vertical position, the horizontal time base and the trigger mode according to the input signal to make the waveform display to the best state.

ASET

AUTOSET AUTO_SETUP | ASET

Command

DESCRIPTION

The AUTO_SETUP command attempts to identify the waveform type and automatically adjusts controls to produce a usable display of the input signal.

COMMAND SYNTAX

AUTO_SETUP

EXAMPLE

The following command instructs the oscilloscope to perform an auto-setup.
Command message:
ASET

CHANNEL Commands

The CHANNEL subsystem commands control the analog channels. Channels are independently programmable for offset, probe, coupling, bandwidth limit, inversion, and more functions. The channel index (1, 2, 3, or 4) specified in the command selects the analog channel that is affected by the command.

ATTN
BWL
CPL
OFST
SKEW
TRA
UNIT
VDIV
INVS

CHANNEL — ATTENUATION | ATTN

Command /Query

DESCRIPTION

The ATTENUATION 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.

The ATTENUATION? query returns the current probe attenuation factor for the selected channel.

COMMAND SYNTAX

<channel>:ATTENUATION <attenuation>

<channel>:={C1,C2,C3,C4}

<attenuation>:={0.1,0.2,0.5,1,2,5,10,20,50,100,200,500,1000,2000,5000,10000}

QUERY SYNTAX

<channel>:ATTENUATION?

RESPONSE FORMAT

<channel>:ATTENUATION <attenuation>

EXAMPLE

The following command sets the attenuation factor of Channel 1 to 100:1. To ensure the data matches the true signal voltage values, the physical probe attenuation must match the scope attenuation values for that input channel.

Command message:
C1:ATTN 100

RELATED COMMANDS

VDIV
OFST

CHANNEL BANDWIDTH_LIMIT | BWL

Command /Query

DESCRIPTION

BANDWIDTH_LIMIT enables or disables the bandwidth-limiting low-pass filter. If the bandwidth filters are on, it will limit the bandwidth to reduce display noise. When you turn Bandwidth Limit ON, the Bandwidth Limit value is set to 20 MHz. It also filters the signal to reduce noise and other unwanted high frequency components.

The BANDWIDTH_LIMIT? query returns whether the bandwidth filters are on.

COMMAND SYNTAX

BANDWIDTH_LIMIT<channel>,<mode> [,<channel>,<mode>[,<channel>,<mode>[, <channel>,<mode>]]]

<channel>:={C1,C2,C3,C4}

<mode>:={ON,OFF}

QUERY SYNTAX

BANDWIDTH_LIMIT?

RESPONSE FORMAT

BANDWIDTH_LIMIT <channel>,<mode> [,<channel>,<mode>[,<channel>,<mode>[, <channel>,<mode>]]]

EXAMPLE

- The following command turns on the bandwidth filter for all channels.
Command message:
BWL C1,ON,C2,ON,C3,ON,C4,ON

- The following command turns the bandwidth filter on for Channel 1 only.
Command message:
BWL C1,ON

CHANNEL

COUPLING | CPL

Command /Query

DESCRIPTION

The COUPLING command selects the coupling mode of the specified input channel.

The COUPLING? query returns the coupling mode of the specified channel.

COMMAND SYNTAX

<channel>:COUPLING <coupling>

<channel>:={C1,C2,C3,C4}

<coupling>:={A1M,A50,D1M,D50,GND}

- A — alternating current.
- D — direct current.
- 1M — 1MΩ input impedance.
- 50 — 50Ω input impedance.

Note:
Options of <coupling> vary from models. See the data sheet or the channel menu of oscilloscope for details.

QUERY SYNTAX

<channel>:COUPLING?

RESPONSE FORMAT

<channel>:COUPLING <coupling>

EXAMPLE

The following command sets the coupling of Channel 2 to 50 Ω, DC.
Command message:
C2:CPL D50

CHANNEL

OFFSET | OFST

Command/Query

DESCRIPTION

The OFFSET command allows adjustment of the vertical offset of the specified input channel. The maximum ranges depend on the fixed sensitivity setting.

The OFFSET? query returns the offset value of the specified channel.

COMMAND SYNTAX

<channel>:OFFSET <offset>

<channel>:={C1,C2,C3,C4}

<offset>:= vertical offset value with unit, see the data sheet for details.

Note:

• If there is no unit (V/mV/uV) added, it defaults to volts (V).

• 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>:OFFSET?

RESPONSE FORMAT

<channel>:OFFSET <offset>
<offset>:= Numerical value in E-notation with SI unit.

EXAMPLE

• The following command sets the offset of Channel 2 to -3 V.
Command message:
C2:OFST -3V

• The following command sets the offset of Channel 1 to -50 mV.
Command message:
C1:OFST -50mV

RELATED COMMANDS

VDIV
ATTN

CHANNEL

SKEW

Command/Query

DESCRIPTION

The 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 skew control to remove cable-delay errors between channels.

The SKEW? query returns the skew value of the specified trace.

COMMAND SYNTAX

<trace>:SKEW <skew>

<trace>:={C1,C2,C3,C4}

<skew>:= -100 ns to +100 ns.

QUERY SYNTAX

<trace>:SKEW?

RESPONSE FORMAT

<trace>:SKEW <skew>

Model	Format of <skew>
T3DSO1000(A)	Numerical value in E-notation with SI unit, such as 9.99E-08S.
T3DSO2000	Numerical value with measurement unit and physical unit, such as 0.00ns.

EXAMPLE

The following command sets skew value of Channel 1 to 3ns.

Command message:
C1:SKEW 3NS

CHANNEL

TRACE | TRA

Command/Query

DESCRIPTION

The TRACE command turns the display of the specified channel on or off.

The TRACE? query returns the current display setting for the specified channel.

COMMAND SYNTAX

<trace>:TRACE <mode>

<trace>:={C1,C2,C3,C4}

<mode>:={ON,OFF}

QUERY SYNTAX

<trace>:TRACE?

RESPONSE FORMAT

<trace>:TRACE <mode>

EXAMPLE

The following command displays Channel 1.

Command message:
C1:TRA ON

CHANNEL

UNIT

Command /Query

DESCRIPTION

The UNIT command sets the unit of the specified trace. Measurement results, channel sensitivity, and trigger level will reflect the measurement units you select.

The UNIT? query returns the unit of the specified trace.

COMMAND SYNTAX

<channel>:UNIT <type>

<channel>:={C1,C2,C3,C4}

<type>:={V,A}

QUERY SYNTAX

<channel>:UNIT?

RESPONSE FORMAT

<channel>:UNIT <type>

EXAMPLE

The following command sets the unit of Channel 1 to V.

Command message:
C1:UNIT V

CHANNEL

VOLT_DIV | VDIV

Command /Query

DESCRIPTION

The VOLT_DIV command sets the vertical sensitivity in Volts/div.
If the probe attenuation is changed, the scale value is multiplied by the probe's attenuation factor.

The VOLT_DIV? query returns the vertical sensitivity of the specified channel.

COMMAND SYNTAX

<channel>:VOLT_DIV <v_gain>

<channel>:={C1,C2,C3,C4}

<v_gain>:= 500uV to 10V.

Note:
If there is no unit (V/mV/uV) added, it defaults to volts (V).

QUERY SYNTAX

<channel>:VOLT_DIV?

RESPONSE FORMAT

<channel>:VOLT_DIV <v_gain>
<v_gain>:= Numerical value in E-notation with SI unit.

EXAMPLE

The following command sets the vertical sensitivity of Channel 1 to 50 mV/div.

Command message:
C1:VDIV 50mV

RELATED COMMANDS

ATTN

CHANNEL

INVERTSET | INVS

Command/Query

DESCRIPTION

The INVERTSET command mathematically inverts the specified traces or the math waveform.

The INVERTSET? query returns the current state of the channel inversion.

COMMAND SYNTAX

<trace>:INVERTSET <state>

<trace>:={C1,C2,C3,C4,MATH}

<state>:= {ON,OFF}

QUERY SYNTAX

<trace>:INVERTSET?

RESPONSE FORMAT

<trace>:INVERTSET <state>

EXAMPLE

The following command inverts the trace of Channel 1.

Command message:
C1:INVS ON

CURSOR Commands

The CURSOR 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 X and Y cursors, and query delta X and delta Y cursor values.

CRMS
CRST
CRTY
CRVA?

CURSOR

CURSOR_MEASURE | CRMS

Command /Query

DESCRIPTION

The CURSOR_MEASURE command specifies the type of cursor or parameter measurement to be displayed

The CURSOR_MEASURE? query returns which cursors or parameter measurements are currently displayed.

COMMAND SYNTAX

CURSOR_MEASURE <mode>

Format 1:
<mode>:={OFF,ON}

- OFF — manual mode.
- ON — track mode.

Format 2:
<mode>:={OFF,MANUAL,TRACK}

- OFF — close the cursors.
- MANUAL — manual mode.
- TRACK — track mode.

Note:
The table on next page shows the available command format in each oscilloscope series.

QUERY SYNTAX

CURSOR_MEASURE?

RESPONSE FORMAT

CURSOR_MEASURE <mode>

EXAMPLE

• The following command turns cursor function off on the T3DSO1000(A).
Command message:
CRMS OFF

• The following command sets cursor mode to track mode on the T3DSO1000(A).
Command message:
CRMS ON

RELATED COMMANDS

CRVA?
CRST

Format in Each Oscilloscope Series

Model	Command Format
T3DSO2000	Format 1
T3DSO1000(A)	Format 2

CURSOR

CURSOR_SET | CRST

Command /Query

DESCRIPTION

The CURSOR_SET command allows the user to position any one of the four independent cursors at a given screen location. The positions of the cursors can be modified or queried even if the required cursor is not currently displayed on the screen. When setting a cursor position, a trace must be specified, relative to which the cursor will be positioned.

The CURSOR_SET? query returns the current position of the cursor(s). The values returned depend on the grid type selected.

COMMAND SYNTAX

<trace>:CURSOR_SET

<cursor>,<position>[,<cursor>,<position>[,<cur sor> ,<position>[,<cursor>,<position>]]]

<trace>:={C1,C2,C3,C4}

<cursor>:={VREF,VDIF,TREF,TDIF,HRDF,HDIF}

- VREF — The voltage-value of Y1 (curA) under manual mode.
- VDIF — The voltage-value of Y2 (curB) under manual mode.
- TREF — The time value of X1 (curA) under manual mode.
- TDIF — The time value of X2 (curB) under manual mode.
- HREF — The time value of X1 (curA) under track mode.
- HDIF — The time value of X2 (curB) under track mode.

<position>:= -(grid/2) *DIV to (grid/2)*DIV when <cursor> = {TREF, TDIF, HRDF, HDIF} (horizontal)
grid: The grid numbers in horizontal direction.
<position>:= -4*DIV to 4*DIV when <cursor> = { VREF,VDIF}.(vertical)

Note:

- The horizontal position range is related to the size of screen.
- You need to add the unit to the position value.

QUERY SYNTAX

<trace>:CURSOR_SET? <cursor>[,<cursor>[,<cursor>[,<cursor>]]]

<cursor>:={VREF,VDIF,TREF,TDIF,HREF,HDIF}

RESPONSE FORMAT

<trace>:CURSOR_SET <cursor>,<position>[,<cursor>,<position>[,<cursor>,<position>[,<cursor>,<position>]]]

EXAMPLE

• When the current time base is 1 us, vdiv is 500 mV, the cursor mode is manual, the following command sets the X1 positions to -3 DIV, Y2 position to −1 DIV, using Channel 1 as a reference.
Command message:
C1:CRST TREF,-3us,VDIF,-500mV

• When the current time base is 1 us, the cursor mode is track, the following command sets the X1 positions to -1 DIV, X2 position to 2 DIV, using Channel 1 as a reference.
Command message:
C1:CRST HREF,-1us,HDIF,2us

RELATED COMMANDS

CRMS
CRVA?

CURSOR

CURSOR_TYPE | CRTY

Command /Query

DESCRIPTION

The CURSOR_TYPE command specifies the type of cursor to be displayed when the cursor mode is manual.

The CURSOR_TYPE query returns the current type of cursor.

COMMAND SYNTAX

CURSOR_TYPE <type>

<mode>:={X,Y,X-Y}

QUERY SYNTAX

C U R S O R _ T Y P E ?

RESPONSE FORMAT

CURSOR_TYPE <type>

EXAMPLE

The following command sets cursor type to Y.

Command message:
CRTY Y

RELATED COMMANDS

CRMS

CURSOR

CURSOR_VALUE? | CRVA?

Query

DESCRIPTION

The CURSOR_VALUE? query returns the values measured by the specified cursors for a given trace.

QUERY SYNTAX

<trace>:CURSOR_VALUE? <mode>

<trace>:= {C1, C2, C3, C4}

<mode>:= {HREL,VREL}

- HREL — return the delta time value, reciprocal of delta time value, X1 (curA) time value and X2 (curB) time value.
- VREL — return the delta volt value, Y1 (curA) volt value and Y2 (curB) volt value under manual mode.

Note:
For older models, VREL is the delta volt value under manual mode. See models on page 14.

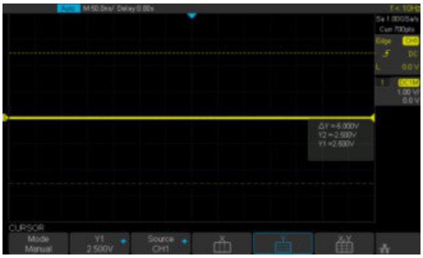
RESPONSE FORMAT

<trace>:CURSOR_VALUE HREL,<delta>,<1/delta>,<value1>,<value2>

<trace>:CURSOR_VALUE VREL,<delta>,<value1>,<value2>

EXAMPLE

When the cursor mode is manual, and the cursor type is Y, the following query returns the vertical value on channel 1.



Query message:

C1:CRVA? VREL

Response message:
C1:CRVA VREL,-5.00E+00V,2.50E+00V,-2.50E+00V

RELATED COMMANDS

CRMS

DIGITAL Commands

The DIGITAL subsystem commands control the viewing of digital channels. They also control threshold settings for groups of digital channels.

DGCH
DGST
DGTH
SW
TRA
TSM
CUS

Note:
These commands are only valid for models which have the MSO Option installed.

DIGITAL

DIGITAL_CHANNEL | DGCH

Command /Query

DESCRIPTION

The DIGITAL_CHANNEL command turns digital display on or off for the specified channel.

The DIGITAL_CHANNEL? query returns the current digital display setting for the specified channel.

COMMAND SYNTAX

<digital>:DIGITAL_STATE <state>

<digital>:={D0,D1,D2,D3,D4,D5,D6,D7,D8,D9, D10,D11,D12,D13,D14,D15}

<state>:={OFF,ON}

QUERY SYNTAX

<digital>:DIGITAL_STATE?

RESPONSE FORMAT

<digital>:DIGITAL_STATE <state>

EXAMPLE

The following command sets D8 display on.
Command message:
D8:DGCH ON

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	yes
T3DSO1000(A)	yes - except T3DSO1102

DIGITAL

DIGITAL_STATE | DGST

Command /Query

DESCRIPTION

The DIGITAL_STATE command is used to set the state of digital.

The DIGITAL_STATE? query returns the state of digital.

COMMAND SYNTAX

DIGITAL_STATE <state>

<state>:={OFF,ON}

QUERY SYNTAX

DIGITAL_STATE?

RESPONSE FORMAT

DIGITAL_STATE <state>

EXAMPLE

The following command sets Digital function on.
Command message:
DGST ON

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	yes
T3DSO1000(A)	yes - except T3DSO1102

DIGITAL **DIGITAL_THR | DGTH**

Command /Query

DESCRIPTION

The DIGITAL_THR command sets the threshold for the specified group of channels. The threshold is used for triggering purposes and for displaying the digital data as high (above the threshold) or low (below the threshold).

The DIGITAL_THR? query returns the threshold value for the specified group of channels.

COMMAND SYNTAX

<group>:DIGITAL_THR <type>[,<level>]

<group>:={C1,C2}
- C1 — D0-D7.
- C2 — D8-D15.

<type>:={TTL,CMOS,CMOS3.3,CMOS2.5,CU STOM}

<level>:= -5V to 5V when <type> is CUSTOM.

Note:
- If there is no unit(V) added to <level>, it defaults to be V.
- If you set the threshold to a value outside of the legal range, the threshold is automatically set to the nearest legal value.

QUERY SYNTAX

<group>:DIGITAL_THR?

RESPONSE FORMAT

Format 1:
DIGITAL_THR <type>

Format 2:
DIGITAL_THR <group>:<level>

<type>	**Response Format**
TTL/CMOS/CMOS3.3/CMOS2.5	Format 1
CUSTOM	Format 2

EXAMPLE

• For T3DSO1000(A) series, when the Digital function is on, the following command sets the threshold of D0-D7 to LVLCMOS3.3.
Command message:
C1:DGTH CMOS3.3

• For T3DSO1000(A) series, when the Digital function is on, the following command sets the threshold of D8-D15 to 3 V.
Command message:
C2:DGTH CUSTOM,3V

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	yes
T3DSO1000(A)	yes - except T3DSO1102

.

DIGITAL

SWITCH | SW

Command /Query

DESCRIPTION

The SWITCH command is used to set the state of digital.

The SWITCH? query returns the state of digital.

COMMAND SYNTAX

<function>:SWITCH <state>

<function>:={DI}

<state>:={OFF,ON}

QUERY SYNTAX

<function>:SWITCH?

RESPONSE FORMAT

<function>:SWITCH <state>

EXAMPLE

For T3DSO1000(A) series, the following command sets Digital function on.
Command message:
DI:SWITCH ON

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes - except T3DSO1102

.

DIGITAL — TRACE | TRA

Command /Query

DESCRIPTION

The TRACE command turns digital display on or off for the specified channel.

The TRACE? query returns the current digital display setting for the specified channel.

COMMAND SYNTAX

<digital>:TRACE <state>

<digital>:={D0,D1,D2,D3,D4,D5,D6,D7,D8,D9, D10,D11,D12,D13,D14,D15}

<state>:={OFF,ON}

QUERY SYNTAX

<digital>:TRACE?

RESPONSE FORMAT

<digital>:TRACE <state>

EXAMPLE

For T3DSO1000(A) series, the following command sets D8 display on.
Command message:
D8:TRACE ON

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes - except T3DSO1102

.

DIGITAL THRESHOLD_MODE | TSM

Command /Query

DESCRIPTION

The THRESHOLD_MODE command sets the threshold type for the specified group of channels. The threshold is used for triggering purposes and for displaying the digital data as high (above the threshold) or low (below the threshold).

The THRESHOLD_MODE? query returns the threshold type for the specified group of channels.

COMMAND SYNTAX

<group>:THRESHOLD_MODE <type>

<group>:={H8,L8}
- H8 — D8-D15.
- L8 — D0-D7.

<type>:={TTL,CMOS,LVCMOS33,LVCMOS25,CUSTOM}

QUERY SYNTAX

<group>:THRESHOLD_MODE?

RESPONSE FORMAT

<group>:THRESHOLD_MODE <type>

EXAMPLE

For T3DSO1000(A) series, when the Digital function is on, the following command sets the threshold of D0-D7 to LVLCMOS3.3.
Command message:
L8:TSM LVCMOS33

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes - except T3DSO1102

DIGITAL

CUSTOM | CUS

Command /Query

DESCRIPTION

The CUSTOM command sets the threshold value by customer for the specified group of channels. The threshold is used for triggering purposes and for displaying the digital data as high (above the threshold) or low (below the threshold).

The CUSTOM? query returns the threshold value set by customer for the specified group of channels.

COMMAND SYNTAX

<group>:CUSTOM <value>

<group>:={H8,L8}
- H8 — D8-D15.
- L8 — D0-D7.

<value>:= volt value with unit.

Note:
- You need to add the volt unit(V/mV) to the value. If there is no unit added, it defaults to volts (V).
- The range of value varies from models. See the data sheet for details.
- An out-of-range value will be adjusted to the closest legal value.

QUERY SYNTAX

<group>:CUSTOM?

RESPONSE FORMAT

<group>:CUSTOM <value>

EXAMPLE

For T3DSO1000(A) series, when the Digital function is on, the following command sets the threshold value of D8-D15 to 5V.
Command message:
L8:CUSTOM 5V

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes - except T3DSO1102

.

DISPLAY Commands

The DISPLAY subsystem is used to control how waveforms, and the graticules are displayed on the screen.

DTJN
GRDS
INTS
MENU
PESU

DISPLAY

DOT_JOIN | DTJN

Command /Query

DESCRIPTION

The DOT_JOIN command sets the interpolation lines between data points.

COMMAND SYNTAX

DOT_JOIN <state>

<state>:={ON,OFF}

- ON — dots. This mode displays data more quickly than vector mode but does not draw lines between sample points.
- OFF — vectors. This is the default mode and draws lines between points.

QUERY SYNTAX

DOT_JOIN?

RESPONSE FORMAT

DOT_JOIN <state>

EXAMPLE

The following command turns off the interpolation lines.

Command message:
DTJN ON

DISPLAY

GRID_DISPLAY | GRDS

Command /Query

DESCRIPTION

The GRID_DISPLAY command selects the type of the grid which is used to display.

The GRID_DISPLAY? query returns the current type of grid.

COMMAND SYNTAX

GRID_DISPLAY <type>

< type >:={FULL,HALF,OFF}

QUERY SYNTAX

GRID_DISPLAY?

RESPONSE FORMAT

GRID_DISPLAY <type>

EXAMPLE

The following command changes the type of grid to full grid.

Command message:
GRDS FULL

DISPLAY

INTENSITY | INTS

Command/Query

DESCRIPTION

The INTENSITY command sets the intensity level of the grid or the trace.

The INTENSITY? query returns the grid and trace intensity levels.

COMMAND SYNTAX

INTENSITY GRID,<value>,TRACE,<value>

<value>:= 0(or 30) to 100

Note:
You can also set the intensity level of the grid or trace using a key-value pair alone, see the example for details.

QUERY SYNTAX

INTENSITY?

RESPONSE FORMAT

INTENSITY TRACE,<value>,GRID,<value>

EXAMPLE

The following command changes the grid intensity level to 75%.
Command message:
INTS GRID,75

DISPLAY

MENU

Command/Query

DESCRIPTION	The MENU command enables or disables to display the menu. The MENU? query returns whether the menu is displayed.
COMMAND SYNTAX	MENU <state> <state>:={ON,OFF}
QUERY SYNTAX	MENU?
RESPONSE FORMAT	MENU <state>
EXAMPLE	The following command enables the display of the menu. Command message: *MENU ON*

DISPLAY

PERSIST_SETUP | PESU

Command /Query

DESCRIPTION

The PERSIST_SETUP command selects the persistence duration of the display, in seconds, in persistence mode.

The PERSIST_SETUP? query returns the current status of the persistence.

COMMAND SYNTAX

PERSIST_SETUP <time>

Models	<time>:=
T3DSO1000(A)	{OFF,INFINITE,1,5,10,30}
Others	{INFINITE,1,5,10,30}

Note:

- See models on page 14.
- See the command PERS in Obsolete Commands for Old Models to set persist off .
- Options of <time> vary from models. See the data sheet or the display menu of the oscilloscope for details.

QUERY SYNTAX

PERSIST_SETUP?

RESPONSE FORMAT

PERSIST_SETUP <time>

EXAMPLE

The following command sets the variable persistence at 5 seconds.
Command message:
PESU 5

HISTORY Commands

The HISTORY subsystem commands control the waveform recording function and the history waveform play function.

FRAM
FTIM?
HSMD
HSLST

HISTORY — FRAME_SET | FRAM

Command/ Query

DESCRIPTION

The FRAME_SET command is used to set history current frame number.

The FRAME_SET? query returns the current frame number.

COMMAND SYNTAX

FRAM <frame_num>

<frame_num>:= 0 to the max frame number.

Note:
You can send the query FRAM? to get the max frame number when the history function is turned on for the first time.

QUERY SYNTAX

FRAM?

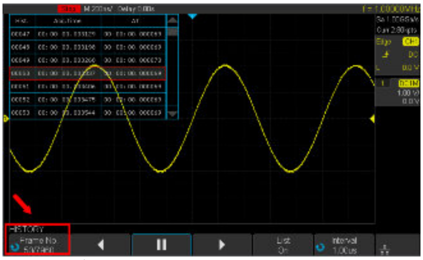
RESPONSE FORMAT

FRAM <frame_num>

Note:
The query is only valid for T3DSO1000(A) series.

EXAMPLE

When the history function is on, the following command sets current frame number to 50. Then you can see the response on the screen as shown below.



Command message:
FRAM 50

HISTORY

FRAME_TIME? | FTIM?

Query

DESCRIPTION

The FRAME_TIME query returns the acquire timestamp of the current frame.

QUERY SYNTAX

FTIM?

RESPONSE FORMAT

Format 1:
FTIM hour: minute: second. micro-second

Format 2:
\xFF\x0F\x03\x01&\xD5\x02\x00

Note:

- Format 2 is binary data and has no key word.
- The table below shows the available response format in each oscilloscope series.

EXAMPLE

For the T3DSO1000(A) series, when the history function is on, the following query returns the acquire time of the current frame.
Query message:
FTIM?

Response message:
FTIM 00: 05: 12. 650814

Format in Each Oscilloscope Series

Model	Response Format
T3DSO2000	Format 2
T3DSO1000(A)	Format 1

HISTORY

HISTORY_MODE | HSMD

Command/ Query

DESCRIPTION

The HISTORY_MODE command is used to set the state of history mode.

The HISTORY_MODE? query returns the current state of history mode.

COMMAND SYNTAX

HSMD <state>

<state>:={ON,OFF}

QUERY SYNTAX

HSMD?

RESPONSE FORMAT

HSMD <state>

EXAMPLE

The following command sets the state of history mode to ON.
Command message:
HSMD ON

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes

HISTORY

HISTORY_LIST | HSLST

Command/ Query

DESCRIPTION

The HISTORY_LIST command is used to set the state of history list.

The HISTORY_LIST? query returns the current state of history list.

COMMAND SYNTAX

HSLST <state>

<state>:={ON,OFF}

Note:
This command can only be used when History function is turned on.

QUERY SYNTAX

HSLST?

RESPONSE FORMAT

HSLST <state>

EXAMPLE

When History function is on, the following command sets the state of history list to ON.
Command message:
HSLST ON

RELATED COMMANDS

HSMD

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes

MATH Commands

The MATH subsystem controls the math functions in the oscilloscope. As selected by the DEF command, these math functions are available:
Operators: Add, Subtract, Multiply, Divide.
Operators perform their function on two analog channel sources.
Transforms: DIFF, Integrate, FFT, SQRT.

DEF
INVS
MTVD
MTVP
FFTC
FFTF
FFTP
FFTS
FFTT?
FFTU
FFTW

MATH **DEFINE | DEF**

Command /Query

DESCRIPTION

The DEFINE command sets the desired waveform math operation.

The DEFINE? query returns the current operation for the selected function.

COMMAND SYNTAX

DEFINE EQN,‘<equation>‘

Note:
<equation> is the mathematical expression, enclosed by single or double quotation marks.

Function Equations	
<source1> + <source2>	Addition
<source1> - <source2>	Subtraction
<source1>*<source2>	Multiplication
<source1>/<source2>	Ratio
FFT<source>	FFT
INTG<source>	Integral
DIFF<source>	Differentiator
SQRT<source>	Square Root

<source>:={C1,C2,C3,C4}

<source1>:={C1,C2,C3,C4}

<source2>:={C1,C2,C3,C4}

QUERY SYNTAX

DEFINE?

RESPONSE FORMAT

DEFINE EQN,‘<equation>‘

EXAMPLE

•When the Math function is on, and both Channel 1 and Channel 2 are on, the following command sets the math operation to Multiplication, source1 to C1, source2 to C2.
Command message:
*DEFINE EQN,’C1*C2’*

• When the Math function is on, and Channel 1

is on, the following command sets the math operation to Differentiator, source to C1.
Command message:
DEFINE EQN,'DIFFC1'

MATH — INVERTSET | INVS

Command/Query

DESCRIPTION

The INVERTSET command inverts the math waveform.

The INVERTSET? query returns whether the math waveform is inverted or not.

Note:
This command is only valid in add, subtract, multiply and divide operation.

COMMAND SYNTAX

<trace>:INVERTSET <state>

<trace>:={MATH}

<state>:= {ON,OFF}

QUERY SYNTAX

<trace>:INVERTSET?

RESPONSE FORMAT

<trace>:INVERTSET <state>

EXAMPLE

When the Math function is on, and the operation is Add, the following command inverts the math waveform.
Command message:
MATH:INVS ON

MATH
Command/Query

MATH_VERT_DIV | MTVD

DESCRIPTION

The MATH_VERT_DIV command sets the vertical scale of the selected math operation. This command is only valid in add, subtract, multiply and divide operation.

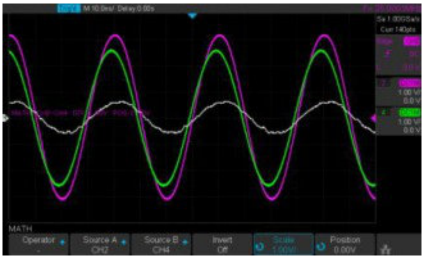
The MATH_VERT_DIV? query returns the current scale value for the selected operation.

COMMAND SYNTAX

MATH_VERT_DIV <scale>

<scale>:={500uV,1mV,2mV,5mV,10mV,20mV,50mV,100mV,200mV,500mV,1V,2V,5V,10V,20V ,50V,100V}(for add, subtract, multiply and divide)

Note:
Legal values for the scale depend on the selected operation. For details, please refer to the math menu of the oscilloscope as shown below.



QUERY SYNTAX

MATH_VERT_DIV?

RESPONSE FORMAT

MATH_VERT_DIV <scale>

Model	Format of <scale>
T3DSO1000(A)	Numerical value in E-notation with SI unit, such as 5.00E-01V.
others	Numerical value

	with measurement unit and physical unit, such as 500mV.

EXAMPLE

When the Math function is on, and the operator is Add, the following command changes the vertical scale of the math waveform to 1 V.

Command message:
MTVD 1V

MATH MATH_VERT_POS | MTVP

Command/Query

DESCRIPTION

The MATH_VERT_POS command sets the vertical position of the math waveform with specified source.

The FFT waveform isn‘t included, but we have another command which called FFTP to set vertical position.

The MATH_VERT_POS? query returns the vertical position of the math waveform.

COMMAND SYNTAX

MATH_VERT_POS <point>

<point>:= -255 to 255.

Note:
The point represents the screen pixels and is related to the screen center. For example, if the point is 50. The math waveform will be displayed 1 grid above the vertical center of the screen. Namely one grid is 50.

QUERY SYNTAX

MATH_VERT_POS?

RESPONSE FORMAT

MATH_VERT_POS <point>

EXAMPLE

When the Math function is on, the following command sets the vertical position of the math waveform to 1 grid above the screen vertical center.
Command message:
MTVP 50

RELATED COMMANDS

FFTP

MATH

Command /Query

FFT_CENTER | FFTC

DESCRIPTION

The FFT_CENTER command sets the center frequency when FFT (Fast Fourier Transform) is selected.

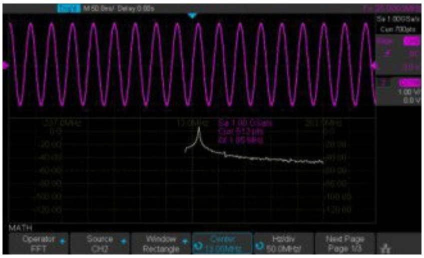
The FFT_CENTER? query returns the current center frequency of FFT waveform.

COMMAND SYNTAX

FFT_CENTER <center>
<center>:= frequency value with unit (MHz/ kHz/ Hz).

Note:

- If you set the center to a value outside of the legal range, the center value is automatically set to the nearest legal value. Legal values are affected by the Hz/div setting.
- The range for center is related to the horizontal scale of FFT and varied by models. See the math menu of oscilloscope as shown below for details.



QUERY SYNTAX

FFT_CENTER?

RESPONSE FORMAT

FFT_CENTER <center>

EXAMPLE

When the Math function is on, the operator is FFT, and the horizontal scale is 100 MHz, the following command sets the center frequency of FFT to 58 MHz.
Command message:
FFTC 58MHz

RELATED COMMANDS FFTT?

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes

MATH **FFT_FULLSCREEN | FFTF**

Command /Query

DESCRIPTION

The FFT_FULLSCREEN command sets the display mode of FFT waveform.

The FFT_FULLSCREEN? query returns whether the FFT waveform is full screen displayed.

COMMAND SYNTAX

FFT_FULLSCREEN <state>

<state>:= {OFF,ON, EXCLU}

- OFF — Split Screen.
- ON — Full Screen.
- EXCLU — Exclusive.

QUERY SYNTAX

FFT_FULLSCREEN?

RESPONSE FORMAT

FFT_FULLSCREEN <state>

EXAMPLE

When the Math function is on, and the operator is FFT, the following command sets the display mode of FFT waveform to Full Screen.
Command message:
FFTF ON

MATH FFT_POSITION | FFTP

Command /Query

DESCRIPTION

The FFT_POSITION command sets the vertical offset of FFT waveform. The unit is related to the vertical scale type of the current FFT and the unit of the channel.

The FFT_POSITION? query returns the current vertical offset of the FFT waveform.

Note:

• This command is only valid when the scale type is Vrms.

COMMAND SYNTAX

FFT_POSITION <offset>

<offset>:= -24.4*DIV to 15.6*DIV.

Note:

• If there is no unit (V/mV/uV) added, it defaults to volts (V).

• If you set the offset to a value outside of the legal range, the center value is automatically set to the nearest legal value. Legal values are affected by the Scale setting.

QUERY SYNTAX

FFT_POSITION?

RESPONSE FORMAT

FFT_POSITION <offset>

<offset>:= Numerical value in E-notation with SI unit.

EXAMPLE

• When the Math function is on, the operator is FFT, and the scale is 10 mV, the following steps set the offset of FFT waveform to 28 mV.

Step 1: Send command to set the scale unit to Vrms.

Command message:

FFTU VRMS

Step 2: Send command to set the offset to 28mV

Command message:
FFTP 28mV

• When the Math function is on, the operator is FFT, and the scale is 5 V, the following steps set the offset of FFT waveform to -13.5 V.

Step 1: Send command to set the scale unit to Vrms.

Command message:
FFTU VRMS

Step 2: Send command to set the offset to -13.5V

Command message:
FFTP -13.5V

RELATED COMMANDS

FFTS
FFTU

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes

MATH

FFT_SCALE | FFTS

Command /Query

DESCRIPTION

The FFT_SCALE command sets the vertical scale of FFT waveform. The unit is related to the vertical scale type of the current FFT and the unit of the channel.

The FFT_SCALE? query returns the current vertical scale of FFT waveform.

COMMAND SYNTAX

FFT_SCALE <scale>
<scale>:={0.1,0.2,0.5,1,2,5,10,20} when scale type is dBVrms or dBm.

<scale>:={0.001,0.002,0.005,0.01,0.02,0.05,0.1, 0. 2,0.5,1, 2,5,10,20} when scale type is Vrms.

QUERY SYNTAX

FFT_SCALE?

RESPONSE FORMAT

FFT_SCALE <scale>
<scale>:= Numerical value in E-notation with SI unit.

EXAMPLE

• When the Math function is on, and the operator is FFT, the following steps set the vertical scale of FFT to 5 dBVrms.

Step 1: Send command to set the scale unit to dBVrms.

Command message:
FFTU DBVRMS

Step 2: Send command to set the scale to 5.

Command message:
FFTS 5

• When the Math function is on, and the operator is FFT, the following steps set the vertical scale of FFT to 100 mVrms.

Step 1: Send command to set the scale unit to Vrms.

Command message:
FFTU VRMS

Step 2: Send command to set the scale to 0.1.

Command message:
FFTS 0.1

RELATED COMMANDS

UNIT
FFTU
FFTP

MATH FFT_TDIV? | FFTT?

Query

DESCRIPTION

The FFT_TDIV? query returns current horizontal scale of FFT waveform.

QUERY SYNTAX

FFT_TDIV?

RESPONSE FORMAT

FFT_TDIV <value>
<value>:= Numerical value with measurement unit and physical unit.

EXAMPLE

The following query returns the horizontal scale unit of FFT.
Query message:
FFTT?

Response message:
FFTT 100.00MHz

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes

MATH FFT_UNIT | FFTU

Command /Query

DESCRIPTION

The FFT_UNIT command sets the vertical scale type of FFT (Fast Fourier Transform algorithm).

The FFT_UNIT? query returns the current vertical scale type of FFT waveform.

COMMAND SYNTAX

FFT_UNIT <unit>
<unit>:={VRMS,DBM,DBVRMS}

QUERY SYNTAX

FFT_UNIT?

RESPONSE FORMAT

FFT_ UNIT <unit>

EXAMPLE

For T3DSO1000(A) series, when the Math function is on, and the operator is FFT, the following command sets the vertical scale unit of FFT to dBVrms.
Command message:
FFTU DBVRMS

RELATED COMMANDS

FFTS
FFTP

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes

MATH FFT_WINDOW | FFTW

Command /Query

DESCRIPTION

The FFT_WINDOW command allows the selection of five different windowing transforms or operations for the FFT (Fast Fourier Transform) function. Each window is useful for certain classes of input signals.

The FFT_WINDOW? query returns the current window of FFT.

COMMAND SYNTAX

FFT_WINDOW <window>
<window>:={RECT,BLAC,HANN,HAMM,FLATTOP}

- RECT — Rectangle is useful for transient signals, and signals where there are an integral number of cycles in the time record.
- BLAC — Blackman 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).
- HANN — Hanning is useful for frequency resolution and general purpose use. It is good for resolving two frequencies that are close together, or for making frequency measurements.
- HAMM — Hamming.
- FLAT — Flattop is the best for making accurate amplitude measurements of frequency peaks.

QUERY SYNTAX

FFT_WINDOW?

RESPONSE FORMAT

FFT_WINDOW <window>

EXAMPLE

When the Math function is on, and the operator is FFT, the following command sets the FFT window to Hamming.
Command message:
FFTW HAMM

MEASURE Commands

The commands in the MEASURE subsystem are used to make parametric measurements on displayed waveforms.

To make a measurement, the portion of the waveform required for that measurement must be displayed on the oscilloscope screen.

CYMT?
MEAD
PACU
PAVA?

MEASURE

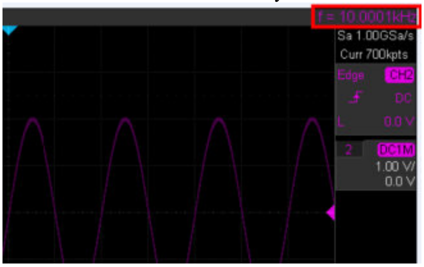
CYMOMETER? | CYMT?

Query

DESCRIPTION

The CYMOMETER? query measures and returns the frequency counter of the specified source. The counter measurement counts the trigger level crossings at the selected trigger slope and displays the results in MHz/kHz/Hz.

In the following picture, the content of the red box is the measured value of the cymometer.



QUERY SYNTAX

CYMOMETER?

RESPONSE FORMAT

CYMOMETER <freq>

Model	Format of <freq>
T3DSO1000(A)	Numerical value in E-notation with SI unit, such as 1.00E+03Hz.
others	Numerical value with measurement unit and physical unit, such as 1.00001kHz.

Note:
When the signal frequency is less than 10 Hz, it Returns 10 Hz‖ or <10Hz‖ .

EXAMPLE

- When the frequency of input signal is 1 Hz, the following returns the value of cymometer which displaying on the screen of the instrument.
  Response message:
  CYMT 10Hz

- When the frequency of input signal is 25.000137 MHz, the following returns the value of cymometer which displaying on the screen of the instrument.
  Response message:
  CYMT 2.50E+07 Hz

MEASURE

MEASURE_DELAY | MEAD

Command/Query

DESCRIPTION

The MEASURE_DELY command places the instrument in the continuous measurement mode and starts a type of delay measurement.

The MEASURE_DELY? query returns the measured value of delay type.

COMMAND SYNTAX

MEASURE_DELAY <type>,<sourceA-sourceB>

<sourceA-sourceB>:={C1-C2,C1-C3,C1-C4,C2-C3,C2-C4,C3-C4}

<type>:={PHA,FRR,FRF,FFR,FFF,LRR,LRF,LFR,LFF,SKEW}

Type	Description
PHA	The phase difference between two channels. (rising edge - rising edge)
FRR	Delay between two channels. (first rising edge - first rising edge)
FRF	Delay between two channels. (first rising edge - first falling edge)
FFR	Delay between two channels. (first falling edge - first rising edge)
FFF	Delay between two channels. (first falling edge - first falling edge)
LRR	Delay between two channels. (First rising edge - last rising edge)

LRF	Delay between two channels. (first rising edge - last falling edge)
LFR	Delay between two channels. (first falling edge - last rising edge)
LFF	Delay between two channels. (first falling edge - last falling edge)
Skew	Delay between two channels. (edge – edge of the same type)

QUERY SYNTAX

<type>,<sourceA-sourceB>:MEASURE_DELY?

RESPONSE FORMAT

<sourceA-sourceB>:MEAD <type>,<value>

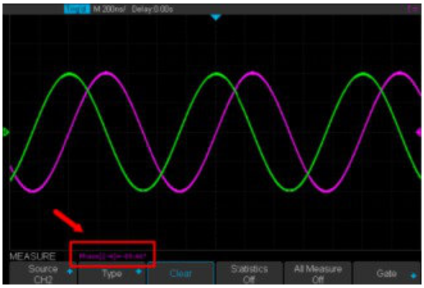
Model	Format of <value>
T3DSO1000(A)	Numerical value in E-notation with SI unit, such as 1.24E-04S. Except for PHA, it returns as “44.65degree”.
others	Numerical value in E-notation with SI unit, such as 2.06E+01degree.

EXAMPLE

The following steps show how to get the measured value of phase between C2 and C4.

Step 1: Send the message to set the measurement to Phase between C2 and C4, and then there displays a phase measurement on the screen.

Command message:
MEAD PHA,C2-C4



Step 2: Send the message to get the measured value of phase.

Command message:
C2-C4:MEAD? PHA

Response message:
C2-C4:MEAD PHA,-89.46degree

MEASURE PARAMETER_CUSTOM | PACU

Command

DESCRIPTION

The PARAMETER_CUSTOM command installs a measurement and starts the specified measurement of the specified source.

See the command PAVA? to get the measured value of specified measurement.

See the command MEAD to install the measurement of delay class.

COMMAND SYNTAX

PARAMETER_CUSTOM

<parameter>,<source>

<source>:= {C1,C2,C3,C4}

<parameter>:={PKPK,MAX,MIN,AMPL,TOP, BASE,CMEAN,MEAN,RMS,CRMS,OVSN,FP RE,OVSP,RPRE,PER,FREQ,PWID,NWID,RIS E,FALL,WID,DUTY,NDUTY,ALL}

Description of Parameter

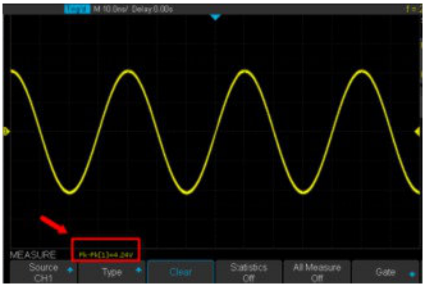
Parameter	Description
PKPK	vertical peak-to-peak
MAX	maximum vertical value
MIN	minimum vertical value
AMPL	vertical amplitude
TOP	waveform top value
BASE	waveform base value
CMEAN	average value in the first cycle
MEAN	average value
RMS	RMS value
CRMS	RMS value in the first cycle
OVSN	overshoot of a falling edge
FPRE	preshoot of a falling edge
OVSP	overshoot of a rising edge
RPRE	preshoot of a rising edge
PER	period
FREQ	frequency

PWID	positive pulse width
NWID	negative pulse width
RISE	rise-time
FALL	fall-time
WID	Burst width
DUTY	positive duty cycle
NDUTY	negative duty cycle
ALL	All measurement

EXAMPLE

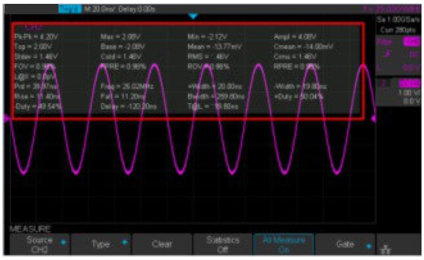
• The following command sets the type of measure to PKPK of Channel 1. Command message:
PACU PKPK,C1

Then, you can see the measurement on the screen.



• The following command sets the type of measure to ALL of Channel 2. Command message:
PACU ALL,C2

Then, you can see a snapshot of all measurements on the screen.



```
M 20.0ns/  Delay:0.00s
CH2
Pk-Pk = 4.20V      Max = 2.08V        Min = -2.12V        Ampl = 4.08V
Top = 2.00V        Base = -2.08V      Mean = -13.77mV     Cmean = -14.00mV
Stdev = 1.46V      Cstd = 1.46V       RMS = 1.46V         Crms = 1.46V
FOV = 0.98%        FPRE = 0.98%       ROV = 0.98%         RPRE = 0.98%
L@X = 0.0pV
Prd = 39.97ns      Freq = 25.02MHz    +Width = 20.00ns    -Width = 19.80ns
Rise = 11.40ns     Fall = 11.20ns     Bwidth = 259.80ns   +Duty = 50.04%
-Duty = 49.54%     Delay = -120.20ns  T@L = 19.80ns
```

RELATED COMMANDS

PAVA?
MEAD

MEASURE PARAMETER_VALUE? | PAVA?

Query

DESCRIPTION

The PARAMETER_VALUE query measures and returns the specified measurement value present on the selected waveform.

There are three uses for this command:

Usage	Description
Usage 1	Specify the source and the measurement. See the command “MEAD?” to get the measured value of delay measurement.
Usage 2	Use “PAVA? CUST<x>” to get customized.
Usage 3	Use “ PAVA? STAT<x>” to get statistics.

QUERY SYNTAX

Usage 1

<source>:PARAMETER_VALUE? <parameter>

<source>:= {C1,C2,C3,C4}

<parameter>:={PKPK,MAX,MIN,AMPL,TOP, BASE,CMEAN,MEAN,RMS,CRMS,OVSN,FPRE,OVSP,RPRE,PER,FREQ,PWID,NWID,RISE,FALL,WID,DUTY,NDUTY,ALL}

See the table **Description of Parameter** for details.

RESPONSE FORMAT

<source>:PARAMETER_VALUE <parameter>,<value>
<value>:= Numerical value in E-notation with SI unit.

QUERY SYNTAX

Usage 2
PARAMETER_VALUE? CUST<x>
<x>:= 1 to 5, and ALL

Custom Parameters	Description
CUST1	The first measure parameter specified by "PACU"
CUST2	The second measure parameter specified by "PACU"
CUST3	The third measure parameter specified by "PACU"
CUST4	The fourth measure parameter specified by "PACU"
CUST5	The fifth measure parameter specified by "PACU"
CUSTALL	All measure parameters specified by "PACU"

Note:

• Installing the measurement as CUST<x> by using command "PACU", before using usage 2.

• When the number of installed measurements is less than 5 and you send the command "PAVA? CUSTALL", it will return OFF as value for remaining custom parameters.

RESPONSE FORMAT

PARAMETER_VALUE CUST<x>:<source>,<parameter>,<value>
<value>:= Numerical value in E-notation with SI unit.

QUERY SYNTAX:

Usage 3
PARAMETER_VALUE? STAT<x>
<x>:= 1 to 5

Custom Parameters	Description
STAT1	Statistics of the first measure parameter specified by "PACU"
STAT2	Statistics of the second measure parameter specified by "PACU"
STAT3	Statistics of the third measure parameter

	specified by "PACU"
STAT4	Statistics of the fourth measure parameter specified by "PACU"
STAT5	Statistics of the fifth measure parameter specified by "PACU"

Note:
Installing the statistics of the measurement as STAT<x> by using command "PACU", before using usage 3.

RESPONSE FORMAT

PARAMETER_VALUE STAT<x> <source> <parameter>:cur,<value1>,mean,<value2>,min, <value3>,max,<value4>,std-dev,<value5>,count,<value6>

Parameter	Description
cur	Current value of measurement
mean	Mean value of measurement
min	Minimum value of measurement
max	Maximum value of measurement
std-dev	Standard deviation of measurement
count	Measurement count

<value>:= Numerical value in E-notation with SI unit.

EXAMPLE

• The following query returns the rise time of Channel 2.

Query message:
C2:PAVA? RISE

Response message:
C2:PAVA RISE, 3.6E-9S

• The following query returns all measurement of Channel 1.

Query message:

C1:PAVA? ALL

Response message:

*C1:PAVA MAX,2.04E+00V,MIN,-2.16E+00V,PKPK,4.20E+00V,TOP,2.00E+00V,BASE,-2.08E+00V,AMPL,4.08E+00V, MEAN,-1.95E-02V,CMEAN,-6.30E-03V,STDEV,1.46E+00V,VSTD,1.46E+00V,RMS,1.46E+00V,CRMS,1.46E+00V,OVSN,1.96%,FPRE,0.98%,OVSP,0.98%,RPRE,0.00%,LEVELX,0.00E+00V,PER,4.00E08S,FREQ,2.5 0E+07Hz,PWID,****,NWID,****,RISE,4.29E-01S,FALL,1.14E-08S,WID,9.99E-08S,DUTY,****,NDUTY,****,DELAY,-6.01E-08S,TIMEL,3.97E-08S*

- The following steps show how the user customize the measurement parameters and get the measured value.

Step 1: Send the command to set the measurement parameter.

Command message:

PACU PKPK,C1

Step 2: Send the query to get the measured value.

Query message:

PAVA? CUST1

Response message:

PAVA CUST1:C1,PKPK,4.08E+00V

Step 3: You can also send the query to get the measured value.

Command message:

PAVA? CUSTALL

Response message:

PAVA CUST1:C1,PKPK,4.08E+00V;CUST2:OFF;CUST3:OFF;CUST4:OFF;CUST5:OFF

• The following steps show how to get the statistical values of user defined measurement parameters.

Step 1: Send the command to set the measurement parameter as the first customized parameter.

Command message:
PACU FREQ,C3

Step 2: Send the query to get the statistical values of the first customized parameter.

Query message:
PAVA? STAT1

Response message:
PAVA STAT1 C3 FREQ:cur,1.00E+06Hz,mean,1.00E+06Hz,min, 9.97E+05Hz,max,1.00E+06Hz,std-dev,1.41E+03Hz,count,171

RELATED COMMANDS

PACU
MEAD

PASS/FAIL Commands

The PASS/FAIL subsystem commands and queries control the mask test features.

- **PACL**
- **PFBF**
- **PFCM**
- **PFDD?**
- **PFDS**
- **PFEN**
- **PFFS**
- **PFOP**
- **PFSC**
- **PFST**

PASS/FAIL

PARAMETER_CLR | PACL

Command

DESCRIPTION	The PARAMETER_CLR command resets the P/F test statistics.
COMMAND SYNTAX	PARAMETER_CLR
RELATED COMMANDS	PFDD?

PASS/FAIL

PF_BUFFER | PFBF

Command/Query

DESCRIPTION

The PF_BUFFER command sets the output mode when the test fails. This is the same as pressing the "Output" button on the menu of PASS/FAIL on the front panel.

The PF_BUFFER? query returns the current output mode of the pass/fail.

COMMAND SYNTAX

PF_BUFFER <state>
<state>:= {ON,OFF}

- ON — The statistical result is displayed when the failed waveform is detected, and the buzzer alarm. (not related to the state of the sound switch)
- OFF — The statistical result is displayed when the failed waveform is detected, but the buzzer does not alarm.

QUERY SYNTAX

PF_BUFFER?

RESPONSE FORMAT

PF_BUFFER <state>

EXAMPLE

When the PASS/FAIL function is on, the following command sets "output" to "ON".
Command message:
PFBF ON

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes

PASS/FAIL

PF_CREATEM | PFCM

Command

DESCRIPTION

The PF_CREATEM command creates a pass/ fail test rule around the current selected channel, using the horizontal adjustment parameters and the vertical adjustment parameters defined by the PFST commands.

Note:
This command is valid only if the pass / fail test function has been opened (PFEN) and is not in operation (PFOP).

COMMAND SYNTAX

PF_ CREATEM

EXAMPLE

The following steps create the mask of the pass/fail.

Step 1: Send command to set the Pass/Fail test enable.

Command message:
PFEN ON

Step 2: Send command to stop the operation.
Command message:
PFOP OFF

Step 3: Send command to create the rule.

Command message:
PFCM

RELATED COMMANDS

PFST
PFSC
PFEN
PFOP

PASS/FAIL

PF_DATADIS? | PFDD?

Query

DESCRIPTION

The PF_DATADIS? query returns the number of the failed frames, passed frames and total frames which are shown on screen.

COMMAND SYNTAX

PF_ DATADIS?

RESPONSE FORMAT

PF_DATADIS
FAIL,<num>,PASS,<num>,TOTAL,<num>

EXAMPLE

The following query returns the number of the message display of the pass/fail.
Query message:
PFDD?

Response message:
PFDD FAIL,0,PASS,0,TOTAL,0

PASS/FAIL

PF_DISPLAY | PFDS

Command /Query

DESCRIPTION

The PF_DISPLAY command displays information in Pass/Fail test features.

The PF_DISPLAY? query returns whether the message of Pass/Fail is displayed.

COMMAND SYNTAX

PF_DISPLAY <state>

<state>:={ON,OFF}

QUERY SYNTAX

PF_DISPLAY?

RESPONSE FORMAT

PF_DISPLAY <state>

EXAMPL

The following steps display the message of Pass/Fail.

Step 1: Send command to set the Pass/Fail test enable.

Command message:
PFEN ON

Step 2: Send command to display the message of Pass/Fail.

Command message:
PFDS ON

RELATED COMMANDS

PFEN

PASS/FAIL

PF_ENABLE | PFEN

Command /Query

DESCRIPTION

The PF_ENABLE command enables or disables the Pass/Fail test features.

The PF_ENABLE? query returns the current state of mask test features.

COMMAND SYNTAX

PF_ENABLE <state>

<state>:= {ON,OFF}

- ON — Enables the mask test features.
- OFF — Disables the mask test features.

QUERY SYNTAX

PF_ENABLE?

RESPONSE FORMAT

PF_ENABLE <state>

EXAMPL

The following command enables mask test features.

Command message:
PFEN ON

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes

PASS/FAIL

PF_FAIL_STOP | PFFS

Command/Query

DESCRIPTION

The PF_FAIL_STOP command sets the switch of the "stop on fail" function. This is the same as pressing the "Stop on Fail" button on the menu of PASS/FAIL on the front panel.

The PF_FAIL_STOP? query returns the state of the "stop on fail" function.

COMMAND SYNTAX

PF_FAIL_STOP <state>

<state>:={ON,OFF}

- ON — To monitor the failure waveform, the oscilloscope stops testing and enters the "STOP" state. At this point, the screen displays the last statistical result.(if the display is already open)

- OFF — To monitor the failure waveform, the oscilloscope will continue to test and update the statistics on the screen immediately.

QUERY SYNTAX

PF_FAIL_STOP?

RESPONSE FORMAT

PF_FAIL_STOP <state>

EXAMPLE

The following command sets "stop on fail" to "off".

Command message:
PFFS OFF

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes

PASS/FAIL

PF_OPERATION | PFOP

Command/Query

DESCRIPTION

The PF_OPERATION command controls to run or stop Pass/Fail test.

The PF_OPERATION? query returns the operation state of Pass/Fail test.

COMMAND SYNTAX

PF_OPERATION <state>

<state>:={ON,OFF}

QUERY SYNTAX

PF_OPERATION?

RESPONSE FORMAT

PF_OPERATION <state>

EXAMPLE

The following command controls to run Pass/Fail test.

Command message:
PFOP ON

RELATED COMMANDS

PFEN

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes

PASS/FAIL | PF_SOURCE | PFSC

Command/Query

DESCRIPTION

The PF_SOURCE command sets measurement sources for Pass/Fail test.

The PF_SOURCE? query returns the measurement source for Pass/Fail test.

COMMAND SYNTAX

PF_SOURCE <trace>

<trace>:={C1,C2,C3,C4}

QUERY SYNTAX

PF_SOURCE?

RESPONSE FORMAT

PF_SOURCE <trace>

EXAMPLE

The following command sets the measurement source to Channel 1 when Channel 1 is on.

Command message:
PFSC C1

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes

PASS/FAIL

PF_SET | PFST

Command /Query

DESCRIPTION

The PF_SET command sets the tolerance in the X/Y direction around the selected waveform defined by PFSC for the Pass/Fail feature. The value of the tolerance will be added and subtracted to horizontal/Vertical values of the waveform to determine the boundaries of the mask.

The PF_ SET? query returns the current setting of the ΔX tolerance and ΔY tolerance for Pass/Fail.

COMMAND SYNTAX

PF_ SET XMASK,<div>,YMASK,<div>

<div>:= 0.04 to 4.0.

Note:
Step value is 0.04.

QUERY SYNTAX

PF_ SET?

RESPONSE FORMAT

PF_ SET XMASK,<div>,YMASK,<div>

EXAMPLE

The following command sets the X mask to 0.4 and the Y mask to 0.52.

Command message:
PFST XMASK,0.4,YMASK,0.52

RELATED COMMANDS

PFSC

PRINT Commands

SCDP

PRINT **SCREEN_DUMP | SCDP**

Query

DESCRIPTION

The SCREEN_DUMP command captures the screen and returns the data of bmp file.

QUERY SYNTAX

SCREEN_DUMP

RESPONSE FORMAT

<bmp header>+<bmp screen data>

Note:
You only need to save the returned information in a BMP format file.

EXAMPLE

The following step shows how to transfers the screen information as a file named screen.bmp in a Python shell.

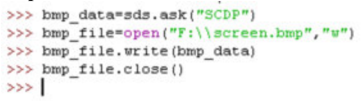
Step 1: Send the query to get the bmp data.

Query message: *SCDP*

Step 2: Create a new bmp file named "screen.bmp".

Step 3: Write the data to the file.

Step 4: Close the file.



```
>>> bmp_data=sds.ask("SCDP")
>>> bmp_file=open("F:\\screen.bmp","w")
>>> bmp_file.write(bmp_data)
>>> bmp_file.close()
>>> |
```

See the code in Screen Dump (SCDP) Example

RECALL Commands

Recall previously saved oscilloscope setups and reference waveforms.

***RCL**
RCPN

RECALL

*RCL

Command

DESCRIPTION

The *RCL command recalls the complete front-panel setup of the instrument from internal memory, using one of the twenty non-volatile panel setups. This command is opposite to the command *SAV.

See the command RCPN for recalling the setup from external.

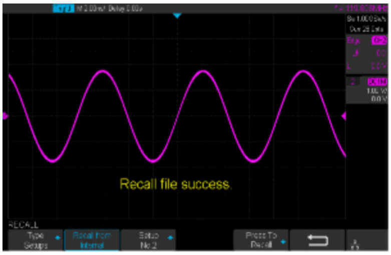
COMMAND SYNTAX

*RCL <setup_num>

<setup_num>:= 0 to 20.

Note:

- When setup_num is 0, it will recall the default panel setup.
- As shown below, when the progress is finished, there will be a prompt message.


Recall file success.

EXAMPLE

When you have stored the instrument setup in No.3, the following command recalls the setup 3.

Command message:
**RCL 3*

RELATED COMMANDS

RCPN
*SAV

RECALL RECALL_PANEL | RCPN

Command

DESCRIPTION

The RECALL_PANEL command recalls a front-panel setup from the specified-DOS path directory in an external memory device.

See the command "*RCL" for recalling from internal.

COMMAND SYNTAX

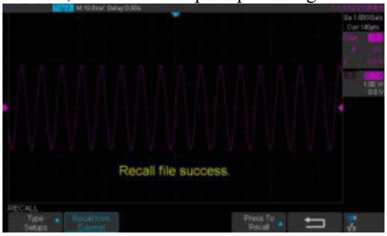
RECALL_PANEL DISK,<device>,FILE,'<filename>'
<device>:= {UDSK}

<filename>:= A waveform file under a legal DOS path.

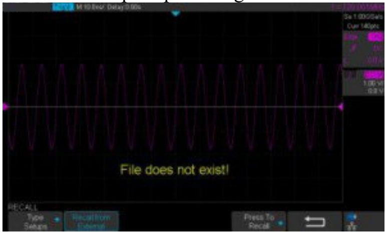
Models	Description
T3DSO1000(A)	The filename string is up to eight characters, with the extension ".xml".
Others	The filename string is up to eight characters, with the extension ".set".

Note:

- See models on page 14.
- For T3DSO1000(A) series, the '/' character to define the root directory is not supported.
- As shown below, when the progress is finished, there will be a prompt message.


Recall file success.

• As shown below, if the filename is wrong, there will be a prompt message.


File does not exist!

EXAMPLE

• For T3DSO1000(A) series, when you plug in an U-disk to the oscilloscope, the following command recalls the front-panel setup from a file called “TEST.xml” in root directory of the USB memory device.

Command message:
RCPN DISK,UDSK,FILE,‘TEST.xml’

• For T3DSO1000(A) series, when you plug in an U-disk to the oscilloscope, the following command recalls the front-panel setup from a file called “TEST.xml” in specified-directory of the USB memory device.

Command message:
RCPN DISK,UDSK,FILE,’/SAVE/TEST.xml’

RELATED COMMANDS

STPN
*RCL

REFERENCE Commands

The REFERENCE system controls the reference waveforms.

REFCL
REFDS
REFLA
REFPO
REFSA
REFSC
REFSR

REFERENCE — REF_CLOSE | REFCL

Command

DESCRIPTION

The REF_CLOSE command closes the Reference function.

COMMAND SYNTAX

REF_CLOSE

EXAMPLE

The following command closes the Reference function.

Command message:
REFCL

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes

REFERENCE REF_DISPLAY | REFDS

Command /Query

DESCRIPTION

The REF_DISPLAY command enables or disables the current reference channel shown on the screen.

The REF_DISPLAY? query returns whether the current reference channel shows on the screen.

COMMAND SYNTAX

REF_ DISPLAY <state>

<state>:= {ON,OFF}

Note:
Only used when the current reference channel has been stored, and the Reference function is enable.

QUERY SYNTAX

REF_ DISPLAY?

RESPONSE FORMAT

REF_ DISPLAY <state>

EXAMPLE

The following command displays the waveform of the current reference channel.
Command message:
REFDS ON

RELATED COMMANDS

REFCL

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes

REFERENCE

REF_LOCATION | REFLA

Command /Query

DESCRIPTION

The REF_LOCATION command selects the current reference channel.

The REF_LOCATION? query returns the current reference channel.

COMMAND SYNTAX

REF_LOCATION <location>

<location>:= {REFA,REFB,REFC,REFD}

QUERY SYNTAX

REF_LOCATION?

RESPONSE FORMAT

REF_LOCATION <location>

EXAMPLE

The following command selects REFA as the current reference channel.

Command message:
REFLA REFA

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes

REFERENCE

REF_POSITION | REFPO

Command /Query

DESCRIPTION

The REF_POSITION command sets the vertical offset of the current reference channel. This command is only used when the current reference channel has been saved, and the display state is on.

The REF_POSITION? query returns the vertical offset of the current reference channel.

COMMAND SYNTAX

REF_ POSITION <offset>

<offset>:= vertical offset value with unit.

Note:

- If there is no unit(V/mV/uV) added, it defaults to be V.
- The range of legal offset varies with the value set by the REFSC command. If you set the offset to a value outside of the legal range, the offset value is automatically set to the nearest legal value.

QUERY SYNTAX

REF_ POSITION?

RESPONSE FORMAT

REF_ POSITION <offset>
<offset>:= Numerical value in E-notation with SI unit.

EXAMPLE

When the Reference function is on, REFB has been saved and the scale is 2 V, the following command sets the current reference channel vertical offset to 0.2 V.

Command message:
REFPO 0.2V

RELATED COMMANDS

REFSC

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes

REFERENCE REF_SAVE | REFSA

Command

DESCRIPTION

The REF_SAVE command saves the waveform (screen range) of the specified source as the reference waveform of the current reference channel to the memory and displays it on the screen.

COMMAND SYNTAX

REF_SAVE

EXAMPLE

When the Reference function is on, the REF source is Channel 2, and the REF location is REFA, the following command saves Channel 2 as REFA and displays REFA on screen.

Command message:
REFSA

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes

REFERENCE

REF_SCALE | REFSC

Command /Query

DESCRIPTION

The REF_SCALE command sets the vertical scale of the current reference channel. This command is only used when the current reference channel has been stored, and the display state is on.

The REF_SCALE? query returns the vertical scale of the current reference channel.

COMMAND SYNTAX

REF_ SCALE <scale>

<scale>:= 500uV to 10V.

Note:
If there is no unit(V/mV/uV) added, it defaults to be V.

QUERY SYNTAX

REF_ SCALE?

RESPONSE FORMAT

REF_ SCALE <scale>
<scale>:= Numerical value in E-notation with SI unit.

EXAMPLE

When the Reference function is on, and REFA has been saved, the following command sets the vertical scale of REFA to 100 mV.

Command message:
REFSC 100mV

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes

REFERENCE

REF_SOURCE | REFSR

Command /Query

DESCRIPTION

The REF_SOURCE command sets the reference waveform source.

The REF_SOURCE? query returns the source of the current reference channel.

COMMAND SYNTAX

REF_SOURCE <source>

<source>:= {C1,C2,C3,C4,MATH}

QUERY SYNTAX

REF_SOURCE?

RESPONSE FORMAT

REF_SOURCE <source>

EXAMPLE

When Channel 1 is on, the following command selects Channel 1 as the source of current reference channel.

Command message:
REFSR C1

Note:
The table below shows the availability of command in each oscilloscope series.

Model	Valid?
T3DSO2000	no
T3DSO1000(A)	yes

SAVE Commands

Save oscilloscope setups and waveform data.

***SAV**
PNSU
STPN

SAVE

***SAV**
Command

DESCRIPTION

The *SAV command stores the complete front-panel setup of the instrument in internal memory.

This instruction does not support storing to external temporarily. See the command STPN for external storage.

COMMAND SYNTAX

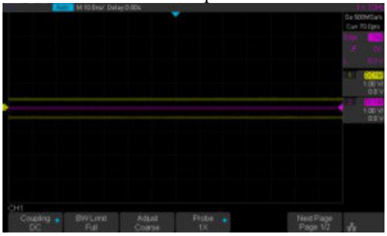
*SAV <setup_num>

<setup_num>:= 1 to 20.

Note:
If there is already a file in the specified location, it will overwrite the original file.

EXAMPLE

When you want to save the current setup in panel as shown below, the following command saves it to setup No.3.



Command message:
**SAV 3*

If you want to recall this setup, send the following command.

Command message:
**RCL 3*

RELATED COMMANDS

STPN
*RCL

SAVE PANEL_SETUP | PNSU

Command /Query

DESCRIPTION

The PANEL_SETUP command use the encoded data get from "PNSU?" to set the panel setup.

The PNSU? query return the panel setup in binary format from scope.

COMMAND SYNTAX

PANEL_SETUP <binary data>

<binary data>:= A setup previously read by PNSU?

QUERY SYNTAX

PANEL_SETUP?

RESPONSE FORMAT

PANEL_SETUP <binary data>

EXAMPLE

The following steps show how to use the query and command to set the panel setup.

Step 1: Send the command to set the response format.

Command message:
CHDR OFF

Step 2: Send the query to get the binary data of setup.

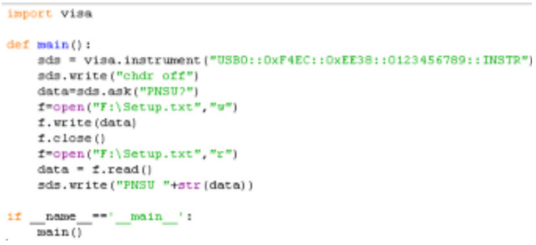
Command message:
PNSU?

Response message:
<binary data>

Step 3: Change the panel setup, and then send the command to restore setup get from step2.

Command message:
PNSU <binary data>

Step 4: You can also save the data in step 2 to a text file and make it easier to recall later. The following program is used as a reference.



```
import visa

def main():
    sds = visa.instrument("USB0::0xF4EC::0xEE38::0123456789::INSTR")
    sds.write("chdr off")
    data=sds.ask("PNSU?")
    f=open("F:\Setup.txt","w")
    f.write(data)
    f.close()
    f=open("F:\Setup.txt","r")
    data = f.read()
    sds.write("PNSU "+str(data))

if __name__=='__main__':
    main()
```

SAVE STORE_PANEL | STPN

Command

DESCRIPTION

The STORE_PANEL command stores the complete front-panel setup of the instrument into a file on the specified-DOS path directory in a USB memory device.

See the command "*SAV" for internal storage.

COMMAND SYNTAX

STORE_PANEL DISK,<device>,FILE,_<filename>'

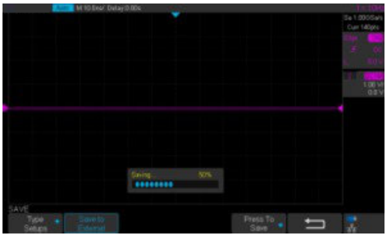
<device>:= {UDSK}

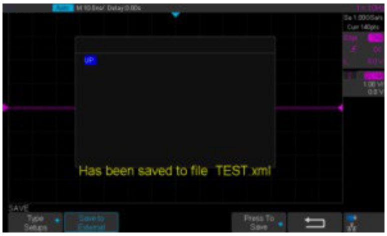
<filename>:= A waveform file under a legal DOS path.

Models	Description
T3DSO1000(A)	The filename string is up to eight characters, with the extension ".xml".
Others	The filename string is up to eight characters, with the extension ".set".

Note:

- See models on page 14.
- For T3DSO1000(A) series, the '/' character to define the root directory is not supported.
- As shown below, during the execution of the command, a progress bar will appear on the interface. When the progress is finished, there will be a prompt message.

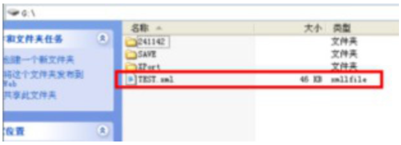



Has been saved to file TEST.xml

EXAMPLE

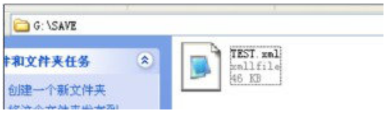
• For T3DSO1000(A) series, the following command saves the current setup to root directory of the USB memory device in a file called "TEST.xml".

Command message:
STPN DISK,UDSK,FILE,'TEST.xml'



• For T3DSO1000(A) series, the following command saves the current setup to the specified-directory of the USB memory device in a file called "TEST.xml".

Command message:
STPN DISK,UDSK,FILE,'/SAVE/TEST.xml'



RELATED COMMANDS

*SAV
RCPN

STATUS Commands

IEEE 488.2 defines data structures, commands, and common bit definitions for status reporting. There are also instrument-defined structures and bits.
An overview of the oscilloscope's status reporting structure is shown in the following commands.

INR?

STATUS

INR?

Query

DESCRIPTION

The INR? query reads and clears the contents of INternal state change Register (INR). The INR register records the completion of various internal operations and state transitions.

QUERY SYNTAX

INR?

RESPONSE FORMAT

INR <value>

<value>:= 0 to 65535.

Note :

- This query only returns 0 bit and 13 bit.
- See the table **INternal State Register (INR) Structure** as shown below for details.

EXAMPLE

The following steps show the change of INR.

Step 1: When the trigger mode is single, and there is no signal input, send the query.

Response message:
INR 0

Step 2: Now, input a signal to trigger. The acquisition mode is Stop. Then, send the query.

Response message:
INR 1

Step 3: Now, change the trigger mode to Auto. Then, send the query.

Response message:
INR 8193

Step 4: Now, change the trigger mode to Single. The acquisition mode changes to be Stop. And then, send the query.

Response message:
INR 8193

Step 5: After sending the query in step 4, send the query again.

Response message:
INR 0

Step 6: After step 2, not to input the signal, change the trigger mode to single. And then, send the query.

Response message:
INR 8192

INternal State Register (INR) Structure

Bit	Bit value	Description
15	---	Not used (always 0)
14	---	Not used (always 0)
13	8192	Trigger is ready
12	4096	Pass/Fail test detected desired outcome
11	2048	Waveform processing has terminated in Trace D
10	1024	Waveform processing has terminated in Trace C
9	512	Waveform processing has terminated in Trace B
8	256	Waveform processing has terminated in Trace A
7	128	A memory card, floppy or hard disk exchange has been detected
6	64	Memory card, floppy or hard disk has become full in ―AutoStore Fill‖ mode
5	---	Not use(always 0)
4	16	A segment of a sequence waveform has been acquired
3	8	A time-out has occurred in a data block transfer
2	4	A return to the local state is detected
1	2	A screen dump has terminated
0	1	A new signal has been acquired

SYSTEM Commands

The SYSTEM subsystem commands control basic system functions of the oscilloscope.

***CAL?**
BUZZ
CONET
SCSV

SYSTEM

*CAL?
Query

DESCRIPTION

The *CAL? query starts the user calibration procedure and return a response.

The user calibration can quickly make the oscilloscope achieve the best working state, in order to obtain the most accurate measurement value.

All function keys have been disabled during the self calibration process.

Before starting the user calibration procedure, you must disconnect anything from inputs.

QUERY SYNTAX

*CAL?

RESPONSE FORMAT

*CAL 0

- 0 — Calibration successful.

EXAMPLE

The following query starts a self-calibration.
Query message:
**CAL?*

Response message:
**CAL 0*

SYSTEM

BUZZER | BUZZ

Command /Query

DESCRIPTION

The BUZZER command enables or disables the buzzer.

The BUZZER? query returns the switch state of the buzzer.

COMMAND SYNTAX

BUZZER <state>

<state>:= {ON,OFF}

QUERY SYNTAX

BUZZER?

RESPONSE FORMAT

BUZZER <state>

EXAMPLE

The following command enables the oscilloscope buzzer.

Command message:
BUZZ ON

SYSTEM

COMM_NET | CONET

Command /Query

DESCRIPTION

The COMM_NET command sets the IP address of the oscilloscope's internal network interface.

When using this command, DHCP should be off.

The COMM_NET? query returns the IP address of the oscilloscope's internal network interface.

COMMAND SYNTAX

COMM_NET <ip_add0>,<ip_add1>,<ip_add2>,<ip_add3>
< ip_add0 >:= 1 to 223(except 127).
< ip_add1 >:= 0 to 255.
< ip_add2 >:= 0 to 255.
< ip_add3 >:= 0 to 255.

QUERY SYNTAX

COMM_NET?

RESPONSE FORMAT

COMM_NET <ip_add0>,<ip_add1>,<ip_add2>,<ip_add3>

EXAMPLE

The following command sets the IP address to 10.11.0.230.

Command message:
CONET 10,11,0,230

SYSTEM

SCREEN_SAVE | SCSV

Command/Query

DESCRIPTION

The SCREEN_SAVE command controls the automatic screen saver, which automatically shuts down the internal color monitor after a preset time.

The SCREEN_SAVE? query returns whether the automatic screen saver feature is on.

Note:
When the screen saver is enabled, the oscilloscope is still fully functional.

COMMAND SYNTAX

SCREEN_SAVE <time>

<time>:={OFF,1MIN,5MIN,10MIN,30MIN ,60MIN}

- OFF — Do not use screen saver.
- Others — When the oscilloscope enters the idle state and holds for the specified time, screen saver will be enabled.

QUERY SYNTAX

SCREEN_SAVE?

RESPONSE FORMAT

SCREEN_SAVE <time>

EXAMPLE

The following command sets the automatic screen saver to 10 minutes.

Command message:
SCSV 10MIN

TIMEBASE Commands

The TIMEBASE subsystem commands control the horizontal (X-axis) functions. The time per division, delay, and reference can be controlled for the main and window (zoomed) time bases.

TDIV
TRDL
HMAG
HPOS

TIMEBASE

TIME_DIV | TDIV

Command/Query

DESCRIPTION

The TIME_DIV command sets the horizontal scale per division for the main window.

The TIME_DIV? query returns the current horizontal scale setting in seconds per division for the main window.

COMMAND SYNTAX

TIME_DIV <value>

<value>:={1NS,2NS,5NS,10NS,20NS,50NS,100NS,200NS,500NS,1US,2US,5US,10US,20US,50US,100US,200US,500US,1MS,2MS,5MS,10MS,20MS,50MS,100MS,200MS,500MS,1S,2S,5S,10S,20S,50S,100S}

- NS — for nanoseconds.
- US — for microseconds.
- MS — for milliseconds.
- S — for seconds.

Note:
The range of value varies from the models. See the data sheet for details.

QUERY SYNTAX

TIME_DIV?

RESPONSE FORMAT

TIME_DIV <value>
<value>:= Numerical value in E-notation with SI unit.

EXAMPLE

The following command sets the horizontal scale to 500 µs.

Command message:
TDIV 500US

RELATED COMMANDS

TRDL
HMAG
HPOS

TIMEBASE **TRIG_DELAY | TRDL**

Command /Query

DESCRIPTION

The TRIG_DELAY command sets the time interval between the trigger event and the horizontal center point on the screen. The maximum position value depends on the time/division settings.

• Pre-trigger acquisition — Data acquired before the trigger occurs. Negative trigger delays must be given in seconds.

• Post-trigger acquisition — Data acquired after the trigger has occurred.

The TRIG_DELAY? query returns the current time from the trigger to the horizontal center point in seconds.

COMMAND SYNTAX

TRIG_DELAY <delay>

<delay>:= time value with unit.

Note:

• The range of delay is related to the time base. See the data sheet for details.

• If you set the delay to a value outside of the legal range, the delay value is automatically set to the nearest legal value.

QUERY SYNTAX

TRIG_DELAY?

RESPONSE FORMAT

TRIG_DELAY <value>

Model	Format of <skew>
T3DSO1000(A)	Numerical value in E-notation with SI unit, such as 1.00E-04S.
others	Numerical value with measurement unit and physical

	unit, such as 3.58ns.

EXAMPLE

When the time base is 1us/div, the following command sets the trigger delay to -4.8us (pre trigger).

Command message:
TRDL -4.8US

RELATED COMMANDS

TDIV

TIMEBASE HOR_MAGNIFY | HMAG

Command /Query

DESCRIPTION

The HOR_MAGNIFY command sets the zoomed (delayed) window horizontal scale (seconds/div). The main sweep scale determines the range for this command. The maximum value is the TDIV value.

The HOR_MAGNIFY? query returns the current zoomed window scale setting.

COMMAND SYNTAX

Format 1:
HOR_MAGNIFY <value>

<value >:={1NS,2NS,5NS,10NS,20NS,50NS,100NS,200NS,500NS,1US,2US,5US,10US,20US,50US,100US,200US,500US,1MS,2MS,5MS,10MS,20MS}

The range of value is related to the current time base. It is from 1NS to the current time base.

Format 2:
HOR_MAGNIFY <factor>

<factor>:= 1 to 2,000,000.

The range of <factor> is related to the current time base and the range of the time base.

Note:
The table on next page shows the available format in each oscilloscope series.

QUERY SYNTAX

HOR_MAGNIFY?

RESPONSE FORMAT

HOR_MAGNIFY <value>
<value>:= Numerical value in E-notation with SI unit.

HOR_MAGNIFY <factor>

EXAMPLE

For T3DSO1000(A) series, when the time base is 1ms/div, and Zoom function is on, the following command sets the zoomed (delayed) window horizontal scale to 1US.

Command message:
HMAG 1US

RELATED COMMANDS TDIV

Format in Each Oscilloscope Series

Model	Command Format
T3DSO2000	Format 2
T3DSO1000(A)	Format 1

TIMEBASE HOR_POSITION | HPOS

Command /Query

DESCRIPTION

The HOR_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.

The HOR_POSITION? query the current horizontal window position setting in the zoomed view.

COMMAND SYNTAX

Format 1:
HOR_POSITION <position>

<position>:= time value with unit.

Note:
• You need add the time unit(s/ms/us/ns) to the position. If there is no unit added, it defaults to be S.

• The range of position is related to the main sweep range and the main sweep horizontal position. The range after magnifying which beyond the screen could display, and it will be adjusted to the proper value.

Format 2:
HOR_POSITION <factor_div>

< factor_div>:= the factor of zoomed time base.

Note:
The table on next page shows the available format in each oscilloscope series.

QUERY SYNTAX

HOR_POSITION?

RESPONSE FORMAT

HOR_POSITION <position>
<position>:= Numerical value in E-notation with SI unit.

HOR_POSITION <factor_div>

EXAMPLE

For T3DSO1000(A) series, when the time base is 10 us/div, the horizontal position is 0, Zoom function is on, and the zoomed scale is 5 us. The range of zoom position is from -35 us to 35 us. The following command sets the zoom position to 100 ns.

Command message:
HPOS 100ns

RELATED COMMANDS

HMAG
TDIV
TRDL

Format in Each Oscilloscope Series

Model	Command Format
T3DSO2000	Format 2
T3DSO1000(A)	Format 1

TRIGGER Commands

The TRIGGER subsystem controls the trigger modes and parameters for each trigger type.

SET50
TRCP
TRLV
TRLV2
TRMD
TRPA
TRSE
TRSL
TRWI

TRIGGER — SET50 Command

DESCRIPTION

The SET50 command automatically sets the trigger levels to center of the trigger source waveform.

When High and Low (dual) trigger levels are used (as Runt triggers, for example), this command has no effect.

COMMAND SYNTAX

SET50

EXAMPLE

When the trigger type is edge and the trigger source is Channel 1, the following command sets the trigger level to the center of Channel 1.

Command message:
SET50

RELATED COMMANDS

TRLV

TRIGGER

TRIG_COUPLING | TRCP

Command /Query

DESCRIPTION

The TRIG_COUPLING command sets the input coupling for the selected trigger sources.

The TRIG_COUPLING? query returns the trigger coupling of the selected source.

COMMAND SYNTAX

<trig_source>:TRIG_COUPLING <trig_coupling>

<trig_source>:={C1,C2,C3,C4,EX,EX5}

<trig_coupling>:={AC,DC,HFREJ,LFREJ}

- AC — AC coupling block DC component 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.
- DC — DC coupling allows dc and ac signals into the trigger path.
- HFREJ — HFREJ coupling places a low-pass filter in the trigger path.
- LFREJ — LFREJ coupling places a high-pass filter in the trigger path.

QUERY SYNTAX

<trig_source>:TRIG_COUPLING?

RESPONSE FORMAT

<trig_source>:TRIG_COUPLING <trig_coupling>

EXAMPLE

The following command sets the coupling mode of the trigger source Channel 2 to AC.

Command message:
C2:TRCP AC

RELATED COMMANDS

TRSE

TRIGGER

TRIG_LEVEL | TRLV

Command /Query

DESCRIPTION

The TRIG_LEVEL command sets the trigger level voltage for the active trigger source.

When there are two trigger levels to set, this command is used to set the higher trigger level voltage for the specified source. TRLV2 is used to set the lower trigger level voltage.

The TRIG_LEVEL? query returns the trigger level of the current trigger source.

COMMAND SYNTAX

<trig_source>:TRIG_LEVEL <trig_level>

<trig_source>:={C1,C2,C3,C4,EX,EX5}

<trig_level>:= -4.5*DIV to 4.5*DIV for internal triggers.

<trig_level>:= -3*DIV to 3*DIV for external triggers.

Note:

- You need to add the volt unit(V/mV) to the trig_level. If there is no unit added, it defaults to volts (V).
- An out-of-range value will be adjusted to the closest legal value.

QUERY SYNTAX

<trig_source>:TRIG_LEVEL?

RESPONSE FORMAT

<trig_source>:TRIG_LEVEL <trig_level>
<trig_level>:= Numerical value in E-notation with SI unit.

EXAMPLE

When the vertical scale of Channel 3 is 200 mV, and the trigger source is Channel 3, the following command sets the trigger level of Channel 3 to 52.00 mV.

Command message:
C3:TRLV52MV

RELATED COMMANDS	TRSE TRLV2

TRIGGER

TRIG_LEVEL2 | TRLV2

Command /Query

DESCRIPTION

The TRIG_LEVEL2 command sets the lower trigger level voltage for the specified source.

Higher and lower trigger levels are used with runt /slope triggers.

The TRIG_LEVEL2? query returns the lower trigger level voltage for the specified source.

COMMAND SYNTAX

<trig_source>:TRIG_LEVEL2 <trig_level>

<trig_source>:= {C1,C2,C3,C4}

<trig_level>:= -4.5*DIV to 4.5*DIV.

Note:

- You need add the volt unit(V/mV) to the trig_level. If there is no unit added, it defaults to volts (V).
- An out-of-range value will be adjusted to the closest legal value.

QUERY SYNTAX

<trig_source>:TRIG_LEVEL2?

RESPONSE FORMAT

<trig_source>:TRIG_LEVEL2 <trig_level>
<trig_level>:= Numerical value in E-notation with SI unit.

EXAMPLE

When the trigger type is slope, the following steps set the high trigger level of Channel 2 to 3.5 V, and the low trigger level of Channel 2 to 800 mV.

Step 1: Send the command to set high trigger level.

Command message:
C2:TRLV 3.5V

Step 2: Send the command to set low trigger level.

Command message:

C2:TRLV2 800mV

RELATED COMMANDS

TRSE
TRLV

TRIGGER **TRIG_MODE | TRMD**

Command /Query

DESCRIPTION

The TRIG_MODE command selects the trigger sweep mode.

The TRIG_MODE? query returns the current trigger sweep mode.

COMMAND SYNTAX

TRIG_MODE <mode>

<mode>:= {AUTO,NORM,SINGLE,STOP}

• AUTO — When AUTO sweep mode is selected, the oscilloscope begins to search for the trigger signal that meets the conditions.
If the trigger signal is satisfied, the running state on the top left corner of the user interface shows Trig'd, and the interface shows stable waveform.
Otherwise, the running state always shows Auto, and the interface shows unstable waveform.

• NORM — When NORMAL sweep mode is selected, the oscilloscope enters the wait trigger state and begins to search for trigger signals that meet the conditions.
If the trigger signal is satisfied, the running state shows Trig'd, and the interface shows stable waveform.
Otherwise, the running state shows Ready, and the interface displays the last triggered waveform (previous trigger) or does not display the waveform (no previous trigger).

• SINGLE — When SINGLE sweep mode is selected, the backlight of SINGLE key lights up, the oscilloscope enters the waiting trigger state and begins to search for the trigger signal that meets the conditions.
If the trigger signal is satisfied, the running state shows Trig'd, and the interface shows stable waveform. Then, the oscilloscope stops scanning, the RUN/STOP key is red light, and the running status shows Stop.

Otherwise, the running state shows Ready, and the interface does not display the waveform.

• STOP — STOP is a part of the option of this command, but not a trigger mode of the oscilloscope.

QUERY SYNTAX

TRIG_MODE?

RESPONSE FORMAT

TRIG_MODE <mode>

EXAMPLE

The following command sets the trigger mode to Normal.

Command message:
TRMD NORM

RELATED COMMANDS

ARM
STOP

TRIGGER

TRIG_PATTERN | TRPA

Command /Query

DESCRIPTION

The TRIG_PATTERN command specifies the channel values to be used in the pattern trigger and sets the condition of the pattern trigger.

The TRIG_PATTERN? query returns channel values and the condition of the pattern trigger.

COMMAND SYNTAX

TRIG_PATTERN <source>,<status>[,<source>,<status>[,<source>,<status>[,<source>,<status>]]],STATE,<condition>

< source >:={C1,C2,C3,C4}

<status>:={X,L,H}

< condition >:={AND,OR,NAND,OR}
• X — Ignore this channel. When all channels are set to X, the oscilloscope will not trigger.
• L — Low level.(lower than the threshold level of the channel)
• H — High level.(higher than the threshold level of the channel)

Note:
The status of source can only be set when the source is on.

QUERY SYNTAX

TRIG_PATTERN?

RESPONSE FORMAT

TRIG_PATTERN <source>,<status>,<source>,<status>,<source>,<status>,<source>,<status>,STATE,<condition>

EXAMPLE

When the trigger type is Pattern, and Channel 2 & Channel 3 are on, the following command sets the Channel 2 and Channel 3 to low and the condition to AND.

Command message:
TRPA C2,L,C3,L,STATE,AND

TRIGGER

TRIG_SELECT | TRSE

Command /Query

DESCRIPTION

The TRIG_SELECT command selects the condition that will trigger the acquisition of waveforms.

Depending on the trigger type, additional parameters must be specified. These additional parameters are grouped in pairs. The first in the pair names the variable to be modified, while the second gives the new value to be assigned. Pairs may be given in any order and restricted to those variables to be changed.

The TRIG_SELECT? query returns the current trigger condition.

Parameter			description
SLEW	Slope	IL	Interval larger
GLIT	Glitch/ Pulse	IS	Interval smaller
INTV	Interval	I2	Interval in range
DROP	Dropout	I1	Interval out of range
SR	Source	PL	Pulse larger
TI	Time	PS	Pulse smaller
HT	Hold type/ Limit range	P2	Pulse in range
HV	Hold value/ Limit value	P1	Pulse out of range

COMMAND SYNTAX (FOR ALL BUT TV)

TRIG_SELECT <trig_type>,SR,<source>,HT,<hold_type>,HV,<hold_value1>[,HV2,<hold_value2>]

<trig_type>:={EDGE,SLEW,GLIT,INTV,RUNT,DROP}

<source>:={C1,C2,C3,C4,LINE,EX,EX5}

Note:
LINE/EX/EX5 can only be selected when the trigger type is Edge.

<hold_type>:={TI,OFF} for EDGE trigger.
<hold_type>:={TI} for DROP trigger.
<hold_type>:={PS,PL,P2,P1}for GLIT/RUNT trigger.
<hold_type>:={IS,IL,I2,I1} for SLEW/INTV trigger.

<hold_value1>:= a time value with unit.
<hold_value2>:= a time value with unit.

Note:
• If there is no unit(S/mS/uS/nS) added, it defaults to be S.
• The range of hold_values varies from trigger types. [80nS, 1.5S] for Edge trigger, and [2nS, 4.2S] for others.

QUERY SYNTAX

TRIG_SELECT?

RESPONSE FORMAT

TRIG_SELECT <trig_type>,SR,<source>,HT,<hold_type>,HV,<hold_value1>[,HV2,<hold_value2>]

EXAMPLE

• When you want to set trigger type to Edge, trigger source to Channel 1, hold type to TIME, and the time value to 1.43uS, the following comes true.

Command message:
TRSE EDGE,SR,C1,HT,TI,HV,1.43uS

• When you want to set trigger type to Pulse, trigger source to Channel 2, limit range to [5nS, 1uS] , the following comes true.

Command message:

TRSE GLIT,SR,C2,HT,P2,HV,5nS,HV2,1uS

• When you want to set trigger type to Dropout, trigger source to Channel 4, overtime value to 2.8 mS , the following comes true.

Command message:
TRSE DROP,SR,C4,HT,TI,HV,2.8mS

TV COMMAND SYNTAX

TRIG_SELECT <trig_type>,SR,<source>,STAN,<standard>,SYNC,<sync_type>[,LINE,<line>[,FLD,<field>]]

Parameter description	
STAN	Standard
FLD	field
CUST	Custom

<trig_type>:= {TV}

<source>:={C1,C2,C3,C4}

<standard>:={NTSC,PAL,720P/50,720P/60,1080P/50,1080P/60,1080I/50,1080I/60, CUST}

<line>:=allows triggering on a specific line of video. The line number limits vary with the standard and mode, as shown in the following table.

TV Trigger Line Number Limits

standard	**Mode**		
	Line	**Field 1**	**Field 2**
NTSC		1~263	1 to 262
PAL		1 to 313	1 to 312
720P/50	1 to 750		
720P/60	1 to 750		
1080P/50	1-1125		
1080P/60	1-1125		

1080I/ 50		1 to 563	1 to 562
1080I/ 60		1 to 563	1 to 562
CUST	1 to number of Lines		

<field>:= [1,2]
for NTSC/PAL/1080I/50/1080I/60

<field>:=1 to <field_count>for CUST.

<field_count>:=1 to 8 depending on the interlace.

Note:
Field can only be selected when the standard is NTSC/PAL/1080I/50/1080I/60/CUST.

TV QUERY SYNTAX

TRIG_SELECT?

TV RESPONSE FORMAT

TRIG_SELECT

<trig_type>,SR,<source>,STAN,<standard>,SYNC,<sync_type>[,LINE,<line>[,FLD,<field>]]

TV EXAMPLE

• When you want to set trigger type to Video, trigger source to Channel 1, standard to NTSC, and SYNC to ANY, the following comes true.

Command message:
TRSE TV,SR,C1,STAN,NTSC,SYNC,ANY

• When you want to set trigger type to Video, trigger source to Channel 1, standard to PAL, Line to 300, and Field to 2, the following comes true.

Command message:
TRSE TV,SR,C1,STAN,PAL,SYNC,SELECT,LINE,300,FLD,2

• When you want to set trigger type to Video, trigger source to Channel 2, standard to 1080P/50, and Line to 200, the following comes true.

Command message:

TRSE TV,SR,C2,STAN,1080P/50,SYNC,SELECT,LINE,200

TRIGGER

TRIG_SLOPE | TRSL

Command /Query

DESCRIPTION

The TRIG_SLOPE command sets the trigger slope of the specified trigger source.

The TRIG_SLOPE? query returns the trigger slope of the selected source.

COMMAND SYNTAX

<trig_source>:TRIG_SLOPE <trig_slope>

<trig_source>:={C1,C2,C3,C4,EX,EX5}

<trig_slope>:={NEG,POS,WINDOW} for edge trigger.

<trig_slope>:={NEG,POS} for other trigger.

- NEG — falling edge.
- POS — rising edge.
- WINDOW — altering edge.

QUERY SYNTAX

<trig_source>:TRIG_SLOPE?

RESPONSE FORMAT

<trig_source>:TRIG_SLOPE <trig_slope>

EXAMPLE

The following command sets the trigger slope of Channel 2 to negative.

Command message:
C2:TRSL NEG

RELATED COMMANDS

TRSE

TRIGGER

TRIG_WINDOW | TRWI

Command /Query

DESCRIPTION

The TRIG_WINDOW command sets the relative height of the two trigger line of the trigger window type.

Note:
This command is only valid when the window type is relative.

The TRIG_WINDOW? query returns relative height of the two trigger line of the trigger window type.

COMMAND SYNTAX

TRIG_WINDOW <value>

<value>: 0 to 9*DIV when the center level is 0.

Note:
• You need add the volt unit(V/mV) to the value. If there is no unit added, it defaults to be V.
• The range of value is related to the center value of the level.

QUERY SYNTAX

TRIG_WINDOW?

RESPONSE FORMAT

TRIG_WINDOW <value>
<value>:= Numerical value in E-notation with SI unit.

EXAMPLE

When the window type is relative, and the center level is 1 V, the following command sets the relative height of the two trigger line to 2 V.

Command message:
TRWI 2V

RELATED COMMANDS

TRLV
TRLV2

WAVEFORM Commands

The WAVEFORM subsystem is used to transfer data to a controller from the oscilloscope waveform memory.

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. 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.

WF?
WFSU

WAVEFORM

WAVEFORM? | WF?

Query

DESCRIPTION

The WAVEFORM? query transfers a waveform from the oscilloscope to the controller.

Note:
The format of the waveform data depends on the current settings specified by the last WFSU command.

QUERY SYNTAX

<trace>:WAVEFORM? <section>

<trace>:={C1,C2,C3,C4,MATH,D0,D1,D2,D3,D4,D5,D6,D7,D8,D9,D10,D11,D12,D13,D14,D15}
- C[X] — Analog channel.
- D[X] — Digital channel. Only valid for T3DSO1000(A) series.
- MATH — Valid except for the FFT waveform and only valid for T3DSO1000(A) series.

<section>:={DAT2}
- DAT2 — Return the main data include the head, the wave data and the ending flag. The length of data is current memory depth.

RESPONSE FORMAT

<trace>:WAVEFORM <data block>

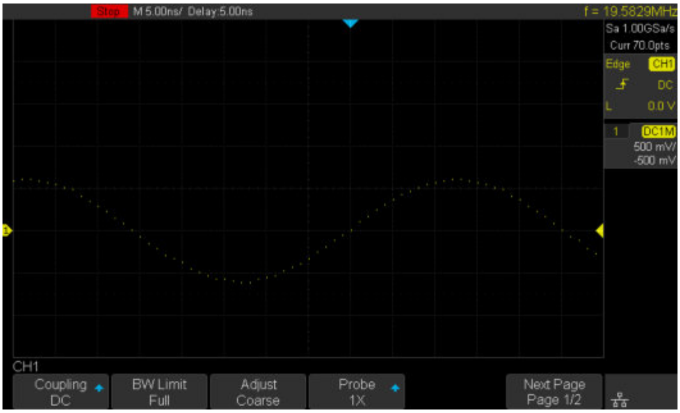
RELATED COMMANDS

WFSU

EXAMPLE

For T3DSO1000(A) series, the following steps show how to use the command to reconstitute the display of waveform.

For analog channel waveform:



Step 1: Send the query to get the data of waveform.

Query message:
C1:WF? DAT2

Response message:

The head of message: C1:WF ALL. These are followed by the string #9000000070, the beginning of a binary block in which nine ASCII integers are used to give the length of the block (70 bytes). After the length of block, is beginning of the wave data. "0A 0A" means the end of data.

```
Data                                                 Description
-------------------------------------------------    ----------------
43 31 3A 57 46 20 41 4C 4C 2C 23 39 30 30 30 30      C1:WF ALL,#90000
30 30 30 37 30 02 03 03 03 03 03 01 00 FE FC F9      00070...........
F7 F3 F0 ED E9 E6 E3 DF DC D9 D6 D3 D1 CF CE CD      ................
CC CC CC CD CE CF D1 D4 D6 D9 DC E0 E2 E6 EA ED      ................
F1 F4 F7 FA FC FE 00 02 02 03 03 03 02 01 00 FE      ................
FC F9 F6 F3 F0 ED EA E6 E2 DF DC 0A 0A               .............
```

Step 2: Calculate the voltage value corresponding to the data point.
Using the formula: voltage value (V) = code value *(vdiv /25) - voffset.

code value: The decimal of wave data.

Note: If the decimal is greater than "127", it should minus 255. Then the value is code value. Such as the wave data is "FC" convert to decimal is "252". So the code value is 252-255 = -3.

vdiv: The Volts/div value.

voffset: The voltage position value.

The picture above as an example:

Send command *C1:VDIV?*
Return *C1:VDIV 5.00E-01V*.

Get the current Volts/div values: vdiv = 0.5V.

Send command *C1:OFST?*
Return *C1:OFST -5.00E-01V*.

Get the current voltage position values: voffset = -0.5V.

According to the wave data, we can know the first point of waveform is the 22th data "02", convert to decimal is "2" (Hexadecimal converted to decimal).

The first point of wave data voltage value = 2*(0.5/25)-(-0.5) = 0.54V.

Step 3: Calculate the time value of the data point.

Using the formula: time value(S) = -(timebase*grid/2).

timebase: The timebase value.

grid: The grid numbers in horizontal direction.

The picture above as an example:

Send command *TDIV?*
Return *TDIV 5.00E-09S*.

Get the current timebase: timebase = 5.00E-09S.

The time value of the first data point: time value = - (5.00E-09*14/2) = -35.00E-09(s) = -35(ns).

Send command *SARA?*
Return *SARA 1.00E+09Sa/s*.

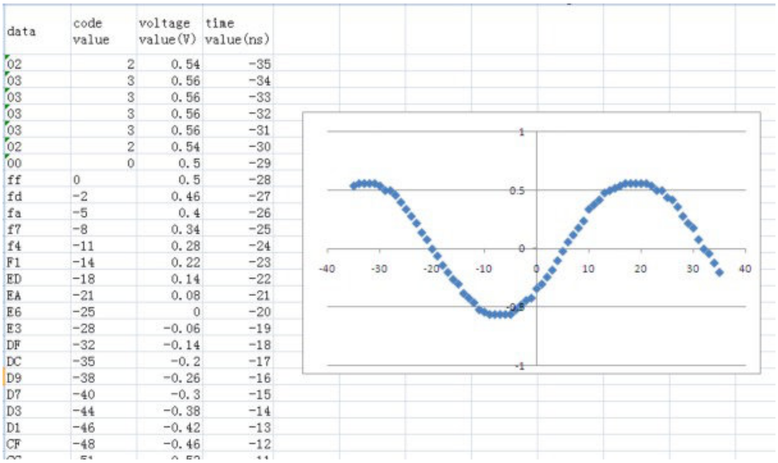
Get the current sampling rate: sampling rate= 1.00GSa/s.

The time interval: time inter = 1/ sampling rate = 1ns.

So the time value of the second data point: value = -35ns+1ns = -34ns.

The following are two ways of waveform reconstruction:

Use Excel to reconstruct the waveform:

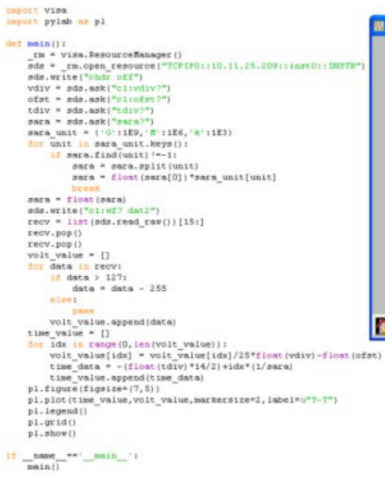


data	code value	voltage value(V)	time value(ns)
02	2	0.54	-35
03	3	0.56	-34
03	3	0.56	-33
03	3	0.56	-32
03	3	0.56	-31
02	2	0.54	-30
00	0	0.5	-29
ff	0	0.5	-28
fd	-2	0.46	-27
fa	-5	0.4	-26
f7	-8	0.34	-25
f4	-11	0.28	-24
F1	-14	0.22	-23
ED	-18	0.14	-22
EA	-21	0.08	-21
E6	-25	0	-20
E3	-28	-0.06	-19
DF	-32	-0.14	-18
DC	-35	-0.2	-17
D9	-38	-0.26	-16
D7	-40	-0.3	-15
D3	-44	-0.38	-14
D1	-46	-0.42	-13
CF	-48	-0.46	-12

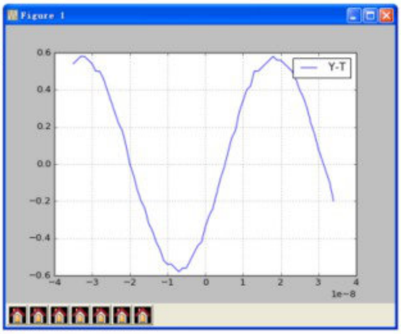
Use python to reconstruct the waveform: (See the code in Read Waveform

Data (WF) Example)

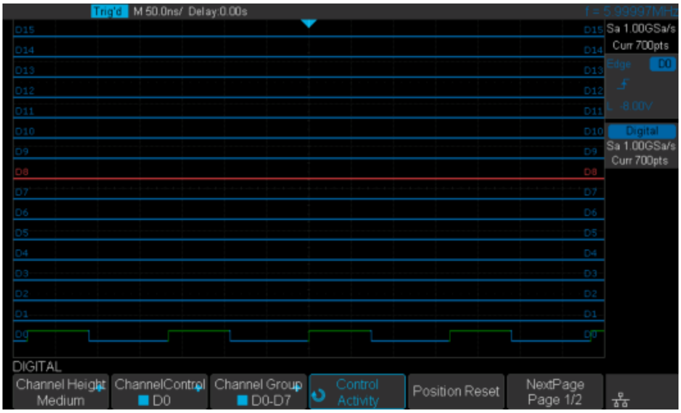
Note: If you want the command return the “numerical” data type only (i.e. return as *”1.00E+09”* when send the command *”SARA?”*), send the command *”CHDR OFF”* at the first. See CHDR for details.



```
import visa
import pylab as pl

def main():
    _rm = visa.ResourceManager()
    sds = _rm.open_resource("TCPIP0::10.11.25.209::inst0::INSTR")
    sds.write("chdr off")
    vdiv = sds.ask("c1:vdiv?")
    ofst = sds.ask("c1:ofst?")
    tdiv = sds.ask("tdiv?")
    sara = sds.ask("sara?")
    sara_unit = {'G':1E9,'M':1E6,'k':1E3}
    for unit in sara_unit.keys():
        if sara.find(unit)!=-1:
            sara = sara.split(unit)
            sara = float(sara[0])*sara_unit[unit]
            break
    sara = float(sara)
    sds.write("c1:wf? dat2")
    recv = list(sds.read_raw())[15:]
    recv.pop()
    recv.pop()
    volt_value = []
    for data in recv:
        if data > 127:
            data = data - 255
        else:
            pass
        volt_value.append(data)
    time_value = []
    for idx in range(0,len(volt_value)):
        volt_value[idx] = volt_value[idx]/25*float(vdiv)-float(ofst)
        time_data = -(float(tdiv)*14/2)+idx*(1/sara)
        time_value.append(time_data)
    pl.figure(figsize=(7,5))
    pl.plot(time_value,volt_value,markersize=2,label=u"Y-T")
    pl.legend()
    pl.grid()
    pl.show()

if __name__=='__main__':
    main()
```



For digital channel waveform:



Step 1: Send the query to get the data of waveform.

Query message:
D0:WF? DAT2

Response message:
The head of message: *D0:WF ALL*. These are followed by the string *#9000000700*, the beginning of a binary block in which nine ASCII integers are used to give the length of the data (700 points). For digital, one bit represents a data point, so there are 88 bytes. After the length of block, is beginning of the wave data. “0A 0A” means the end of data.

```
Data                                                   Description
---------------------------------------------------    ----------------
44 30 3A 57  46 20 41 4C  4C 2C 23 39  30 30 30 30     D0:WF ALL,#90000
30 30 37 30  30 00 00 80  FF FF FF FF  FF FF FF FF     00700...........
FF FF 00 00  00 00 00 00  00 00 00 00  C0 FF FF FF     ................
FF FF FF FF  FF FF 7F 00  00 00 00 00  00 00 00 00     ................
00 E0 FF FF  FF FF FF FF  FF FF FF 3F  00 00 00 00     ................
00 00 00 00  00 00 F8 FF  FF FF FF FF  FF FF FF FF     ................
0F 00 00 00  00 00 00 00  00 00 00 FC  FF 0A 0A        ...............|
```

Step 2: Covert to the high (1) and low (0) corresponding to the data point.

According to the wave data, we can know the first eight points of waveform is the 22th byte “00”, convert to binary is “00000000” (Hexadecimal converted to binary (LSB)).

Step 3: Calculate the time value of the data point.

Using the formula: time value(S) = - (timebase*grid/2).

timebase: The timebase value.

grid: The grid numbers in horizontal direction.

The picture above as an example:

Send command *TDIV?*
Return *TDIV 5.00E-08S*.

Get the current timebase: timebase = 5.00E-08S.

The time value of the first data point: time value = - (5.00E-08*14/2) = - 3.50E-07(s) = -350(ns).

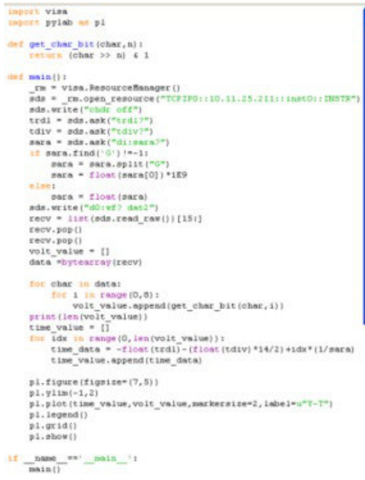
Send command *DI:SARA?*
Return *DI:SARA 1.00E+09Sa/s*.

Get the current sampling rate: sampling rate= 1GSa/s.

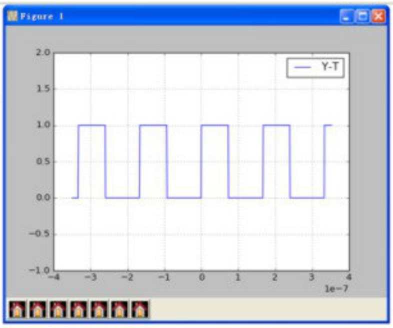
The time interval: time inter = 1/ sampling rate = 1ns.

So the time value of the second data point: value = -350ns+1ns = -349ns.

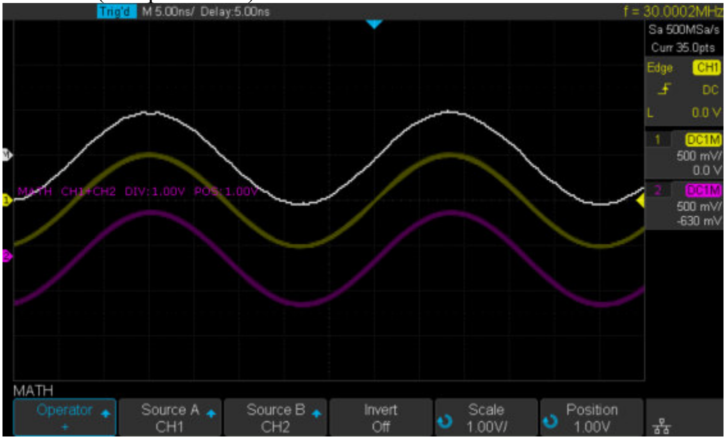
Use python to reconstruct the waveform: (See the code in Read Waveform Data of Digital Example)



```
import visa
import pylab as pl

def get_char_bit(char,n):
    return (char >> n) & 1

def main():
    _rm = visa.ResourceManager()
    sds = _rm.open_resource("TCPIP0::10.11.25.211::inst0::INSTR")
    sds.write("chdr off")
    trdl = sds.ask("trdl?")
    tdiv = sds.ask("tdiv?")
    sara = sds.ask("di:sara?")
    if sara.find('G')!=-1:
        sara = sara.split("G")
        sara = float(sara[0])*1E9
    else:
        sara = float(sara)
    sds.write("d0:wf? dat2")
    recv = list(sds.read_raw())[15:]
    recv.pop()
    recv.pop()
    volt_value = []
    data =bytearray(recv)

    for char in data:
        for i in range(0,8):
            volt_value.append(get_char_bit(char,i))
    print(len(volt_value))
    time_value = []
    for idx in range(0,len(volt_value)):
        time_data = -float(trdl)-(float(tdiv)*14/2)+idx*(1/sara)
        time_value.append(time_data)

    pl.figure(figsize=(7,5))
    pl.ylim(-1,2)
    pl.plot(time_value,volt_value,markersize=2,label=u"Y-T")
    pl.legend()
    pl.grid()
    pl.show()

if __name__=='__main__':
    main()
```



For math (except for FFT) waveform:



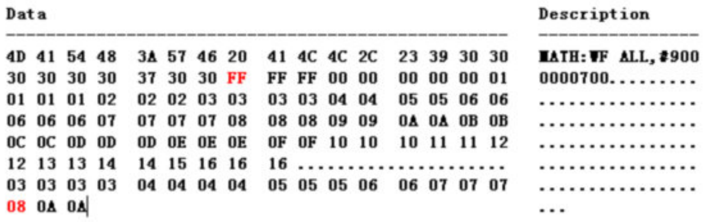
Step 1: Send the query to get the data of waveform.

Query message:

MATH:WF? DAT2

Response message:

The head of message: *MATH:WF ALL*. These are followed by the string #9000000700, the beginning of a binary block in which nine ASCII integers are used to give the length of the block (700 bytes). The point number is 700 with interpolation. After the length of block, is beginning of the wave data. “0A 0A” means the end of data.



```
Data                                                   Description
-----------------------------------------------------  ----------------
4D 41 54 48  3A 57 46 20  41 4C 4C 2C  23 39 30 30     MATH:WF ALL,#900
30 30 30 30  37 30 30 FF  FF FF 00 00  00 00 00 01     0000700.........
01 01 01 02  02 02 03 03  03 03 04 04  05 05 06 06     ................
06 06 06 07  07 07 07 08  08 08 09 09  0A 0A 0B 0B     ................
0C 0C 0D 0D  0D 0E 0E 0E  0F 0F 10 10  10 11 11 12     ................
12 13 13 14  14 15 16 16  16 .....................     ................
03 03 03 03  04 04 04 04  05 05 05 06  06 07 07 07     ................
08 0A 0A                                               ...
```

Step 2: Calculate the voltage value corresponding to the data point.
Using the formula: voltage value (V) = code value *(vdiv /25).

code value: The decimal of wave data. Different from the code of analog channel waveform, it contains the offset.

Note: If the decimal is greater than “127”, it should minus 255. Then the value is code value. Such as the wave data is “FC” convert to decimal is “252”. So the code value is 252-255 = -3.

vdiv: The Volts/div value of math.

The picture above is an example:

Send command *MTVD?*
Return *MTVD 1.00E+00V*.

Get the current Volts/div values: vdiv = 1V.

According to the wave data, we can know the first point of waveform is the 24th data “FF”, convert to decimal is “255” (Hexadecimal converted to decimal). Then minus 255, the code value is 0.

The first point of wave data voltage value = 0*(1/25) = 0V.

Step 3: Calculate the time value of the data point.

Using the formula: time value(S) = - (timebase*grid/2).

timebase: The timebase value.

grid: The grid numbers in horizontal direction.

The picture above as an example:

Send command *TDIV?*
Return *TDIV 5.00E-09S*.

Get the current timebase: timebase = 5.00E-09S.

The time value of the first data point: time value = - (5.00E-09*14/2) = -35.00E-09(s) = -35(ns).

Send command *SARA?*
Return *SARA 5.00E+08Sa/s*.

Get the current sampling rate: sampling rate= 500MSa/s.

Send command *SANU? C1*
Return *SANU 3.50E+01pts*.

Get the number of sampling points: points number = 35pts.

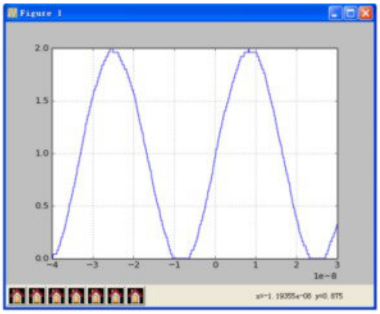
The interpolation multiplier: interpolation multiplier = length of the block / points number = 700/35 = 20

The time interval: time inter = 1/ sampling rate/ interpolation multiplier = 0.1ns.

So the time value of the second data point: value = -35ns+0.1ns = -34.9ns.

Use python to reconstruct the waveform:

```
import visa
import pylab as pl

def main():
    _rm =visa.ResourceManager()
    sds = _rm.open_resource("TCPIP0::10.11.25.209::inst0::INSTR")
    sds.write("chdr off")
    vdiv = sds.ask("MTVD?")
    trdl = sds.ask("trdl?")
    tdiv = sds.ask("tdiv?")
    sara = sds.ask("sara?")
    sanu = sds.ask("SANU? C1")
    if sara.find('G')!=-1:
        sara = sara.split("G")
        sara = float(sara[0])*1E9
    else:
        sara = float(sara)
    sds.write("math:wf? dat2")
    recv = list(sds.read_raw())[15:]
    recv.pop()
    recv.pop()
    insert = len(recv)/float(sanu)

    volt_value = []
    for data in recv:
        if data > 127:
            data = data - 255
        else:
            pass
        volt_value.append(data)
    time_value = []
    for idx in range(0,len(volt_value)):
        volt_value[idx] = volt_value[idx]/25*float(vdiv)
        time_data = -float(trdl)-(float(tdiv)*14/2)+idx*(1/sara/insert)
        time_value.append(time_data)
    pl.figure(figsize=(7,5))
    pl.plot(time_value,volt_value,markersize=2)
    pl.legend()
    pl.grid()
    pl.show()

if __name__=='__main__':
    main()
```



WAVEFORM

WAVEFORM_SETUP |WFSU

Command/Query

DESCRIPTION

The WAVEFORM_SETUP command specifies the amount of data in a waveform to be transmitted to the controller.

The WAVEFORM_SETUP? query returns the transfer parameters currently in use.

COMMAND SYNTAX

WAVEFORM_SETUP SP,<sparsing>,NP,<number>,FP,<point>

• SP — Sparse point. It defines the interval between data points.

For example:
SP = 0 sends all data points.
SP = 4 sends every 4 data points.

• NP — The number of points. It indicates how many points should be transmitted. For example:

NP = 0 sends all data points.
NP = 50 sends a maximum of 50 data points.

• FP — First point. It specifies the address of the first data point to be sent. For waveforms acquired in sequence mode, this refers to the relative address in the given segment.

For example:
FP = 0 corresponds to the first data point.
FP = 1 corresponds to the second data point.

Note:
• You can set the sparse point or number of points or the first point using key-value pairs alone. See the example for details.
• After power on, SP is set to 0, NP is set to 0, and FP is set to 0.

QUERY SYNTAX

WAVEFORM_SETUP?

RESPONSE FORMAT

WAVEFORM_SETUP SP,<sparsing>,NP,<number>,FP,<point>

EXAMPLE

The following command specifies that every 3 data points (SP=3) starting at the 200th point should be transferred.

Command message:
WFSU SP,3,FP,200

RELATED COMMANDS

WF?

WGEN Commands

When the built-in waveform generator is licensed (Option AWG), you can use it to output sine, square, ramp, pulse, DC, noise, exponential rise, exponential fall, cardiac, Gaussian pulse and arbitrary waveforms. The WGEN commands are used to select the waveform function and parameters.

ARWV
PROD?
STL?
WGEN
WVPR?

Note:
These commands are only valid for the model which has installed AWG option.

Availability of WGEN Commands in Each Oscilloscope Series

Model	Valid?
T3DSO2000	yes
T3DSO1000(A)	yes - except T3DSO1102

WGEN

ARBWAVE | ARWV

Command

DESCRIPTION

The ARBWAVE command sets the basic waveform type.

COMMAND SYNTAX

ARBWAVE INDEX,<index>

<index>:= {0,1,2,3,4,5,6,7,8,9}.

EXAMPLE

For T3DSO2000 series, when the AWG option is installed, the following command set the index of waveform type to 3.

Command message:
ARWV INDEX,3

Note:
See the table **Availability of WGEN Commands in Each Oscilloscope Series** for details.

WGEN

PRODUCT? | PROD?

Query

DESCRIPTION

The PRODUCT? query returns the product model or the upper limit of frequency of the output signal.

QUERY SYNTAX

PRODUCT? <parameter>

<parameter>:={MODEL,BAND}

• MODEL — return the product model.

• BAND — return the upper limit of frequency of the output signal.

RESPONSE FORMAT

PRODUCT <parameter>,<value>

EXAMPLE

For T3DSO2000 series, when the AWG option is installed, the following query returns the upper limit of frequency of the output signal.

Query message:
PROD? BAND

Response message:
PROD BAND,25MHz

Note:
See the table **Availability of WGEN Commands in Each Oscilloscope Series** for details.

WGEN

STORELIST? | STL?

Query

DESCRIPTION

The STORELIST? query returns the stored arbitrary waveforms list with indexes and names. If the store unit is empty, the command will return “EMPTY” string.

QUERY SYNTAX

STORELIST? <type>

<type>:={DEBUG,RELEASE}

- DEBUG — return built-in waveforms. (include sine, noise, cardiac, gaus_pulse, exp_rise, exp_fall, and four waveforms defined by user)

- RELEASE — return four waveforms defined by user.

RESPONSE FORMAT

STORELIST <list>

EXAMPLE

For T3DSO2000 series, when the AWG option is installed, the following query returns the waveform storage list.

Query message:
STL? DEBUG

Response message:
STL
M0,SINE,M1,NOISE,M2,CARDIAC,M3,GAUS_PULSE,M4,EXP_RISE,M5,EXP_FALL,M6,EMPTY,M7,EMPTY,M8,EMPTY,M9,EMPTY

Note:
See the table **Availability of WGEN Commands in Each Oscilloscope Series** for details.

WGEN

WAVEGENERATOR | WGEN

Command/Query

DESCRIPTION

The WAVEGENERATOR command sets parameters of basic waveform.

The WAVEGENERATOR? query returns the waveform parameters.

COMMAND SYNTAX

WAVEGENERATOR <parameter>,<value>

<parameter>:= {a parameter from the table below}.

<value>:={value of the corresponding parameter}.

Parameters	Value	Description
OUTP	<state>	:={ON,OFF}.
WVTP	<type>	:={SINE,SQUARE,RAMP,PULSE,DC,NOISE,CARDIAC,GAUS_PULSE,EXP_RISE,EXP_FALL,ARB1,ARB2,ARB3,ARB4}. If the command doesn't set basic waveform type, WVPT will be set to the current waveform.
FREQ	<frequency>	:= 0.000001 Hz to 25000000 Hz. Not valid when WVTP is NOISE or DC.
AMPL	<amplitude>	:= 0.004V to 6 V. Not valid when WVTP is NOISE or DC.
OFST	<offset>	:= -(6 - AMP)/2 to (6 - AMP)/2(V). Not valid when WVTP is NOISE.
DCOFST	<dc_offset>	:= -3V to 3 V. Only valid when WVTP is DC.
DUTY	<duty>	:= 20% to 80%. Only valid when WVTP is SQUARE.
SYMM	<sym>	:= 0 to 100%. Only valid when WVTP is RAMP.
WIDTH	<width>	:= 0.000000048s to 0.001s. Only valid when WVTP is PULSE.
STDEV	<std>	:= 0.0003V to 0.45V. Only valid when WVTP is NOISE.
MEAN	<mean>	:= -(0.45-STD)*(20/3)-(0.45-STD)*(20/3) (V). Only valid when WVTP is NOISE.

LOAD	<load>	:={ HZ, 50}.

QUERY SYNTAX

WAVEGENERATOR? <parameter>

<parameter>:={OUTP,WVTP,FREQ,AMPL,OFST,DCOFST,DUTY,SYMM,WIDTH,STDEV,MEAN,LOAD,ALL}

RESPONSE FORMAT

WAVEGENERATOR <parameter>,<value>

EXAMPLE

• For T3DSO2000 series, when the AWG option is installed, the following command set the type to square, amplitude to 2.5 V, frequency to 10 kHz and duty to 45%.

Command message:
WGEN TYPE,SQUARE,FREQ,10000Hz,AMPL,2.5V,DUTY,45%

• For T3DSO2000 series, when the AWG option is installed, the following command set the type to noise, stdev to 0.2 V, mean to 1 V.

Command message:
WGEN TYPE,NOISE,STDEV,0.2V,MEAN,1V

• For T3DSO2000 series, when the AWG option is installed, the following command set the output to off.

Command message:
WGEN OUPT,OFF

Note:
See the table **Availability of WGEN Commands in Each Oscilloscope Series** for details.

WGEN — WAVE_PARA? | WVPR?

Query

DESCRIPTION

The WAVE_PARA? query returns the location, name, frequency, amplitude, and offset of four arbitrary waveforms.

QUERY SYNTAX

WAVE_PARA? <index>

RESPONSE FORMAT

WAVE_PARA POS,<index>,WVNM,<name>,FREQ,<freq>,AMPL,<ampl>,OFST,<ofst>

EXAMPLE

For T3DSO2000 series, when the AWG option is installed, the following query returns the parameters of M0.

Query message:
WVPR? M0

Response message:
WVPR POS,M0,WVNM,SINE,FREQ,1.000000e+03,AMPL,6.000000e+00,OFST,0.000000e+00

RELATED COMMANDS

STL?

Note:
See the table **Availability of WGEN Commands in Each Oscilloscope Series** for details.

Programming Examples

This chapter gives some examples for the programmer. In these examples you can see how to use VISA or sockets, in combination with the commands described above to control the oscilloscope. By following these examples, you can develop many more applications.

VISA Examples

VC++ Example

Environment: Win7 32-bit, Visual Studio.
Description: Use National Instruments VISA to control the device with USBTMC or TCP/IP access. Perform a write and read operation.
Steps:
1.Open Visual Studio, create a new VC++ win32 project.

2.Set the project environment to use the NI-VISA library. There are two ways to use NI-VISA, static or automatic:

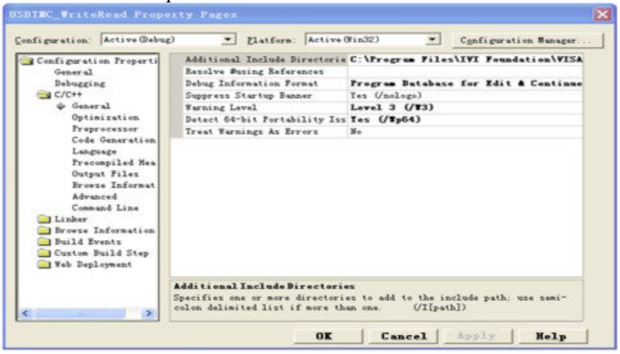
a) Static:

Find the files visa.h, visatype.h, visa32.lib in the NI-VISA installation path, copy them to your project, and add them into the project. In the projectname.cpp file, add the follow two lines:

```
#include "visa.h"
#pragma comment(lib,"visa32.lib")
```

b) Automatic:

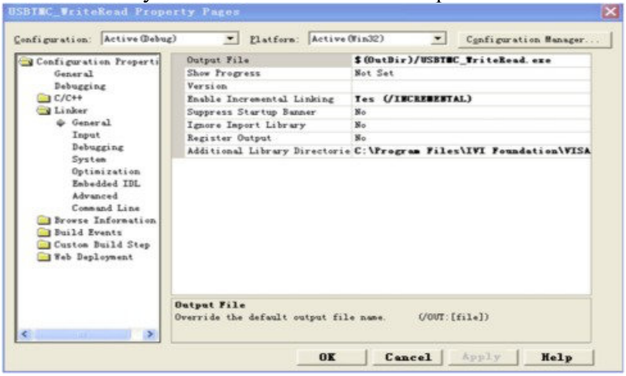
Set the .h file include directory, the NI-VISA install path, in our computer we set the path is: C:\Program Files\IVI Foundation \VISA\WinNT\include. Set this path to project---properties---c/c++---General---Additional Include Directories: See the picture.



Additional Include Directorie	C:\Program Files\IVI Foundation\VISA
Resolve #using References	
Debug Information Format	Program Database for Edit & Continue
Suppress Startup Banner	Yes (/nologo)
Warning Level	Level 3 (/W3)
Detect 64-bit Portability Iss	Yes (/Wp64)
Treat Warnings As Errors	No

Additional Include Directories
Specifies one or more directories to add to the include path: use semi-colon delimited list if more than one. (/I[path])

Set lib path set lib file:
Set lib path: the NI-VISA install path, in our computer we set the path is : C:\Program Files\IVI Foundation\VISA\WinNT
\lib\msc. Set this path to project---properties---Linker---General---Additional Library Directories: as shown in the pictures below.

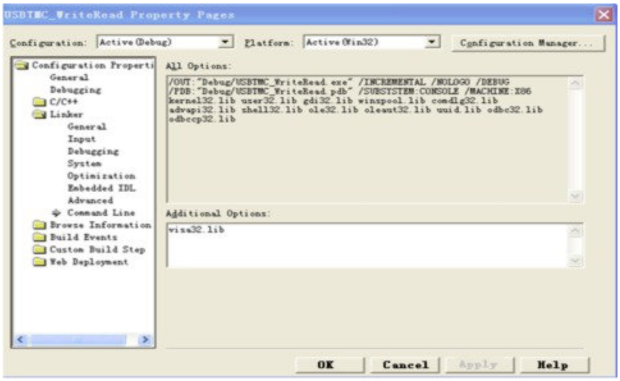

USBTMC_WriteRead Property Pages

Configuration: Active(Debug) Platform: Active(Win32) Configuration Manager...

Output File	$(OutDir)/USBTMC_WriteRead.exe
Show Progress	Not Set
Version	
Enable Incremental Linking	Yes (/INCREMENTAL)
Suppress Startup Banner	No
Ignore Import Library	No
Register Output	No
Additional Library Directorie	C:\Program Files\IVI Foundation\VISA

Output File
Override the default output file name.   (/OUT:[file])

Set lib file:project---properties---Linker---Command Line---Additional Options: visa32.lib


USBTMC_WriteRead Property Pages

Configuration: Active(Debug) Platform: Active(Win32) Configuration Manager...

All Options:

```
/OUT:"Debug/USBTMC_WriteRead.exe" /INCREMENTAL /NOLOGO /DEBUG
/PDB:"Debug/USBTMC_WriteRead.pdb" /SUBSYSTEM:CONSOLE /MACHINE:X86
kernel32.lib user32.lib gdi32.lib winspool.lib comdlg32.lib
advapi32.lib shell32.lib ole32.lib oleaut32.lib uuid.lib odbc32.lib
odbccp32.lib
```

Additional Options:

```
visa32.lib
```

Include visa.h file in the projectname.cpp file:
#include <visa.h>

3. Coding:

a) USBTMC:

```
IntUsbtmc_test() {
        /* This code demonstrates sending synchronous read & write commands */
        /* to an USB Test & Measurement Class (USBTMC) instrument using    */
        /* NI-VISA                    */
        /* The example writes the "*IDN?\n" string to all the USBTMC   */
        /* devices connected to the system and attempts to read back        */
        /* results using the write and read functions.                         */
        /* The general flow of the code is*/
        /*    Open Resource Manager        */
        /*    Open VISA Session to an Instrument                          */
        /*    Write the Identification Query Using viPrintf     */
        /*    Try to Read a Response With viScanf    */
        /*    Close the VISA Session        */
        /***************************** ****************************/
        ViSession defaultRM;
        ViSession instr;
        ViUInt32 numInstrs;
        ViFindList findList;
        ViUInt32 retCount;
        ViUInt32 writeCount;
        ViStatus status;
        Char instrResourceString[VI_FIND_BUFLEN];
        Unsignedchar buffer[100];
        Charstringinput[512];
        Int i;
        /** First we must call viOpenDefaultRM to get the manager *
        handle.  We will store this handle in defaultRM.*/
        status=viOpenDefaultRM (&defaultRM);
```

```
if (status<VI_SUCCESS) {
        printf ("Could not open a session to the VISA Resource Manager!\n");
        returnstatus;
}
/* Find all the USB TMC VISA resources in our system and store the  number of
resources in the system in numInstrs.                    */
status = viFindRsrc (defaultRM, "USB?*INSTR", &findList, &numInstrs,
instrResourceString);
if (status<VI_SUCCESS)
{
        printf ("An error occurred while finding resources.\nHit enter to continue.");
        fflush(stdin);
        getchar();
        viClose (defaultRM);
        returnstatus;
}
/** Now we will open VISA sessions to all USB TMC instruments. *
We must use the handle from viOpenDefaultRM and we must
* also use a string that indicates which instrument to open.  This
* is called the instrument descriptor.  The format for this string
* can be found in the function panel by right clicking on the
* descriptor parameter. After opening a session to the
* device, we will get a handle to the instrument which we
* will use in later VISA functions.  The AccessMode and Timeout
* parameters in this function are reserved for future
* functionality.  These two parameters are given the value VI_NULL.*/
for (i=0; i<numInstrs; i++) {
        if (i> 0)
        {
```

```
        viFindNext (findList, instrResourceString);
    }
    status = viOpen (defaultRM, instrResourceString, VI_NULL, VI_NULL, &instr);
    if (status<VI_SUCCESS)
    {
        printf ("Cannot open a session to the device %d.\n", i+1);
        continue;
    }
    /* * At this point we now have a session open to the USB TMC instrument.
    * We will now use the viPrintf function to send the device the string "*IDN?\n", *
    asking for the device's identification.  */
    char * cmmand ="*IDN?\n";
    status = viPrintf  (instr, cmmand);
    if (status<VI_SUCCESS)
    {
        printf ("Error writing to the device %d.\n", i+1);
        status = viClose (instr);
        continue;
    }
    /** Now we will attempt to read back a response from the device to
    * the identification query that was sent.   We will use the viScanf *
    function to acquire the data.
    * After the data has been read the response is displayed.*/
    status =  viScanf(instr, "%t", buffer); if
    (status<VI_SUCCESS)
    {
    printf ("Error reading a response from the device %d.\n", i+1);
    } else
    {
        printf ("\nDevice %d: %*s\n", i+1,retCount, buffer); }
```

```
                status = viClose (instr);
        }
        /** Now we will close the session to the instrument using
        * viClose. This operation frees all system resources.                    */
        status = viClose (defaultRM);
        printf("Press 'Enter' to exit.");
        fflush(stdin);
        getchar();
        return 0;
}
```

b) TCP/IP:

```
        intTCP_IP_Test(char *pIP) {
                char outputBuffer[VI_FIND_BUFLEN];
                ViSession defaultRM, instr;
                ViStatus status;
                ViUInt32 count;
                ViUInt16 portNo;
                /* First we will need to open the default resource manager. */
                status = viOpenDefaultRM (&defaultRM);
                if (status<VI_SUCCESS)
                {
                        printf("Could not open a session to the VISA Resource Manager!\n");
                }
                /* Now we will open a session via TCP/IP device */
                charhead[256] ="TCPIP0::";
                chartail[] ="::INSTR";
                charresource [256];
                strcat(head,pIP);
```

```
            strcat(head,tail);
            status = viOpen (defaultRM, head, VI_LOAD_CONFIG, VI_NULL, &instr);
            if (status<VI_SUCCESS) {
                    printf ("An error occurred opening the session\n");
                    viClose(defaultRM); }
            status = viPrintf(instr, "*idn?\n");
            status = viScanf(instr, "%t", outputBuffer); if
            (status<VI_SUCCESS)
                     {
                    printf("viRead failed with error code: %x \n",status);
                    viClose(defaultRM);
            } else
            {
                    printf ("\ndata read from device: %*s\n", 0,outputBuffer); }
            status = viClose (instr);
            status = viClose (defaultRM);
            printf("Press 'Enter' to exit.");
            fflush(stdin);
            getchar();
             return 0;



    }
```

VB Example

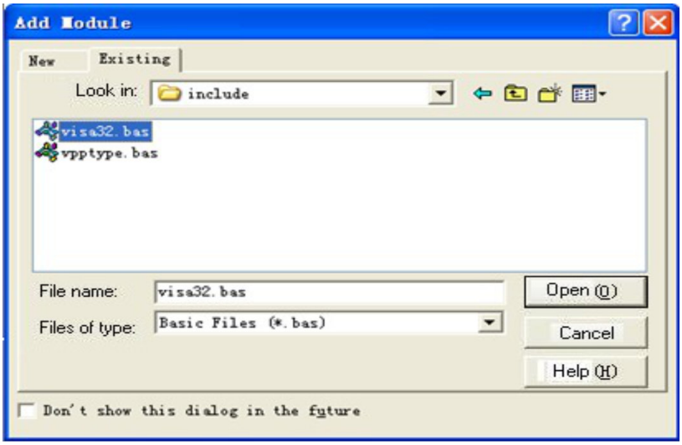
Environment: Windows7 32-bit, Microsoft Visual Basic 6.0

Description: The function of this example: Use the NI-VISA, to control the device with USBTMC and TCP/IP access to do a write and read.

Steps:

1.Open Visual Basic, and build a standard application program project.

2.Set the project environment to use the NI-VISA lib: Click the Existing tab of Project>>Add Module, search the visa32.bas file in the "include" folder under the NI-VISA installation path and add the file, as shown in the figure below:


Add Module

New | Existing

Look in: include

visa32.bas
vpptype.bas

File name: visa32.bas

Files of type: Basic Files (*.bas)

Open (O)
Cancel
Help (H)

Don't show this dialog in the future

3. Coding:

a) USBTMC:

```
Private Function Usbtmc_test() As Long
    ' This code demonstrates sending synchronous read & write commands
' to an USB Test & Measurement Class (USBTMC) instrument using '
NI-VISA
' The example writes the "*IDN?\n" string to all the USBTMC '
devices connected to the system and attempts to read back
' results using the write and read functions.
 ' The general flow of the code is
'    Open Resource Manager
'    Open VISA Session to an Instrument
'    Write the Identification Query Using viWrite '
     Try to Read a Response With viRead
'    Close the VISA Session
Const MAX_CNT = 200

Dim defaultRM As Long
Dim instrsesn As Long
Dim numlnstrs As Long
Dim findList As Long Dim
retCount As Long Dim
writeCount As Long Dim
status As Long
Dim instrResourceString As String * VI_FIND_BUFLEN
Dim buffer As String * MAX_CNT
Dim i As Integer
 ' First we must call viOpenDefaultRM to get the manager '
handle. We will store this handle in defaultRM.
status = viOpenDefaultRM(defaultRM)
If (status < VI_SUCCESS) Then
        Debug.Print "Could not open a session to the VISA Resource Manager!"
        Usbtmc_test = status
        ExitFunction
End If
```

```
' Find all the USB TMC VISA resources in our system and store the
' number of resources in the system in numInstrs.
 status=viFindRsrc(defaultRM,"USB?*INSTR",findList,numlnstrs,instrResourceString)
If (status < VI_SUCCESS) Then
        Debug.Print "An error occurred while finding resources."
        viClose  (defaultRM)
        Usbtmc_test = status
        Exit Function
End If

 ' Now we will open VISA sessions to all USB TMC instruments.
 ' We must use the handle from viOpenDefaultRM and we must
' also use a string that indicates which instrument to open. This
' is called the instrument descriptor.  The format for this string
' can be found in the function panel by right clicking on the
' descriptor parameter. After opening a session to the
' device, we will get a handle to the instrument which we
' will use in later VISA functions.   The AccessMode and Timeout '
parameters in this function are reserved for future
' functionality.  These two parameters are given the value VI_NULL.
For i = 0 To numInstrs If
        (i > 0) Then
                status = viFindNext(findList, instrResourceString)
        End If
       status = viOpen(defaultRM, instrResourceString, VI_NULL, VI_NULL, instrsesn)
        If (status < VI_SUCCESS) Then
                Debug.Print "Cannot open a session to the device ", i + 1
                GoTo NextFind
        End If

        ' At this point we now have a session open to the USB TMC instrument.
```

```
            ' We will now use the viWrite function to send the device the string "*IDN?", '
            asking for the device's identification.
            status = viWrite(instrsesn, "*IDN?", 5, retCount)
            If (status < VI_SUCCESS) Then
                 Debug.Print "Error writing to the device."
                 status = viClose(instrsesn)
                 GoTo NextFind
            End If

            ' Now we will attempt to read back a response from the device to '
            the identification query that was sent.  We will use the viRead
            ' function to acquire the data.
            ' After the data has been read the response is displayed.
            status = viRead(instrsesn, buffer, MAX_CNT, retCount)
            If (status < VI_SUCCESS) Then
                Debug.Print "Error reading a response from the device.", i + 1
            Else
                Debug.Print i + 1, retCount, buffer
            End If
            status = viClose(instrsesn)
        Next i

        ' Now we will close the session to the instrument using '
        viClose. This operation frees all system resources.
         status = viClose(defaultRM)
        Usbtmc_test = 0
    End Function
```

b) TCP/IP:

```
    Private Function TCP_IP_Test(ip As String) As Long
```

```
Dim outputBuffer As String * VI_FIND_BUFLEN
Dim defaultRM As Long
Dim instrsesn As Long
Dim status As Long
Dim count As Long

' First we will need to open the default resource manager.
status = viOpenDefaultRM (defaultRM)
If (status < VI_SUCCESS) Then
        Debug.Print "Could not open a session to the VISA Resource Manager!"
        TCP_IP_Test = status
        Exit Function
End If

' Now we will open a session via TCP/IP device
status = viOpen(defaultRM, "TCPIP0::" + ip + "::INSTR", VI_LOAD_CONFIG,
VI_NULL, instrsesn)
 If (status < VI_SUCCESS) Then
        Debug.Print "An error occurred opening the session"
        viClose (defaultRM)
        TCP_IP_Test = status
        Exit Function
End If

status = viWrite(instrsesn, "*IDN?", 5, count) If
 (status < VI_SUCCESS) Then
        Debug.Print "Error writing to the device."
End If
status = viRead(instrsesn, outputBuffer, VI_FIND_BUFLEN, count) If
(status < VI_SUCCESS) Then
        Debug.Print "Error reading a response from the device.", i + 1
```

```
    Else
        Debug.Print "read from device:", outputBuffer
    End If
    status = viClose(instrsesn)
    status = viClose(defaultRM)
    TCP_IP_Test = 0
End Function
```

MATLAB Example

Environment: Windows7 32-bit, MATLAB R2010b

Description: The function of this example: Use the NI-VISA, to control the device with USBTMC or TCP/IP access to do a write and read.

Steps:

1.Open MATLAB, and modify the current directory. In this demo, the current directory is modified to D:\USBTMC_TCPIP_Demo.

2. Click File>>New>>Script in the Matlab interface to create an empty M file.

3. Coding:

a) USBTMC:

```
function USBTMC_test()
% This code demonstrates sending synchronous read & write commands
% to an USB Test & Measurement Class (USBTMC) instrument using %
NI-VISA

%Create a VISA-USB object connected to a USB instrument
vu = visa('ni','USB0::0xF4EC::0xEE38::0123456789::INSTR ');

%Open the VISA object created
fopen(vu);

%Send the string "*IDN?",asking for the device's identification.
fprintf(vu,'*IDN?');

%Request the data
outputbuffer = fscanf(vu);
disp(outputbuffer);

%Close the VISA object
fclose(vu);
delete(vu);
clear vu;

end
```

b) TCP/IP:

```
function TCP_IP_test( IPstr )
% This code demonstrates sending synchronous read & write commands
% to an TCP/IP instrument using NI-VISA

%Create a VISA-TCPIP object connected to an instrument
%configured with IP address.
vt = visa('ni',['TCPIP0::',IPstr,'::INSTR']);

%Open the VISA object created
fopen(vt);

%Send the string "*IDN?",asking for the device's identification.
fprintf(vt,'*IDN?');

%Request the data
outputbuffer = fscanf(vt);
disp(outputbuffer);

%Close the VISA object
fclose(vt);
delete(vt);
clear vt;

end
```

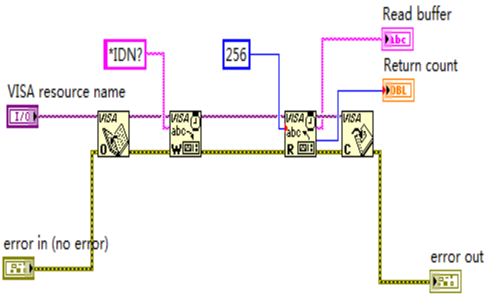
LabVIEW Example

Environment: Windows7 32-bit, LabVIEW 2011

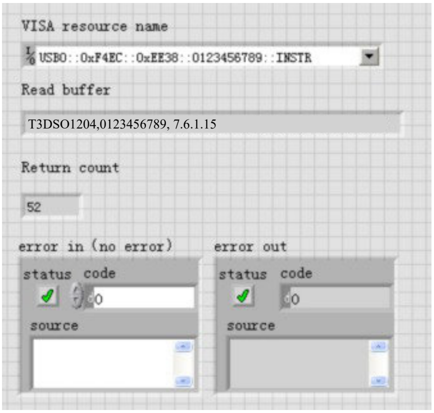
Description: The functions of this example: use the NI-VISA, to control the device with USBTMC and TCP/IP access to do a write and read.

Steps:

1. Open LabVIEW, create a VI file.
2. Add controls. Right-click in the **Front Panel** interface, select and add **VISA resource name**, error in, error out and some indicators from the Controls column.
3. Open the **Block Diagram** interface. Right-click on the **VISA resource name** and you can select and add the following functions from VISA Palette from the pop-up menu: **VISA Write**, **VISA Read**, **VISA Open** and **VISA Close**.
4. The connection is as shown in the figure below:



5. Select the device resource from the VISA Resource Name list box and run the program.

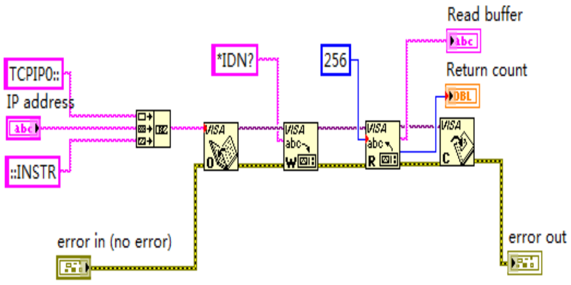


T3DSO1204,0123456789, 7.6.1.15

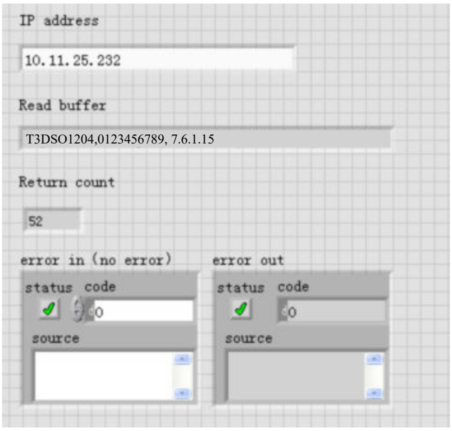
52

In this example, the VI opens a VISA session to a USBTMC device, writes a command to the device, and reads back the response. After all communication is complete, the VI closes the VISA session.

6. Communicating with the device via TCP/IP is similar to USBTMC. But you need to change VISA Write and VISA Read Function to Synchronous I/O. The LabVIEW default is asynchronous I/O. Right-click the node and select Synchronous I/O Mod>>Synchronous from the shortcut menu to write or read data synchronously.
7. The connection is as shown in the figure below:



8. Input the IP address and run the program.



IP address

10.11.25.232

Read buffer

T3DSO1204,0123456789, 7.6.1.15

Return count

52

error in (no error)

status ✓ code 0

source

error out

status ✓ code 0

source

C# Example

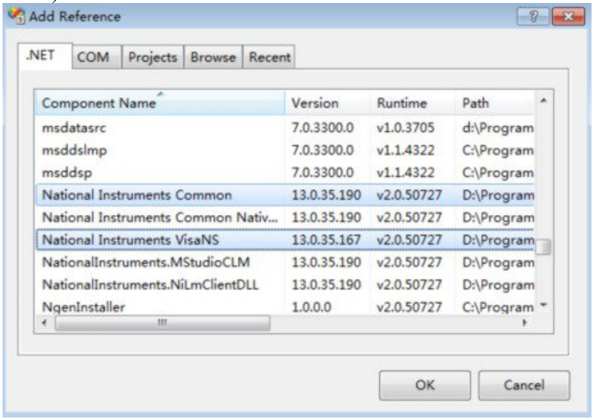
Environment: Windows7 32-bit, Visual Studio

Description: The functions of this example: use the NI-VISA, to control the device with USBTMC or TCP/IP access to do a write and read.

Steps:

1.Open Visual Studio, create a new C# project.

2.Add References. Add NationalInstruments.Common.dll and NationalInstruments.VisaNS.dll to the project. (Notice: you must install the .NET Framework 3.5/4.0/4.5 Languages support when you install the NI-VISA.)



Component Name	Version	Runtime	Path
msdatasrc	7.0.3300.0	v1.0.3705	d:\Program
msddslmp	7.0.3300.0	v1.1.4322	C:\Program
msddsp	7.0.3300.0	v1.1.4322	C:\Program
National Instruments Common	13.0.35.190	v2.0.50727	D:\Program
National Instruments Common Nativ...	13.0.35.190	v2.0.50727	D:\Program
National Instruments VisaNS	13.0.35.167	v2.0.50727	D:\Program
NationalInstruments.MStudioCLM	13.0.35.190	v2.0.50727	D:\Program
NationalInstruments.NiLmClientDLL	13.0.35.190	v2.0.50727	D:\Program
NgenInstaller	1.0.0.0	v2.0.50727	C:\Program

3. Coding:

```
using System;

using System.Collections.Generic;

using System.Linq;

using System.Text;

using NationalInstruments.VisaNS;


namespace TestVisa
```

```
{
    class Program
    {
        static void Main(string[] args)
        {
            // Find all the USBTMC resources
            string[]
            usbRsrcStrings=ResourceManager.GetLocalManager().FindResources("
            USB?*INSTR");
            if (usbRsrcStrings.Length <= 0)
            {
                Console.WriteLine("Can not find USBTMC Device!");
                return;
            }

            //Choose the first resource string to connect the device.
            //You can input the address manually
            //USBTMC:
            //MessageBasedSession
            mbSession=(MessageBasedSession)ResourceManager.GetLocalManager
            ().Open("USB0::0xF4EC::0xEE38::0123456789:: INSTR");
            /TCP IP:
            //MessageBasedSession
            mbSession=(MessageBasedSession)ResourceManager.GetLocalManager
            ().Open("TCPIP0::192.168.1.100::INSTR");
            MessageBasedSession
            mbSession=(MessageBasedSession)ResourceManager.GetLocalManager
            ().Open(usbRsrcStrings[0]);
            mbSession.Write("*IDN?");
            string result = mbSession.ReadString();
            mbSession.Dispose();
```

```
                Console.WriteLine(result);
            }
        }
    }
```

Examples of Using Sockets

Socket communication is a basic communication technology in computer network. It allows applications to communicate through the standard network protocol mechanism built by network hardware and operation system.
This method is a two-way communication between the instrument and the computer through a fixed port number.

Note that SCPI strings are terminated with a “\n” (new line) character.

Python Example

Python has a low-level networking module that provides access to the socket interface. Python scripts can be written for sockets to do a variety of test and measurement tasks.

Environment: Windows 7 32-bit, Python v2.7.5
Description: Open a socket, send a query, and repeat this loop for 10 times, finally close the socket.

Below is the code of the script:

```
#!/usr/bin/env python

#-*- coding:utf-8 –*-

#-------------------------------------------------------------------------- #

The short script is a example that open a socket, sends a query, #

print the return message and closes the socket.

#--------------------------------------------------------------------------

import socket   # for sockets

import sys  # for exit

import time # for sleep

#--------------------------------------------------------------------------

remote_ip = "10.11.13.32"  # should match the instrument‘s IP address

port = 5024 # the port number of the instrument service

count = 0
```

```
def SocketConnect():
    try:
        #create an AF_INET, STREAM socket (TCP)
        s = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
    except socket.error:
        print ('Failed to create socket.')
        sys.exit();
    try:
        #Connect to remote server
        s.connect((remote_ip , port))
        info = s.recv(4096)
        print (info)
    except socket.error:
        print ('failed to connect to ip ' + remote_ip)
    return s

def SocketQuery(Sock, cmd):
    try :
        #Send cmd string
        Sock.sendall(cmd)
        time.sleep(1)
    except socket.error:
        #Send failed
        print ('Send failed')
        sys.exit()
    reply = Sock.recv(4096)
    return reply

def SocketClose(Sock):
    #close the socket
    Sock.close()
    time.sleep(.300)

def main():
    global remote_ip
    global port global
    count

    # Body: send the SCPI commands *IDN? 10 times and print the return message
    s = SocketConnect()
    for i in range(10):
        qStr = SocketQuery(s, b'*IDN?')
        print (str(count) + ":: " + str(qStr))
        count = count + 1
    SocketClose(s)
    input('Press "Enter" to exit')

if __name__ == '__main__':
    proc = main()
```

C Example

```
int MySocket;
if((MySocket=socket(PF_INET,SOCK_STREAM,0))==-1)
{
        exit(1);
}
struct in_addr
{
        unsigned long s_addr;
};
struct sockaddr_in
{
        short int sin_family; // Address family
        unsigned short int sin_port; // Port number
        struct in_addr sin_addr; // Internet address
        unsigned char sin_zero[8]; // Padding
};
struct sockaddr_in MyAddress;

// Initialize the whole structure to zero
memset(&MyAddress,0,sizeof(struct sockaddr_in)); //
Then set the individual fields
MyAddress.sin_family=PF_INET; // IPv4
MyAddress.sin_port=htons(5025); // Port number used by most instruments
MyAddress.sin_addr.s_addr=inet_addr(―169.254.9.80‖ ); // IP Address

// Establish TCP connection
if(connect(MySocket,(struct sockaddr*)&MyAddress,sizeof(struct sockaddr_in))==-1)
{
        exit(1);
}

// Send SCPI command
if(send(MySocket,"*IDN?\n",6,0)==-1)
{
        exit(1);
}

// Read response
char buffer[200];
int actual;
if((actual=recv(MySocket,&buffer[0],200,0))==-1)
{
        exit(1);
}
```

```
buffer[actual]=0; // Add zero character (C string)
printf(”Instrument ID: %s\n”,buffer);

// Close socket
if(close(MySocket)==-1)
{
        exit(1);
}
```

Common Command Examples

This section lists the programming instances of common commands.

Environment: Windows 7 32-bit, Python v3.4.3, pyvisa-1.7, Matplotlib-1.5.1

Read Waveform Data (WF) Example

```
import visa
import pylab as pl

def main():
    _rm = visa.ResourceManager()
    dso = _rm.open_resource("USB0::0xF4EC::0xEE38::0123456789::INSTR")
    dso.write("chdr off")
    vdiv = dso.query("c1:vdiv?")
    ofst = dso.query("c1:ofst?")
    tdiv = dso.query("tdiv?")
    sara = dso.query("sara?")
    sara_unit = {'G':1E9,'M':1E6,'k':1E3}
    for unit in sara_unit.keys():
        if sara.find(unit)!=-1:
            sara = sara.split(unit)
            sara = float(sara[0])*sara_unit[unit]
            break
    sara = float(sara)
    dso.timeout = 30000 #default value is 2000(2s)
    dso.chunk_size = 20*1024*1024 #default value is 20*1024(20k bytes)
    dso.write("c1:wf? dat2")
    recv = list(dso.read_raw())[15:]
    recv.pop()
    recv.pop()
    volt_value = []
    for data in recv:
        if data > 127:
            data = data - 255
        else:
            pass
        volt_value.append(data)
    time_value = []
    for idx in range(0,len(volt_value)):
        volt_value[idx] = volt_value[idx]/25*float(vdiv)-float(ofst)
        time_data = -(float(tdiv)*14/2)+idx*(1/sara)
        time_value.append(time_data)
    pl.figure(figsize=(7,5))
    pl.plot(time_value,volt_value,markersize=2,label=u"Y-T")
    pl.legend()
    pl.grid()
    pl.show()

if __name__=='__main__':
    main()
```

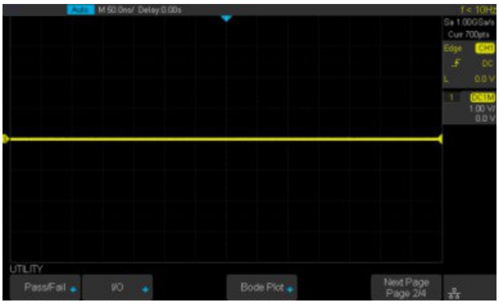
Read Waveform Data of Digital Example

```
import visa import
pylab as pl

def  get_char_bit(char,n):
    return (char >> n) & 1

def main():
    _rm = visa.ResourceManager()
    dso = _rm.open_resource("USB0::0xF4EC::0xEE38::0123456789::INSTR")
    dso.write("chdr off")
    tdiv = dso.query("tdiv?")
    sara = dso.query("di:sara?")
    sara_unit = {'G':1E9,'M':1E6,'k':1E3}
    for unit in sara_unit.keys():
        if sara.find(unit)!=-1:
            sara = sara.split(unit)
            sara = float(sara[0])*sara_unit[unit]
            break
    sara = float(sara)
    dso.timeout = 30000 #default value is 2000(2s)
    dso.chunk_size = 20*1024*1024  #default value is 20*1024(20k bytes)
    dso.write("d0:wf? dat2")
    recv = list(dso.read_raw())[15:]
    recv.pop()
    recv.pop()
    volt_value = []
    data =bytearray(recv)

    for char in data:
        for i in range(0,8):
            volt_value.append(get_char_bit(char,i))
    print(len(volt_value))
    time_value = []
    for idx in range(0,len(volt_value)):
        time_data = -(float(tdiv)*14/2)+idx*(1/sara)
        time_value.append(time_data)

    pl.figure(figsize=(7,5))
    pl.ylim(-1,2)
    pl.plot(time_value,volt_value,markersize=2,label=u"Y-T")
    pl.legend()
    pl.grid()
    pl.show()

if __name__=='__main__':
    main()
```

Screen Dump (SCDP) Example

```
import visa

def main():
    _rm = visa.ResourceManager()
    dso = _rm.open_resource("USB0::0xF4EC::0xEE38::0123456789::INSTR ")
    file_name = "F:\\SCDP.bmp"
    dso.write("SCDP")
    result_str = dso.read_raw()
    f = open(file_name,'wb')
    f.write(result_str)
    f.flush()
    f.close()

if __name__=='__main__':
    main()
```

Then you can open the file as shown below:



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