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Digital Storage Oscilloscope

GDS-806/810/820/840

Programming Manual

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GW Part No: 82DS-82000I0

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Due to continuous improvements in the GDS-806/810/820/840 Digital Storage Oscilloscope, information contained in this manual is subject to change without notice. Contact GOOD WILL, for revisions and corrections.

GOOD WILL Instrument Co., LTD.

NO. 95-11, PAO-CHUNG ROAD, HSIN-TIEN CITY,

TAIPEI HSIEN, TAIWAN

Telephone – 886-2-29179188 Fax – 886-2-2917-9189

E-mail - marketing@goodwill.com.tw

http://www.goodwill.com.tw

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1. Introduction

Users can drive this digital storage oscilloscope by using the GPIB (*General Purpose Interface Bus*) system with a computer, or from a computer across the RS-232 serial connection. Commands sent over either interface can read or set any GDS-806/810/820/840's instructions. This chapter explains how to carry out the following tasks.

Notes for GPIB installation

If you are setting up the oscilloscope with a GPIB system, please check the following regulations:

- *Only a maximum of 15 devices can be connected to a single GPIB bus.*
- *Do not use more than 20 m of cable to connect devices to a bus.*
- *Connect one device for every 2 m of cable used.*
- *Each device on the bus needs a unique device address. No two devices can share the same device address.*
- *Turn on at least two-thirds of the devices on the GPIB system while you use the system.*
- *Do not use loop or parallel structure for the topology of GPIB system.*

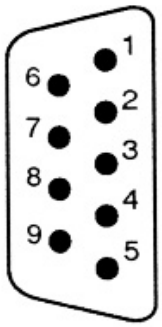
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Notes for RS-232 Configuration

This oscilloscope contains a DB 9-pin, male RS-232 connector for serial communication with a computer or terminal. The RS-232 interface of this oscilloscope is configured as an RS-232 "***Data Terminal Equipmen***t", so that data is sent from pin 3 and received on pin 2. For remote controls, the RS-232 interface has to be connected with a computer or terminal.

Pin Assignments

The pin assignments for RS-232 interface of the oscilloscope are listed below.



1. No connection
2. Receive Data(RxD) (input)
3. Transmit Data(TxD) (output)
4. No connection
5. Signal Ground (GND)
6. No connection
7. No connection
8. No connection
9. No connection

Figure 1-1: Pin assignments for the RS232 connector

DB9 to DB9 Wiring

The wiring configuration is used for computer with DB9 connectors that configured as Data Terminal Equipment.

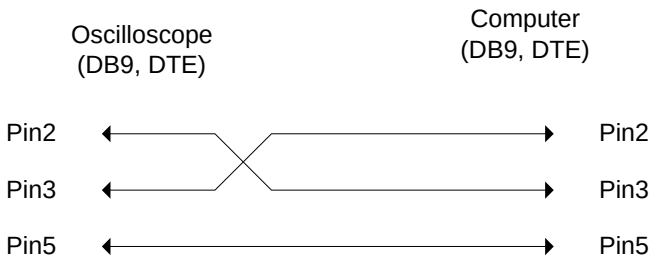


Figure 1-2: DB9 to DB9 wiring

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When the oscilloscope is set up with a RS-232 interface, please check the following points:

- ***Do not connect the output line of one DTE device to the output line of the other.***
- ***Many devices require a constant high signal on one or more input pins.***
- ***Ensure that the signal ground of the equipment is connected to the signal ground of the external device.***
- ***Ensure that the chassis ground of the equipment is connected to the chassis ground of the external device.***
- ***Do not use more than 15m of cable to connect devices to a PC.***
- ***Ensure the same configurations are used on the device as the one used on PC terminal.***
- ***Ensure the connector for the both side of cable and the internal connected line are met the demand of the instrument.***

Computer's Connection for RS-232

A personal computer with a COM port is the essential facilities in order to operate the digitizing oscilloscope via RS-232 interface.

The connections between oscilloscope and computer are as follows:

I. Connect one end of a RS-232 cable to the computer.

II. Connect the other end of the cable to the RS-232 port on the oscilloscope.

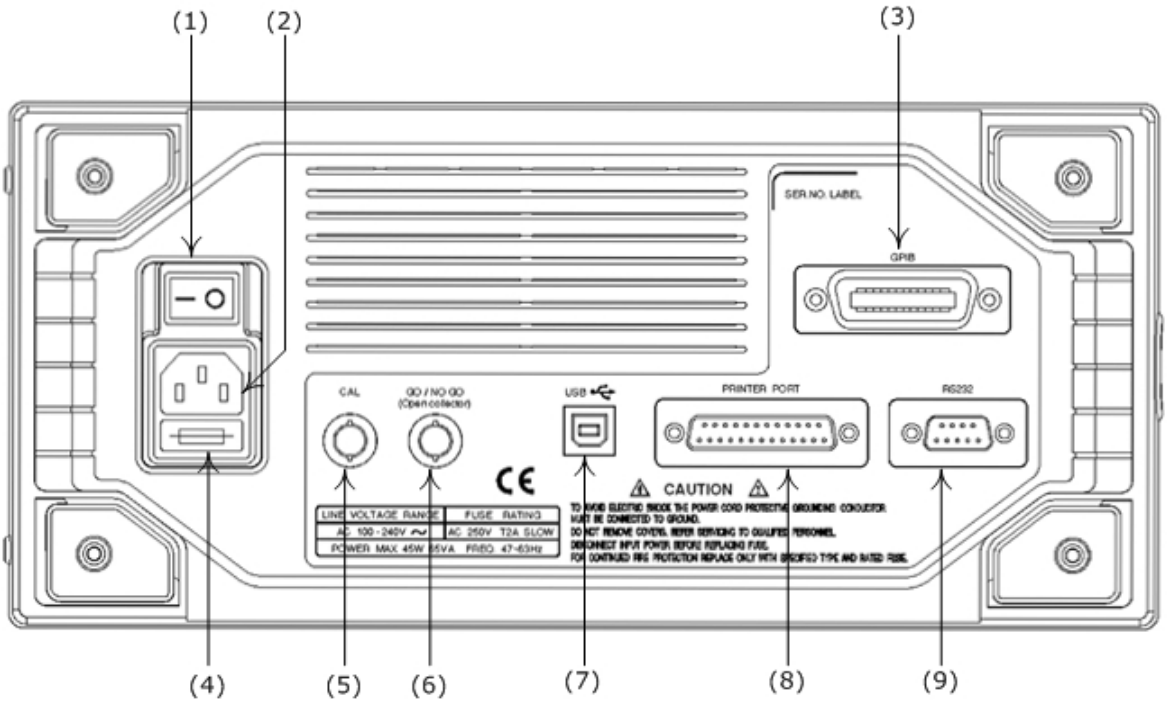
III. Turn on the oscilloscope.

IV. Turn on the computer.

Figure 1-3, shows the GPIB port and RS-232 port's locations on the rear panel of the oscilloscope.

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Figure 1-3. Rear panel of the oscilloscope



(1): Main power switch
(2): AC power socket
(3): GPIB port (option for all series oscilloscopes)
(4): Fuse drawer
(5): “SELF CAL” BNC output
(6): “GO/NO GO” BNC output (option for GDS-806/810)
(7): USB connector (option for GDS-806/810)
(8): Printer port (option for GDS-806/810)
(9): RS-232 port

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2. Computer's Connection

A personal computer with a GPIB card is the essential stuff in order to operate the oscilloscope via GPIB interface.

The connections between oscilloscope and computer are following:

I. Connect one end of a GPIB cable to the computer.

II. Connect the other end of the GPIB cable to the GPIB port on the Oscilloscope.

III. Turn on the oscilloscope.

IV. Turn on the computer.

The GPIB interface capabilities:

The GPIB interface of the oscilloscope corresponds to the standard of IEEE488.1-1987, IEEE488.2-1992 and SCPI-1994. The GPIB interface functions are listed as follows:

SH1(Source Handshake):	The oscilloscope can transmit multilane messages across the GPIB.
AH1(Acceptor Handshake):	The oscilloscope can receive multilane messages across the GPIB.
T6(Talker):	Talker interface function includes basic talker, serial poll, and unaddress if MLA capabilities, without talk only mode function.
L4 (Listener):	The oscilloscope becomes a listener when the controller sends its listen address with the ATN (attention) line asserted. The oscilloscope does not have listen only capability.

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SR1 (Service Request):	The oscilloscope asserts the SRQ (Service request) line to notify the controller when it requires service.
RL1 (Remote/Local):	The oscilloscope responds to both the GTL (Go to Local) and LLO (Local Lock Out) interface messages.
PP0 (Parallel Poll):	The oscilloscope has no Parallel Poll interface function.
DC1 (Device Clear):	The oscilloscope has Device clear capability to return the device to power on status.
DT0 (Device Trigger):	The oscilloscope has no Device Trigger interface function.

C0 (Controller) : This oscilloscope can not control other devices.

The GPIB address setting

To change the GPIB address, please use the following steps:

- Press the **UTILITY** button on the front panel. The utility menu provides **Interface Menu** sub menu by pressing **F2** softkey which GPIB sub menu is included. Press **F1** softkey to select GPIB setting menu.

  For GPIB sub menu

  - **Type GPIB**: Select GPIB port.
  - **Addr 1~30**: select the appropriate address for GPIB.
  - **Previous Menu**: back to previous menu.

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The GPIB connection testing

If you want to test the GPIB connection is whether working or not, use the National Instrument's "Interactive Control utility" for instance, you communicate with the GPIB devices through calls you interactively type in at the keyboard.

The Interactive Control can help you to learn about the instrument and to troubleshoot problems by displaying the following information on your screen after you enter a command:

- Results of the status word (`ibsta`) in hexadecimal notation
- Mnemonic constant of each bit set in `ibsta`
- Mnemonic value of the error variable (`iberr`) if an error exists (the ERR bit is set in `ibsta`)
- Count value for each read, write, or command function
- Data received from your instrument

You can access online help in Interactive Control by entering help at the prompt, or you can get help on a specific function by entering help <function> at the prompt, where <function> is the name of the function for which you want help.

To start Interactive Control within National Instrument's "Measurement & Automation Explorer", complete the following steps:

1. Select Tools→I-488.2 Utilities→Interactive Control.

2. Open either a board handle or device handle to use for further NI-488.2 calls. Use `ibdev` to open a device handle, `ibfind` to open a board handle, or the set 488.2 command to switch to a 488.2 prompt.

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The following example uses `ibdev` to open a device, assigns it to access board gpib0, chooses a primary address of 7 with no secondary address, sets a timeout of 10 seconds, enables the `END` message, and disables the `EOS` mode.

```
:ibdev
    enter board index: 0
    enter primary address: 7
    enter secondary address: 0
    enter timeout: 13
    enter 'EOI on last byte' flag: 1
    enter end-of-string mode/byte: 0
ud0:
```

Note: If you type a command and no parameters, Interactive Control prompts you for the necessary arguments. If you already know the required arguments, you can type them at the command prompt, as follows:

```
:ibdev 0 7 0 13 1 0
ud0:
```

Note: If you do not know the primary and secondary address of your GPIB instrument, right-click on your GPIB interface in Measurement & Automation Explorer and select Scan for Instruments. After Explorer scans your interface, it displays your instrument address in the right window panel.

3. After you successfully complete `ibdev`, you have a `ud` prompt. The new prompt, `ud0`, represents a device-level handle that you can use for further NI-488.2 calls. To clear the device, use `ibclr`, as follows:

```
ud0: ibclr
[0100] (cmpl)
```


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4. To write data to the device, use `ibwrt`.

```
ud0: ibwrt "*IDN?"
[0100] (cmpl)
count: 5
```

5. To read data from your device, use `ibrd`. The data that is read from the instrument is displayed. For example, to read 28 bytes, enter the following:

```
ud0: ibrd 28
[0100] (cmpl)
count: 28

47 57 2C 20 47 44 53 2D     GW, GDS-
38 32 30 2C 20 50 39 32     820, P92
30 31 33 30 2C 20 56 2E     0130, V.
31 2E 30 39                 1.09
```

6. When you finish communicating with the device, make sure you put it offline using the `ibonl` command, as follows:

```
ud0: ibonl 0
[0100] (cmpl)
:
```

The `ibonl` command properly closes the device handle and the `ud0` prompt is no longer available.

7. To exit Interactive control, type `q`.

For the details, please refer to National Instrument's manual.

If you do not receive a proper response from the oscilloscope, please check the power is on, the GPIB address is correct, and all cable connections are active,

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The RS232 connection testing

If you want to test whether the RS-232 connection is working or not, you can send a command from computer. For instance, using a terminal program send the query command

*idn?

should return the Manufacturer, model number, serial number and firmware version in the following format:

GW,GDS-820,P920130,V.2.01

If you do not receive a proper response from the oscilloscope, please check if the power is on, the RS-232 configurations are the same on both sides, and all cable connections are active.

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3. Remote Control's Commands

This oscilloscope can be operated from computer via the GPIB port or RS-232 port. The remote commands of this oscilloscope are compatible with IEEE-488.2 and SCPI standards partially.

SCPI

SCPI (Standard Commands for Programmable Instruments) is a standard that created by an international consortium of the major test and measurement equipment manufacturers. The IEEE-488.2 syntax has been adopted by SCPI to furnish common commands for the identical functions of different programmable instruments.

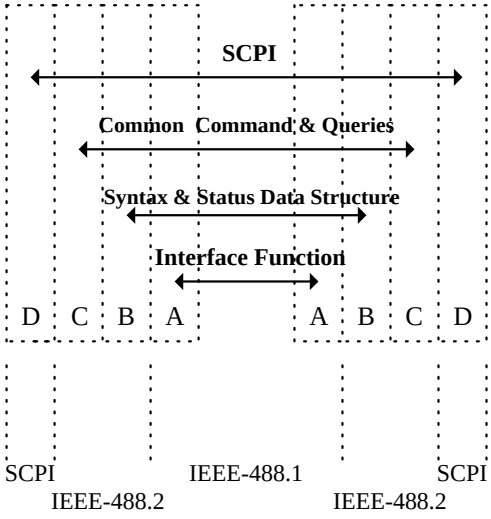


Figure 3-1: the relationship between IEEE-488.1, IEEE-488.2, and SCPI.

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As shown in the figure 3-1, the IEEE-488.1 standard locates at layer A, the layer A is belonged to the protocol of interface function on the GPIB bus. The source handshake (SH), acceptor handshake (AH) and talker are included in this layer (10 interface functions totally).

At layer B, the syntax and data structure could be the essence of entire IEEE-488.2 standard. The syntax defines the function of message communication, which contain the <PROGRAM MESSAGE> (or simply “commands”) and <RESPONSE MESSAGE>. The two kinds of messages are represented the syntax formation of device command and return value. The data structure is the constitution of status reporting, which IEEE-488.2 standard have been defined.

The common commands and queries are included with layer C. Commands and queries can be divided into two parts: mandatory and optional. Commands modify control settings or tell the instrument to perform a specific action. Queries cause the instrument to send data or status information back to the computer. A question mark at the end of a command identifies it as a query.

Layer D is interrelated with device information. Different devices have different functions. SCPI command sets are belonged to this layer.

Command Syntax

If you want to transfer any of the instructions to an instrument, and comply with SCPI, there are three basic elements must be included.

- Command header
- Parameter (if required)
- Message terminator or separator

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Command Header

The command header has a hierarchical structure that can be represented by a command tree (Figure 3-2).

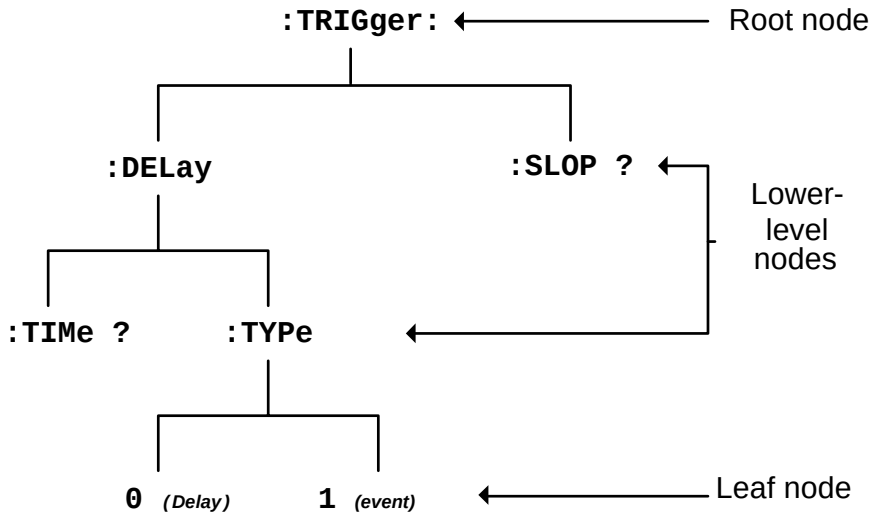


Figure 3-2: Tree hierarchy

The top level of the tree is the root level. A root node is located at the root level. A root node and one or more lower-level nodes form a header path to the last node called the leaf node.

The command header is configured by header path and leaf node. Figure 3-3 shows the command header for the leaf node.

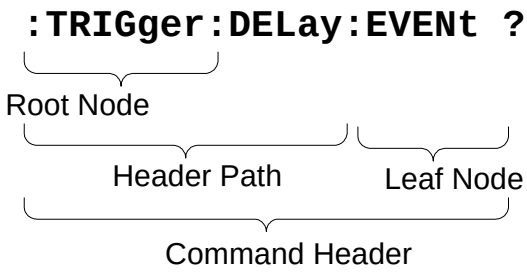


Figure 3-3: Command header

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Parameter

If the command has parameters, the values have to be included. In this manual, when we expressed the syntax of the command, the < > symbols are used for enclosing the parameter type. For instance, the syntax of the command in Figure 8-5 includes the Boolean parameter type

NOTE: Do not include the <, >, or | symbols when entering the actual value for a parameter.

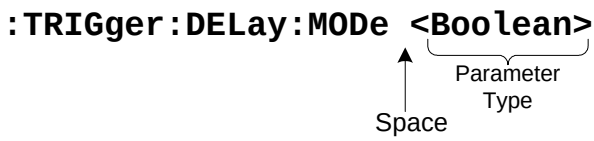


Figure 3-4: Command Header with Parameter

Table 3-1 defines the Boolean and other parameter types for the oscilloscope.

Parameter Type	Description	Example
Boolean	Boolean numbers or values	1 0
NR1	Integers	0, 1, 18
NR2	Decimal numbers	1.5, 3.141, 8.4
NR3	Floating point numbers	4.5E-1, 8.25E+1
NRf	NR1, NR2, or NR3	1, 1.5, 4.5E-1

Table 3-1: Parameter Types for Syntax Descriptions

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For the actual value of the parameter type <Boolean>, you have to enter 0 instead of “OFF” or enter 1 instead of “ON”.

The following example includes both the header and a value for the parameter type:

```
:TRIGger:NREJ 0
```

Parameter values that appeared in this manual are often separated by a vertical line. This vertical line means the same thing as the word "or," For example, values for the parameter <Boolean> are

```
0|1
```

This is the same thing as saying "0 (off) or 1 (on)" Any single value is a valid parameter.

Message Terminator and Message Separator

In accordance with IEEE 488.2 standard, this oscilloscope accepts any of the following message terminators:

- LF^END Line feed code (hexadecimal 0A) with END message
- LF Line feed code
- <dab>^END Last data byte with END message

These terminators are compatible with most application programs.

A semicolon separates one command from another when the commands appear on the same line.

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Entering Commands

The standards that govern the command set for this oscilloscope allow for a certain amount of flexibility when you enter commands. For instance, you can abbreviate many commands or combine commands into one message that you send to the oscilloscope. This flexibility, called friendly listening, saves programming time and makes the command set easier to remember and use.

Command Characters

This oscilloscope is not sensitive to the case of command characters. You can enter commands in either uppercase or lowercase.

You can precede any command with white space characters. You must, however, use at least one space between the parameter and the command header.

Abbreviating Commands

Most commands have a long form and a short form. The listing for each command in this section shows the abbreviations in upper case. For instance, you can enter the query

```
:TIMebase:SCALe ?
```

simply as

```
:TIM:SCAL ?
```


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Combining Commands

You can use a semicolon (;) to combine commands and queries. This oscilloscope executes coherent commands in the order it receives them. When you coherent queries, the oscilloscope will combine the responses into a single response message. For example, if the frequency and amplitude of the signal are equal to 100kHz and 1V, the command

```
:MEASure:FREQuency?;:MEASure:VAMPlitude?
```

returns the message

100kHz 1v

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4. Details of Command Reference

Each command in this chapter will give a brief description. The examples of each command will be provided and what query form might return.

*CLS (no query form)

Clears all event status data register. This includes the Output Queue, Operation Event Status Register, Questionable Event Status Register, and Standard Event Status Register.

Syntax

`*CLS`

Examples

`*CLS` clears all event registers.

*ESE

Sets or returns the bits in the Event Status Enable Register (ESER). The ESER enables the Standard Event Status Register (SESR) to be summarized on bit 5 (ESB) of the Status Byte Register (SBR).

Syntax

`*ESE<NR1>`

`*ESE?`

Arguments

<NR1> is a number from 0 to 255. The binary bits of the ESER are set according to this value.

Returns

<NR1> is a number from 0 to 255 that indicates the decimal value of the binary bits of the ESER.

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Examples

*ESE 65 sets the ESER to binary 0100 0001.

If the ESER contains the binary value 1000 0010, the *ESE? will return the value of 130.

***ESR? (query only)**

Returns and clears the contents of the Standard Event Status Register (SESR).

Syntax

*ESR?

Returns

<NR1> is a number from 0 to 255 that indicates the decimal value of the binary bits of the ESER.

Examples

If the ESER contains the binary value 1100 0110, the *ESR? will return the value of 198.

***IDN? (query only)**

Returns the unique identification code of the oscilloscope.

Syntax

*IDN?

Examples

*IDN?

Returns GW,GDS-806/GDS-810/GDS-820/GDS-840,0,<Firmware version>

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*LRN? (query only)

Returns the string that the oscilloscope settings will be listed.

Syntax

*LRN?

Returns

```
:ACQuire:AVERage 1;LENGth 500;MODe 0;POINt;:ACQuire:AVERage 1;LENGth 500;MODe 0;
POINt;:ACQuire:AVERage 1;LENGth 500;MODe 0;POINt;:TIMebase:DELay 0.000e+00;SCALe
 2.500e-05;SWEep 0;WINDow:DELay 0.000e+00;SCALe 1.000e-09;:TIMebase:DELay 0.000e
+00;SCALe 2.500e-05;SWEep 0;WINDow:DELay 0.000e+00;SCALe 1.000e-09;:DISPlay:WAVe
form 0;DISPCONTrast 19;GRATicule 0;:DISPlay:WAVeform 0;DISPCONTrast 19;GRATicule
 0;:MEASure:SOURce 1;FALL 37.96us;FREQuency 15.62kHz;NWIDth 18.34us;PDUTy 69.82%
;PERiod 64.00us;PWIDth 44.68us;RISe 6.506us;VAMPlitude 1.44V;VAVerage 35.0mV;VHI
 520mV;VLO -920mV;VMAX 620mV;VMIN -920mV;VPP 1.54V;VRMS 440mV;:MEASure:SOURce 2;
FALL ?;FREQuency ?;NWIDth ?;PDUTy ?;PERiod ?;PWIDth ?;RISe ?;VAMPlitude chan off
!;VAVerage chan off!;VHI chan off!;VLO chan off!;VMAX chan off!;VMIN chan off!;V
PP chan off!;VRMS chan off!;:AUToset;:PRINt;:REFResh;:RUN;:STOP
```

*OPC?

The command form (*OPC) sets the operation complete bit (bit 0) in the Standard Event Status Register (SESR) when all pending operations finish.

The query form (*OPC?) tells the oscilloscope to place an ASCII 1 in the Output Queue when the oscilloscope completes all pending operations.

Syntax

*OPC

*OPC?

Returns

1

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***RCL**

Recall the setting data from memory which previous saved. The settings of RS-232 (or GPIB) can be stored in memory of M1~M15. However, if users recall the stored memory which the settings of RS-232 or GPIB are different with present settings, the RS-232 (or GPIB) settings will keep with the present situation. The RS-232 (or GPIB) settings will not to be influenced by the recall setting of RS-232 (or GPIB) for this moment.

Syntax

`*RCL <NR1>`

Arguments: 1~15

Examples

`*RCL 1` recalls the setting data which located at first position of memory address.

***RST (no query form)**

Sets all control settings of oscilloscope to their default values but does not purge stored setting.

Syntax

`*RST`

***SAV**

Saves the setting data to memory.

Syntax

`*SAV <NR1>`

Arguments

1~15

Examples

`*SAV 2` saves the setting data to the second position of memory queue.

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*SRE

Setup the contents of the Service Request Enable Register (SRER). The query form returns the contents of the SRER. Bit 6 of the SRER is always zero. The bits on the SRER correspond to the bits on the SBR.

Syntax

*SRE <NR1>

*SRE?

Arguments

<NR1> is an integer from 0 to 255.

Returns

<NR1>

Examples

*SRE 7 sets bits of the SRER to 0000 0111.

If the *SRE? returns 0000 0011, the setting of *SRE is 3.

*STB? (query only)

Query of the Status Byte register (SBR) with *STB? will return a decimal number representing the bits that are set (true) in the status register.

Syntax

*STB?

Returns

<NR1>

Examples

*STB? returns 81 if SBR contains the binary value 0101 0001.

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*WAI (no query form)

WAI prevents the programming instrument from executing further commands or queries until all pending operations finish.

Syntax

`*WAI`

:ACQuire:AVERage

Select the average number of waveform acquisition. The range for averaging is from 2 to 256 in powers of 2.

Note: Before implement this instrument, please apply ":ACQuire:MODe 2" in advance!

Syntax

`:ACQuire:AVERage {1|2|3|4|5|6|7|8}`

`:ACQuire:AVERage?`

Arguments

1→Average number is 2

2→Average number is 4

3→Average number is 8

4→Average number is 16

5→Average number is 32

6→Average number is 64

7→Average number is 128

8→Average number is 256

Returns

<NR1>

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:ACQuire:LENGth

Select the number of record length. This oscilloscope provides record length of 500, 1250, 2500, 5000, 12500, 25000, 50000, and 125000.

Syntax

`:ACQuire:LENGth {0|1|2|3|4|5|6|7}`

`:ACQuire:LENGth?`

Arguments

`0`→Record length is 500 `1`→Record length is 1250 2→Record length is 2500

3→Record length is 5000 4→Record length is 12500 5→Record length is 25000

6→Record length is 50000 7→Record length is 125000

Returns

<NR1>

:ACQuire:MODe

Select the waveform acquisition mode. There are four different acquisition mode: sample, peak detection, average and accumulate.

Syntax

`:ACQuire:MODe {0|1|2}`

`:ACQuire:MODe?`

Arguments

`0`→Select the sample mode `1`→Select the peak detection mode

2→Select the average mode

Returns

<NR1>

Note: Please select the specific acquire mode before implement any acquisition.

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:ACQuire<X>:MEMory? (query only) *(Available for firmware 2.03 and above only)*

Transfer the total waveform data from the acquisition memory. (The memory capacity can be selected as 500, 1250, 2500, 5000, 12500, 25000, 50000, or 125000 points. See Page 25 for details.)

Syntax

`:ACQuire<X>:MEMory?`

Arguments

<X>→Specify the channel number (1|2)

Returns

The string of data is following.

#	Data size digit	Data size	Sample rate	Channel indicator	Reserved data	Waveform data

#: Begin a transmission of data string.

Data size digit: Indicate the digits of following data string amount (1 digit).

Data size: the amount of current data string (4, 5, or 6 digits). Next table lists the relations between data size digit, data size and record length.

Data String / Record length	Begin a transmission of data string	Data size digit	Data size	
Record length=500	#	4	1008	The rest of data
Record length=1250	#	4	2508	The rest of data
Record length=2500	#	4	5008	The rest of data
Record length=5000	#	5	10008	The rest of data
Record length=12500	#	5	25008	The rest of data
Record length=25000	#	5	50008	The rest of data
Record length=50000	#	6	100008	The rest of data
Record length=125000	#	6	250008	The rest of data

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Sample Rate: Indicates the corresponding sample rate of received waveform data (4 bytes). The sample rate is indicated by floating point format which compatible with IEEE 754 standards.

Note: This block uses little-endian byte ordering. See Appendix A for more conversion information

Channel indicator: Show the channel which sent the waveform data (1 byte).

1→Channel one　　2→Channel two

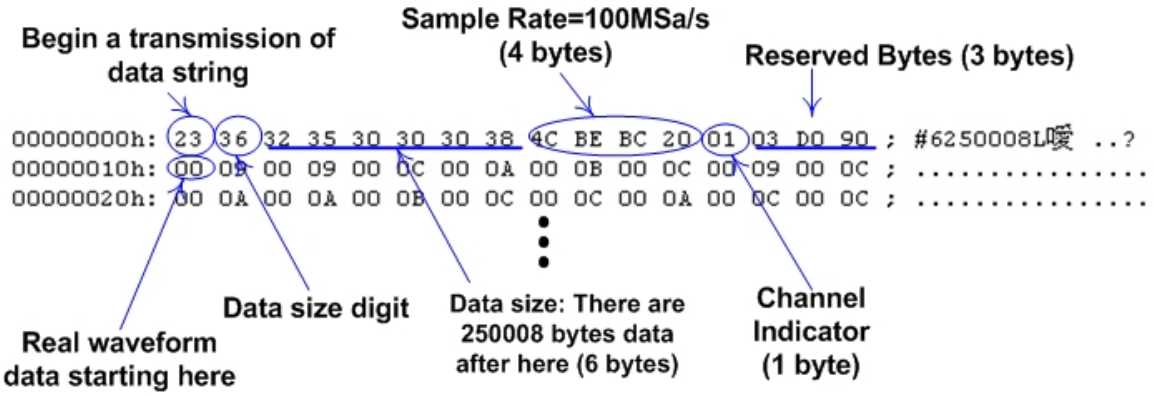
Reserved Data: Not used (3 bytes).

Waveform data: Depends on the specify record length, the effective waveform data which covers 500 points (1000 bytes), 1250 points (2500 bytes), 2500 points (5000 bytes), 5000 points (10000 bytes), 12500 points (25000 bytes), 25000 points (50000 bytes) , 50000 points (100000 bytes) or 125000 points (250000 bytes).
Each point is composed by two bytes (the integer value of 16 bits). The high byte (MSD) will be prior transferred.

Example 1

Transfer the waveform data (sample rate = 100MSa/s) of channel 1 at 250000 points record length:

`:ACQuire1:MEMory?` The oscilloscope will return the following messages:



Note: Please select the specific memory length before implement any acquisition. See explanation for "`:ACQuire:LENGth`".

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:ACQuire<X>:POINt (query only)

Transfer the displayed waveform data (always 500 points data totally) from the oscilloscope. Each point is composed by two bytes (the integer value of 16 bits). The high byte (MSD) will be prior transferred.

Syntax

`:ACQuire<X>:POINt`

Arguments

<X>→Specify the channel number (1|2)

Returns

The string of data is following.

#	Data size digit	Data size	Horizontal scale	Channel indicator	Waveform data size	Waveform data

#: Begin a transmission of data string.

Data size digit: Indicate the digits of following data string amount (1 digit).

Data size: the amount of current data string (4 digits).

Horizontal scale: The corresponding Horizontal scale of received waveform data (4 bytes). The Horizontal scale is indicated by floating point format which compatible with IEEE 754 standards.

Channel indicator: Show the channel which sent the waveform data.

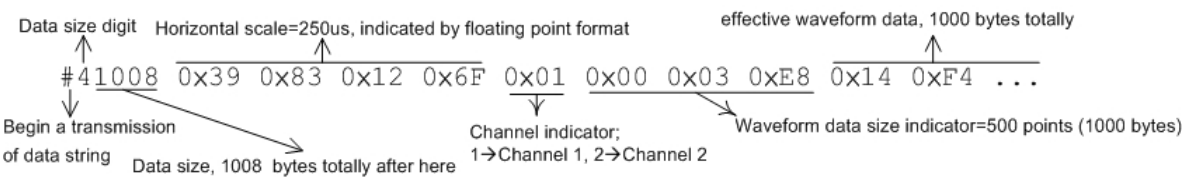
Waveform data size: The total amounts indicator of waveform data (4 bytes).

Waveform data: The effective waveform data which covers 500 points (1000 bytes) totally

Example

Transfer the waveform data of channel 1 at 250 μs per division:

`:ACQuire1:POINt` , the oscilloscope will return the following messages:



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:AUToset

Perform an automatic setup in order to optimize the acquisition parameters.

Syntax

```
:AUToset
```

:CHANnel<X>:BWLimit

Enable or disable the bandwidth limit function.

Syntax

```
:CHANnel<X>:BWLimit {0|1}
```

```
:CHANnel<X>:BWLimit?
```

Arguments

<X>→Specify the channel number (1|2)

0→Disable bandwidth limit 1→Enable bandwidth limit

Returns <NR1>

:CHANnel<X>:COUPling

Select the different coupling states for the oscilloscope.

Syntax

```
:CHANnel<X>:COUPling {0|1|2}
```

```
:CHANnel<X>:COUPling?
```

Arguments

<X>→Specify the channel number (1|2)

0→Place scope in AC coupling state 1→Place scope in DC coupling state

2→Place scope in grounding state

Returns

<NR1>

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:CHANnel<X>:DISPlay

Enable or disable the channel's display.

Syntax

`:CHANnel<X>:DISPlay {0|1}`

`:CHANnel<X>:DISPlay?`

Arguments

<X>→Specify the channel number (1|2)

`0`→Disable channel <X> display `1`→Enable channel <X> display

Returns

<NR1>

:CHANnel<X>:INVert

Enable or disable the waveform invert function.

Syntax

`:CHANnel<X>:INVert {0|1}`

`:CHANnel<X>:INVert?`

Arguments

<X>→Specify the channel number (1|2)

`0`→Disable invert function `1`→Enable invert function

Returns

<NR1>

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:CHANnel<X>:MATH

Set the math expression.

Syntax

`:CHANnel<X>:MATH {0|1|2|3}`

Arguments

<X>→Specify the channel number (1|2)

0→Select the add operator　　1→Select the subtract operator

2→Select the FFT operation　　3→Turn off math function

Returns

<NR1>

:CHANnel<X>:OFFSet

Sets or query the offset voltage.

Syntax

`:CHANnel<X>:OFFSet <NR3>`

`:CHANnel<X>:OFFSet?`

Arguments

<X>→Specify the channel number (1|2)

<NR3> is the desired offset value in volts. The range is dependent on the scale and the probe attenuation factor. The offset ranges are following:

Offset Range:	
2mV/div ~ 50mV/div	±0.5V
100mV/div ~ 500mV/div	±5V
1V/div ~ 5V/div	±50V

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Next table shows the relationship between the <NR3> value and matching offset voltage.

0.002→2mV	0.01→10mV	0.1→100mV	1→1V
0.005→2mV	0.02→20mV	0.2→200mV	2→2V
	0.05→50mV	0.5→500mV	5→5V

Returns

<NR3>

:CHANnel<X>:PROBe

Select the different probe attenuation factor.

Syntax

`:CHANnel<X>:PROBe {0|1|2}`

`:CHANnel<X>:PROBe?`

Arguments

<X>→Specify the channel number (1|2)

0→1X 1→10X 2→100X

Returns

<NR1>

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:CHANnel<X>:SCALe

Sets or query the vertical scale of the specified channel.

Syntax

:CHANnel<X>:SCALe <NR3>

:CHANnel<X>:SCALe?

Arguments

<X>→Specify the channel number (1|2)

<NR3> is the desired gain value in volts per division. The range is 2mV/div to 5V/div (with 1X probe).

Next table shows the relationship between the <NR3> value and matching scale.

0.002→2mV	0.01→10mV	0.1→100mV	1→1V
0.005→2mV	0.02→20mV	0.2→200mV	2→2V
	0.05→50mV	0.5→500mV	5→5V

Returns

<NR3>

Examples

:CHANnel1:SCALe 1, setup the channel one at 1V per division.

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:CURSor:X<X>Position

Select the cursors position of X axis.

Syntax

`:CURSor:X<X>Position <NR1>`

`:CURSor:X<X>Position?`

Arguments

<X>→Specify the cursor (1|2)

<NR1> is the desired position. For x-axis operation, the range is 1 to 249; for y-axis operation, the range is 1 to 199.

Returns

<NR1>

CURSor:Y<X>Position

Select the cursors position of Y axis.

Syntax

`:CURSor:Y<X>Position <NR1>`

`:CURSor:Y<X>Position?`

Arguments

<X>→Specify the cursor (1|2)

<NR1> is the desired position. For x-axis operation, the range is 1 to 249; for y-axis operation, the range is 1 to 199.

Returns

<NR1>

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:CURSor:<X>DELta? (query only)

Return the time or voltage diversity between the two vertical or horizontal cursors.

Syntax

```
:CURSor:XDELta?
```

```
:CURSor:YDELta?
```

Arguments

<X>→Specify the time or voltage diversity (X|Y)

Returns

<NR3>

:CURSor:XDISplay

Enable or disable the cursors display for X axis.

Syntax

```
:CURSor:XDISplay {0|1}
```

Arguments

0→Disable cursors display　　1→Enable cursors display

Returns

<NR1>

:CURSor:YDISplay

Enable or disable the cursors display for Y axis.

Syntax

```
:CURSor:YDISplay {0|1}
```

Arguments

0→Disable cursors display　　1→Enable cursors display

Returns

<NR1>

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:CURSor:SOURce

Select which channel cursors is active for front panel control.

Syntax

`:CURSor:SOURce {1|2|3}`

`:CURSor:SOURce?`

Arguments

1→Select channel 1 for cursors measurement

2→Select channel 2 for cursors measurement

3→Select math function for cursors measurement

Returns

<NR1>

:DISPlay:ACCumulate

Select the accumulate display mode.

Syntax

`:DISPlay:ACCumulate {0|1}`

`:DISPlay:ACCumulate?`

Arguments

0→Disable accumulate display mode 1→Enable accumulate display mode

Returns

<NR1>

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:DISPlay:CONTrast

Select contrast level of LCD screen for data readout and waveform displays.

Syntax

`:DISPlay:CONTrast <NR1>`

`:DISPlay:CONTrast?`

Arguments

`<NR1>` is the desired brightness level. The range is from 0~20 (0% to 100%).

Returns

<NR1>

:DISPlay:GRATicule

Select graticule display type for LCD screen.

Syntax

`:DISPlay:GRATicule {0|1|2}`

`:DISPlay:GRATicule?`

Arguments

`0`→Select full grids

`1`→Select cross type

2→Only the frame is displayed

Returns

<NR1>

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:DISPlay:WAVeform

Select the dots (or vectors) display for data.points.

Syntax

```
:DISPlay:WAVeform <0|1>
:DISPlay:WAVeform?
```

Arguments

0→Enable vectors display　　1→Enable dots display

Returns

<NR1>

:GONogo:CLEar *(Available for firmware 2.0 and above only)*

Clear the total and failure counter value on the screen. This command is equal to the function key "**F5**" of GO/NO-GO template edit menu.

Syntax

```
:GONogo:CLEar
```

Examples

```
:GON:CLE clear the GO/NO-GO counter displayed.
```


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:GONogo:EXECute *(Available for firmware 2.0 and above only)*

Start or stop the execution of GO/NO-GO comparison function. This command is equal to the function key "**F4**" of GO/NO-GO menu.

Syntax

`:GONogo:EXECute {0|1}`

`:GONogo:EXECute?`

Arguments

`0`→Stop GO/NO-GO comparison `1`→Start GO/NO-GO comparison

Returns

<NR1>

:GONogo:FUNCtion *(Available for firmware 2.0 and above only)*

This command is used to initialize or relieve the GO/NO-GO function. Before the GO/NO-GO comparison is started. This command must be executed to enable the comparison unit. This command is equal to the function key "**F4**" of GO/NO-GO menu.

Syntax

`:GONogo:FUNCtion {0|1}`

`:GONogo:FUNCtion?`

Arguments

`0`→Relieve GO/NO-GO function `1`→Initialize GO/NO-GO function

Returns

<NR1>

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:GONogo:NGCount? (query only) *(Available for firmware 2.0 and above only)*

Return the value of fail count and total count.

Syntax

```
:GONogo:NGCount?
```

Returns

<NR1>

:GONogo:NGDefine *(Available for firmware 2.0 and above only)*

Sets and query the user-defined NO-GO conditions. This command is equal to the function key "**F4**" pressing for UTILITY menu of second page.

Syntax

```
:GONogo:NGDefine {0|1}
:GONogo:NGDefine?
```

Arguments

0→Define waveform not exceed the template means NO-GO

1→Define waveform exceed the template means NO-GO

Returns

<NR1>

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:GONogo:SOURce *(Available for firmware 2.0 and above only)*

Sets and query the user-defined GO/NO-GO comparison source channel. This command is equal to the function key "**F2**" pressing of GO/NO-GO menu.

Syntax

`:GONogo:SOURce {0|1}`

`:GONogo:SOURce?`

Arguments

`0`→Select CH1 to be the comparison source.

`1`→Select CH2 to be the comparison source.

Returns

<NR1>

:GONogo:VIOLation *(Available for firmware 2.0 and above only)*

Sets and query the user-defined GO/NO-GO violation conditions. This command is equal to the function key "**F3**" pressing of GO/NO-GO menu.

Syntax

`:GONogo:VIOLation {0|3}`

`:GONogo:VIOLation?`

Arguments

`0`→Stop

`1`→Stop + beep

2→Continue

3→Continue + beep

Returns

<NR1>

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:MEASure:FALL? (query only)

Return the value of timing measurement that taken for falling edge of the first pulse in the waveform.

Syntax

`:MEASure:FALL?`

Returns

<NR3>.

Note: Please select the specific channel before implement any measurement. See explanation for ":MEASure:SOURce"

:MEASure:FREQuency? (query only)

Return the value of Frequency measurement.

Syntax

`:MEASure:FREQuency?`

Returns

<NR3>.

Note: Please select the specific channel before implement any measurement. See explanation for ":MEASure:SOURce"

:MEASure:NWIDth? (query only)

Return the value of timing measurement of the first negative pulse in the waveform.

Syntax

`:MEASure:NWIDth?`

Returns

<NR3>.

Note: Please select the specific channel before implement any measurement. See explanation for ":MEASure:SOURce"

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:MEASure:PDUTy? (query only)

Return the ratio of the positive pulse width to the signal period.

Syntax

`:MEASure:PDUTy?`

Returns

<NR2>. is the percentage of ratio. The range is from 1 to 99.

Note: Please select the specific channel before implement any measurement. See explanation for "`:MEASure:SOURce`"

:MEASure:PERiod? (query only)

Return the timing value of period measurement.

Syntax

`:MEASure:PERiod?`

Returns

<NR3>.

Note: Please select the specific channel before implement any measurement. See explanation for "`:MEASure:SOURce`"

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:MEASure:PWIDth? (query only)

Return the value of timing measurement of the first positive pulse in the waveform.

Syntax

`:MEASure:PWIDth?`

Returns

<NR3>.

Note: Please select the specific channel before implement any measurement. See explanation for ":MEASure:SOURce"

:MEASure:RISe? (query only)

Return the value of timing measurement that taken for rising edge of the first pulse in the waveform.

Syntax

`:MEASure:RISe?`

Returns

<NR3>.

Note: Please select the specific channel before implement any measurement. See explanation for ":MEASure:SOURce"

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:MEASure:SOURce

Select the measured channel (channel 1 or 2). The default setting of measured channel is channel one.

Note: Please select the specific channel before implement any measurement.

Syntax

`:MEASure:SOURce {1|2}`

Arguments

1→Enable the measurement functions for channel 1

2→Enable the measurement functions for channel 2

Returns

<NR1>.

:MEASure:VAMPlitude? (query only)

Return the voltages of high value minus the low value.

Syntax

`:MEASure:VAMPlitude?`

Returns

<NR3>.

Note: Please select the specific channel before implement any measurement. See explanation for "`:MEASure:SOURce`"

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:MEASure:VAVerage? (query only)

Return the average voltages.

Syntax

`:MEASure:VAVerage?`

Returns

<NR3>.

Note: Please select the specific channel before implement any measurement. See explanation for ":MEASure:SOURce"

:MEASure:VHI? (query only)

Return the value of global high voltage.

Syntax

`:MEASure:VHI?`

Returns

<NR3>.

Note: Please select the specific channel before implement any measurement. See explanation for ":MEASure:SOURce"

:MEASure:VLO? (query only)

Return the value of global low voltage.

Syntax

`:MEASure:VLO?`

Returns

<NR3>.

Note: Please select the specific channel before implement any measurement. See explanation for ":MEASure:SOURce"

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:MEASure:VMAX? (query only)

Return the value of maximum amplitude.

Syntax

:MEASure:VMAX?

Returns

<NR3>.

Note: Please select the specific channel before implement any measurement. See explanation for ":MEASure:SOURce"

:MEASure:VMIN? (query only)

Return the value of minimum amplitude.

Syntax

:MEASure:VMIN?

Returns

<NR3>.

Note: Please select the specific channel before implement any measurement. See explanation for ":MEASure:SOURce"

:MEASure:VPP? (query only)

Return the value of V_{max} minus V_{min}.

Syntax

:MEASure:VPP?

Returns

<NR3>.

Note: Please select the specific channel before implement any measurement. See explanation for ":MEASure:SOURce"

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:MEASure:VRMS? (query only)

Return the value of true Root Mean Square voltage.

Syntax

`:MEASure:VRMS?`

Returns

<NR3>.

Note: Please select the specific channel before implement any measurement. See explanation for ":MEASure:SOURce"

:PRINt

Begin a hardcopy to a specified printer.

Syntax

`:PRINt`

:REFResh

Refresh the waveform data of LCD screen and re-display the waveform data.

Syntax

`:REFResh`

:RUN

Controls the RUN state of trigger system. The acquisition cycle will follow each qualified trigger in the RUN state.

Syntax

`:RUN`

:STOP

Controls the STOP state of trigger system. The acquisition cycle only triggered when the `:RUN` command is received.

Syntax

`:STOP`

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:SYSTem:UNLock

The front panel keyboards and knobs of the oscilloscope will be disabled after any one of the remote control command received. Use this command in order to re-activate the front panel keyboards and knobs.

Syntax

```
:SYSTem:UNLock
```

:TEMPlate<X>:DOWNload? *(Available for firmware 2.0 and above only)*

Download the user-selected template.

Syntax

```
:TEMPlate1:DOWNload?
```

Arguments

<X>→Specify the template number (1|100)

Returns

Format:
The string of data is following.

#	Data size digit	Data size	Package type	Template number	Position	Text string	Reserved	Check sum	Template data

#: Begin of data string.

Data size digit: Indicate the digits of following data string amount (1 digit), The value is '3' in ASCII code.

Data size: The amount of current data string (3 digits). The value is "548" in ASCII code.

Package type: The GO/NO-GO template package type (1 bytes). The value is 0x03 in hex.

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Template number: The location of template stored in memory. The valid range is from 1 to 100 dots. The content is a single byte in hex (0x01 ~ 0x64).

Position: The position of template. The valid range is from -300 to +300 dots. The content is a two bytes signed integer in hex (0xFED4 ~ 0x012C). (2 bytes, high byte first)

Text string: The user defined string that will be shown on the screen. Here we support English only. The string must include an ending character 0x00. (39 bytes).

Reserved: This location is reserved for future usage. (1 bytes).

Check sum: The check sum value is coming from the sum of 500 bytes of template data. This value is 32 bits unsigned integer in hex (4 bytes, high byte first).

Template data: The effective template data which covers 250 points totally(500 bytes). Each point is two bytes signed integer in hex. The valid range is from –100 to 100(0x0064 ~ 0xFF9C)

Example

The following is a partial of returned data from template location 1:

```
00000000h: 23 33 35 34 38 03 01 FF CE 54 68 69 73 20 69 73 ; #3548..   This is
00000010h: 20 61 20 74 65 6D 70 6C 61 74 65 20 66 6F 72 20 ;  a template for
00000020h: 4D 49 4E 20 62 6F 75 6E 64 61 72 79 2E 00 00 00 ; MIN boundary....
00000030h: 00 00 00 16 DA 00 35 00 34 00 34 00 34 00 34 00 ; ....?5.4.4.4.4.
00000040h: 34 00 34 00 34 00 34 00 34 00 34 00 34 00 35 00 35 00 ; 4.4.4.4.4.4.5.5.
```


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:TEMPlate<X>:UPLoad *(Available for firmware 2.0 and above only)*

Upload the user-defined template to the assigned location.

Syntax

`:TEMPlate1:UPLoad#3548.....`

Format:
The string of data is following.

#	Data size digit	Data size	Package type	Template number	Position	Text string	Reserved	Check sum	Template data

#: Begin a transmission of data string.

Data size digit: Indicate the digits of following data string amount(1 digit), The value is '3' in ASCII code.

Data size: The amount of current data string (3 digits). The value is "548" in ASCII code.

Package type: The GO/NO-GO template package type (1 bytes). The value is 0x03 in hex.

Template number: The location of template stored in memory. The valid range is from 1 to 100 dots. The content is a single byte in hex (0x01 ~ 0x64).

Position: The position of template. The valid range is from -300 to +300 dots. The content is a two bytes signed integer in hex (0xFED4 ~ 0x012C). (2 bytes, high byte first)

Text string: The user defined string that will be shown on the screen. Here we support English only. The string must include an ending character 0x00. (39 bytes).

Reserved: This location is reserved for future usage. (1 bytes).

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Check sum: The check sum value is coming from the sum of 500 bytes of template data. This value is 32 bits unsigned integer in hex (4 bytes, high byte first).

Template data: The effective template data which covers 250 points totally(500 bytes). Each point is two bytes signed integer in hex. The valid range is from –100 to 100(0x0064 ~ 0xFF9C)

Arguments

<X>→Specify the template number (1|100)

Example

The following is a partial of command file including the command. It's used for transmitting template data to location 1:

```
00000000h: 3A 54 45 4D 50 31 3A 55 50 4C 23 33 35 34 38 03 ; :TEMP1:UPL#3548.
00000010h: 01 FF CE 54 68 69 73 20 69 73 20 61 20 74 65 6D ; .   This is a tem
00000020h: 70 6C 61 74 65 20 66 6F 72 20 4D 49 4E 20 62 6F ; plate for MIN bo
00000030h: 75 6E 64 61 72 79 2E 00 00 00 00 00 00 16 DA 00 ; undary.........?
00000040h: 35 00 34 00 34 00 34 00 34 00 34 00 34 00 34 00 ; 5.4.4.4.4.4.4.
```

Note: In this case the position is –50 (0xFFCE) dots. The check sum is 0x000016DA

:TEMPlate:MAX *(Available for firmware 2.0 and above only)*

Sets and query the number of template used for maximum boundary.

Syntax

```
:TEMPlate:MAX {1|100}

:TEMPlate:MAX?
```

Returns

<NR1>

Note: A template can be defined as either MAX or MIN template only.

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:TEMPlate:MIN *(Available for firmware 2.0 and above only)*

Sets and query the number of template used for minimum boundary.

Syntax

`:TEMPlate:MIN {1|100}`

`:TEMPlate:MIN?`

Returns

<NR1>

Note: A template can be defined as either MAX or MIN template only.

:TEMPlate:MODe *(Available for firmware 2.0 and above only)*

Sets and query the template mode. When we select Auto mode, the auto template source is coming from CH1 or CH2. When we set normal mode, the template is coming from 1 of the 100 templates.

Syntax

`:TEMPlate:MODe {0|1}`

`:TEMPlate:MODe?`

Arguments

`0`→Select auto template. `1`→Select normal template.

Returns

<NR1>

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:TEMPlate:POSition:MAX *(Available for firmware 2.0 and above only)*

Sets and query the position of maximum template. This command will not change the position value that stored in flash ROM. Unless you press the “Save & Create” key in GO/NO-GO edit menu. That means if you exit from the GO/NO-GO function, we will recall the value from flash ROM.

Syntax

`:TEMPlate:POSition:MAX <NR2>`

`:TEMPlate:POSition:MAX?`

Arguments

<NR2> is the desired template position. The range is from -12.0 ~ +12.0 div.

Returns

<NR2>

Note: 1 division = 25 dots

:TEMPlate:POSition:MIN *(Available for firmware 2.0 and above only)*

Sets and query the position of minimum template. This command will not change the position value that stored in flash ROM. Unless you press the “Save & Create” key in GO/NO-GO edit menu. That means if you exit from the GO/NO-GO function, we will recall the value from flash ROM.

Syntax

:TEMPlate:POSition:MIN <NR2>

:TEMPlate:POSition:MIN?

Arguments

<NR2> is the desired template position. The range is from -12.0 ~ +12.0 div.

Returns

<NR2> Div

Note: 1 division = 25 dots

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:TEMPlate:TOLerance *(Available for firmware 2.0 and above only)*

Sets and query the tolerance of auto template.

Syntax

`:TEMPlate:TOLerance <NR2>`

`:TEMPlate:TOLerance?`

Arguments

`<NR2>` is the desired tolerance percentage. The range is from 0.4~40 (0.4% to 40%).

Returns

`<NR2> %`

TIMebase:DELay

Sets the horizontal position (delay timebase) parameter.

Syntax

`:TIMebase:DELay <NR3>`

`:TIMebase:DELay?`

Arguments

`<NR3>` is the desired delay time.

Returns

<NR3>

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:TIMebase:SCALe

Sets the horizontal timebase scale per division (SEC/DIV).

Syntax

`:TIMebase:SCALe <NR3>`

`:TIMebase:SCALe?`

Arguments

Sec/div	**NR3**	Sec/div	**NR3**	Sec/div	**NR3**
1ns	**1e^{-9}**	5 μs	**5e^{-6}**	25ms	**25e^{-3}**
2.5ns	**2.5e^{-9}**	10 μs	**10e^{-6}**	50ms	**50e^{-3}**
5ns	**5e^{-9}**	25 μs	**25e^{-6}**	100ms	**100e^{-3}**
10ns	**10e^{-9}**	50 μs	**50e^{-6}**	250ms	**250e^{-3}**
25ns	**25e^{-9}**	100 μs	**100e^{-6}**	500ms	**500e^{-3}**
50ns	**50e^{-9}**	250 μs	**250e^{-6}**	1s	**1**
100ns	**100e^{-9}**	500 μs	**500e^{-6}**	2.5s	**2.5**
250ns	**250e^{-9}**	1ms	**1e^{-3}**	5s	**5**
500ns	**500e^{-9}**	2.5ms	**2.5e^{-3}**	10s	**10**
1 μs	**1e^{-6}**	5ms	**5e^{-3}**		
2.5 μs	**2.5e^{-6}**	10ms	**10e^{-3}**		

`<NR3>` is the desired timebase scale per division.

Returns

<NR3>

Examples

`:TIMebase:SCALe 5e-3` sets timebase scale to 5ms per division.

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:TIMebase:SWEep

Selects the horizontal timebase sweep mode. This command is equivalent to setting the horizontal menu.

Syntax

`:TIMebase:SWEep <0|1|2|3|4>`

`:TIMebase:SWEep?`

Arguments

`0`→Main timebase

1→Window

2→Window Zoom

3→Roll mode

4→XY mode

Returns

<NR1>

:TIMebase:WINDow:DELay

Setting and query the zoomed area (the gray color area) for window zoomed display.

Syntax

`:TIMebase:WINDow:DELay <NR3>`

`:TIMebase:WINDow:DELay?`

Arguments

`<NR3>` is the desired position (delay time).

Returns

<NR3>

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:TIMebase:WINDow:SCALe

Sets and query the scale (length) of the windows zoomed timebase.

Syntax

`:TIMebase:WINDow:SCALe <NR3>`

`:TIMebase:WINDow:SCALe?`

Arguments

`<NR3>` is the desired scale (length) of the windows zoomed timebase.

Returns

<NR3>

:TRIGger:COUPle

Select and query the type of trigger coupling.

Syntax

`:TRIGger:COUPle <0|1>`

`:TRIGger:COUPle?`

Arguments

`0`→AC `1`→DC

Returns

<NR1>

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:TRIGger:DELay:TIMe

Sets and query the user-defined delay trigger time.

Syntax

`:TRIGger:DELay:TIMe <NR3>`

`:TRIGger:DELay:TIMe?`

Arguments

<NR3> is the desired user-defined delay time. The range is from 100ns~1.3ms.

Returns

<NR3>

Note: Please select the specific delay type before implement any measurement. See explanation for ":TRIGger:DELay:TYPe"

:TRIGger:DELay:EVENt

Sets and query the user-defined delay trigger events.

Syntax

`:TRIGger:DELay:EVENt <NR1>`

`:TRIGger:DELay:EVENt?`

Arguments

<NR1> is the desired user-defined delay trigger events. The range is from 2~65000.

Returns

<NR1>

Note: Please select the specific delay type before implement any measurement. See explanation for ":TRIGger:DELay:TYPe"

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:TRIGger:DELay:LEVel

Sets and query the user-defined start trigger signal level.

Syntax

`:TRIGger:DELay:LEVel <NR3>`

`:TRIGger:DELay:LEVel?`

Arguments

`<NR3>` is the desired user-defined start trigger signal level. The range is ±12.

Returns

<NR3>

:TRIGger:DELay:MODe

Select and query the different start trigger (i.e. external trigger) signal level.

Syntax

`:TRIGger:DELay:MODe <0|1|2>`

`:TRIGger:DELay:MODe?`

Arguments

`0`→TTL

`1`→ECL

2→USR

Returns

<NR1>

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:TRIGger:DELay:TYPe

Select and query the different delay trigger settings.

Syntax

`:TRIGger:ADVance:TYPe <0|1>`

`:TRIGger:ADVance:TYPe?`

Arguments

`0`→Time setting

`1`→Event setting

Returns

<NR1>

:TRIGger:FREQuency? (query only)

Return the readout value of trigger frequency counter.

Syntax

`:TRIGger:FREQuency?`

Returns

<NR3>.

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:TRIGger:LEVel

Select and query the trigger level.

Syntax

`:TRIGger:LEVel <NR3>`

`:TRIGger:LEVel?`

Arguments

`<NR3>` is the desired trigger level voltage.

Returns

<NR3>

:TRIGger:MODe

Select and query the trigger mode.

Syntax

`:TRIGger:MODe <0|1|2|3>`

`:TRIGger:MODe?`

Arguments

`0`→Auto Level

`1`→Auto

2→Normal

3→Single

Returns

<NR1>

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:TRIGger:NREJ

Switch and query the noise rejection mode.

Syntax

`:TRIGger:NREJ <0|1>`

`:TRIGger:NREJ?`

Arguments

0→OFF 1→ON

Returns

<NR1>

:TRIGger:PULSe:MODe

Switch and query different pulse trigger type.

Syntax

`:TRIGger:PULSe:MODe <0|1|2|3>`

`:TRIGger:PULSe:MODe?`

Arguments

0→<

1→>

2→=

3→≠

Returns

<NR1>

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:TRIGger:PULSe:TIMe

Select the time value for pulse width.

Syntax

`:TRIGger:PULSe:TIMe <NR3>`

`:TRIGger:PULSe:TIMe?`

Arguments

`<NR3>` is the desired time value of pulse width, the unit is in second.

Returns

<NR3>

:TRIGger:REJect

Select and query the frequency rejection mode.

Syntax

`:TRIGger:REJect <0|1|2>`

`:TRIGger:REJect?`

Arguments

`0`→OFF

`1`→Low frequency reject mode

2→High frequency reject mode

Returns

<NR1>

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:TRIGger:SLOP

Switch and query the rising or falling trigger slope.

Syntax

`:TRIGger:SLOP <0|1>`

`:TRIGger:SLOP?`

Arguments

`0`→Rising slope `1`→Falling slope

Returns

<NR1>

:TRIGger:SOURce

Select and query the trigger source.

Syntax

`:TRIGger:SOURce <0|1|2|3>`

`:TRIGger:SOURce?`

Arguments

`0`→Channel 1

`1`→Channel 2

2→External trigger

3→AC line voltage

Returns

<NR1>

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:TRIGger:TYPe

Select and query the trigger type.

Syntax

`:TRIGger:TYPe <0|1|2|3>`

`:TRIGger:TYPe?`

Arguments

`0`→Edge

`1`→Video

2→Pulse

3→Delay

Returns

<NR1>

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:TRIGger:VIDeo:FIELd

Select and query the field on which the video trigger mode will be triggered.

Syntax

`:TRIGger:VIDeo:FIELd <0|1|2>`

`:TRIGger:VIDeo:FIELd?`

Arguments

`0`→Line　　`1`→Odd frame (Field 1)

2→Even frame (Field 2)

Returns

<NR1>

:TRIGger:VIDeo:LINe

Select and query the specified line for video signal.

Syntax

`:TRIGger:VIDeo:LINe <NR1>`

`:TRIGger:VIDeo:LINe?`

Arguments

`<NR1>` is the desired line.

For NTSC system, the range of line is from 1~263 for Odd frame, 1-262 for even frame.

For PAL system, the range of line is from 1~313 for Odd frame, 1-312 for even frame.

Returns

<NR1>

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:TRIGger:VIDeo:POLarity

Select and query the input video polarity.

Syntax

`:TRIGger:VIDeo:POLarity <0|1>`

`:TRIGger:VIDeo:POLarity?`

Arguments

`0`→Positive-going sync pulses

`1`→Negative-going sync pulses

Returns

<NR1>

:TRIGger:VIDeo:TYPe

Select and query the TV broadcast system.

Syntax

`:TRIGger:VIDeo:TYPe <0|1|2>`

`:TRIGger:VIDeo:TYPe?`

Arguments

`0`→PAL

`1`→NTSC

`2`→SECAM

Returns

<NR1>

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:WMEMory<X>:DISPlay

Select whether the stored waveform will be displayed after being saved.

Syntax

`:WMEMory<X>:DISPlay <NR1>`

`:WMEMory<X>:DISPlay?`

Arguments

<X>→Specify the location of RefA or RefB memory (1|2)

0→OFF

1→ON

Returns

<NR1>

:WMEMory<X>:ERASe

Select whether the stored waveform will be erased after being saved.

Syntax

`:WMEMory<X>:ERASe`

Arguments

<X>→Specify the location of RefA or RefB memory (1|2)

:WMEMory<X>:LOCate

Set the position of stored waveform.

Syntax

`:WMEMory<X>:LOCate <NR1>`

Arguments

<X>→Specify the location of RefA or RefB memory (1|2)

<NR1> is the desired position. The rage is from –200 to +200.

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:WMEMory<X>:OFFSet

After the "`:WMEMory<X>:LOCate`" command is specified, you can adjust the position up or down by this command.

Syntax

`:WMEMory<X>:OFFSet <NR1>`

Arguments

<X>→Specify the location of RefA or RefB memory (1|2)

<NR1> is the desired offset position. The rage is from –100 to +100.

:WMEMory<X>:SAVe

Select whether the memory set will be saved.

Syntax

`:WMEMory<X>:SAVe <1|2|3>`

Arguments

<X>→Specify the location of RefA or RefB memory (1|2)

1→Channel 1

2→Channel 2

3→Math function

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5. Status Reports

A set of status registers allows the user to quickly determine the Digital storage oscilloscope's internal processing status. The status register, as well as the status and event reporting system, adhere to SCPI recommendations.

Structure of System

The sketch of the status and event reporting system is showed on figure 5-1. Each component of the sketch represents a set of registers and queues which can read, report, or enable the occurrence of certain events within the system.

If a specific event in the Digital storage oscilloscope that sets a bit in a *status register*, reading the status registers can tell you what types of events have occurred.

Each bit in the status register corresponds to a bit in an *enable register;* the enable bit must be high for the event to be reported to the Status Byte Register.

A Service Request (SRQ) is the last event to occur. The SRQ requests an interrupt on the GPIB to report events to the system controller.

Status Registers

There are two kinds of status registers are included with this oscilloscope.

- OPERation Status Registers (CONDition, EVENt, and ENABle)
- QUEStionable Status Registers (CONDition, EVENt, and ENABle)

The STATus subsystem is the hierarchical set of commands (Figure 5-2) that read the SCPI defined status registers.

The lower level nodes: QUEStionable and OPERation each have three 16 bits registers: CONDition, EVENt, and ENABle. Figure 5-3 shows the sequential relationship between these three types of registers and the commands that relate to each register.

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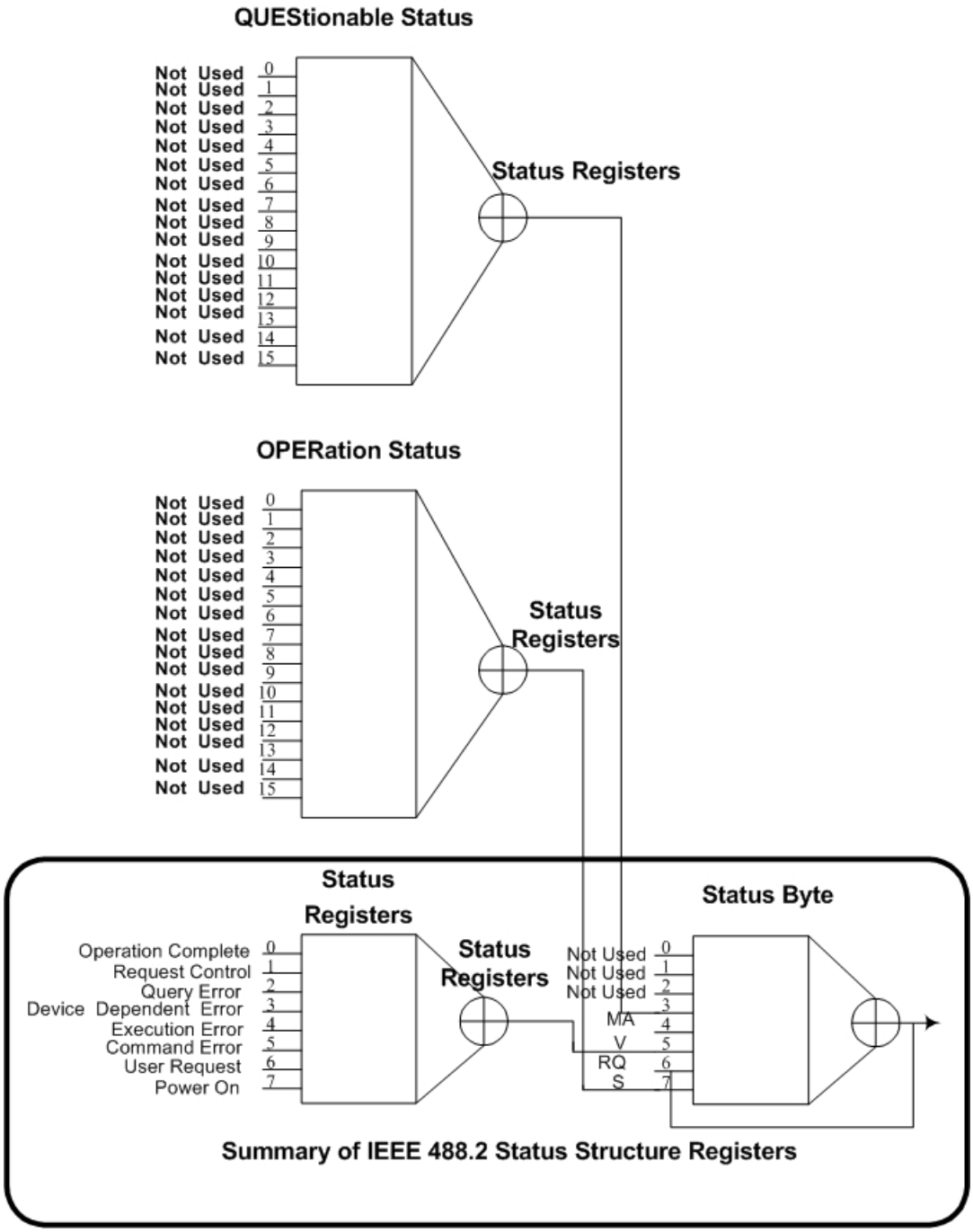


Figure 5-1. A graphic represents the status registers and their connections.

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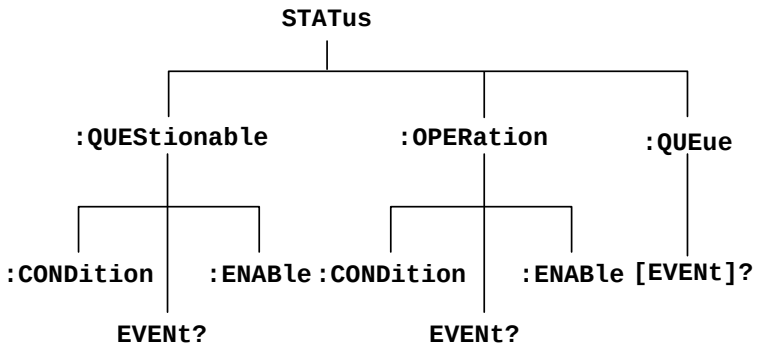


Figure 5-2: STATus hierarchy of SCPI defined register

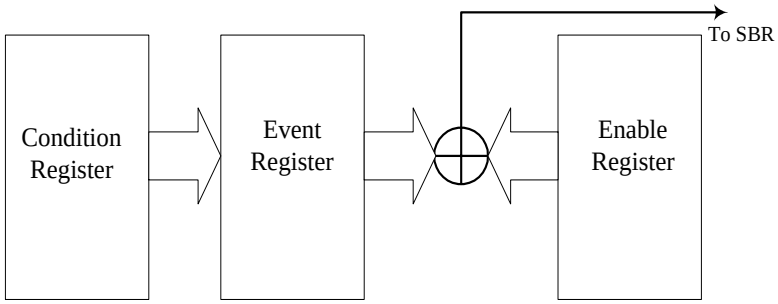


Figure 5-3: Status registers and related commands

The CONDition register is a read-only register which monitors the present state of the instrument. The CONDition register updates in real time and the inputs are not latched or buffered. When a condition monitored by the CONDition register becomes true, the bit for that condition also becomes true (1). When the condition is false, the bit is 0.

The read-only EVENt register latches any false-to-true change in condition. Once the bit in the EVENt register is set, it is no longer affected by changes in the corresponding bit of the CONDition register. The bit remains set until the controller reads it. The command *CLS (Clear Status) clears the EVENt registers.

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QUEStionable Status Registers.

Table 5-1 shows the bit designations of the 16 bit QUEStionable Status Register.

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
NU	*NU	NU	NU	NU	NU	NU	NU
32768	16384	8192	4096	2048	1024	512	256
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
NU	NU	NU	NU	NU	NU	NU	NU
128	64	32	16	8	4	2	1

Table 5-1: QUEStionable Status Register

OPERation Status Registers.

Table 5-2 shows the bit designations of the 16 bit OPERation Status Register.

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
NU	NU	NU	NU	NU	NU	NU	NU
32768	16384	8192	4096	2048	1024	512	256
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
NU	NU	NU	NU	NU	NU	NU	NU
128	64	32	16	8	4	2	1

Table 5-2: OPERation Status Register

* NU: not used

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Status Registers.

There are two status registers are included with this oscilloscope which defined by IEEE-488.1 and IEEE-488.2 standards.

- Status Byte Register (SBR)
- Standard Event Status Register (SESR)

Status Byte Register (SBR): The SBR (Table 5-3) summaries the status of all other registers and queue.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
OPER	RQS	ESB	MAV	QUES	NU	NU	NU
128	64	32	16	8	4	2	1

Table 5-3: Status Byte Register (SBR)

From the bit 0 to bit 2 are not used, these bits are always zero.

The bit 3 (QUES, QUEStionable) is the summary bit for the QESR (QUEStionable Event Status Register). When this bit is high it indicates that status is enabled and present in the QESR.

The bit 4 (MAV, Message Available) indicates that output is available in the output queue.

The bit 5 (ESB, Event Status Bit) is the summary bit for the Standard Event Status Register (SESR). When this bit is high it indicates that status is enabled and present in the SESR.

The bit 6 (RQS, Request Service) is obtained from a serial poll. This bit shows that this oscilloscope requests service from the GPIB controller.

The bit 7 (OPER, OPERation) is the summary bit for the OESR (OPERation EVENt STATus Register).

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Use serial poll or the *STB? Query to read the contents of the SBR. The bits in the SBR are set and cleared depending on the contents of the Standard Event Status Register (SESR), the Standard Event Status Register (SESR), and the Output Queue.

Standard Event Status Register (SESR): Table 5-4 shows the SESR

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
PON	USR	CME	EXE	DDE	QYE	NU	OPC
128	64	32	16	8	4	2	1

Table 5-4: Standard Event Status Register (SESR)

The bit 0 (OPC, Operation Complete) shows that the operation is complete. This bit is active when all pending operations are complete following an *OPC command.

The bit 1 is always zero.

The bit 2 (QYE, Query Error) indicates a command or query protocol error. The bit 3 (DDE, Device Error) shows that a device error occurred.

The bit 4 (EXE, Execution Error) shows that an error occurred while the oscilloscope was execution a command or query.

The bit 5 (CME, Command Error) shows that an error occurred while the oscilloscope was paring a command or query.

The bit 6 (USR, User Request) is ignored here for this oscilloscope.

The bit 7 (PON, Power On) shows that the oscilloscope was powered on.

Use the *ESR? Query to read the SESR. Reading the SESR clears the bits of the registers so that the register can accumulate information about new events.

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Enable Registers.

The enable registers determine whether certain events are reported to the Status Byte Register and SRQ. This oscilloscope has the following enable registers.

- Event Status Enable Register (ESER)
- OPERation Enable Register
- QUEStionable Enable Register
- Service Request Enable Register (SRER)

When one of the bits of the enable registers is high and the corresponding bit in the status register is high, the enable registers will perform a logical OR function, the output that controls the set bit of the Status Byte Register is high.

Various commands set the bits in the enable registers. The following sections describe the enable registers and the commands that set them.

Event Status Enable Register (ESER): The ESER controls which types of events are summarized by the Event Status Bit (ESB) in the SBR. The bits of the ESER correspond to the bits of the SESR.

Use the *ESE command to set the bits in ESER. Use the *ESE? command to read it.

OPERation Enable Register: Even though the OPERation Enable Register is present in this digital storage oscilloscope, the OPERation registers do not report any conditions.

QUEStionable Enable Register: The QUEStionable Enable Register controls which types of events are summarized by the QUES status bit in the SBR.

Service Request Enable Register (SRER): The SRER controls which bits in the SBR generate a service request.

Use the *SRE command to set the SRER. Use the *SRE? command to read it.

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Queues

The output queue is included with this digital storage oscilloscope.

Output Queue: This digital storage oscilloscope store query responses in the output queue by succeeding the IEEE 488.2 protocol. If the Digital storage oscilloscope receives a lot of un-read query data simultaneously, the output buffer of Digital storage oscilloscope will be covered repeatedly; for this moment, the output buffer will generate errors probably. The computer must read a query response before it sends the next command (or query) or it loses response to earlier queries.

When an error or event occurs, the output queue stores the message. The output queue stores and reports the messages on a FIFO (first in first out) state.

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6. Error Messages

Table 6-1 lists the SCPI error messages for this digital storage oscilloscope.

Error Code	SCPI Error Code／Explanation
-100	Command error
-102	Syntax error
/*Execution Error*/	
-220	Parameter error
-221	Settings conflict
-222	Data out of range
-223	Too much data
-224	Illegal parameter value
-232	Invalid format

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7. Program Template for GPIB

```
/* Filename - gds820ex1.c
 *
 * This is an example program written in C.  We use a NI's GPIB interface
 * card and one X86 PC to control GDS-806/810/820/840.  This program could
 * get the waveform data from GDS-806/810/820/840, and save them to a file.
 * You can use Microsoft Visual C++ or Borland C++ Builder to compile this
 * file.  And you must link this file with an object file
 * (BORLANDC_GPIB-32.OBJ) for Borland C++ or GPIB-32.OBJ for Visual C++ )
 * that provided by  National Instruments Corporation. DECL-32.H is a
 * Win32 C/C++ include file, that contains NI-488.2 function prototypes
 * and various pre-defined constants. It's also provided by NI.
 *
 * Copyright GOOD WILL INSTRUMENT
 * All Rights Reserved.
 */

#include <stdio.h>
#include <stdlib.h>
#include <string.h>

/*
 *  Include the WINDOWS.H and DECL-32.H files. The standard Windows
 *  header file, WINDOWS.H, contains definitions used by DECL-32.H and
 *  DECL-32.H contains prototypes for the GPIB routines and constants.
 */
#include <windows.h>
#include "decl-32.h"

#define ARRAYSIZE 1100             /* Size of read buffer            */
#define BDINDEX              0     /* Board Index                   */
#define PRIMARY_ADDR_OF_DMM   7    /* Default primary address of
                                      GDS-806/810/820/840*/
#define NO_SECONDARY_ADDR     0    /* Secondary address of device     */
#define TIMEOUT             T3s    /* Timeout value = 5 seconds       */
```


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```
#define EOTMODE                1     /* Enable the END message         */
#define EOSMODE                0     /* Disable the EOS mode           */
void Acquire(void);
void Delay(int);
void ShowIbsta(char);

int  Dev;                             /* Device handle                */
unsigned char ReadBuffer[201];       /* Read data buffer                */
char ErrorMnemonic[21][5] = {"EDVR", "ECIC", "ENOL", "EADR", "EARG",
                             "ESAC", "EABO", "ENEB", "EDMA", "",
                             "EOIP", "ECAP", "EFSO", "", "EBUS",
                             "ESTB", "ESRQ", "", "", "", "ETAB"};
unsigned char WaveBuf[ARRAYSIZE];

int _cdecl main(void)
{
int i, count=0;
unsigned char ch;
    Dev = ibdev (BDINDEX, PRIMARY_ADDR_OF_DMM, NO_SECONDARY_ADDR,
                 TIMEOUT, EOTMODE, EOSMODE);
    if(ibsta & ERR)
       printf("\n\rUnable to open device");
    ibclr (Dev);
    if(ibsta & ERR)
       printf("\n\rUnable to clear device(ibsta= %x),
(iberr=%x)",ibsta,iberr);

    ibwrt (Dev, "*CLS\n", 5L);     /*Clear ths status registers and*/
    printf("\n\r*CLS\n\r");         /*Output buffer of GDS-806/810/820/840./
    if((ibsta&ERR)||(ibsta&TIMO)){
       ShowIbsta(1);
       return 0;
    }
```


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```
Delay(1000);
ibwrt (Dev, "*IDN?\n", 6L);   /*Get the unique identification */
printf("*IDN?\n\r");          /*code of the GDS-806/810/820/840.*/
if((ibsta&ERR)||(ibsta&TIMO)){
    ShowIbsta(1);
    return 0;
}
while(1){
    ibrd (Dev, ReadBuffer, 100);    /*Read datas from input bufer. */
    if((ibsta&ERR)||(ibsta&TIMO)){
        ShowIbsta(0);
        return 0;
    }
    for(i=0;i<ibcntl;i++){
        ch=ReadBuffer[i];
        WaveBuf[count++]=ch;
    }
    if(ch=='\n'){
        WaveBuf[count]=0x00;
        printf("%s\n\r",WaveBuf);
        break;
    }
}

Delay(1000);
ibwrt (Dev, ":RUN\n", 5L);    /*Let the GDS-806/810/820/840 run.  */
printf(":RUN\n\r");
if((ibsta&ERR)||(ibsta&TIMO)){
    ShowIbsta(1);
    return 0;
}
```


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```
Delay(1000);
ibwrt (Dev, ":CHANnel1:DISPlay 1\n", 20L);/*Set channel 1 display on  */
printf(":CHANnel1:DISPlay 1\n\r");
if((ibsta&ERR)||(ibsta&TIMO)){
    ShowIbsta(1);
    return 0;
}

Delay(1000);
ibwrt (Dev, ":TIMebase:SCALe 2.5e-4\n", 23L);/*Set timebase: 200us/div*/
printf(":TIMebase:SCALe 2.5e-4\n\r");
if((ibsta&ERR)||(ibsta&TIMO)){
    ShowIbsta(1);
    return 0;
}

Delay(1000);
ibwrt (Dev, ":CHANnel1:OFFSet 0\n", 19L); /*Set offset voltage: 0V  */
printf(":CHANnel1:OFFSet 0\n\r");
if((ibsta&ERR)||(ibsta&TIMO)){
    ShowIbsta(1);
    return 0;
}

Delay(1000);
ibwrt (Dev, ":CHANnel1:SCALe 0.5\n", 20L); /*Set vertical scale:
                                            500mV/div */
printf(":CHANnel1:SCALe 0.5\n\r");
if((ibsta&ERR)||(ibsta&TIMO)){
    ShowIbsta(1);
    return 0;
}
```


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```
Delay(1000);
ibwrt (Dev, ":ACQuire:MODe 0\n", 16L);    /*Set acquire mode:
                                            sample mode */
printf(":ACQuire:MODe 0\n\r");
if((ibsta&ERR)||(ibsta&TIMO)){
   ShowIbsta(1);
   return 0;
}

Delay(1000);
ibwrt (Dev, ":TRIGger:LEVel 0.3\n", 19L); /*Set trigger level: 0.3V*/
printf(":TRIGger:LEVel 0.3\n\r");
if((ibsta&ERR)||(ibsta&TIMO)){
   ShowIbsta(1);
   return 0;
}

Delay(1000);
ibwrt (Dev, ":TRIGger:MODe 1\n", 16L);   /*Set trigger mode: AUTO */
printf(":TRIGger:MODe 1\n\r");
if((ibsta&ERR)||(ibsta&TIMO)){
   ShowIbsta(1);
   return 0;
}

Delay(10000); /*Waiting for acquisition process and GDS-820/GDS-840
               internal*/
             /*process. The delay time depend on the timebase that*/
             /*you selected. Low speed division require much more */
             /*time for acquisition.  It's recommended a minimum */
             /*200ms delay time after the last command, before   */
             /*getting the waveform data from GDS-806/810/820/840.    */
Acquire();                            /*Get waveform data.      */
```


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```
    ibwrt (Dev, ":SYSTEM:UNLOCK\n",15L);  /*Unlock GDS-806/810/820/840
                                            from remote control.*/
    printf(":SYSTEM:UNLOCK\n\r");
    if((ibsta&ERR)||(ibsta&TIMO)){
        ShowIbsta(1);
        return 0;
    }
    ibonl(Dev,0);                          /*Take the device offline. */
    return 1;
}

void Acquire(void)
{
short i, j;
FILE *writeP;
char writeFilename[15] = "wavedata.txt";
short wave;
int tmp, count=0;
    ibwrt (Dev, ":ACQUIRE1:POINT\n", 16L);
    printf(":ACQUIRE1:POINT\n\r");

    Delay(1000);
    if((ibsta&ERR)||(ibsta&TIMO)){
        ibclr (Dev);
        ibwrt (Dev, "*CLS\n", 5L);
        ShowIbsta(1);
        Delay(100000);
        ibwrt (Dev, ":ACQUIRE1:POINT\n", 16L); /*Try again! */
        printf(":ACQUIRE1:POINT\n\r");

        if((ibsta&ERR)||(ibsta&TIMO)){
            ShowIbsta(1);
            Delay(100000);
            exit (1);
        }
    }
```


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```
    while(1){
        ibrd(Dev, ReadBuffer, 100);
        if((ibsta&ERR)||(ibsta&TIMO)){
            ShowIbsta(0);
            Delay(100000);
            exit (1);
        }
        for(i=0;i<ibcntl;i++)
            WaveBuf[count++]=ReadBuffer[i];
        printf("\rReceived: %7d    ", count);
        if(count>=1014){
             printf("\rReceived: %7d bytes.\n\r", count);
            break;
        }
    }


    /*Open file "wavedata.txt" and write waveform datas to it.*/
    writeP=fopen(writeFilename, "w");
    if(writeP == NULL){
     printf("error: cannot write '%s'\n", writeFilename);
     exit(1);
    }
    j=14;
    for(i=0;i<500;i++){
        wave=WaveBuf[j++]<<8;
        wave+=WaveBuf[j++];
        fprintf(writeP, "%d\n", wave);
    }
    tmp = fclose(writeP);
    if(tmp == EOF){
        printf("error: cannot write '%s'\n\r", writeFilename);
        exit(1);
    }
}
```


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```
void Delay(int i)
{
int j,k;
    for(j=0;j<i;j++){
       for(k=0;k<30000;k++)
           ;
   }
}


void ShowIbsta(char c)
{
   if(ibsta & ERR){
    if(c)
          printf("\n\rUnable write to device(ibsta= %x),
(iberr=%x)\n\r",ibsta,iberr);
       else
          printf("\n\rUnable read from device(ibsta= %x),
(iberr=%x)\n\r",ibsta,iberr);
   }
   else{
       if(c)
          printf("\n\rWrite, ibsta= %x",ibsta);
       else
          printf("\n\rRead, ibsta= %x",ibsta);
   }
}
```


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Appendix A: How can we convert the hexadecimal format to a floating point format

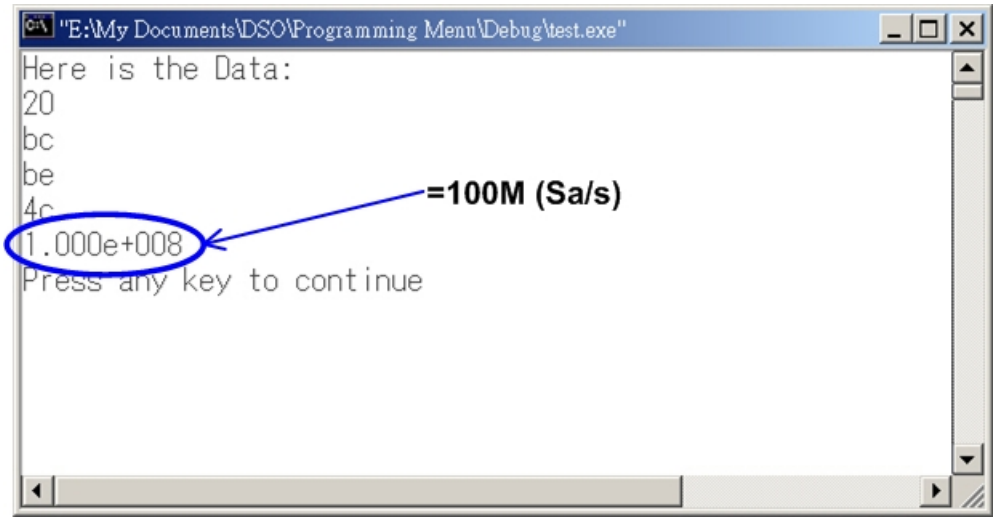
Question: *As the previous example listed on page 27, how can the hexadecimal value of "0×4C 0×BE 0×BC 0×20" transfer to 100M(Sa/s)?*

Answer:

just use the attached C language program:

```
#include <stdio.h>
int main()
{
   union data
   {
      char a[4];
      float f;
   } myData;
   myData.a[0]=0x20;   /* little-endian byte ordering here,        */
   myData.a[1]=0xbc;   /* so, the last of 0x20 should be placed    */
   myData.a[2]=0xbe;   /* in the first order.                       */
   myData.a[3]=0x4c;
   printf("Here is the Data:\n%0x\n%0x\n%0x\n%0x\n%.3e\n",\
             myData.a[0]&0xff,
             myData.a[1]&0xff,
             myData.a[2]&0xff,
             myData.a[3]&0xff,\
             myData.f );
   return 0;
}
```

and the output result is following:



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