TELEDYNE LECROY
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WaveAce 1000/2000
Remote Control
Command Reference

700 Chestnut Ridge Road
Chestnut Ridge, NY, 10977-6499
Tel: (845) 425-2000, Fax: (845) 578 5985
teledynelecroy.com

WaveAce 1000/2000 Remote Control Operator's Manual

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Part I: Introduction to Remote Control

About This Manual

This manual includes a complete list of the command you'll need to perform most WaveAce® 1000 and 2000 operations remotely.

Part I is an introduction to remote control and remote command syntax.

Part II lists all supported command headers with valid data parameters and values.

About Remote Control

WaveAce 1000 and 2000 series oscilloscopes can be controlled remotely through a USBTMC or TCP/IP (LAN) interface. USB control is a standard feature on all WaveAce devices; TCP/IP control is standard on WaveAce 2000 devices only.

Remote control is accomplished through the exchange of program messages between the oscilloscope and a controller computer using the selected interface. The USBTMC interface utilizes standard IEEE 488.1 and IEEE 488.2 (GPIB) messages. The TCP/IP interface utilizes Teledyne LeCroy's VICP protocol, which emulates IEEE 488.2 and includes standard operation bits in a header defined by the VICP protocol.

All program messages exchanged between the scope and the controller must be formatted according to these protocols.

See **Program Messages** (on page 6) for more information about constructing commands and queries for control programs. The supported commands are listed in **Commands and Queries by Subsystem** (on page 12) and **Command and Queries by Name (Alphabetical)** (on page 15), and are detailed in the Command Reference section of this manual.

Remote Control Through USB

The USB interface is standard on every WaveAce oscilloscope. The rear panel USB port is the remote control interface.

1. Attach a USB A/B cable from the USB-B port on the rear panel of the scope to a USB-A port on the controller computer.

2. Install NI-VISA on the controller machine. NI-VISA contains the USB drivers needed to form the interface between the oscilloscope and the controller. NI-VISA can be downloaded free from www.ni.com/visa. You may use either the NI-VISA run-time or the full download. The run-time download is significantly smaller.

You can send remote commands to the oscilloscope directly from the WaveStudio® terminal. WaveStudio can be downloaded free at teledynelecroy.com/support/softwaredownload, under Oscilloscope Downloads -> Oscilloscope Software Utilities.

Remote Control Through LAN

WaveAce 2000 series oscilloscopes have a standard LAN connection port for remote control that utilizes Teledyne LeCroy's VICP protocol for transmitting messages. This protocol emulates IEEE 488.2 (GPIB) and includes operation bits corresponding to SRQ, EOI, Clear, and others in a header that is defined by the VICP protocol.

The WaveAce must be assigned a static IPv4 address for remote control; do not use an address from the DHCP pool.

You can send remote commands to the oscilloscope directly from the WaveStudio® terminal. WaveStudio can be downloaded free at teledynelecroy.com/support/softwaredownload, under Oscilloscope Software Utilities.

On the Controller

For communication using the VICP (LAN) interface, no additional driver software is required when using WaveStudio. For VICP communication with other applications that use the VISA standard, NI-VISA must be installed, along with Teledyne LeCroy's 'VICP Passport'. The Passport extends VISA to support Teledyne LeCroy's VICP protocol. The VICP passport may be downloaded from teledynelecroy.com. Also see the application brief LAB_WM827 Understanding VICP and the VICP Passport on Teledyne LeCroy's website for more information.

On the Instrument

1. Attach an Ethernet cable from the LAN port on the rear of the scope to an Ethernet port on the controller machine or a connection device on the same network as the controller.

2. From the WaveAce menu, choose **Utility > IP Settings** (on the third page of settings).

3. Enter an **IP Address**, **Subnet Mask**, and **Gate Way**. Enter values by selecting each segment and turning the Adjust knob until the desired number is reached. Press the top soft key to jump to the next field or press the Adjust knob to tab to the next segment of the current field. Leave DHCP disabled.

Program Messages

Program messages are composed of commands or queries separated by semicolons and ending with a terminator:

```
<command/query>; . . . . . ;<command/query> <terminator>
```

Command/Query Syntax

The general form of a command or a query is an optional **header path**, followed by a command **header**, optionally followed by one or several **parameters** (shown as **<data>** in the following construct):

```
[header_path:]<header>[?] [<data>,...,<data>]
```

NOTE:

There is a space between the header and the first parameter.

Commas separate parameters.

The question mark **[?]** is optional and turns the command into a query.

The oscilloscope does not distinguish between upper- and lowercase characters. Commands/queries are shown mixed-case in this manual to call out the short form within the long form.

Header path

Commands or queries that apply to a subsection of the oscilloscope, such as a single input channel, must have their headers prefixed with a path name indicating the channel or trace recipient of the command. It's recommended to always use header paths to minimize the risk of error if the command order changes.

The header path normally consists of an abbreviated path name followed by a colon (:) immediately preceding the command header.

```
C1:OFST -300 MV
```

The target waveform trace is specified using the following header path names:

Header Path Name	Oscilloscope Reference
C1, C2	Channels 1 and 2
C3, C4	Channels 3 and 4 (on four-channel models)
M1,M2,M3,M4,M5,M6,M7,M8,M9,M10	Memory Units 1 through 10
TA, TB, TC, TD	FFT of the corresponding Channel 1-4; in some commands also used to refer to zooms.
EX, EX5	External trigger
LINE	LINE source for trigger

NOTE: Header paths TA-TD are used only to refer to the FFT of the channel, or in some cases to expanded traces (zooms).

Header paths need only be specified once until the path changes. Subsequent commands without header paths are assumed to refer to the most recently defined path:

`C2:VDIV?;C2:OFST?` is equivalent to `C2:VDIV?;OFST?`

Header

The header is the mnemonic form of the operation to be performed by the oscilloscope. Most headers have a more easily recognized **long form** and a **short form** for better transfer and decoding speed. The two can be used interchangeably:

`TRIG_MODE AUTO` is equivalent to `TRMD AUTO`

Some command or query mnemonics are imposed by the IEEE 488.2 standard. All these mnemonics begin with an asterisk *.

Data Parameters

When a command uses additional data values, they are expressed as ASCII data that can take the form of character, numeric, string, or block data. Macro parameters are not implemented.

An exception is the transfer of waveforms with the WAVEFORM command/query, where the waveform is expressed as a sequence of binary data values.

Character Data

These are simple alphanumeric words or abbreviations indicating a specific action.

In commands where you can specify many parameters, or where not all parameters are applicable at the same time, the format requires pairs of character data values. The first value names the parameter to be modified, while the second gives its value.

```
HARDCOPY_SETUP DEST,PRINTER,PRINTER,EPSON
```

Here, two pairs are shown: the first specifies the DESTination is a PRINTER, while the second specifies the PRINTER is EPSON. Any HARDCOPY_SETUP parameters that are not relevant for printers, or are left unchanged, are omitted from the command.

Numeric Data

The numeric data type is used to enter quantitative information. Numbers can be entered as integers, fractions, or exponents:

```
C1:VPOS -5
C2:OFST 3.56
TDIV 5.0E-6
```

Numeric values can be followed with multipliers and units modifying the value of the numeric expression. The following table of mnemonics is recognized:

Multiplier	Exponential Notation	Suffix
EX	1E18	Exa-
T	1E12	Tera-
MA	1E6	Mega-
M	1E-3	milli-
N	1E-9	nano-
F	1E-15	femto-
PE	1E15	Peta-
G	1E9	Giga-
K	1E3	kilo-
U	1E-6	micro-

Multiplier	Exponential Notation	Suffix
P	1E-12	pico-
A	1E-18	atto-

String Data

This is used to send multiple characters as a single parameter. Enclose any sequence of ASCII characters between single or double quotation marks:

```
DIRectory DISK,UDSK,ACTION,CREATE,'20120801Results'
```

Block Data

These are binary data values used to transfer waveforms from the oscilloscope to the controller using the WAVEFORM command/query.

Buffer size limitations apply to block data:

- If data exceeding the oscilloscope's 512 byte input buffer limited is received, the excess is discarded until a terminator (delimiter) is detected.
- If data exceeding the output queue is transmitted, commands that are not interpreted and excess data are discarded.

Terminator/Delimiter

The oscilloscope does not decode an incoming program message before receiving its terminator unless the message is longer than the 512 byte input buffer, at which point the oscilloscope starts analyzing the message once the buffer is full.

Terminators vary by interface:

State	TCP/IP	USB
Recv	EOI	CR
Send	LF+EOI	LF+CR

Response Messages

The oscilloscope sends a response message to the controller in answer to a query. The format of response messages is the same as that of program messages: commands separated by semi-colons and ending in terminators. Suffix units are also expressed in the response. These messages can be sent back to the oscilloscope in the form in which they were received to be accepted as valid commands.

For example, if the controller sends the message:

```
TIME_DIV?;TR_MODE NORM;C1:COUPLING?
```

The oscilloscope might respond with:

```
TIME_DIV 50 NS;C1:COUPLING D50
```

Note the response message refers only to the two queries that were sent in the original message.

Whenever you expect a response from the oscilloscope, add the query form of the command to the control program following the command to specify that a read response is desired. If the controller sends another command without reading the response to the previous one, the response message in the output buffer of the oscilloscope will be discarded.

The oscilloscope follows stricter rules for response messages than for program messages:

- Program messages may be in upper- or lower-case characters, but response messages will always be upper-case.
- Program messages may contain extraneous spaces or tabs, but response messages will not.
- Program messages can contain a mix of short and long form command/query headers, but response messages will always contain the short form unless you use the COMM_HEADER command to specify the long form or no header at all.

Using Status Registers

Status registers allow you to quickly determine the instrument's internal processing status at any time. These registers and the oscilloscope's status reporting system, which group related functions together, are designed to comply with IEEE 488.2 recommendations.

Registers such as the Standard Event Status Register (ESR) are required by the IEEE 488.2 Standard. Others are device specific. Commands associated with IEEE 488.2 mandatory status registers are preceded with an asterisk * in the Command Reference section.

- Enable registers such as the Standard Event Status Enable Register (ESE) are used to generate a bit-wise AND with their associated status registers.
- The ESR primarily summarizes errors, whereas INR summarizes the instrument’s internal working state. Additional details of errors reported by ESR can be obtained with the queries CMR?, DDR?, and EXR?.

If you were to send the erroneous command TRIG_MAKE SINGLE to your instrument, the oscilloscope would reject it and set the Command Error Register (CMR) to the value 1 (unrecognized command/query header). The non-zero value of CMR would be reported to Bit 5 of the Standard Event Status Register (ESR), which is then set.

You can read the value of CMR and simultaneously reset to zero at any time using the CMR? command. The occurrence of a command error can also be detected by analyzing the response to *ESR?.

Standard Event Status Register (ESR)

ESR is a 16-bit register reflecting the occurrence of events. ESR bit assignments have been standardized by IEEE 488.2. Only the lower eight bits are currently in use.

Read ESR using the *ESR? query. The response is the binary weighted sum of the register bits. The register is cleared with *ESR? or ALST?, with *CLS, or when power is applied to the scope. For example, the response message *ESR 160 indicates that a command error occurred and the ESR is being read for the first time after power-on. The value 160 can be broken down into 128 (Bit 7) plus 32 (bit 5). See the table with the ESR command description in Part Two for the conditions corresponding to the bit set.

The Power ON bit appears only on the first *ESR? query after power-on (since the query clears the register). You can determine this type of command error by reading the CMR bit with CMR?. It is not necessary to read/ clear this register in order to set the CMR bit in the ESR on the next command error.

Standard Event Status Enable Register (ESE)

This register allows you to report one or more events in the ESR.

Modify ESE with *ESE and clear it with *ESE 0 (or by powering-on the oscilloscope). Read it with *ESE?. For example, use *ESE 4 to set bit 2 (decimal 4) of the ESE Register to enable query error reporting.

Internal State Change Status Register (INR)

INR reports the completion of a number of internal operations (the events tracked by this 16-bit-wide register are listed with the INR? description in Part II).

Read the register using INR?. The response is the binary weighted sum of the register bits. Clear the register with INR? or ALST?, a *CLS command, or when power is applied to the oscilloscope.

Command Error Status Register (CMR)

This register contains the code of the last command error detected by the oscilloscope. List these error codes using CMR?.

Read CMR with CMR?. The response is the error code. Clear the register with a CMR? or ALST? query, a *CLS command, or when power is applied to the oscilloscope.

Device Dependent Error Status Register (DDR)

DDR indicates the type of hardware errors affecting your instrument. Individual bits in this register report specific hardware failures. List them using DDR?.

Also, read this register using the DDR? query. The response is the binary weighted sum of the error bits. Clear it with another DDR? or with ALST?, a *CLS command, or when power is applied to the oscilloscope.

Execution Error Status Register (EXR)

EXR contains the code of the last execution error detected by the oscilloscope. List these error codes with EXR?.

Read the register, again using the EXR? query. The response is the error code. Clear with another EXR? or with ALST?, a *CLS command, or when power is applied to the oscilloscope.

Commands and Queries by Subsystem

Acquisition - Controlling Waveform Captures

Short Form	Long Form	What the Command/Query Does
***TRG**	***TRG**	Executes an ARM command.
ACQW	**ACQUIRE_WAY**	Specifies the acquisition mode.
ARM	**ARM_ACQUISITION**	Changes acquisition state from stopped to single.
ASET	**AUTO_SETUP**	Adjusts vertical, timebase and trigger parameters.
ATTN	**ATTENUATION**	Selects the vertical attenuation factor of the probe.
BWL	**BANDWIDTH_LIMIT**	Enables/disables bandwidth-limiting low-pass filter.
CPL	**COUPLING**	Selects the specified input channel's coupling mode.
FRTR	**FORCE_TRIGGER**	Forces the instrument to make one acquisition.
ILVD	**INTERLEAVED**	Enables/disables Random Interleaved Sampling (RIS).
OFST	**OFFSET**	Allows output channel vertical offset adjustment.
PDET	**PEAK_DETECT**	Enables or disables built-in peak detection function.
STOP	**STOP**	Immediately stops signal acquisition.
TDIV	**TIME_DIV**	Modifies the timebase setting.
TRCP	**TRIG_COUPLING**	Sets the coupling mode of the specified trigger source.
TRDL	**TRIG_DELAY**	Sets the time at which the trigger is to occur.
TRLV	**TRIG_LEVEL**	Adjusts the trigger level of the specified trigger source.
TRMD	**TRIG_MODE**	Specifies the trigger mode.
TRSE	**TRIG_SELECT**	Selects the condition that will trigger acquisition.
TRSL	**TRIG_SLOPE**	Sets the trigger slope of the specified trigger source.
VDIV	**VOLT_DIV**	Sets the vertical sensitivity.
WAIT	**WAIT**	Prevents new analysis until current is completed.

Cursor - Performing Measurements

Short Form	Long Form	What the Command/Query Does
CRMS	**CURSOR_MEASURE**	Specifies the type of cursor/parameter measurement.
CRST	**CURSOR_SET**	Allows positioning of any cursor.
CRVA?	**CURSOR_VALUE?**	Returns trace values measured by specified cursors.
PACU	**PARAMETER_CUSTOM**	Controls parameters with customizable qualifiers.
PAVA?	**PARAMETER_VALUE?**	Returns current parameter, mask test values.

Display - Displaying Waveforms

Short Form	Long Form	What the Command/Query Does
DTJN	DOT_JOIN	Controls the interpolation lines between data points.
HMAG	HOR_MAGNIFY	Horizontally expands the expanded trace.
HPOS	HOR_POSITION	Horizontally positions intensified zone's center.
INTS	INTENSITY	Controls the brightness of the grid.
PERS	PERSIST	Enables or disables the persistence display mode.
PESU	PERSIST_SETUP	Selects display persistence duration.
SCSV	SCREEN_SAVE	Enables or disables the screen saver.
TRA	TRACE	Enables or disables the display of a trace.

Miscellaneous

Short Form	Long Form	What the Command/Query Does
*CAL?	*CAL?	Performs a complete internal calibration.
*IDN?	*IDN?	Returns device identification data.
ACAL	AUTO_CALIBRATE	Performs periodic calibration of instrument. Supported only on WaveAce 2000 series.
BUZZ	BUZZER	Controls the buzzer in the instrument.
CHDR	COMM_HEADER	Controls formatting of query responses.
DEF	DEFINE	Specifies mathematical function to perform.
DIR	DIRCTORY	Creates or deletes file directories on mass storage devices.
FLNM	FILENAME	Changes default filename of traces, setups and hard copies.

Save/Recall Setup - Making and Restoring Front Panel Settings

Short Form	Long Form	What the Command/Query Does
*RST	*RST	Initiates a device reset.
*SAV	*SAV	Stores current state in internal memory.
RCPN	RECALL_PANEL	Recalls a front panel setup from mass storage.

Status - Obtaining Status Information Using Status Registers

Short Form	Long Form	What the Command/Query Does
***CLS**	***CLS**	Clears all status data registers.
***ESE**	***ESE**	Sets the standard Event Status Enable register (ESE).
***ESR?**	***ESR?**	Reads, clears the Event Status Register (ESR).
***OPC**	***OPC**	Sets the OPC bit in the Event Status Register (ESR).
ALST?	**ALL_STATUS?**	Reads and clears the contents of all status registers.
CMR?	**CMR?**	Reads, clears the CoMmand error Register (CMR).
DDR?	**DDR?**	Reads, clears the Device Dependent Register (DDR).
EXR?	**EXR?**	Reads, clears the EXecution error Register (EXR).
INR?	**INR?**	Reads, clears INternal state change Register (INR).

Waveform Transfer – Creating and Preserving Waveforms

Short Form	Long Form	What the Command/Query Does
STO	**STORE**	Stores a trace in internal memory or mass storage.
WF	**WAVEFORM**	Transfers a waveform from controller to scope.
WFSU	**WAVEFORM_SETUP**	Specifies amount of waveform data to go to controller.

Commands and Queries by Name (Alphabetical)

Short Form	Long Form	What the Command/Query Does
*CAL?	*CAL?	Performs a complete internal calibration.
*CLS	*CLS	Clears all status registers.
*ESE	*ESE	Sets the standard Event Status Enable register (ESE).
*ESR?	*ESR?	Reads, clears the Event Status Register (ESR).
*IDN?	*IDN?	Returns device identification data.
*OPC	*OPC	Sets the OPC bit in the Event Status Register (ESR).
*RST	*RST	Initiates a device reset.
*SAV	*SAV	Stores current state in internal memory.
*TRG	*TRG	Executes an ARM command.
ACAL	AUTO_CALIBRATE	Performs periodic calibration of instrument. Supported only on WaveAce 2000 series.
ACQW	ACQUIRE_WAY	Specifies the acquisition mode.
ALST?	ALL_STATUS?	Reads and clears the contents of all status registers.
ARM	ARM_ACQUISITION	Changes acquisition state from stopped to single.
ASET	AUTO_SETUP	Adjusts vertical, timebase and trigger parameters.
ATTN	ATTENUATION	Selects the vertical attenuation factor of the probe.
BUZZ	BUZZER	Controls the buzzer in the instrument.
BWL	BANDWIDTH_LIMIT	Enables/disables bandwidth-limiting low-pass filter.
CHDR	COMM_HEADER	Controls formatting of query responses.
CMR?	CMR?	Reads, clears the CoMmand error Register (CMR).
CPL	COUPLING	Selects the specified input channel's coupling mode.
CRMS	CURSOR_MEASURE	Specifies the type of cursor/parameter measurement.
CRST	CURSOR_SET	Allows positioning of any cursor.
CRVA?	CURSOR_VALUE?	Returns trace values measured by specified cursors.
DDR?	DDR?	Reads, clears the Device Dependent Register (DDR).
DEF	DEFINE	Specifies mathematical function to perform.
DIR	DIRCTORY	Creates or deletes file directories on mass storage devices.
DTJN	DOT_JOIN	Controls the interpolation lines between data points.
EXR?	EXR?	Reads, clears the EXecution error Register (EXR).
FLNM	FILENAME	Changes default filename of traces, setups and hard copies.
FRTR	FORCE_TRIGGER	Forces the instrument to make one acquisition.
HMAG	HOR_MAGNIFY	Horizontally expands the expanded trace.
HPOS	HOR_POSITION	Horizontally positions intensified zone's center.
ILVD	INTERLEAVED	Enables/disables Random Interleaved Sampling (RIS).
INR?	INR?	Reads, clears INternal state change Register (INR).

Short Form	Long Form	What the Command/Query Does
INTS	INTENSITY	Controls the brightness of the grid.
OFST	OFFSET	Allows output channel vertical offset adjustment.
PACU	PARAMETER_CUSTOM	Controls parameters with customizable qualifiers.
PAVA?	PARAMETER_VALUE?	Returns current parameter, mask test values.
PDET	PEAK_DETECTED	Enables or disables built-in peak detection function.
PERS	PERSIST	Enables or disables the persistence display mode.
PESU	PERSIST_SETUP	Selects display persistence duration.
RCPN	RECALL_PANEL	Recalls a front panel setup from mass storage.
SCSV	SCREEN_SAVE	Enables or disables the screen saver.
STO	STORE	Stores a trace in internal memory or mass storage.
STOP	STOP	Immediately stops signal acquisition.
TDIV	TIME_DIV	Modifies the timebase setting.
TRA	TRACE	Enables or disables the display of a trace.
TRCP	TRIG_COUPLING	Sets the coupling mode of the specified trigger source.
TRDL	TRIG_DELAY	Sets the time at which the trigger is to occur.
TRLV	TRIG_LEVEL	Adjusts the trigger level of the specified trigger source.
TRMD	TRIG_MODE	Specifies the trigger mode.
TRSE	TRIG_SELECT	Selects the condition that will trigger acquisition.
TRSL	TRIG_SLOPE	Sets the trigger slope of the specified trigger source.
VDIV	VOLT_DIV	Sets the vertical sensitivity.
WAIT	WAIT	Prevents new analysis until current is completed.
WF	WAVEFORM	Transfers a waveform from controller to scope.
WFSU	WAVEFORM_SETUP	Specifies amount of waveform data to go to controller.

Part II: Command Reference

All remote control commands and queries recognized by the instrument can be executed in either a **local** or **remote** state.

This section lists commands and queries by short name in alphabetical order within subsystem.

Command Notation

A brief explanation of the operation performed by the command or query is followed by the formal syntax, with the full-name header given in lowercase characters and the short form derived from it in uppercase characters (e.g., **DoT_JoiN** and **DTJN**).

Where applicable, the syntax of the query is given with the format of its response. For each command, a short GPIB example illustrating a typical use is also provided. The device name of the oscilloscope is defined as **SCOPE%** in the examples, but you can substitute any valid device name.

Queries obtain information. They are recognized by **?** following their headers. Many commands can be used as queries simply by adding the question mark.

TIP: You can always find out the correct form of a command by manually setting up the oscilloscope in the exact required condition, and then sending a query which corresponds to the command. The reply from the oscilloscope can then be copied into your program as a command.

Commands make use of the following notational symbols:

- **< >** - Angular brackets enclose words 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 for use in a command instead of the placeholder.
- **{ }** - Braces enclose a list of choices, one of which must be made.
- **[ ]** - Square brackets enclose optional items.
- **…** - An ellipsis indicates the items to its left and right can be repeated any number of times.

ACQUISITION - *TRG

The *TRG command executes an ARM command. *TRG is the equivalent of the 488.1 GET (Group Execute Trigger) message.

Command Syntax

```
*TRG
```

Related Commands

```
ARM_ACQUISITION, STOP, WAIT, FORCE_TRIGGER
```

ACQUISITION - ARM_ACQUISITION, ARM

The ARM_ACQUISITION command arms the scope or forces a single acquisition if it is already armed.

Command Syntax

```
ARM_acquisition
```

Related Commands

```
STOP, *TRG, TRIG_MODE, WAIT, FORCE_TRIGGER
```

ACQUISITION - AUTO_SETUP, ASET

The AUTO_SETUP command displays the input signal(s) by adjusting the vertical, timebase, and trigger parameters. AUTO_SETUP operates on all channels.

If signals are detected on several channels, the lowest numbered channel with a signal determines the selection of the timebase and trigger source.

If only one input channel is turned on, the timebase will be adjusted for that channel.

Command Syntax

```
Auto_SETup
```

ACQUISITION – ACQUIRE_WAY, ACQW

The ACQUIRE_WAY command specifies the acquisition mode.

The ACQUIRE_WAY? query returns the current acquisition mode.

Command Syntax

```
<channel>: ACQuire_Way <mode>[,<time>]

<channel>:= {C1,C2,C3,C4,EX,EX10}

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

<time>:= {4,16,32,64,128,256}
```

NOTE: The time parameter can only be set with the AVERAGE acquisition mode.

Query Syntax

```
<channel>:ACQUIRE_WAY?
```

Response Format

```
<channel>: ACQuire_Way <mode>[,<time>]
```

Example

The following command sets the acquisition mode to Average every 16:

```
C1:ATTN 100
```

Related Commands

```
AVGA, PDET
```

ACQUISITION - ATTENUATION, ATTN

The ATTENUATION command selects the vertical attenuation factor of the probe. Values up to 1000 can be specified.

The ATTENUATION? query returns the attenuation factor of the specified channel.

Command Syntax

```
<channel>: ATTeNuation <attenuation>

<channel>:= {C1,C2,C3,C4,EX,EX10}

<attenuation>:= {1,5,10,50,100,500,1000}
```

Query Syntax

```
<channel>:ATTeNuation?
```

Response Format

```
<channel>:ATTeNuation  <attenuation>
```

Example

The following instruction sets to 100 the attenuation factor of Channel 1:

```
C1:ATTN 100
```

ACQUISITION - BANDWIDTH_LIMIT, BWL

The BWL command enables or disables the bandwidth limit (low-pass filter) of the specified input channel.

The BWL? query returns the enabled/disabled status. If all the channels are in the same state, it returns the state; if not, it returns each individual channel state.

Command Syntax

```
BandWidth_Limit <channel>,<mode>[,<channel>,<mode>...]

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

<mode>: = {ON, OFF}
```

Query Syntax

```
BWL?
```

Response Format

```
BWL <mode>
```

Example

This instruction sets a low-pass filter on Channel 2:

```
BWL C2,ON
```

ACQUISITION - COUPLING, CPL

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,M1,M2,M3,M4,M5,M6,M7,M8,M9,M10}

<coupling>:= {A1M*, D1M*, GND}
```

* Attenuation pertains only to instruments with a probe connected.

Query Syntax

```
<channel>:CouPLing?
```

Response Format

```
<channel>:CouPLing <coupling>

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

COUPLING OVL is returned in the event of signal overload while in DC 50 Ω coupling. In this condition, the oscilloscope will disconnect the input.

Example

The following instruction sets the coupling of Channel 2 to Ground:

```
C2:CPL GND
```

ACQUISITION - FORCE_TRIGGER, FRTR

Causes the instrument to make one acquisition.

Command Syntax

```
FoRce_TRigger
```

Example

Either of the following instructions forces the oscilloscope to make one acquisition:

```
TRMD SINGLE;ARM;FRTR...

TRMD STOP;ARM;FRTR...
```

ACQUISITION - INTERLEAVED, ILVD

The INTERLEAVED command enables or disables Equivalent Time Mode for timebase settings where both single shot and RIS mode are available.

Equivalent Time Mode is not available for sequence mode acquisitions. If sequence mode is on, ILVD ON turns it off.

The response to the INTERLEAVED? query indicates whether the oscilloscope is in Equivalent Time Mode.

Command Syntax

```
InterLeaVeD  <mode>

<mode>:= {ON, OFF}
```

Query Syntax

```
InterLeaVeD?
```

Response Format

```
InterLeaVeD <mode>
```

Example

The following instructs the oscilloscope to use Equivalent Time Mode:

```
ILVD ON
```

Related Commands

```
TIME_DIV, TRIG_MODE
```

ACQUISITION - OFFSET, OFST

The OFFSET command allows adjustment of the vertical offset of the specified input channel. The OFFSET? query returns the DC offset value of the specified channel.

The maximum ranges depend on the fixed sensitivity setting. If an out-of-range value is entered, the oscilloscope is set to the closest possible value.

NOTE: The probe attenuation factor is not taken into account in offset adjustments. Also, the unit V is optional.

Command Syntax

`<channel>:OFfSeT <offset>`

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

`<offset>:=` Refer to datasheet specification for your Teledyne LeCroy oscilloscope at teledynelecroy.com.

Query Syntax

`<channel>:OFfSeT?`

Response Format

`<channel>:OFfSeT <offset>`

Example

The following instruction sets the offset of Channel 2 to -3 V:

```
C2:OFST -3V
```

ACQUISITION – PEAK DETECT, PDET

The PEAK_DETECT command switches ON or OFF the peak detector built into the acquisition system.

The PEAK_DETECT? query returns the current status of the peak detector.

Command Syntax

```
Peak_DETect <state>

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

Query Syntax

```
Peak_DETect?
```

Response Format

```
PDET <state>
```

Example

The following instruction turns on the peak detector:

```
PDET ON
```

ACQUISITION - STOP

The STOP command immediately stops the acquisition of a signal. If the trigger mode is AUTO or NORM, STOP places the oscilloscope in STOPPED trigger mode to prevent further acquisition.

Command Syntax

```
STOP
```

Related Commands

```
ARM_ACQUISITION, TRIG_MODE, WAIT, FORCE_TRIGGER
```

ACQUISITION - TIME_DIV, TDIV

The **TIME_DIV** command modifies the timebase setting. The new timebase setting can be specified with units: N/NS for nanoseconds, U/US for microseconds, M/MS for milliseconds, or S for seconds. Alternatively, you can use exponential notation: 10E-6.

The **TIME_DIV?** query returns the current timebase setting.

Command Syntax

`Time_DIV <value>`

`<value>:=` Refer to datasheet specification for your Teledyne LeCroy oscilloscope at at teledynelecroy.com.

The default unit S (seconds) is optional.

Query Syntax

`Time_DIV?`

Response Format

`Time_DIV <value>`

Example

The following instruction sets the time base to 500 µs/div:

`TDIV 500US`

The following instruction sets the time base to 2 msec/div:

`TDIV 0.002`

Related Commands

`TRIG_DELAY, TRIG_MODE`

ACQUISITION - TRIG_COUPLING, TRCP

The TRIG_COUPLING command sets the coupling mode of the specified trigger source.

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

Command Syntax

```
<trig_source>:TRig_CouPling <coupling>

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

<coupling>:= {AC,DC,HFREI,LFREI}
```

Query Syntax

```
<trig_source>:TRig_CouPling?
```

Response Format

```
<trig_source>:TRig_CouPling <trig_coupling>
```

Example

The following instruction sets the coupling mode of the trigger source Channel 2 to DC:

```
C2:TRCP DC
```

Related Commands

```
TRIG_COUPLING, TRIG_DELAY, TRIG_LEVEL, TRIG_MODE, TRIG_SELECT, TRIG_SLOPE
```

ACQUISITION - TRIG_DELAY, TRDL

The TRIG_DELAY command sets the time at which the trigger is to occur with respect to the nominal zero delay position, which defaults to the center of the grid.

RANGE

Negative delay: 0 to - divisions x Time/div supported by scope

Postive delay: 0 to + division x Time/div supported by scope

If a value outside these ranges is specified, the trigger time is set to the nearest limit.

Command Syntax

`TRig_DeLay <value>`

`<value>:=` delay time as per RANGE previously described in this topic.

NOTE: The value parameter is optional.

Query Syntax

`TRig_DeLay?`

Response Format

The response to the TRIG_DELAY? query indicates the trigger time with respect to the first acquired data point.

`TRig_DeLay <value>`

Example

The following instruction sets the trigger delay to -20 S (post-trigger):

`TRDL -20S`

Related Commands

`TIME_DIV, TRIG_COUPLING, TRIG_LEVEL, TRIG_MODE, TRIG_SELECT, TRIG_SLOPE`

ACQUISITION - TRIG_LEVEL, TRLV

The TRIG_LEVEL command adjusts the trigger level of the specified trigger source. An out-of-range value will be adjusted to the closest legal value.

The TRIG_LEVEL? query returns the current trigger level.

Command Syntax

```
[<trig_source>]:TRig_LeVel <trig_level>
```

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

Query Syntax

```
<trig_source>:TRig_LeVel?
```

Response Format

```
<trig_source>:TRig_LeVel <trig_level>
```

Example

The following instruction adjusts the trigger level of Channel 2 to -3.4 V:

```
C2:TRLV -3.4V
```

Related Commands

```
TRIG_COUPLING, TRIG_DELAY, TRIG_MODE, TRIG_SELECT, TRIG_SLOPE
```

ACQUISITION - TRIG_MODE, TRMD

The TRIG_MODE command specifies the trigger mode.

The TRIG_MODE? query returns the current trigger mode.

Command Syntax

```
TRig_MoDe <mode>
```

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

Query Syntax

```
TRig_MoDe?
```

Response Format

```
TRig_MoDe <mode>
```

Example

The following instruction selects the normal mode:

```
TRMD NORM
```

Related Commands

```
ARM_ACQUISITION, FORCE_TRIGGER, STOP, TRIG_SELECT, TRIG_COUPLING,
TRIG_LEVEL, TRIG_SLOPE
```

ACQUISITION - TRIG_SELECT, TRSE

The TRIG_SELECT command selects the condition that triggers the acquisition of waveforms. Only the Edge trigger is supported.

Command Syntax

`TRig_Select EDGE,SR,<source>,HT,TI,HV,<hold_value>`

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

`<hold_value>:=` Refer to the trigger information provided for your oscilloscope model.

NOTE: When specifying <hold_value>, the unit S (seconds) is optional.

Query Syntax

`TRig_SElect?`

Response Format

`TRig_SElect <trig_type>,SR,<source>,HT,<hold_type>,HV,<hold_value>`

HV2 only returned if <hold_type> is P2 or I2.

Example

The following instruction selects the single-source trigger with Channel 1 as trigger source. Hold type and hold value are chosen as "pulse smaller" than 20 ns:

`TRSE SNG,SR,C1,HT,PS,HV,20 NS`

ACQUISITION - TRIG_SLOPE, TRSL

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,LINE,EX,EX5}

<trig_slope>:= {NEG, POS}
```

Query Syntax

```
<trig_source>:TRig_SLope?
```

Response Format

```
<trig_source>:TRig_SLope <trig_slope>
```

Example

The following instruction sets the trigger slope of Channel 2 to negative:

```
C2:TRSL NEG
```

Related Commands

```
TRIG_COUPLING, TRIG_DELAY, TRIG_LEVEL, TRIG_MODE, TRIG_SELECT, TRIG_SLOPE
```

ACQUISITION - VOLT_DIV, VDIV

The VOLT_DIV command sets the vertical sensitivity in Volts/div.

The probe attenuation factor is not taken into account for adjusting vertical sensitivity.

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>:=` Refer to product datasheet at teledynelecroy.com.

NOTE: When specifying <v_gain>, the unit V is optional.

Query Syntax

`<channel>:Volt_DIV?`

Response Format

`<channel>:Volt_DIV <v_gain>`

Example

The following instruction sets the vertical sensitivity of channel 1 to 50 mV/div:

```
C1:VDIV 50MV
```

ACQUISITION - WAIT

The WAIT command prevents your instrument from analyzing new commands until the current acquisition has been completed. The optional argument specifies the timeout (in seconds) after which the scope stops waiting for new acquisitions. If <t> is not given, or if <t> = 0.0, the scope waits indefinitely.

Command Syntax

```
WAIT [<t>]
```

<t>:= timeout in seconds (default is indefinite)

Example

```
ARM;WAIT;*OPC;C1:PAVA? MAX
```

This example finds the maximum amplitudes of several signals acquired one after another. ARM starts a new data acquisition. The WAIT command ensures that the maximum is evaluated for the newly acquired waveform.

C1:PAVA? MAX instructs the oscilloscope to evaluate the maximum data value in the Channel 1 waveform.

Related Commands

```
*TRG, TRIG_MODE, ARM
```

CURSOR - CURSOR_MEASURE, CRMS

The CURSOR_MEASURE command specifies the type of cursor or parameter measurement to be displayed, and is the main command for displaying parameters and Pass/Fail. Use it to turn on/off cursors.

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

Command Syntax

```
CuRsor_MeaSure <mode>

<mode>:= {HREL, VREL}
```

Where:

HREL - Horizontal relative cursors.
VREL - Vertical relative cursors.

Query Syntax

```
CuRsor_MeaSure?
```

Response Format

```
CuRsor_MeaSure <mode>
```

Example

The following instruction switches on the vertical relative cursors:

```
CRMS VREL
```

Related Commands

```
CURSOR_SET, PARAMETER_VALUE,
```

CURSOR - CURSOR_SET, CRST

The CURSOR_SET command allows you to position any one of the independent cursors at a given grid location. When you are setting a cursor position, you must specify an active trace relative to which the cursor is positioned.

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

HREF Horizontal Cursor A	VREF Vertical Cursor A.
HDIF Horizontal Cursor B	VDIF Vertical Cursor B.

Command Syntax

```
<trace>:CuRsor_SeT <cursor>,<position>,...
```

```
<trace>:= {TA,TB,TC,TD,C1,C2,C3,C4,M1,M2,M3,M4,M5,M6,M7,M8,M9,M10}
```

```
<cursor>:= {HABS, VABS, HREF, HDIF, VREF, VDIF}
```

```
<position>:=  0 to 10 DIV (horizontal);-3.99 to 3.99 DIV (vertical)
```

Query Syntax

```
<trace>:CuRsor_SeT? <cursor>
```

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

No <cursor> implies ALL, even though not all are visible.

Response Format

```
<trace>:CuRsor_SeT <cursor>,<position>,...<cursor>,<position>
```

If the position of a cursor cannot be determined, its position will be given as UNDEF.

Example

The following instruction positions the VREF and VDIF cursors at +3 DIV and -2 DIV respectively, using Trace TA as a reference:

```
TA:CRST VREF,3DIV,VDIF,-2DIV
```

Related Commands

```
CURSOR_MEASURE, CURSOR_VALUE?, PARAMETER_VALUE?
```

CURSOR - CURSOR_VALUE?, CRVA?

The CURSOR_VALUE? query returns the values measured by the specified cursors. The PARAMETER_VALUE? query is used to obtain measured waveform parameter values.

The keyword ALL should not be used; neither should multiple keywords. If they are used, the word UNDEF is returned.

For the CRVA? query to work, the specified trace must be visible, and the current cursor mode must be the same as in the query. If it is not the same, UNDEF is returned.

Query Syntax

```
<trace>:CuRsor_VAlue?  [<mode>]

<trace>:= {TA,TB,TC,TD,C1,C2,C3,C4}

<mode>:= {HABS, HREL, VABS, VREL}
```

Where:

HABS - Horizontal absolute
HREL - Horizontal relative
VABS – Vertical absolute
VREL – Vertical relative

Response Format

```
<trace>:CuRsor_VAlue HABS,<abs_hori>,<abs_vert>

<trace>:CuRsor_VAlue HREL,<delta_hori>,<delta_vert>,<abs vert_ref>,
<abs vert_dif>,<slope>
```

The dV/dt value <slope> is displayed in the appropriate trace label box.

```
<trace>:CuRsor_VAlue VABS,<abs_vert>

<trace>:CuRsor_VAlue VREL,<delta_vert>
```

For horizontal cursors, both horizontal and vertical values are given. For vertical cursors only vertical values are given.

Example

The following query reads the measured absolute horizontal value of the cross-hair cursor (HABS) on Channel 2:

```
C2:CRVA? HABS
```

Response message:

```
C2:CRVA HABS,34.2E-6 S, 244 E-3 V
```

CURSOR - PARAMETER_CUSTOM, PACU

The PArameter_CUstom command controls the placement of custom cursors and can also be used to assign any parameter for histogramming.

The command allows you to specify on which line (1 to 5) of the parameter table the cursor value will appear when viewed on the WaveAce display.

NOTE: Use PAVA? to read the value of parameters that were set up with PACU.

Command Syntax

`Parameter_Custom <line>,<parameter>,<source>`

Where:

`<line>:= 1 to 5`

`<parameter>:=` parameter from the table below or returned with the PAVA? query

`<source>:= {C1,C2,C3,C4,C1-C2,C1-C3,C1-C4,C2-C3,C2-C4,C3-C4,TA,TB,TC,TD}`

NOTE: Multi-source expressions (e.g., C1-C2) used only with delay measurements PHASE, FRR, FRF, FFR, FFF, LRR, LRF, LFR, and LFF.

Parameters

Parameter	Definition
AMPL	V Amplitude
BASE	V Base
CRMS	Root mean squared (current)
CMEAN	V Average
DUTY	+ Duty cycle
FALL	Fall time 90% to 10%
FFF	Time between first falling edge of Source 1 and falling edge of Source 2
FFR	Time between first falling edge of Source 1 and rising edge of Source 2
FPRE	Falling edge preshoot
FREQ	Frequency
FRF	Time between first rising edge of Source 1 and falling edge of Source 2
FRR	Time between first rising edge of Source 1 and rising edge of Source 2
LFF	Time between last falling edge of Source 1 and falling edge of Source 2
LFR	Time between last falling edge of Source 1 and rising edge of Source 2
LRF	Time between last rising edge of Source 1 and falling edge of Source 2
LRR	Time between last rising edge of Source 1 and rising edge of Source 2

Parameter	Definition
MAX	Maximum value
MEAN	Mean value
MIN	Minimum value
NDUTY	- Duty cycle
NWID	Negative width (negative edge to positive edge)
OVSN	Overshoot negative/FOV
OVSP	Overshoot positive/ROV
PER	Period
PHASE	Amount one waveform leads or lags another in time, expressed in degrees, where 360 degrees is one waveform cycle
PKPK	Peak to peak
PWID	Positive width (positive edge to negative edge)
RISE	Rise time 10% to 90%
RMS	Root mean square
RPRE	Rising edge preshoot
TOP	Top
WID	Width

Query Syntax

```
PArameter_CUstom? <line>
```

Response Format

```
PArameter_Custom <line>,<parameter>,<source>
```

Example

```
PACU 1,MAX,C1
```

Related Commands

PARAMETER_VALUE

CURSOR - PARAMETER_VALUE?, PAVA?

The PArameter_VAlue query returns the current values of the pulse waveform parameters and mask tests for the specified trace. Traces do not need to be displayed or selected to obtain the values measured by the pulse parameters or mask tests.

Custom parameters can be read using the syntax CUST<n>, where <n> refers to lines 1 through 5 of the parameter table to the right of the WaveAce display. The query returns values for all the parameters assigned to that location using the PACU command.

Query Syntax

`<trace>:PArameter_VAlue? [<parameter>,...,<parameter>]`

OR

`PArameter_VAlue? CUST<n>`

Where:

`<trace>:= {C1,C2,C3,C4,TA,TB,TC,TD}`

`<parameter>:=` Refer to parameter table.

`<n>:= 1 to 5`

Parameters

Parameter	Definition
AMPL	V Amplitude
BASE	V Base
CRMS	Root mean squared (current)
CMEAN	V Average
DUTY	+ Duty cycle
FALL	Fall time 90% to 10%
FFF	Time between first falling edge of Source 1 and falling edge of Source 2
FFR	Time between first falling edge of Source 1 and rising edge of Source 2
FPRE	Falling edge preshoot
FREQ	Frequency
FRF	Time between first rising edge of Source 1 and falling edge of Source 2
FRR	Time between first rising edge of Source 1 and rising edge of Source 2
LFF	Time between last falling edge of Source 1 and falling edge of Source 2
LFR	Time between last falling edge of Source 1 and rising edge of Source 2
LRF	Time between last rising edge of Source 1 and falling edge of Source 2
LRR	Time between last rising edge of Source 1 and rising edge of Source 2

Parameter	Definition
MAX	Maximum value
MEAN	Mean value
MIN	Minimum value
NDUTY	- Duty cycle
NWID	Negative width (negative edge to positive edge)
OVSN	Overshoot negative/FOV
OVSP	Overshoot positive/ROV
PER	Period
PKPK	Peak to peak
PWID	Positive width (positive edge to negative edge)
RISE	Rise time 10% to 90%
RMS	Root mean square
RPRE	Rising edge preshoot
TOP	Top
WID	Width

Response Format

`<trace>:PArameter_VAlue <parameter>,<value>,<state>...`

`<value>:=` A decimal numeric value

`<state>:= {OK, AV, PT, IV, NP, GT, LT, OF, UF, OU}`

NOTE: If <parameter> is not specified, or is equal to ALL, all standard voltage and time parameters are returned followed by their values and states. When PAVA? Is used to query a Custom parameter, the <trace> prefix is returned for consistency. The source for the measurement is configured using the PACU command.

Example

The following instruction query reads the rise time of Trace B (TB):

```
TB:PAVA? RISE
```

Response message:

```
TB:PAVA RISE,3.6E-9S,OK
```

Related Commands

`CURSOR_MEASURE, CURSOR_SET, PARAMETER_CUSTOM`

DISPLAY - DOT_JOIN, DTJN

The DOT_JOIN command controls the interpolation lines between data points. Setting DOT_JOIN ON selects Points in the Display dialog; DOT_JOIN OFF selects Line.

Command Syntax

```
DOT_JOIN <state>

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

Query Syntax

```
DoT_JoiN?
```

Response Format

```
DoT_JoiN <state>
```

Example

The following instruction turns off the interpolation lines:

```
DTJN OFF
```

DISPLAY - HOR_MAGNIFY, HMAG

The HOR_MAGNIFY command horizontally expands traces (zooms) by a specified factor. Magnification factors not within the range of permissible values will be rounded off to the nearest legal value.

The HOR_MAGNIFY? query returns the current magnification factor.

Command Syntax

```
Hor_MAGnify <factor>
```

```
<factor>:= 1 to 2000
```

Query Syntax

```
Hor_MAGnify?
```

Response Format

```
Hor_MAGnify <factor>
```

Example

The following instruction horizontally magnifies traces by a factor of 5:

```
HMAG 5
```

DISPLAY - HOR_POSITION, HPOS

The HOR_POSITION command repositions the geometric center of a zoom to display different portions of the trace. Allowed positions range from division 0 through 10. If the source trace was acquired in sequence mode, the shift will only apply to a single segment at a time.

The difference between the specified and the current horizontal position is applied to all zooms. However, if the difference would cause any zoom trace to go outside the left or right screen boundaries, the difference is adapted before being applied to the traces.

The HOR_POSITION? query returns the position of the geometric center of the zoom.

NOTE: Segment number 0 has the special meaning **Show All Segments Unexpanded**.

Command Syntax

```
Hor_POSition <hor_position>,<segment>

<hor_position>:= 0 to 10 DIV

<segment>:= 0 to max segments
```

NOTE: The segment number is only relevant for waveforms acquired in sequence mode; it is ignored in single waveform acquisitions. When the segment number is set to 0, all segments are shown. The unit DIV is optional.

Query Syntax

```
Hor_POSition?
```

Response Format

```
Hor_POSition <hor_position>[,<segment>]
```

Example

The following instruction positions the center of the zoom at division 3:

```
HPOS 3
```

DISPLAY - INTENSITY, INTS

The INTenSity command sets the intensity level of the grid and trace.

Command Syntax

```
INTenSity GRID,<value>[PCT],TRACE,<value>[PCT]
```

Query Syntax

```
INTenSity?
```

Response Format

```
INTenSity TRACE,<value>,GRID,<value>
```

Example

The following example sets the grid intensity to 60% and trace intensity to 90%.

```
INTS GRID,60,TRACE,90
```

DISPLAY - PERSIST, PERS

The PERSIST command enables or disables the persistence display mode.

Command Syntax

```
PERSist <mode>
```

```
<mode>:= {ON, OFF}
```

Query Syntax

```
PERSist?
```

Response Format

```
PERSist <mode>
```

Example

The following instruction turns the persistence display ON:

```
PERS ON
```

Related Commands

```
PERSIST_SETUP
```

DISPLAY - PERSIST_SETUP, PESU

The PERSIST_SETUP command sets the duration of the display, in seconds, when in persistence mode. The persistence can be set on all traces or per trace.

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

Command Syntax

```
PErsist_SetUp <time>

<time>:=  {1, 2, 5, infinite}
```

NOTE: The <mode> argument **Top2** used by some older instruments is not supported.

Query Syntax

```
PErsist_SetUp?
```

Response Format

```
PErsist_SetUp <time>
```

Example

The following instruction sets the variable persistence to 10 seconds on all traces:

```
PESU 20
```

Related Commands

```
PERSIST
```

DISPLAY – SCREEN SAVE, SCSV

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 indicates whether the automatic screen saver feature is on or off.

NOTE: When the screen save is in effect, the oscilloscope is still fully functional.

Command Syntax

```
SCreen_SaVe <enabled>

<enabled>:= {YES,NO}
```

Query Syntax

```
SCreen_SaVe?
```

Response Format

```
SCreen_SaVe <state>

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

Example

The following enables the automatic screen saver:

```
SCSV YES
```

DISPLAY - TRACE, TRA

The TRACE command enables or disables the display of a trace. An environment error is set if an attempt is made to display more than four waveforms. Refer to the table in STATUS - EXR? (on page 63) for more information.

The TRACE? query indicates whether or not the specified trace is displayed.

Command Syntax

```
<trace>:TRAce <mode>
```

```
<trace>:= {C1,C2,C3,C4,TA,TB,TC,TD}
```

```
<mode>:= {ON, OFF}
```

Query Syntax

```
<trace>:TRAce?
```

Response Format

```
<trace>:TRAce <mode>
```

Example

The following instruction displays Trace C1:

```
C1:TRA ON
```

MISCELLANEOUS - *CAL?

The *CAL? query causes the oscilloscope to perform an internal self-calibration and generates a response that indicates whether or not your oscilloscope completed the calibration without error. This internal calibration sequence is the same as that which occurs at power-up. At the end of the calibration, after the response has indicated how the calibration terminated, the oscilloscope returns to the state it was in just prior to the calibration cycle.

Query Syntax

```
*CAL?
```

Response Format

```
*CAL? <diagnostics>
```

```
<diagnostics>:=  0 (calibration successful)
```

Response message (if no failure):

```
*CAL 0
```

MISCELLANEOUS - *IDN?

The *IDN? query causes the instrument to identify itself. The response comprises manufacturer, oscilloscope model, serial number, and firmware revision level.

Query Syntax

```
*IDN?
```

Response Format

```
*IDN LECROY,<model>,<serial_number>,<firmware_level>
```

`<model>:=` A six- or seven-character model identifier

`<serial_number>:=` A nine- or 10-digit decimal code

`<firmware_level>:=` major release, minor release, and update levels formatted xx.y.z

Example response message:

*IDN LECROY,WaveAce1012,LCRY2150C12345,5.01.02.09

MISCELLANEOUS – AUTO-CALIBRATE, ACAL

Available only on WaveAce 2000 models, AUTO_CALIBRATE enables or disables automatic calibration of the oscilloscope. If ACAL is ON at power-up, all input channels are periodically calibrated for the current input amplifier and timebase settings, whether the instrument has been adjusted or not. This is separate from the calibration the instrument performs whenever you adjust a gain or offset.

ACAL OFF disables Auto-calibration. You can issue a *CAL? query at any time to fully calibrate the oscilloscope, but periodic calibrations stop if ACAL is OFF.

The response to the AUTO_CALIBRATE? query indicates whether auto-calibration is enabled or disabled.

Command Syntax

```
Auto_CALibrate <state>

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

Query Syntax

```
Auto_CALibrate?
```

Response Format

```
Auto_CALibrate <state>
```

Related Commands

```
*CAL?
```

MISCELLANEOUS - BUZZER, BUZZ

The buzzer command controls the built-in buzzer. By means of the BEEP argument, the buzzer can be activated to sound short beeps at key points in the control program.

Command Syntax

```
BUZZer <state>

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

Example

The following instruction turns off the buzzer:

```
BUZZ OFF
```

MISCELLANEOUS - COMM_HEADER, CHDR

The COMM_HEADER command controls the way the oscilloscope formats responses to queries. There are three response formats:

- LONG, responses contain the long form of the header : C1:VOLT_DIV 200E-3 V
- SHORT, responses contain the short form of the header : C1:VDIV 200E-3 V
- OFF, headers and units are omitted: 200E-3

Unless you specify otherwise, the SHORT response format is used by default.

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 COMM_HEADER setting.

Command Syntax

```
Comm_HeaDeR <mode>

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

Query Syntax

```
Comm_HeaDeR?
```

Response Format

```
Comm_HeaDeR <mode>
```

Example

The following instruction sets the response header format to LONG:

```
CHDR LONG
```

MISCELLANEOUS - DEFINE, DEF

The DEFINE command specifies a mathematical function to be performed. This command is used to control all math tools in the standard oscilloscope.

Command Syntax

```
DEFine EQN,'[<function>]<expression>'
```

Query Syntax

```
DEFine?
```

Response Format

```
DEFine EQN,'[<function>]<expression>'
```

Equations

Where <source> is shown enclosed in parentheses ( ), the function is included in the equation.

Function	Expression	Description
DIFFERENCE	<source1>-<source2>	Difference of two waveforms.
FFT	(<source>)	Fast Fourier Transform of waveform.
PRODUCT	<source1>*<source2>	Product of two waveforms.
RATIO	<source1>/<source2>	Ratio of two waveforms.
SUM	<source1>+<source2>	Sum of two waveforms.

Source Values

```
<sourceN>:= {C1,C2,C3,C4}
```

Examples

Compute the product of Channel 1 and Channel 2:

```
DEF EQN,'C1*C2'
```

Related Commands

```
INR?, PARAMETER_CUSTOM, PARAMETER_VALUE?
```

MISCELLANEOUS - DELETE_FILE, DELF

The DELETE_FILE command deletes a file from the currently selected directory.

Command Syntax

```
DELF '<filename>'
```

Example

The following instruction deletes a trace file:

```
DELF 'TESTRUN.TRC'
```

MISCELLANEOUS - DIRECTORY, DIR

The DIRECTORY command is used to create or delete file directories on mass storage devices. It also allows selection of the current working directory and listing of files in the directory.

The query response consists of a double-quoted string containing a DOS-like listing of the directory. If no mass storage device is present, or if it is not formatted, the string is left empty.

Command Syntax

```
DIRectory DISK,UDSK,ACTION,<action>,'<directory>'
```

`<action>:=  {CREATE, DELETE, SWITCH}`

`<directory>:=` A legal DOS path or filename (can include the '\' character to define the root directory)

Query Syntax

```
DIRectory? DISK,UDSK
```

Response Format

```
DIRectory? DISK,UDSK,'<directory>'
```

`<directory>:=` A variable length string detailing the file content of the hard disk

MISCELLANEOUS – FILENAME, FLNM

The FILENAME command is used to change the default filename given to any traces, setups or hard copies (screen prints) when being saved to a mass storage device.

Command Syntax

`FiLeNaMe TYPE,<type>,FILE,'<filename>'`

Where:

`<type>:= {C1,C2,C3,C4,SETUP,TA,TB,TC,TD,HCOOPY}`

`<filename>:=` alphanumeric string of up to 8 characters forming a legal DOS filename, enclosed by quotes.

Query Syntax

`FiLeNaMe?  TYPE,<type>`

`<type>: {ALL,C1,C2,C3,C4,SETUP,TA,TB,TC,TD,HCOOPY}`

Response Format

`FILENAME TYPE,<type>,FILE,'<filename>'[TYPE,<type>,FILE,'<filename>'…]`

Example

The following command names Channel 1 waveform file 'TESTWF.DAV':

`FLNM TYPE,C1,FILE, 'TESTWF'`

NOTE: The file's extension is automatically specified by the oscilloscope.

Related Commands

DIRECTORY, DELETE_FILE

SAVE / RECALL SETUP - *RCL

The *RCL command sets the state of your instrument, using one of the six non-volatile panel setups (Panel 1 to Panel 6), by recalling the complete front panel setup of the oscilloscope. Entering panel setup 0 corresponds to the default panel setup.

The *RCL command produces an effect the opposite of the *SAV command.

If the desired panel setup is not acceptable, the EXecution error status Register (EXR) is set and the EXE bit of the standard Event Status Register (ESR) is set.

Command Syntax

```
*RCL <panel_setup>

<panel_setup>:= 0 to 6
```

Example

The following instruction recalls your instrument setup previously stored in panel setup 3:

```
*RCL 3
```

Related Commands

```
*SAV, EXR?
```

SAVE / RECALL SETUP - *RST

The *RST command initiates a device reset. *RST sets all eight traces to the GND line and recalls the default setup.

Command Syntax

```
*RST
```

Related Commands

```
*CAL?
```

SAVE / RECALL SETUP - *SAV

The *SAV command stores the current state of your instrument in non-volatile internal memory. The *SAV command stores the complete front panel setup of the oscilloscope at the time the command is issued.

NOTE: Communication parameters (those modified by the commands COMM_HEADER and WAVEFORM_SETUP) are not saved when *SAV is used.

Command Syntax

```
*SAV <panel_setup>
```

```
<panel_setup>:= 1 to 6
```

Example

The following instruction saves the current instrument setup in panel setup 3:

```
*SAV 3
```

Related Commands

```
PANEL_SETUP
```

SAVE / RECALL SETUP - RECALL_PANEL, RCPN

The RECALL_PANEL command recalls a front panel setup from the root directory on an external storage device (USB drive).

Command Syntax

```
ReCall_PaNel DISK,UDSK,FILE,'<filename>'
```

`<filename>:=` A string of up to characters with the extension .SET.

Example

The following instruction recalls the front panel setup from file P012.SET on the USB drive:

```
RCPN DISK,UDSK,FILE,'P012.SET'
```

Related Commands

```
PANEL_SETUP, *SAV
```

STATUS - *CLS

The *CLS command clears all status data registers.

Command Syntax

```
*CLS
```

Related Commands

```
ALL_STATUS, CMR, DDR, *ESR, EXR, *STB
```

STATUS - *ESE

The *ESE command sets the value of the ESB bit in the Event Status Enable register (ESE). The *ESE? query reads the contents of the ESE register.

Command Syntax

```
*ESE <value>
```

```
<value>:= 0 to 255
```

Query Syntax

```
*ESE?
```

Response Format

```
*ESE <value>
```

Example

The following allows the ESB bit to be set if a user request (URQ bit 6, decimal 64) and/or a device dependent error (DDE bit 3, decimal 8) occurs. Summing these values yields the ESE register mask 64+8=72.

```
*ESE 72
```

Related Commands

```
*ESR?
```

STATUS - *ESR?

The *ESR? query reads and clears the contents of the Event Status Register (ESR). The response represents the sum of the binary values of the register bits 0 to 7. The following table provides an overview of the ESR register structure.

Query Syntax

*ESR?

Response Format

*ESR <value>

<value>:= 0 to 255

Response message:

*ESR 0

Related Commands

ALL_STATUS, *CLS, *ESE

ESR? Status Register Structure

Bit	Value	Name	Description	Note
15...8			0 - Reserved by IEEE 488.2.	
7	128	PON	1 - Power OFF-to-ON transition has occurred.	The Power On (PON) bit is always turned on (1) when the unit is powered up.
6	64	URQ	1 - Not used.	On older Teledyne LeCroy oscilloscopes, this bit reports soft key inputs. It does not apply to WaveAce oscilloscopes.
5	32	CME	1 - CoMmand parser Error has been detected.	The CoMmand parser Error bit (CME) is set true (1) whenever a command syntax error is detected. The CME bit has an associated CoMmand parser Register (CMR) which specifies the error code. Refer to the query CMR? for further details.
4	16	EXE	1 - EXecution Error detected.	The EXecution Error bit (EXE) is set true (1) when a command cannot be executed due to some device condition (for example, the oscilloscope in local state) or a semantic error. The EXE bit has an associated Execution Error Register (EXR) that specifies the error code. Refer to query EXR? for further details.

Bit	Value	Name	Description	Note
3	8	DDE	1 - Device Dependent (specific) Error occurred.	The Device specific Error (DDE) is set true (1) whenever a hardware failure has occurred at power-up or at execution time, such as a channel overload condition, or a trigger or timebase circuit defect. The origin of the failure can be localized with the DDR? query.
2	4	QYE	1 - QueRY Error occurred.	The QueRY Error bit (QYE) is set true (1) whenever (a) an attempt is made to read data from the Output Queue when no output is either present or pending, (b) data in the Output Queue has been lost, (c) both output and input buffers are full (deadlock state), (d) an attempt is made by the controller to read before having sent an <END>, (e) a command is received before the response to the previous query was read (output buffer flushed).
1	2	RQC	0 - Oscilloscope never ReQuests bus Control.	The ReQuest Control bit (RQC) is always false (0), as the oscilloscope has no GPIB controlling capability.
0	1	OPC	0 - OPeration Complete bit not used.	The OPeration Complete bit (OPC) is set true (1) whenever *OPC has been received, since commands and queries are strictly executed in sequential order. The oscilloscope starts processing a command only when the previous command has been entirely executed

STATUS - *OPC

The *OPC (OPeration Complete) command sets to true the OPC bit (bit 0) in the Standard Event Status Register (ESR).

The *OPC? query always responds with the ASCII character 1 because the oscilloscope only responds to the query when the previous commands are entirely executed. Since *OPC? executes only when processing is complete, it is recommended for synchronization purposes.

Command Syntax

```
*OPC
```

Query Syntax

```
*OPC?
```

Response Format

```
*OPC 1
```

STATUS - ALL_STATUS?, ALST?

The ALL_STATUS? query reads and clears the contents of all status registers: ESR, INR, DDR, CMR, and EXR. For an interpretation of the contents of each register, refer to the appropriate status register.

The query is useful to obtain a complete overview of the state of your oscilloscope.

Query Syntax

```
ALl_STatus?
```

Response Format

```
ALl_STatus ESR,<value>,INR,<value>,DDR,<value>,CMR,<value>,
EXR,<value>,URR,<value>

<value>:= 0 to 65535
```

Example

The following instruction reads the contents of all the status registers:

```
ALST?
```

Response message:

```
ALST ESR,000052,INR,000005,DDR,000000,CMR,000004,EXR,000024
```

Related Commands

```
*CLS, CMR?, DDR?, *ESR?, EXR?
```

STATUS - CMR?

The CMR? query reads and clears the contents of the CoMmand error Register (refer to the following table for details) which specifies the last syntax error type detected by your oscilloscope.

Query Syntax

```
CMR?
```

Response Format

```
CMR <value>

<value>:= 0 to 13
```

Related Commands

```
ALL_STATUS?, *CLS
```

CMR? Status Register Structure

Value	Description
1	Unrecognized command/query header.
2	Illegal header path.
3	Illegal number.
4	Illegal number suffix.
5	Unrecognized keyword.
6	String error.
7	GET embedded in another message.
10	Arbitrary data block expected.
11	Non-digit character in byte count field of arbitrary data block.
12	EOI detected during definite length data block transfer.
13	Extra bytes detected during definite length data block transfer.

STATUS - DDR?

The DDR? query reads and clears the contents of the Device Dependent or device specific error Register (DDR). In the case of a hardware failure, the DDR register specifies the origin of the failure. The following table provides details.

Query Syntax

DDR?

Response Format

DDR <value>

<value>:= 0 to 65535

DDR? Status Register Structure

Bit	Value	Description
15...14		0 - Reserved.
13	8192	1 - Timebase hardware failure detected.
12	4096	1 - Trigger hardware failure detected.
11	2048	1 - Channel 4 hardware failure detected.
10	1024	1 - Channel 3 hardware failure detected.
9	512	1 - Channel 2 hardware failure detected.
8	256	1 - Channel 1 hardware failure detected.
7	128	1 - External input overload condition detected.
6...4		0 - Reserved.
3	8	1 - Channel 4 overload condition detected.
2	4	1 - Channel 3 overload condition detected.
1	2	1 - Channel 2 overload condition detected.
0	1	1 - Channel 1 overload condition detected.

STATUS - EXR?

The EXR? query reads and clears the contents of the EXecution error Register (EXR). The EXR register specifies the type of the last error detected during execution.

Query Syntax

EXR?

Response Format

EXR? <value>

<value>:= 21 to 64

Example

The following instruction reads the contents of the EXR register:

EXR?

Response message (if no fault):

EXR 0

Related Commands

ALL_STATUS, *CLS

EXR? Status Register Structure

Value	Description
21	Permission error. The command cannot be executed in local mode.
22	Environment error. The oscilloscope is not configured to correctly process a command. For instance, the oscilloscope cannot be set to RIS at a slow timebase.
23	Option error. The command applies to an option which has not been installed.
24	Unresolved parsing error.
25	Parameter error. Too many parameters specified.
26	Non-implemented command.
27	Parameter missing. A parameter was expected by the command.
30	Hex data error. A non-hexadecimal character has been detected in a hex data block.
31	Waveform error. The amount of data received does not correspond to descriptor indicators.
32	Waveform descriptor error. An invalid waveform descriptor has been detected.
33	Waveform text error. A corrupted waveform user text has been detected.
34	Waveform time error. Invalid RIS or TRIG time data has been detected.

Value	Description
35	Waveform data error. Invalid waveform data have been detected.
36	Panel setup error. An invalid panel setup data block has been detected.
50	No mass storage present when user attempted to access it. *
51	Mass storage not formatted when user attempted to access it. *
53	Mass storage was write protected when user attempted to create a file, to delete a file, or to format the device. *
54	Bad mass storage detected during formatting. *
55	Mass storage root directory full. Cannot add directory. *
56	Mass storage full when user attempted to write to it. *
57	Mass storage file sequence numbers exhausted (999 reached). *
58	Mass storage file not found. *
59	Requested directory not found. *
61	Mass storage filename not DOS compatible, or illegal filename. *
62	Cannot write on mass storage because filename already exists. *

STATUS - INR?

The INR? query reads and clears the contents of the 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
```

Sample Response message:

```
INR 1026
```

Related Commands

```
ALL_STATUS, *CLS
```

INR Status Register Structure

Bit	Value	Description
15		0 - Reserved for future use.
14	16384	1 - Probe was changed.
13	8192	1 - Trigger is ready.
12	4096	1 - Pass/Fail test detected desired outcome.
11	2048	1 - Waveform processing has terminated in trace F4.
10	1024	1 - Waveform processing has terminated in trace F3.
9	512	1 - Waveform processing has terminated in trace F2.
8	256	1 - Waveform processing has terminated in trace F1.
7	128	1 - A disk exchange has been detected.
6	64	1 - Disk has become full in AutoStore Fill mode.
5	32	0 - Reserved for Teledyne LeCroy use.
4	16	1 - Segment of a sequence waveform has been acquired in acquisition memory but not yet read out into the main memory.
3	8	1 - Time-out has occurred in a data block transfer.
2	4	1 - Return to the local state is detected.
1	2	1 - Screen dump has terminated.
0	1	1 - New signal acquired in acquisition memory and read out to the main memory.

WAVEFORM TRANSFER - STORE, STO

The STORE command stores the contents of the selected trace.

Command Syntax

```
STOre [<trace>,<dest>]

<trace>:= {TA,TB,TC,TD,C1,C2,C3,C4,ALL_DISPLAYED}

<dest>:= {M1,M2,M3,M4,M5,M6,M7,M8,M9,M10,FILE}
```

Example

The following instruction stores the contents of Trace A (TA) into Memory 1 (M1):

```
STO TA,M1
```

The following instruction stores all currently displayed waveforms onto the memory card:

```
STO ALL_DISPLAYED,FILE
```

The following instruction executes the storage operation currently defined in the Storage Setup:

```
STO
```

WAVEFORM TRANSFER - WAVEFORM, WF

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

WAVEFORM stores an external waveform back into the oscilloscope's internal memory. A waveform consists of several distinct entities:

- DESC - The descriptor
- TEXT - The user text
- TIME - The time descriptor
- DAT1 - The data block

  and, optionally...

- DAT2 - A second block of data

NOTE: Only complete waveforms queried with WAVEFORM? ALL can be restored to the oscilloscope.

The WAVEFORM? query instructs the oscilloscope to transmit a waveform to the controller. The entities can be queried independently. When the ALL parameter is specified, all four or five entities are transmitted in one block in the order listed above.

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

Command Syntax

```
<memory>:WaveForm ALL,<data_block>

<memory>:= {M1,M2,M3,M4,M5,M6,M7,M8,M9,M10}

<data_block>:= waveform data block.
```

Query Syntax

```
<trace>:WaveForm? <entity>

<trace>:= {TA,TB,TC,TD,C1,C2,C3,C4,M1,M2,M3,M4,M5,M6,M7,M8,M9,M10}

<entity>:= {DESC, TEXT, TIME, DAT1, DAT2, ALL}
```

If you do not provide a parameter, **ALL** is assumed.

Response Format

```
<trace>:WaveForm <entity>,<waveform_data_block>
```

TIP: It may be convenient to disable the response header if the waveform is to be restored. Refer to the **COMM_HEADER, CHDR** command topic for more information.

Example

The following instruction reads the block DAT1 from Memory 1.

```
M1:WF? DAT1
```

Related Commands

```
WAVEFORM_SETUP
```

WAVEFORM TRANSFER – WAVEFORM SETUP, WFSU

The WAVEFORM_SETUP command specifies the amount of data in a waveform to be transmitted to the controller. This is defined by the parameters: Sparsing, interval between data points; Number of Points, total number of points to be transmitted; First Point, the address of the first data point to be sent; Segment Number, which segment to be sent if the waveform was acquired in sequence mode.

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

Command Syntax

```
WaveForm_SetUp SP,<sparsing>,NP,<number of transferred points>,FP,<first
point>,SN,<segment number>

<sparsing>:= 0 to n where 0 sends all data points
                          n sends every nth data point

<number of transferred points>:= 0 to n where 0 sends all data points n
                          sends a maximum of n data points.

<first points>:= 0 to n where 0 sends the first data point
                          n sends n+1.

<segment number>:= 0 to n where 0 sends all segments
                          n sends the nth segment.
```

NOTE: After power-on, all values are set to 0 (i.e., entire waveforms will be transmitted without sparsing).

Query Syntax

```
WaveForm_SetUp?
```

Response Format

```
WaveForm_SetUp SP,<sparsing>,NP,<number>,FP,<point>,SN,<segment>
```

Example

The following command specifies that every 3rd data point (SP=3) starting at address 200 (FP=200) in segment 23 (SN=23) should be transferred:

```
WFSU SP,3,FP,200,SN,23
```

Related Commands

```
WAVEFORM
```

Appendix: Waveform Template

This section contains the Waveform Template describing the contents of the Waveform Descriptor produced by WF? DESC and WF? ALL queries. After the template, explanations detail the construction of floating point numbers from bytes in the descriptor, followed by program fragments showing a method of performing calculations.

Wave Descriptor Block WAVEDESC; Explanation

```
< 0> DESCRIPTOR_NAME: string ; the first 8 chars are always WAVEDESC

;

< 16> TEMPLATE_NAME: string

;

< 32> COMM_TYPE: enum ; chosen by remote command COMM_FORMAT

_0 byte

_1 word

endenum

;

< 34> COMM_ORDER: enum

_0 HIFIRST

_1 LOFIRST

endenum

;

;

; The following variables of this basic wave descriptor block specify

; the block lengths of all blocks of which the entire waveform (as it is

; currently being read) is composed. If a block length is zero, this

; block is (currently) not present.

;

; Blocks and arrays that are present will be found in the same order
```

```
; as their descriptions below.
;
;BLOCKS :
;
< 36> WAVE_DESCRIPTOR: long ; length in bytes of block WAVEDESC
< 40> USER_TEXT: long ; length in bytes of block USERTEXT
< 44> RES_DESC1: long ;
;
;ARRAYS :
;
< 48> TRIGTIME_ARRAY: long ; length in bytes of TRIGTIME array
;
< 52> RIS_TIME_ARRAY: long ; length in bytes of RIS_TIME array
;
< 56> RES_ARRAY1: long ; an expansion entry is reserved
;
< 60> WAVE_ARRAY_1: long ; length in bytes of 1st simple
; data array. In transmitted waveform,
; represent the number of transmitted
; bytes in accordance with the NP
; parameter of the WFSU remote command
; and the used format (see COMM_TYPE).
;
< 64> WAVE_ARRAY_2: long ; length in bytes of 2nd simple
; data array
;
```

```
< 68> RES_ARRAY2: long

< 72> RES_ARRAY3: long ; 2 expansion entries are reserved

;

; The following variables identify the instrument

;

< 76> INSTRUMENT_NAME: string

;

< 92> INSTRUMENT_NUMBER: long

;

< 96> TRACE_LABEL: string ; identifies the waveform.

;

<112> RESERVED1: word

<114> RESERVED2: word ; 2 expansion entries

;

; The following variables describe the waveform and the time at

; which the waveform was generated.

;

<116> WAVE_ARRAY_COUNT: long ; number of data points in the data

; array. If there are two data

; arrays (FFT or Extrema), this number

; applies to each array separately.

;

<120> PNTS_PER_SCREEN: long ; nominal number of data points

; on the screen

;

<124> FIRST_VALID_PNT: long ; count of number of points to skip
```

```
; before first good point
; FIRST_VALID_POINT = 0
; for normal waveforms.
;
<128> LAST_VALID_PNT: long ; index of last good data point
; in record before padding (blanking)
; was started.
; LAST_VALID_POINT = WAVE_ARRAY_COUNT-1
; except for aborted sequence
; and rollmode acquisitions
;
<132> FIRST_POINT: long ; for input and output, indicates
; the offset relative to the
; beginning of the trace buffer.
; Value is the same as the FP parameter
; of the WFSU remote command.
;
<136> SPARSING_FACTOR: long ; for input and output, indicates
; the sparsing into the transmitted
; data block.
; Value is the same as the SP parameter
; of the WFSU remote command.
;
<140> SEGMENT_INDEX: long ; for input and output, indicates the
; index of the transmitted segment.
; Value is the same as the SN parameter
```

```
; of the WFSU remote command.
;
<144> SUBARRAY_COUNT: long ; for Sequence, acquired segment count,
; between 0 and NOM_SUBARRAY_COUNT
;
<148> SWEEPS_PER_ACQ: long ; for Average or Extrema,
; number of sweeps accumulated
; else 1
;
<152> POINTS_PER_PAIR: word ; for Peak Detect waveforms (which always
; include data points in DATA_ARRAY_1 and
; min/max pairs in DATA_ARRAY_2).
; Value is the number of data points for
; each min/max pair.
;
<154> PAIR_OFFSET: word ; for Peak Detect waveforms only
; Value is the number of data points by
; which the first min/max pair in
; DATA_ARRAY_2 is offset relative to the
; first data value in DATA_ARRAY_1.
;
<156> VERTICAL_GAIN: float
;
<160> VERTICAL_OFFSET: float ; to get floating values from raw data :
; VERTICAL_GAIN * data - VERTICAL_OFFSET
;
```

```
<164> MAX_VALUE: float ; maximum allowed value. It corresponds
; to the upper edge of the grid.
;
<168> MIN_VALUE: float ; minimum allowed value. It corresponds
; to the lower edge of the grid.
;
<172> NOMINAL_BITS: word ; a measure of the intrinsic precision
; of the observation: ADC data is 8 bit
; averaged data is 10-12 bit, etc.
;
<174> NOM_SUBARRAY_COUNT: word ; for Sequence, nominal segment count
; else 1
;
<176> HORIZ_INTERVAL: float ; sampling interval for time domain
; waveforms
;
<180> HORIZ_OFFSET: double ; trigger offset for the first sweep of
; the trigger, seconds between the
; trigger and the first data point
;
<188> PIXEL_OFFSET: double ; needed to know how to display the
; waveform
;
<196> VERTUNIT: unit_definition ; units of the vertical axis
;
<244> HORUNIT: unit_definition ; units of the horizontal axis
```

```
;
<292> HORIZ_UNCERTAINTY: float ; uncertainty from one acquisition to the
; next, of the horizontal offset in seconds
;
<296> TRIGGER_TIME: time_stamp ; time of the trigger
;
<312> ACQ_DURATION: float ; duration of the acquisition (in sec)
; in multi-trigger waveforms.
; (e.g. sequence, RIS, or averaging)
;
<316> RECORD_TYPE: enum
_0 single_sweep
_1 interleaved
_2 histogram
_3 graph
_4 filter_coefficient
_5 complex
_6 extrema
_7 sequence_obsolete
_8 centered_RIS
_9 peak_detect
endenum
;
<318> PROCESSING_DONE: enum
_0 no_processing
_1 fir_filter
```

```
_2 interpolated

_3 sparsed

_4 autoscaled

_5 no_result

_6 rolling

_7 cumulative

endenum

;

<320> RESERVED5: word ; expansion entry

;

<322> RIS_SWEEPS: word ; for RIS, the number of sweeps

; else 1

;

; The following variables describe the basic acquisition

; conditions used when the waveform was acquired

;

<324> TIMEBASE: enum

_0 1_ps/div

_1 2_ps/div

_2 5_ps/div

_3 10_ps/div

_4 20_ps/div

_5 50_ps/div

_6 100_ps/div

_7 200_ps/div

_8 500_ps/div
```

_9 1_ns/div

_10 2_ns/div

_11 5_ns/div

_12 10_ns/div

_13 20_ns/div

_14 50_ns/div

_15 100_ns/div

_16 200_ns/div

_17 500_ns/div

_18 1_us/div

_19 2_us/div

_20 5_us/div

_21 10_us/div

_22 20_us/div

_23 50_us/div

_24 100_us/div

_25 200_us/div

_26 500_us/div

_27 1_ms/div

_28 2_ms/div

_29 5_ms/div

_30 10_ms/div

_31 20_ms/div

_32 50_ms/div

_33 100_ms/div

_34 200_ms/div

```
_35 500_ms/div

_36 1_s/div

_37 2_s/div

_38 5_s/div

_39 10_s/div

_40 20_s/div

_41 50_s/div

_42 100_s/div

_43 200_s/div

_44 500_s/div

_45 1_ks/div

_46 2_ks/div

_47 5_ks/div

_100 EXTERNAL

endenum

;

<326> VERT_COUPLING: enum

_0 DC_50_Ohms

_1 ground

_2 DC_1MOhm

_3 ground

_4 AC,_1MOhm

endenum

;

<328> PROBE_ATT: float

;
```

```
<332> FIXED_VERT_GAIN: enum

_0 1_uV/div

_1 2_uV/div

_2 5_uV/div

_3 10_uV/div

_4 20_uV/div

_5 50_uV/div

_6 100_uV/div

_7 200_uV/div

_8 500_uV/div

_9 1_mV/div

_10 2_mV/div

_11 5_mV/div

_12 10_mV/div

_13 20_mV/div

_14 50_mV/div

_15 100_mV/div

_16 200_mV/div

_17 500_mV/div

_18 1_V/div

_19 2_V/div

_20 5_V/div

_21 10_V/div

_22 20_V/div

_23 50_V/div

_24 100_V/div
```

```
_25 200_V/div
_26 500_V/div
_27 1_kV/div
endenum
;
<334> BANDWIDTH_LIMIT: enum
_0 off
_1 on
endenum
;
<336> VERTICAL_VERNIER: float
;
<340> ACQ_VERT_OFFSET: float
;
<344> WAVE_SOURCE: enum
_0 CHANNEL_1
_1 CHANNEL_2
_2 CHANNEL_3
_3 CHANNEL_4
_9 UNKNOWN
endenum
;
/00 ENDBLOCK
;
;
USERTEXT: BLOCK
```

```
;
; Explanation of the descriptor block USERTEXT at most 160 bytes long.
;
;
< 0> TEXT: text ; a list of ASCII characters
;
/00 ENDBLOCK
;
;
TRIGTIME: ARRAY
;
; Explanation of the trigger time array TRIGTIME.
; This optional time array is only present with SEQNCE waveforms.
; The following data block is repeated for each segment which makes up
; the acquired sequence record.
;
< 0> TRIGGER_TIME: double ; for sequence acquisitions,
; time in seconds from first
; trigger to this one
;
< 8> TRIGGER_OFFSET: double ; the trigger offset is in seconds
; from trigger to zeroth data point
;
/00 ENDARRAY
;
;
```

```
RISTIME: ARRAY
;
; Explanation of the random-interleaved-sampling (RIS) time array RISTIME.
; This optional time array is only present with RIS waveforms.
; This data block is repeated for each sweep which makes up the RIS record
;
< 0> RIS_OFFSET: double ; seconds from trigger to zeroth
; point of segment
;
/00 ENDARRAY
;
;
DATA_ARRAY_1: ARRAY
;
; Explanation of the data array DATA_ARRAY_1.
; This main data array is always present. It is the only data array for
; most waveforms.
; The data item is repeated for each acquired or computed data point
; of the first data array of any waveform.
;
< 0> MEASUREMENT: data ; the actual format of a data is
; given in the WAVEDESC descriptor
; by the COMM_TYPE variable.
;
/00 ENDARRAY
;
```

```
;
DATA_ARRAY_2: ARRAY
;
; Explanation of the data array DATA_ARRAY_2.
; This is an optional secondary data array for special types of waveforms:
; Complex FFT imaginary part (real part in DATA_ARRAY_1)
; Extrema floor trace (roof trace in DATA_ARRAY_1)
; Peak Detect min/max pairs (data values in DATA_ARRAY_1)
; In the first 2 cases, there is exactly one data item in DATA_ARRAY_2 for
; each data item in DATA_ARRAY_1.
; In Peak Detect waveforms, there may be fewer data values in DATA_ARRAY_2,
; as described by the variable POINTS_PER_PAIR.
;
< 0> MEASUREMENT: data ; the actual format of a data is
; given in the WAVEDESC descriptor
; by the COMM_TYPE variable.
;
/00 ENDARRAY
;
;
SIMPLE: ARRAY
;
; Explanation of the data array SIMPLE.
; This data array is identical to DATA_ARRAY_1. SIMPLE is an accepted
; alias name for DATA_ARRAY_1.
;
```

```
< 0> MEASUREMENT: data ; the actual format of a data is
; given in the WAVEDESC descriptor
; by the COMM_TYPE variable.
;
/00 ENDARRAY
;
;
DUAL: ARRAY
;
; Explanation of the DUAL array.
; This data array is identical to DATA_ARRAY_1, followed by DATA_ARRAY_2.
; DUAL is an accepted alias name for the combined arrays DATA_ARRAY_1 and
; DATA_ARRAY_2 (e.g. real and imaginary parts of an FFT).
;
< 0> MEASUREMENT_1: data ; data in DATA_ARRAY_1.
;
< 0> MEASUREMENT_2: data ; data in DATA_ARRAY_2.
;
/00 ENDARRAY
;
;
00 ENDTEMPLATE
```

Oscilloscope's TMPL? Query Response

This template is the oscilloscope's response to a TMPL? query:/00

```
000000 LECROY_2_3: TEMPLATE
8 66 111
;
; Explanation of the formats of waveforms and their descriptors on the
; Teledyne LeCroy Digital Oscilloscopes,
; Software Release 8.1.0, 98/09/29.
;
; A descriptor and/or a waveform consists of one or several logical data
; blocks whose formats are explained below.
; Usually, complete waveforms are read: at the minimum they consist of
; the basic descriptor block WAVEDESC a data array block.
; Some more complex waveforms, e.g. Extrema data or the results of a
 ; Fourier transform, may contain several data array blocks.
; When there are more blocks, they are in the following sequence:
; the basic descriptor block WAVEDESC
; the history text descriptor block USERTEXT (may or may not be present)
; the time array block (for RIS and sequence acquisitions only)
; data array block
; auxiliary or second data array block
;
; In the following explanation, every element of a block is described by
; a single line in the form
;
; <byte position> <variable name>: <variable type> ; <comment>
```

```
;
; where
;
; <byte position> = position in bytes (decimal offset) of the variable,
; relative to the beginning of the block.
;
; <variable name> = name of the variable.
;
; <variable type> = string up to 16-character name
; terminated with a null byte
; byte 08-bit signed data value
; word 16-bit signed data value
; long 32-bit signed data value
; float 32-bit IEEE floating point value
; with the format shown below
; 31 30 .. 23 22 ... 0 bit position
; s exponent fraction
; where
; s = sign of the fraction
; exponent = 8 bit exponent e
; fraction = 23 bit fraction f
; and the final value is
; (-1)**s * 2**(e-127) * 1.f
; double 64-bit IEEE floating point value
; with the format shown below
; 63 62 .. 52 51 ... 0 bit position
```

```
; s exponent fraction
; where
; s = sign of the fraction
; exponent = 11 bit exponent e
; fraction = 52 bit fraction f
; and the final value is
; (-1)**s * 2**(e-1023) * 1.f
; enum enumerated value in the range 0 to N
; represented as a 16-bit data value.
; The list of values follows immediately.
; The integer is preceded by an _.
; time_stamp double precision floating point number,
; for the number of seconds and some bytes
; for minutes, hours, days, months and year.
;
; double seconds (0 to 59)
; byte minutes (0 to 59)
; byte hours (0 to 23)
; byte days (1 to 31)
; byte months (1 to 12)
; word year (0 to 16000)
; word unused
; There are 16 bytes in a time field.
; data byte, word or float, depending on the
; read-out mode reflected by the WAVEDESC
; variable COMM_TYPE, modifiable via the
```

```
; remote command COMM_FORMAT.
; text arbitrary length text string
; (maximum 160)
; unit_definition a unit definition consists of a 48 character
; ASCII string terminated with a null byte
; for the unit name.
```

Decoding Floating Point Numbers

Single precision values are held in four bytes. If these are arranged in decreasing value order we get the following bits:

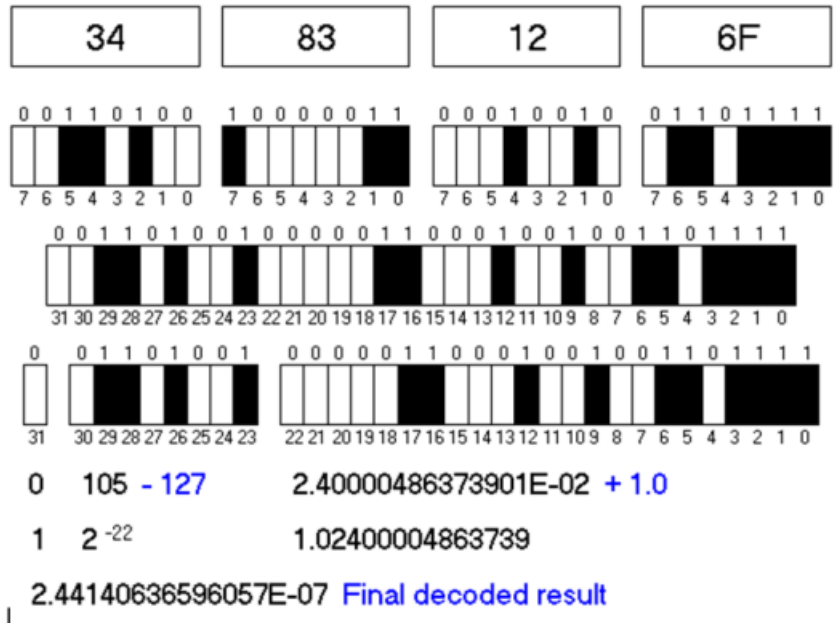
bit 31, bit 30, bit 29, bit 28 . . . . . bit 3, bit 2, bit 1, bit 0

NOTE: If the byte order command CORD is set for low byte first, the bytes as received in a waveform descriptor are received in **reverse order**. However, within a byte the bits keep their order, highest at the left, as expected.

From these bits we are to construct three numbers that are to be multiplied together: **S X E X F** constructed as follows:

$$S = (-1)^{s} E = 2^{(e-127)} \quad F = 1 + f$$

S, **E**, and **F** are calculated directly from the 32 bits. The following diagram illustrates the calculation of the vertical gain example:



In a way not following the byte boundaries, bits are then segregated as follows:

31, 30, 29 . . . . 24, 23, 22, 21 . . . . 2, 1, 0

Sign exponent bits fractional bits

bit 0.5, 0.25, 0.125 . . .

The sign bit s is 1 for a negative number and 0 for a positive number, so it is easy to construct the sign from this:

S = (-1)^s

The 8 exponent bits have the following values: bit 23 is worth 1, bit 24 is worth 2 . . . bit 29 □ 64, bit 3 □ 128, so the resulting number can range from 0 to 28 1, which is 255.

127 is then subtracted from this value e creating a range from -127 to +128. This is then used as an exponent to raise two to a power that is 2^e, to create a value E.

Then we have to create the multiplying number. The values of the 23 bits are as follows: bit 22 is worth 0.5, 21 is worth 0.25, 20 is worth 0.125, 19 is worth 0.0625 . . . .

When all the bits are added together, we obtain a positive number f that can be very close to one, differing from it only by the value of the smallest bit, if all the bits are ones. (Generally the value will be much less than one.) Then we add one to the result, obtaining 1 + f = F. The use of the added one extends the dynamic range of the data. Another way of calculating f is to take the 23-bit number at face value, and divide it by 2^24.

Finally we multiply together the sign, the value E, and the value F to create the final result:

Result = (-1)^s x 2^(e-127) x (1 + f) = S x E x F

700 Chestnut Ridge Road
Chestnut Ridge, NY 10977
USA

teledynelecroy.com