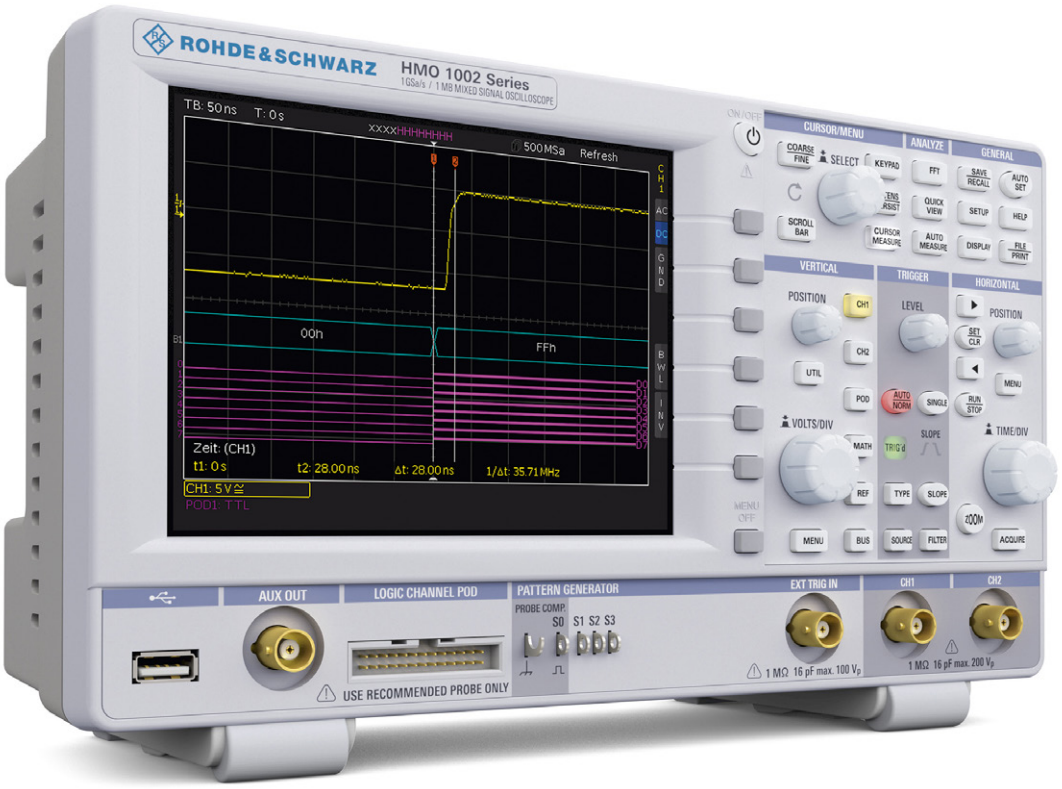
HMO1002系列
HMO1202系列
（等同RTC1002）
数字实时示波器SCPI 编程手册



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Test & Measurement

SCPI Programmers Manual

Version 01

ROHDE&SCHWARZ

Content

1 Basics

This chapter provides basic information on operating an instrument via remote control.

1.1 Remote Control Interfaces

For remote control, Ethernet or USB interface can be used. Optional interfaces are not available.

SCPI (Standard Commands for Programmable Instruments) SCPI commands - messages - are used for remote control. Commands that are not taken from the SCPI standard follow the SCPI syntax rules.

1.1.1 USB Interface

In addition to a LAN interface, the R&S®HMO1002 resp. R&S®HMO1202 series includes a USB device port. For this interface, the user can select if the instrument is accessed via virtual COM port (VCP) or via USB TMC class. The traditional version of the VCP allows the user to communicate with the R&S®HMO1002 resp. R&S®HMO1202 series using any terminal program via SCPI commands once the corresponding Windows drivers have been installed. Naturally, the free software "HMExplorer" is also available for the R&S®HMO1002 resp. R&S®HMO1202 series. This Windows application offers the R&S®HMO1002 resp. R&S®HMO1202 series a terminal function, the option to create screenshots and to read out the measured data from the HMO memory.

The modern alternative to the virtual COM port is to remote control the R&S®HMO1002 resp. R&S®HMO1202 series via USB TMC class. TMC stands for "Test & Measurement Class" which indicates that the connected measurement instrument can be recognized without special Windows drivers if VISA drivers are installed and that it can be used directly in corresponding environments. The GPIB interface serves as model to the structure of the TMC design. A major benefit of the USB TMC class is that by sampling specific registers the controlling software can determine if commands have been terminated and if they have been processed correctly. In contrast, the communication via VCP requires analysis and polling mechanisms within the controlling software which may significantly strain the interface of the measurement instruments. The TMC status registers solve this problem with the USB TMC in the same manner as is the case with the GPIB interface for the hardware, namely via corresponding control lines.

If you are using USB you need to install an USB driver, which can be downloaded free of charge from the Rohde & Schwarz homepage.

NOTICE

The available USB VCP driver is fully tested, functional and released for Windows XP™, Windows Vista™, Windows 7™ or Windows 8™, both as 32Bit or 64Bit versions.

The USB VCP or USB TMC interface has to be chosen in the SETUP menu and does not need any setting.

1.1.2 Ethernet (LAN) Interface

The settings of the parameter will be done after selecting the menu item ETHERNET and the soft key PARAMETER. You can set a fix IP adress or a dynamic IP setting via the DHCP function. Please ask your IT department for the correct setting at your network.

IP address
To set up the connection the IP address of the instrument is required. It is part of the resource string used by the program to identify and control the instrument. The resource string has the form:

TCPIP::‹IP_address›::‹IP_port›::SOCKET

The default port number for SCPI socket communication is 5025. IP address and port number are listed In the „Ethernet Settings“ of the R&S®HMO1002 resp. R&S®HMO1202 series, see also: chapter 1.2.2,“Configuring LAN Parameters“.

Example:
If the instrument has the IP address 192.1.2.3; the valid resource string is:

TCPIP::192.1.2.3::5025::SOCKET

If the LAN is supported by a DNS server, the host name can be used instead of the IP address. The DNS server (Domain Name System server) translates the host name to the IP address. The resource string has the form:

TCPIP::‹host_name›::‹IP_port›::SOCKET

To assign a host name select SETUP button › PAGE 2|2 › DEVICE NAME.

Example: If the host name is ROHDE1; the valid resource string is:

TCPIP::ROHDE1::5025::SOCKET

NOTICE

The end character must be set to linefeed.

1.2 Setting Up a Network (LAN) Connection

1.2.1 Connecting the Instrument to the Network

NOTICE

Risk of network failure
Before connecting the instrument to the network or configuring the network, consult your network administrator. Errors may affect the entire network.

The network card can be operated with a 10 Mbps Ethernet IEEE 802.3 or a 100 Mbps Ethernet IEEE 802.3u interface.

NOTICE

To establish a network connection, connect a commercial RJ-45 cable to one of the LAN ports of the instrument and to a PC.

1.2.2 Configuring LAN Parameters

Depending on the network capacities, the TCP/IP address information for the instrument can be obtained in different ways.
If the network supports dynamic TCP/IP configuration using the Dynamic Host Configuration Protocol (DHCP), and a DHCP server is available, all address information can be assigned automatically.
Otherwise, the address must be set manually. Automatic Private IP Addressing (APIPA) is not supported.

By default, the instrument is configured to use dynamic TCP/IP configuration and obtain all address information automatically. This means that it is safe to establish a physical connection to the LAN without any previous instrument configuration.

NOTICE

Risk of network errors
Connection errors can affect the entire network. If your network does not support DHCP, or if you choose to disable dynamic TCP/IP configuration, you must assign valid address information before connecting the instrument to the LAN. Contact your network administrator to obtain a valid IP address.

Configuring LAN parameters

- Press the SETUP key and then the INTERFACE softkey.
- Press the ETHERNET and then the PARAMETER softkey.

NOTICE

If the instrument is set to use DHCP and cannot find a DHCP server, it takes about two minutes until the Ethernet menu is available.

The „Ethernet Settings“ dialog box is displayed.

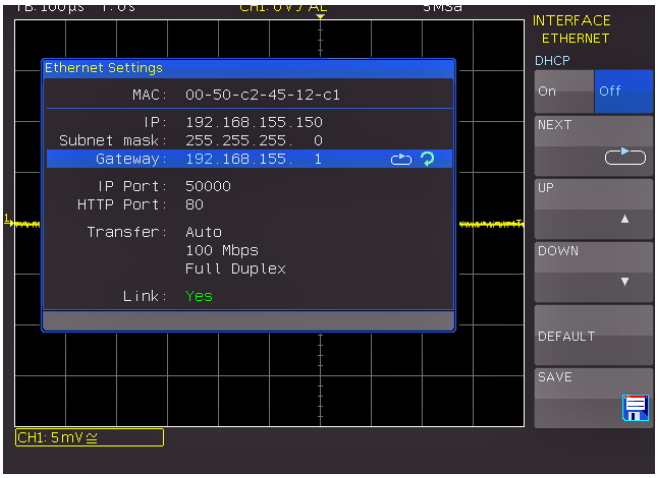

Fig. 1.1: Ethernet Settings dialog box

Some data is displayed for information only and cannot be edited. This includes the „MAC“ (physical) address of the connector and the „Link“ status information.

- Define the IP address of the instrument by entering each of the four blocks individually (manual mode) or choose the automatic IP-Mode.
  a) In manual mode (MAN) define the first block number using the knob.
  b) Press Next to move to the next block and define the number.
  c) When the IP address is complete, press Down to continue with the next setting.
- Define the „Subnetmask“ and „Gateway“ in the same way.
- Select the „IP Port“ - the port number for SCPI socket communication.
- Select the „HTTP Port“ used by the instrument.
- Select the „Transfer“ mode. This mode can either be determined automatically („Auto“ setting), or you can select a combination of a transfer rate and half or full duplex manually.
- Press SAVE to save the LAN parameters.

NOTICE

The „Link“ status information at the bottom of the dialog box indicates whether a LAN connection was established successfully.

Checking LAN and SCPI connection

- Check the LAN connection using ping: ping xxx.yyy.zzz.xxx.
- If the PC can access the instrument, enter the IP address of the address line of the internet browser on your computer: http//:xxx.yyy.zzz.xxx
- The „Instrument Home“ page appears. It provides information on the instrument and the LAN connection.

1.3 Switching to Remote Control

When you switch on the instrument, it is always in manual operation state („local“ state) and can be operated via the front panel. When you send a command from the control computer, it is received and executed by the instrument. The display remains on, manual operation via the front panel is always possible.

1.4 Messages and Command Structure

1.4.1 Messages

Instrument messages are employed in the same way for all interfaces, if not indicated otherwise in the description.
See also:

- Structure and syntax of the instrument messages: chapter 1.4.2, „SCPI Command Structure“.
- Detailed description of all messages: chapter 2, „Command Reference“.

There are different types of instrument messages:

- Commands
- Instrument responses

Commands

Commands (program messages) are messages which the controller sends to the instrument. They operate the instrument functions and request information. The commands are subdivided according to two criteria:

According to the instrument effect:

- Setting commands cause instrument settings such as a reset of the instrument or setting the frequency.
- Queries cause data to be provided for remote control, e.g. for identification of the instrument or polling a parameter value. Queries are formed by appending a question mark to the command header.

According to their definition in standards:

- The function and syntax of the Common commands are precisely defined in standard IEEE 488.2. They are employed identically on all instruments (if implemented). They refer to functions such as management of the standardized status registers, reset and self test.
- Instrument control commands refer to functions depending on the features of the instrument such as voltage settings. Many of these commands have also been standardized by the SCPI committee. These commands are marked as „SCPI compliant“ in the command reference chapters. Commands without this SCPI label are device-specific, however, their syntax follows SCPI rules as permitted by the standard.

Instrument responses

Instrument responses (response messages and service requests) are messages which the instrument is sent to the controller after a query. They can contain measurement results, instrument settings and information on the instrument status.

LAN Interface Messages

In the LAN connection, the interface messages are called low–level control messages. These messages can be used to emulate interface messages of the GPIB bus.

Command	Long term	Effect on the instrument
&DCL	Device Clear	Aborts processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument setting.
&GTL	Go to Local	Transition to the „local“ state (manual control).
&GTR	Go to Remote	Transition to the „remote“ state (remote control).
&LLO	Local Lockout	Disables switchover from remote control to manual control by means of the front panel keys.
&NREN	Not Remote Enable	Enables switchover from remote control to manual operation by means of the front panel keys

Table 1.1: LAN Interface Messages

Universal Commands

Universal commands are encoded in the range 10 through 1F hex. They affect all instruments connected to the bus and do not require addressing.

Command	Effect on the instrument
DCL (Device Clear)	Aborts the processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument settings.
IFC (Interface Clear)	Resets the interfaces to the default setting. IFC is not a real universal command, it is sent via a separate line; it also affects all instruments connected to the bus and does not require addressing
LLO (Local Lockout)	The LOC/IEC ADDR key is disabled.
SPE (Serial Poll Enable)	Ready for serial poll.
SPD (Serial Poll Disable)	End of serial poll.
PPU (Parallel Poll Unconfigure)	End of the parallel-poll state.

Table 1.2: Universal Commands

Addressed Commands
Addressed commands are encoded in the range 00 through 0F hex. They only affect instruments addressed as listeners.

Command	Effect on the instrument
GET (Group Execute Trigger)	Triggers a previously active instrument function (e.g. a sweep). The effect of the command is the same as with that of a pulse at the external trigger signal input.
GTL (Go to Local)	Transition to the „local“ state (manual control).
GTR (Go to Remote)	Transition to the „remote“ state (remote control).
PPC (Parallel Poll Configure)	Configures the instrument for parallel poll.
SDC (Selected Device Clear)	Aborts the processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument setting.

Table 1.3: Addressed Commands

1.4.2 SCPI Command Structure

SCPI commands consist of a so-called header and, in most cases, one or more parameters. The header and the parameters are separated by a „white space“ (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). The headers may consist of several mnemonics (keywords). Queries are formed by appending a question mark directly to the header.

The commands can be either device-specific or device-independent (common commands). Common and device-specific commands differ in their syntax.

Syntax for Common Commands
Common (=device-independent) commands consist of a header preceded by an asterisk (*) and possibly one or more parameters.

***RST**	Reset	Resets the instrument.
***ESE**	Event Status Enable	Sets the bits of the event status enable registers.
***ESR?**	Event Status Query	Queries the content of the event status register.
***IDN?**	Identification Query	Queries the instrument identification string.

Table 1.4: Examples of Common Commands

Syntax for Device-Specific Commands

For demonstration purposes only, assume the existence of the following commands for this section:

- ACQuire:POINts:ARATe
- CALCulate:QMATh<m>:STATe
- CHANnel<m>:DATA:POINts
- BUS<b>:STATe

Long and short form

The mnemonics feature a long form and a short form. The short form is marked by upper case letters, the long form corresponds to the complete word. Either the short form or the long form can be entered; other abbreviations are not permitted.

Example: CALCulate:QMATh<m>:STATe ON is equivalent to CALC:QMAT<m>:STAT ON.

NOTICE

Case-insensitivity

Upper case and lower case notation only serves to distinguish the two forms in the manual, the instrument itself is case-insensitive.

Numeric suffixes

If a command can be applied to multiple instances of an object, e.g. specific channels or sources, the required instances can be specified by a suffix added to the command.
Numeric suffixes are indicated by angular brackets (<1...2>, <m>) and are replaced by a single value in the command. Entries without a suffix are interpreted as having the suffix 1.

Example:
Definition: CHANnel<m>:STATe ON
Command: CHAN2:STAT ON
This command activates channel CH2.

NOTICE

Different numbering in remote control

For remote control, the suffix may differ from the number of the corresponding selection used in manual operation. SCPI prescribes that suffix counting starts with 1. Suffix 1 is the default state and used when no specific suffix is specified.

Optional mnemonics

Some command systems permit certain mnemonics to be inserted into the header or omitted. These mnemonics are marked by square brackets. The instrument must recognize the long command to comply with the SCPI standard. Some commands are shortened by these optional mnemonics.

Example:
HardCOPy[:IMMediate]
HCOP:IMM is equivalent to HCOP

Special characters

|	A vertical stroke in parameter definitions indicates alternative possibilities in the sense of „or". The effectof the command differs, depending on which parameter is used. **Example:** HardCOPy:PAGE:ORIentation LANDscape | PORTrait HCOP:PAGE:ORI LAND specifies landscape orientation. HCOP:PAGE:ORI PORT specifies portrait orientation.
[ ]	Mnemonics in square brackets are optional and may be inserted into the header or omitted. **Example:** HardCOPy[:IMMediate] HCOP:IMM is equivalent to HCOP.
{ }	Parameters in curly brackets are optional.

Table 1.5: Special characters

SCPI Parameters

Many commands are supplemented by a parameter or a list of parameters. The parameters must be separated from the header by a „white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). Allowed parameters are:

- Numeric values
- Special numeric values
- Boolean parameters
- Text
- Character strings
- Block data

The parameters required for each command and the allowed range of values are specified in the command description.

Numeric values

Numeric values can be entered in any form, i.e. with sign, decimal point and exponent. Values exceeding the resolution of the instrument are rounded up or down. The mantissa may comprise up to 255 characters, the exponent must lie inside the value range -32000 to 32000. The exponent is introduced by an „E" or „e". Entry of the exponent alone is not allowed. In the case of physical quantities, the unit can be entered. Allowed unit prefixes are G (giga), MA (mega), MOHM and MHZ are also allowed), K (kilo), M (milli), U (micro) and N (nano). If the unit is missing, the basic unit is used.

Example: TIMebase:SCALe 10µs = TIM:SCAL 1e-5

Units
For physical quantities, the unit can be entered. Allowed unit prefixes are:
- G (giga)
- MA (mega), MOHM, MHZ
- K (kilo)
- M (milli)
- U (micro)
- N (nano)

If the unit is missing, the basic unit is used.

Special numeric values
The texts listed below are interpreted as special numeric values. In the case of a query, the numeric value is provided.
- MIN / MAX / DMAX / DEF
- MINimum and MAXimum denote the minimum and maximum value

Example:
CHAN1:DATA:POIN DEF
CHAN1.DATA:POIN?, Response: 6000

Boolean Parameters
Boolean parameters represent two states. The „ON“ state (logically true) is represented by „ON“ or a numeric value 1. The „OFF“ state (logically untrue) is represented by „OFF“ or the numeric value 0. The numeric values are provided as the response for a query.

Example:
CHAN2:STAT ON
CHAN2:STAT?, Response: 1

Text parameters
Text parameters observe the syntactic rules for mnemonics, i.e. they can be entered using a short or long form. Like any parameter, they have to be separated from the header by a white space. In the case of a query, the short form of the text is provided.

Example:
HardCOPy:PAGE:ORIentation LANDscape
HCOP:PAGE:ORI?, Response: LAND

Block data
Block data is a format which is suitable for the transmission of large amounts of data. The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all end or other control signs are ignored until all bytes are transmitted. #0 specifies a data block of indefinite length. The use of the indefinite format requires a NL^END message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

Overview of Syntax Elements

The following table provides an overview of the syntax elements:

:	The colon separates the mnemonics of a command. In a command line the separating semicolonmarks the uppermost command level.
;	The semicolon separates two commands of a command line. It does not alter the path.
,	The comma separates several parameters of a command.
?	The question mark forms a query.
*	The asterisk marks a common command.
"	Quotation marks introduce a string and terminate it.
#	The hash symbol introduces binary, octal, hexadecimal and block data. – Binary: #B10110 – Octal: #O7612 – Hexa: #HF3A7 – Block: #21312
	A „white space" (ASCII-Code 0 to 9, 11 to 32 decimal, e.g. blank) separates the header from the parameters.

Table 1.6: Syntax Elements

Structure of a command line

A command line may consist of one or several commands. It is terminated by one of the following:

- a <New Line>
- a <New Line> with EOI
- an EOI together with the last data byte

Several commands in a command line must be separated by a semicolon „;". If the next command belongs to a different command system, the semicolon is followed by a colon.

Responses to Queries

A query is defined for each setting command unless explicitly specified otherwise. It is formed by adding a question mark to the associated setting command. According to SCPI, the responses to queries are partly subject to stricter rules than in standard IEEE 488.2.

- The requested parameter is transmitted without a header.

Example:
HCOP:PAGE:ORI?, Response: LAND

- Maximum values, minimum values and all other quantities that are requested via a special text parameter are returned as numeric values.

Example:
CHAN1:DATA:POIN DEF
CHAN1.DATA:POIN?, Response: 6000

- Truth values (Boolean values) are returned as 0 (for OFF) and 1 (for ON).

Example:
CHAN2:STAT ON
CHAN2:STAT?, Response: 1

- Text (character data) is returned in a short form.

Example:
HardCOPy:PAGE:ORIentation LANDscape
HCOP:PAGE:ORI?, Response: LAND

1.5 Command Sequence and Synchronization

A sequential command finishes executing before the next command starts executing. Commands that are processed quickly are usually implemented as sequential commands. Setting commands within one command line, even though they may be implemented as sequential commands, are not necessarily serviced in the order in which they have been received. In order to make sure that commands are actually carried out in a certain order, each command must be sent in a separate command line.

NOTICE

As a general rule, send commands and queries in different program messages.

1.5.1 Preventing Overlapping Execution

To prevent an overlapping execution of commands, one of the commands *OPC, *OPC? or *WAI can be used. All three commands cause a certain action only to be carried out after the hardware has been set. By suitable programming, the controller can be forced to wait for the corresponding action to occur.

Command	Action	Programming the controller
***OPC**	Sets the Operation Complete bit in the ESR after all previous commands have been executed.	• Setting bit 0 in the ESE • Setting bit 5 in the SRE • Waiting for service request (SRQ)
***OPC?**	Stops command processing until 1 is returned.This is only the case after the Opera-tion Complete bit has been set in the ESR. This bit indicates that the previous setting has been completed.	Sending *OPC? directly after the commandwhose processing should be terminated beforeother commands can be executed.
***WAI**	Stops further command processing until allcommands sent before *WAI have been executed.	Sending *WAI directly after the commandwhose processing should be terminated beforeother commands are executed

Table 1.7: Synchronization using *OPC, *OPC? and *WAI

Command synchronization using *WAI or *OPC? appended to an overlapped command is a good choice if the overlapped command takes time to process. The two synchronization techniques simply block overlapped execution of the command. For time consuming overlapped commands it is usually desirable to allow the controller or the instrument to do other useful work while waiting for command execution. Use one of the following methods

***OPC with a service request**

- Set the OPC mask bit (bit no. 0) in the ESE: *ESE 1
- Set bit no. 5 in the SRE: *SRE 32 to enable ESB service request.
- Send the overlapped command with *OPC
- Wait for a service request

The service request indicates that the overlapped command has finished.

***OPC? with a service request**

- Set bit no. 4 in the SRE: *SRE 16 to enable MAV service request.
- Send the overlapped command with *OPC?
- Wait for a service request

The service request indicates that the overlapped command has finished.

Event Status Register (ESE)

- Set the OPC mask bit (bit no. 0) in the ESE: *ESE 1
- Send the overlapped command without *OPC, *OPC? or *WAI
- Poll the operation complete state periodically (by means of a timer) using the sequence: *OPC; *ESR?

A return value (LSB) of 1 indicates that the overlapped command has finished.

***OPC? with short timeout**

- Send the overlapped command without *OPC, *OPC? or *WAI
- Poll the operation complete state periodically (by means of a timer) using the sequence: ‹short timeout›; *OPC?
- A return value (LSB) of 1 indicates that the overlapped command has finished. In case of a timeout, the operation is ongoing.
- Reset timeout to former value
- Clear the error queue with SYStem:ERRor? to remove the „-410, Query interrupted“ entries.

Using several threads in the controller application

As an alternative, provided the programming environment of the controller application supports threads, separate threads can be used for the application GUI and for controlling the instrument(s) via SCPI. A thread waiting for a *OPC? thus will not block the GUI or the communication with other instruments.

1.6 Status Reporting System

The status reporting system stores all information on the current operating state of the instrument, and on errors which have occurred. This information is stored in the status registers and in the error queue. Both can be queried via LAN interface (STATus... commands).

1.6.1 Structure of a SCPI Status Register

Each standard SCPI register consists of 5 parts. Each part has a width of 16 bits and has different functions. The individual bits are independent of each other, i.e. each hardware status is assigned a bit number which is valid for all five parts. Bit 15 (the most significant bit) is set to zero for all parts. Thus the contents of the register parts can be processed by the controller as positive integers.

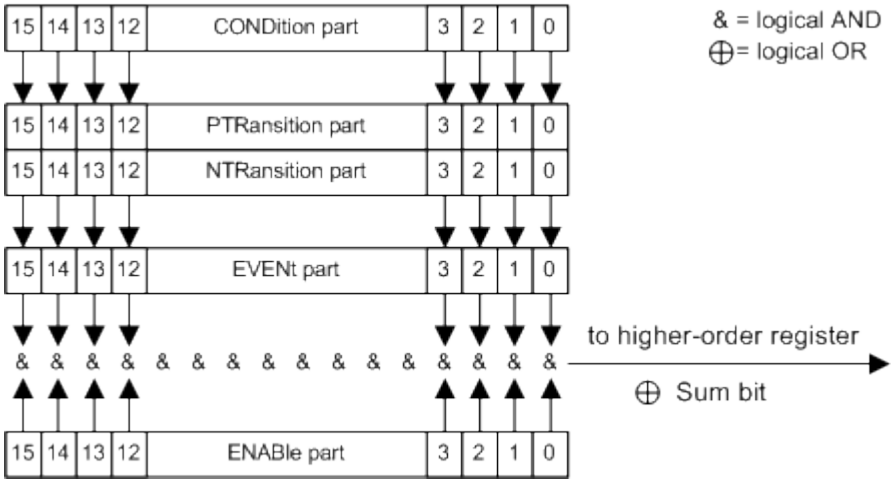

Fig. 1.4: The status-register model

Description of the five status register parts
The five parts of a SCPI register have different properties and functions:

CONDition
- The `CONDition` part is written into directly by the hardware or the sum bit of the next lower register. Its contents reflect the current instrument status. This register part can only be read, but not written into or cleared. Its contents are not affected by reading.

PTRansition
- The two transition register parts define which state transition of the CONDition part (none, 0 to 1, 1 to 0 or both) is stored in the EVENt part. The Positive-TRansition part acts as a transition filter. When a bit of the CONDition part is changed from 0 to 1, the associated PTR bit decides whether the EVENt bit is set to 1.

PTR bit =1: the `EVENt` bit is set.
PTR bit =0: the `EVENt` bit is not set.

This part can be written into and read as required. Its contents are not affected by reading.

NTRansition

- The Negative-TRansition part also acts as a transition filter. When a bit of the CONDition part is changed from 1 to 0, the associated NTR bit decides whether the EVENt bit is set to 1.

NTR bit =1: the EVENt bit is set.
NTR bit =0: the EVENt bit is not set.

This part can be written and read as required. Its contents are not affected by reading.

EVENt

- The EVENt part indicates whether an event has occurred since the last reading, it is the „memory" of the condition part. It only indicates events passed on by the transition filters. It is permanently updated by the instrument. This part can only be read by the user. Reading the register clears it. This part is often equated with the entire register.

ENABle

- The ENABle part determines whether the associated EVENt bit contributes to the sum bit (see below). Each bit of the EVENt part is „ANDed" with the associated ENABle bit (symbol ‚&'). The results of all logical operations of this part are passed on to the sum bit via an „OR" function (symbol ‚+').

ENABle bit = 0: the associated EVENt bit does not contribute to the sum bit
ENABle bit = 1: if the associated EVENt bit is „1", the sum bit is set to „1" as well.

This part can be written and read by the user as required. Its contents are not affected by reading.

Sum bit

- The sum bit is obtained from the EVENt and ENABle part for each register. The result is then entered into a bit of the CONDition part of the higher-order register.

1.6.2 Hierarchy of status registers

STB, SRE

- The STatus Byte (STB) register and its associated mask register Service Request Enable (SRE) form the highest level of the status reporting system. The STB provides a rough overview of the instrument status, collecting the information of the lower-level registers.

ESR, SCPI registers

- The STB receives its information from the following registers:
- The Event Status Register (ESR) with the associated mask register standard Event Status Enable (ESE).
- The STATus:OPERation and STATus:QUEStionable registers which are defined by SCPI and contain detailed information on the instrument.

Output buffer

- The output buffer contains the messages the instrument returns to the controller. It is not part of the status reporting system but determines the value of the MAV bit in the STB and thus is represented in the overview.

All status registers have the same internal structure.
As shown in the following figure, the status information is of hierarchical structure.

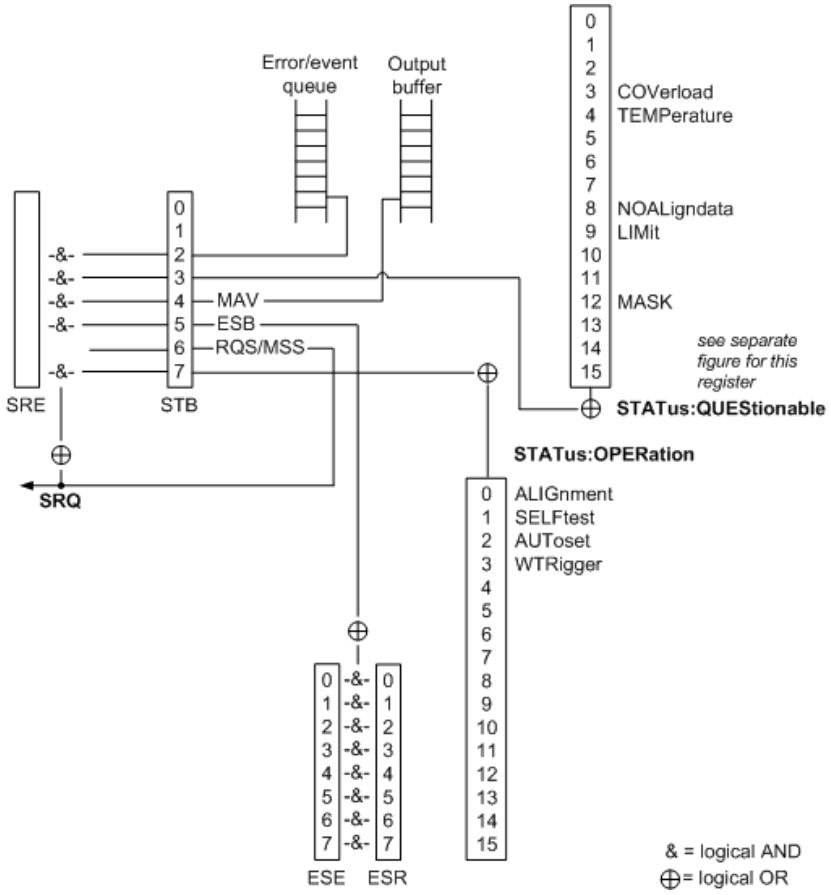

Fig. 1.5: Overview of the status registers hierarchy

NOTICE

SRE, ESE

The service request enable register `SRE` can be used as `ENABle` part of the `STB` if the `STB` is structured according to SCPI. By analogy, the `ESE` can be used as the `ENABle` part of the `ESR`.

1.6.3 Contents of the Status Registers

In the following sections, the contents of the status registers are described in more detail.

Status Byte (STB) and Service Request Enable Register (SRE)

The STatus Byte (STB) is already defined in IEEE 488.2. It provides a rough overview of the instrument status by collecting the pieces of information of the lower registers. A special feature is that bit 6 acts as the sum bit of the remaining bits of the status byte.

The STB can thus be compared with the CONDition part of an SCPI register and assumes the highest level within the SCPI hierarchy. The STB is read using the command *STB or a serial poll.

The STatus Byte (STB) is linked to the Service Request Enable (SRE) register. Each bit of the STB is assigned a bit in the SRE. Bit 6 of the SRE is ignored. If a bit is set in the SRE and the associated bit in the STB changes from 0 to 1, a service request (SRQ) is generated. The SRE can be set using the command *SRE and read using the command *SRE?.

Bit No.	Meaning
0...1	**Not used**
2	**Error Queue not empty** The bit is set when an entry is made in the error queue. If this bit is enabled by the SRE, each entry of the error queue generates a service request. Thus an error can be recognized and specified in greater detail by polling the error queue. The poll provides an informative error message. This procedure is to be recommended since it considerably reduces the problems involved with remote control.
3	**QUEStionable status sum bit** The bit is set if an `EVENt` bit is set in the `QUEStionable` status register and the associated `ENABle` bit is set to 1. A set bit indicates a questionable instrument status, which can be specified in greater detail by polling the `QUEStionable` status register.
4	**MAV bit (message available)** The bit is set if a message is available in the output buffer which can be read. This bit can be used to enable data to be automatically read from the instrument to the controller.
5	**ESB bit** Sum bit of the event status register. It is set if one of the bits in the event status register is set and enabled in the event status enable register. Setting of this bit indicates a serious error which can be specified in greater detail by polling the event status register.
6	**MSS bit (master status summary bit)** The bit is set if the instrument triggers a service request. This is the case if one of the other bits of this registers is set together with its mask bit in the service request enable register SRE.
7	**OPERation status register sum bit** The bit is set if an `EVENt` bit is set in the `OPERation` status register and the associated `ENABle` bit is set to 1. A set bit indicates that the instrument is just performing an action. The type of action can be determined by polling the `OPERation` status register.

Table 1.8: Meaning of the bits used in the status byte

Event Status Register (ESR) and Event Status Enable Register (ESE)
The ESR is defined in IEEE 488.2. It can be compared with the EVENt part of a SCPI register. The event status register can be read out using command *ESR?. The ESE corresponds to the ENABle part of a SCPI register. If a bit is set in the ESE and the associated bit in the ESR changes from 0 to 1, the ESB bit in the STB is set. The ESE register can be set using the command *ESE and read using the command *ESE?.

Bit No.	Meaning
0	**Operation Complete** This bit is set on receipt of the command *OPC exactly when all previous commands have been executed.
1	**Not used**
2	**Query Error** This bit is set if either the controller wants to read data from the instrument without having sent a query, or if it does not fetch requested data and sends new instructions to the instrument instead. The cause is often a query which is faulty and hence cannot be executed.
3	**Device-dependent Error** This bit is set if a device-dependent error occurs. An error message with a number between -300 and -399 or a positive error number, which denotes the error in greater detail, is entered into the error queue.
4	**Execution Error** This bit is set if a received command is syntactically correct but cannot be performed for other reasons. An error message with a number between -200 and -300, which denotes the error in greater detail, is entered into the error queue.
5	**Command Error** This bit is set if a command is received, which is undefined or syntactically incorrect. An error message with a number between -100 and -200, which denotes the error in greater detail, is entered into the error queue.
6	**User Request** This bit is set when the instrument is switched over to manual control.
7	**Power On (supply voltage on)** This bit is set on switching on the instrument.

Table 1.9: Meaning of the bits used in the event status register

STATus:OPERation Register

In the CONDition part, this register contains information on which actions the instrument is being executing. In the EVENt part, it contains information on which actions the instrument has executed since the last reading. It can be read using the commands STATus:OPERation:CONDition? or STATus:OPERation[:EVENt]?. The remote commands for the STATus:OPERation register are described in chapter 2.14.1, „STATus:OPERation Register“, on page 138.

Bit No.	Meaning
0	**ALIGnment** This bit is set as long as the instrument is performing a self alignment.
1	**SELFtest** This bit is set while the selftest is running.
2	**AUToset** This bit is set while the instrument is performing an auto setup.
3	**WTRIgger** This bit is set while the instrument is waiting for the trigger.
4 to 14	**Not used**
15	This bit is always 0.

Table 1.10: Bits in the STATus:OPERation register

STATus:QUEStionable Register

This register contains information about indefinite states which may occur if the unit is operated without meeting the specifications. It can be read using the commands STATus:QUEStionable:CONDition and STATus:QUEStionable[:EVENt].

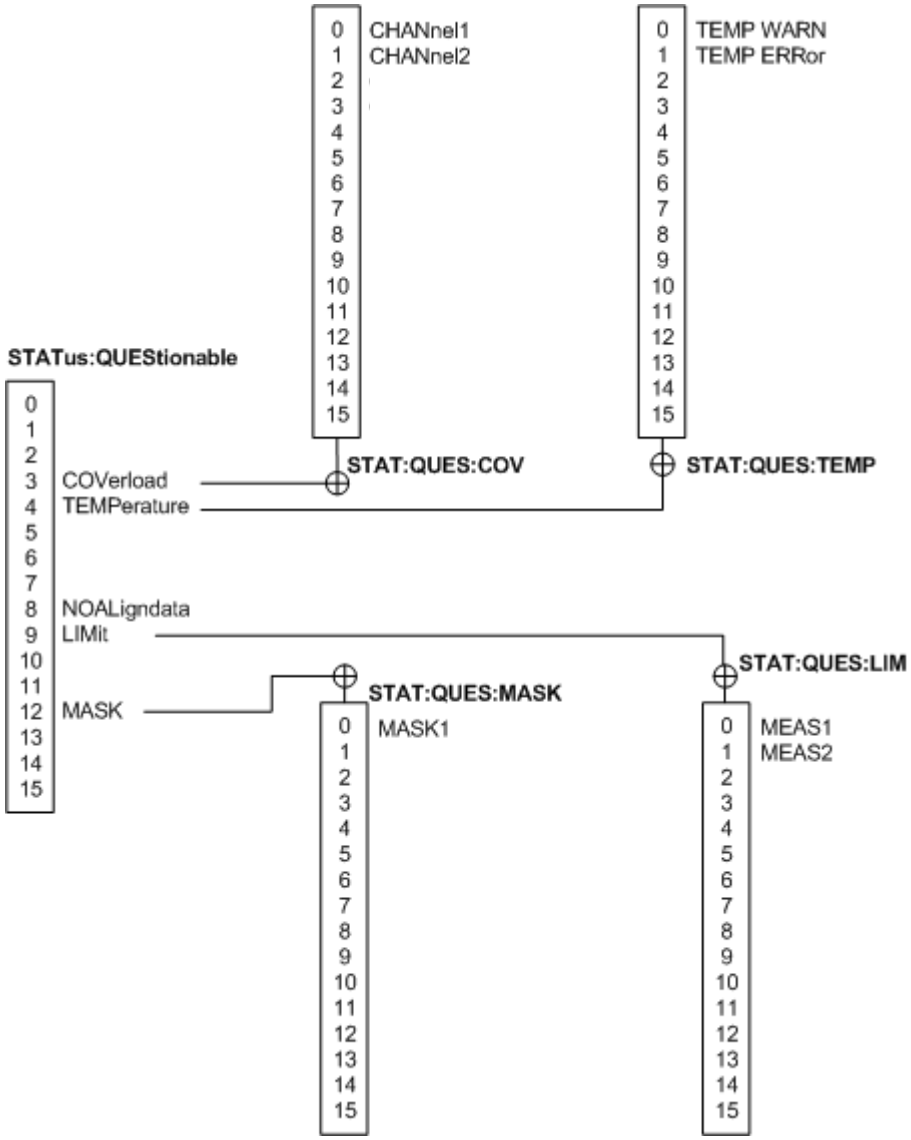

Fig. 1.6: Overview of the STATus:QUEStionable register

Bit No.	Meaning
0 to 2	**Not used**
3	**COVerload** This bit is set if a questionable channel overload occurs (see „STATus:QUEStionable:COVerload regis-ter“, on page 24).
4	**TEMPerature** This bit is set if a questionable temperature occurs (see „STATus:QUEStionable:TEMPerature register“, on page 24).
5 to 7	**Not used**
8	**NOALigndata** This bit is set if no alignment data is available - the instrument is uncalibrated.
9	**LIMit** This bit is set if a limit value is violated (see „STATus:QUEStionable:LIMit register“,on page 25).
10 to 11	**Not used**
12	**MASK** This bit is set if a mask value is violated (see „STATus:QUEStionable:MASK register“,on page 25).
13 to 14	**Not used**
15	This bit is always 0.

Table 1.11: Bits in the STATus:QUEStionable register

STATus:QUEStionable:COVerload register
This register contains all information about overload of the channels. The bit is set if the assigned channel is overloaded.

Bit No.	Meaning
0	CHANnel1
1	CHANnel2

Table 1.12: Bits in the STATus:QUEStionable:COVerload register

STATus:QUEStionable:TEMPerature register
This register contains information about the instrument's temperature.

Bit No.	Meaning
0	**TEMP WARN** This bit is set if a temperature warning on channel 1, 2, 3 or 4 occured.
1	**TEMP ERRor** This bit is set if a temperature error on channel 1, 2, 3 or 4 occured.

Table 1.13: Bits in the STATus:QUEStionable:TEMPerature register

STATus:QUEStionable:LIMit register
This register contains information about the observance of the limits of measurements.This bit is set if the limits of the main or additional measurement of the assigned measurement are violated.

Bit No.	Meaning
0	MEAS1
1	MEAS2

Table 1.14: Bits in the STATus:QUEStionable:LIMit register

STATus:QUEStionable:MASK register
This register contains information about the violation of masks. This bit is set if the assigned mask is violated.

Bit No.	Meaning
0	MASK1

Table 1.15: Bits in the STATus:QUEStionable:MASK register

1.6.4 Application of the Status Reporting System

The purpose of the status reporting system is to monitor the status of one or several devices in a measuring system. To do this and react appropriately, the controller must receive and evaluate the information of all devices. The following standard methods are used:

- Service request (SRQ) initiated by the instrument
- Serial poll of all devices in the bus system, initiated by the controller in order to find out who sent a SRQ and why
- Parallel poll of all devices
- Query of a specific instrument status by means of commands
- Query of the error queue

Service Request
Under certain circumstances, the instrument can send a service request (SRQ) to the controller. Usually this service request initiates an interrupt at the controller, to which the control program can react appropriately. As evident from figure 1.5, an SRQ is always initiated if one or several of bits 2, 3, 4, 5 or 7 of the status byte are set and enabled in the SRE. Each of these bits combines the information of a further register, the error queue or the output buffer. The ENABle parts of the status registers can be set such that arbitrary bits in an arbitrary status register initiate an SRQ. In order to make use of the possibilities of the service request effectively, all bits should be set to „1“ in enable registers SRE and ESE.

The SRQ is the only possibility for the instrument to become active on its own. Each controller program should cause the instrument to initiate a service request if errors occur. The program should react appropriately to the service request.

Serial Poll
In a serial poll, just as with command *STB, the status byte of an instrument is queried. However, the query is realized via interface messages and is thus clearly faster. The serial poll method is defined in IEEE 488.1 and used to be the only standard possibility for different instruments to poll the status byte. The method also works for instruments which do not adhere to SCPI or IEEE 488.2. The serial poll is mainly used to obtain a fast overview of the state of several instruments connected to the controller.

Query of an instrument status
Each part of any status register can be read using queries. There are two types of commands:

- The common commands *ESR?, *IDN?, *IST?, *STB? query the higher-level registers.
- The commands of the STATus system query the SCPI registers (STATus:QUEStionable...)

The returned value is always a decimal number that represents the bit pattern of the queried register. This number is evaluated by the controller program. Queries are usually used after an SRQ in order to obtain more detailed information on the cause of the SRQ.

Decimal representation of a bit pattern
The STB and ESR registers contain 8 bits, the SCPI registers 16 bits. The contents of a status register are specified and transferred as a single decimal number. To make this possible, each bit is assigned a weighted value. The decimal number is calculated as the sum of the weighted values of all bits in the register that are set to 1.

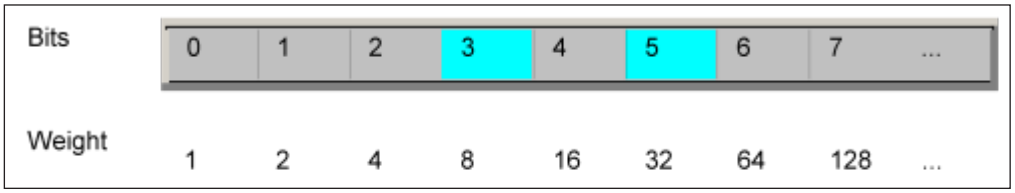

Fig. 1.7: Decimal representation of a bit patter

Example:
The decimal value 40 = 32 + 8 indicates that bits no. 3 and 5 in the status register (e.g. the QUEStionable status summary bit and the ESB bit in the STatus Byte) are set.

Error Queue
Each error state in the instrument leads to an entry in the error queue. The entries of the error queue are detailed plain text error messages that can be looked up in the Error Log or queried via remote control using `SYSTem:ERRor[:NEXT]?` or `SYSTem:ERRor:ALL?`. Each call of `SYSTem:ERRor[:NEXT]?` provides one entry from the error queue. If no error messages are stored there any more, the instrument responds with 0, „No error“.

The error queue should be queried after every SRQ in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried regularly since faulty commands from the controller to the instrument are recorded there as well.

1.6.5 Reset Values of the Status Reporting System

The following table contains the different commands and events causing the status reporting system to be reset. None of the commands, except *RST and SYSTem:PRESet, influence the functional instrument settings. In particular, DCL does not change the instrument settings.

Event	Switching on supply-voltage Power-On-Status-Clear		DCL, SDC (DeviceClear,SelectedDeviceClear)	*RST orSYSTem:PRESet	STATus:PRESet	*CLS
Effect	0	1				
Clear STB, ESR	-	yes	-	-	-	yes
Clear SRE, ESE	-	yes	-	-	-	-
Clear EVENt parts of the registers	-	yes	-	-	-	yes
Clear ENABle parts of all OPERation and QUEStionable registers; Fill ENABle parts of all other registers with „1“.	-	yes	-	-	yes	-
Fill PTRansition parts with „1“; Clear NTRansition parts	-	yes	-	-	yes	-
Clear error queue	yes	yes	-	-	-	yes
Clear output buffer	yes	yes	yes	1)	1)	1)
Clear command processing and input buffer	yes	yes	yes	-	-	-
1) The first command in a command line that immediately follows a <PROGRAM MESSAGE TERMINATOR> clears the output buffer.						

Table 1.16: Resest of the status reporting system

1.7 General Programming Recommendations

Initial instrument status before changing settings
Manual operation is designed for maximum possible operating convenience. In contrast, the priority of remote control is the „predictability“ of the instrument status. Thus, when a command attempts to define incompatible settings, the command is ignored and the instrument status remains unchanged, i.e. other settings are not automatically adapted. Therefore, control programs should always define an initial instrument status (e.g. using the *RST command) and then implement the required settings.

Command sequence
As a general rule, send commands and queries in different program messages. Otherwise, the result of the query may vary depending on which operation is performed first (see also Preventing Overlapping Execution).

Reacting to malfunctions
The service request is the only possibility for the instrument to become active on its own. Each controller program should instruct the instrument to initiate a service request in case of malfunction. The program should react appropriately to the service request.

Error queues

The error queue should be queried after every service request in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried regularly since faulty commands from the controller to the instrument are recorded there as well.

2 Command Reference

This chapter provides the description of all remote commands available for the R&S®HMO1002 resp. R&S®HMO1202 series. The commands are sorted according to the menu structure of the instrument. A list of commands in alphabetical order ist given in the „List of Commands“ at the end of this documentation.

2.1 Common Commands

Common commands are described in the IEEE 488.2 (IEC 625-2) standard. These commands have the same effect and are employed in the same way on different devices.The headers of these commands consist of „*“ followed by three letters. Many common commands are related to the Status Reporting System.

Available common commands:

***CAL?**
Calibration Query

Initiates a calibration of the instrument and subsequently queries the calibration status. Responses > 0 indicate errors.

***CLS**
CLear Status

Sets the status byte (STB), the standard event register (ESR) and the EVENt part of the QUEStionable and the OPERation registers to zero. The command does not alter the mask and transition parts of the registers. It clears the output buffer.

Usage: Setting only

***ESE <Value>**
Event Status Enable

Sets the event status enable register to the specified value. The query returns the contents of the event status enable register in decimal form.

Parameters:
<Value> Range: 0 to 255

***ESR?**
Event Status Read
Returns the contents of the event status register in decimal form and subsequently sets the register to zero.

Return values:
<Contents> Range: 0 to 255

Usage: Query only

***IDN?**
IDeNtification: returns the instrument identification.

Return values:
<ID> Rohde&Schwarz,<device type>,<serial number>,<firmwareversion>

Example: Rohde&Schwarz,HMO1002,020720087,05.450

Usage: Query only

***OPC**
OPeration Complete

Sets bit 0 in the event status register when all preceding commands have been executed. This bit can be used to initiate a service request. The query form writes a „1“ into the output buffer as soon as all preceding commands have been executed. This is used for command synchronization.

***OPT?**
OPTion identification query

Queries the options included in the instrument. For a list of all available options and their description refer to the CD-ROM.

Return values:
<Options> The query returns a list of options. The options are returned at fixed positions in a comma-separated string. A zero is returned for options that are not installed.

Usage: Query only

***PSC <Action>**
Power on Status Clear

Determines whether the contents of the ENABle registers are preserved or reset when the instrument is switched on. Thus a service request can be triggered when the instrument is switched on, if the status registers ESE and SRE are suitably configured. The query reads out the contents of the „power-on-status-clear" flag.

Parameters:
<Action> 0 | 1

0: The contents of the status registers are preserved.
1: Resets the status registers.

***RST**
ReSeT

Sets the instrument to a defined default status. The default settings are indicated in the description of commands.

Usage: Setting only

***SRE <Contents>**
Service Request Enable

Sets the service request enable register to the indicated value. This command determines under which conditions a service request is triggered.

Parameters:
<Contents> Contents of the service request enable register in decimal form.
Bit 6 (MSS mask bit) is always 0.
Range: 0 to 255

***STB?**
STatus Byte query

Reads the contents of the status byte in decimal form.

Usage: Query only

***TRG**
TRiGger

Triggers all actions waiting for a trigger event. In particular, *TRG generates a manual trigger signal (Manual Trigger). This common command complements the commands of the `TRIGger` subsystem.

Usage: Event

***TST?**
self TeST query

Triggers selftests of the instrument and returns an error code in decimal form (see Service Manual supplied with the instrument). „0“ indicates no errors occured.

Usage: Query only

***WAI**
WAIt to continue

Prevents servicing of the subsequent commands until all preceding commands have been executed and all signals have settled (see also command synchronization and *OPC).

Usage: Event

2.2 Acquisition and Setup

2.2.1 Starting and Stopping Acquisition

RUN
Starts the continuous acquisition.

Usage: Event
Asynchronous command

RUNContinous
Same as RUN.

Usage: Event
Asynchronous command

SINGle
Starts a defined number of acquisition cycles.

Usage: Event
Asynchronous command

RUNSingle
Same as SINGle.

Usage: Event
Asynchronous command

STOP
Stops the running acquistion.

Usage: Event
Asynchronous command

2.2.2 Time Base

TIMebase:SCALe <TimeScale>
Sets the horizontal scale for all channel and math waveforms.

Parameters:
<TimeScale> Range: 1E-9 to 50
Default unit: s/div

*RST: 100E-6

TIMebase:RATime?
Queries the real acquisition time used in the hardware. If FFT analysis is performed, the value can differ from the adjusted acquisition time (TIMebase:ACQTime).

Return values:
<HWAcqTime> Default unit: s

Usage: Query only

TIMebase:ACQTime <AcquisitionTime>
Defines the time of one acquisition, that is the time across the 12 divisions of the diagram: **Timebase Scale*12**.

Parameters:
<AcquisitionTime> Range: 12 ns to 600 s
Default unit: s

TIMebase:RANGe <AcquisitionTime>
Defines the time of one acquisition, that is the time across the 12 divisions of the diagram: **Timebase Scale*12**.

Parameters:
<AcquisitionTime> Range: 12 ns to 600 s
Default unit: s

TIMebase:DIVisions?
Queries the number of horizontal divisions on the screen.

Return values:
<HorizDivCount> Range: 12

Usage: Query only

TIMebase:POSition <Offset>
Defines the trigger position (trigger offset) - the time interval between trigger point and reference point to analize the signal some time before or after the trigger event.

See also: TIMebase:REFerence

Parameters:
<Offset> Range: -500 to 500
Default unit: s

*RST: 0

TIMebase:REFerence <ReferencePoint>
Sets the reference point of the time scale (Time Reference) in % of the display. The reference point defines which part of the waveform is shown. If the trigger position is zero, the trigger point matches the reference point. See also: TIMebase:POSition

Parameters:
<ReferencePoint> Range: 10 to 90
Default unit: %

*RST: 50

2.2.3 Acquisition

AUToscale
Performs an autoset process: analyzes the enabled channel signals, and obtains appropriate horizontal, vertical, and trigger settings to display stable waveforms.

Usage: Event
Asynchronous command

ACQuire:MODE <AcquisitionMode>
Selects the method of adding waveform points to the samples of the ADC in order to fill the record length.

Parameters:
<AcquisitionMode> RTIMe | ETIMe

RTIMe (Real Time Mode)
At slow time base settings the sampled points of the input signal are used to build the waveform, no waveform points are added. With fast time base settings, the sample rate is higher than the ADC sample rate. Waveform samples are added to the ADC samples with sin(x)/x interpolation.

ETIMe (Equivalent time)
The waveform points are taken from several acquisitions of a repetive signal at a different time in relation to the trigger point.

*RST: RTIM

ACQuire:INTerpolate <Interpolation>
Defines the interpolation mode.

Parameters:
<Interpolation> LINear | SINX | SMHD

LINear: Linear interpolation between two adjacent sample points.
SINX: Interpolation by means of a sin(x)/x curve.
SMHD: Sample & Hold causes a histogram-like interpolation.

*RST: SINX

ACQuire:AVERage:COUNt <AverageCount>
Defines the number of waveforms used to calculate the average waveform. The higher the number, the better the noise is reduced.

Parameters:
<AverageCount> Only numbers from the 2nd progression are permitted.
Range: 2 to 1024

*RST: 2

ACQuire:AVERage:COMPlete?
Returns the state of averaging.

Return values:
<AverageComplete> 0 | 1

0: The number of acquired waveforms is less than the number required for average calculation.
See ACQuire:AVERage:COUNt.
1: The instrument acquired a sufficient number of waveforms to determine the average.

Usage: Query only

ACQuire:WRATe <WaveformRate>
Defines the mode to set the sample rate (samples per second saved in the memory) and the waveform acquisition rate (waveforms per second).

Parameters:
<WaveformRate> AUTO | MWAVeform | MSAMples

AUTO
To display the best waveform, the instrument selects the optimum combination of waveform acquisition rate and sample rate using the full memory depth.

MWAVeform
Maximum waveform rate: The instrument combines sample rate and memory depth to acquire at maximum waveform acquisition rate. In combination with persistence fuction, the mode can display rare signal anomalies.

MSAMples
Maximum sample rate: The instrument acquires the signal at maximum sample rate and uses the full memory depth. The result is a waveform with maximum number of waveform samples, high degree of accuracy, and low risk of aliasing.

*RST: AUTO

ACQuire:POINts[:VALue]?
The query returns the record length, the number of recorded waveform points.

Return values:
<RecordLength> Record length in Sa

*RST: 960000

Usage: Query only

CHANnel<m>:TYPE <DecimationMode>
Selects the method to reduce the data stream of the ADC to a stream of waveform points with lower sample rate.

Suffix:
<m> The command affects all channels regardless of the indicated channel number. The suffix can be omitted.

Parameters:
<DecimationMode> SAMPle | PDETect | HRESolution

SAMPle
Input data is acquired with a sample rate which is aligned to the time base (horizontal scale) and the record length.

PDETect (Peak Detect)
The minimum and the maximum of n samples in a sample interval are recorded as waveform points.

HRESolution (High Resolution)
The average of n sample points is recorded as waveform point.

*RST: SAMPle

CHANnel<m>:ARIThmetics <TrArithmetic>
Selects the method to build the resulting waveform from several consecutive acquisitions of the signal.

Suffix:
<m> The command affects all channels regardless of the indicated channel number. The suffix can be omitted.

Parameters:
<TrArithmetic> OFF | ENVelope | AVERage | FILTer

OFF
The data of the current acquisition is recorded according to the decimation settings.

ENVelope
Detects the minimum and maximum values in an sample interval over a number of acquisitions.

AVERage
Calculates the average from the data of the current acquisition and a number of acquisitions before. The number of used acquisitions is set with ACQuire:AVERage:COUNt.

FILTer
Sets a low-pass filter with 3 db attenuation at a configurable limit frequency set with ACQuire:FILTer:FREQency. The filter removes higher frequencies from the channel signals.

*RST: OFF

TIMebase:ROLL:ENABle <Roll>
Enables the roll mode.

Parameters:
<Roll> ON | OFF

*RST: OFF

ACQuire:FILTer:FREQency <FilterFrequency>
Sets the limit frequency if CHANnel<m>:ARIThmetics is set to „FILTer".

Parameters:
<FilterFrequency> Limit frequency with 3dB attenuation
Default unit: Hz

ACQuire:POINts:ARATe?
Retrieves the sample rate of the ADC, that is the number of points that are sampled by the ADC in one second.

Return values:
<AcquisitionRate> ADC sample rate in Hz

Usage: Query only

ACQuire:SRATe?
Returns the sample rate, that is the number of recorded waveform samples per second.

Return values:
<SampleRate> Waveform samples per second (Sa/s)

Usage: Query only

ACQuire:STATe <Aquisition State>
Sets the aquisition state of the instrument.

Parameters:
<Aquisition State> RUN | STOP | COMPlete | BREak

RUN
The aquisition is running.

STOP
The acquisition will stop if finished.

COMPlete
The current aquisition is finished and completed.

BREak
Set = break/interrupt of current acquisition
Read = acquisition is finished but interrupted

*RST: RUN

ACQuire:TYPE <Aquisition Type>
Sets the type of the aquisition mode.

Parameters:
<Aquisition Type> REFresh | ROLL | AVERage | ENVelope | FILTer

REFresh
The aquisitions are displayed as they are done.

ROLL
The aquisitions are done in roll mode.

AVERage
The aquisitions are averaged.

FILTer
Sets a low-pass filter with 3 db attenuation at a configurable limit frequency

*RST: OFF

ACQuire:PEAKdetect <PeakDetect>
Enables the peak detection.

Parameters:
<PeakDetect> AUTO | OFF

*RST: OFF

ACQuire:HRESolution <HighRes>
Enables the high resolution mode.

Parameters:
<HighRes> AUTO | OFF

*RST: OFF

2.2.4 Vertical

CHANnel<m>:STATe <State>
Switches the channel signal on or off.

Suffix:
<m> Selects the input channel (1, 2).

Parameters:
<State> ON | OFF

CHANnel<m>:COUPling <Coupling>
Selects the connection of the indicated channel signal.

Suffix:
<m> Selects the input channel (1, 2).

Parameters:
<Coupling> DCLimit | ACLimit | GND

DCLimit: DC coupling
ACLimit: AC coupling
GND: Ground

*RST: DCL

CHANnel<m>:SCALe <Scale>
Sets the vertical scale for the indicated channel.

Suffix:
<m> Selects the input channel (1, 2).

Parameters:
<Scale> Scale value in Volts per div.
Range: 1e-3 to 10

*RST: 5E-3

CHANnel<m>:RANGe <Range>
Sets the voltage range across the 8 vertical divisions of the diagram. Use the command alternativly instead of CHANnel<m>:SCALe.

Suffix:
<m> Selects the input channel (1, 2).

Parameters:
<Range> Range: 8e-3 to 80

*RST: 4E-2

CHANnel<m>:POSition <Position>
Sets the vertical position of the indicated channel and its horizontal axis in the window.

Suffix:
<m> Selects the input channel (1, 2).

Parameters:
<Position> Position value, given in divisions.
Range: -5 to 5 (R&S®HMO1002 series)
-15 to 15 (R&S®HMO1202 series)

*RST: 0.00E+00

CHANnel<m>:OFFSet <Offset>
The offset voltage is subtracted to correct an offset-affected signal.

Suffix:
<m> Selects the input channel (1, 2).

Parameters:
<Offset> Offset value in V
Range: Values depend on vertical scale and probe attenuation

*RST: 0.00E+00

CHANnel<m>:BANDwidth <BandwidthLimit>
Selects the bandwidth limit for the indicated channel.

Suffix:
<m> Selects the input channel (1, 2).

Parameters:
<BandwidthLimit> FULL | B20

FULL: Full bandwidth.
B20: Bandwidth limit 20 MHz

*RST: FULL

CHANnel<m>:POLarity <Polarity>
Turns the inversion of the signal amplitude on or off. To invert means to reflect the voltage values of all signal components against the ground level. Inversion affects only the display of the signal but not the trigger.

Suffix:
<m> Selects the input channel (1, 2).

Parameters:
<Polarity> NORMal | INVerted

*RST: NORM

CHANnel<m>:OVERload <Overload>
Retrieves the overload status of the specified channel from the status bit. When the overload problem is solved, the command resets the status bit.

Suffix:
<m> Selects the input channel (1, 2).

Parameters:
<Overload> ON | OFF
Use OFF to reset the overload status bit.

*RST: OFF

Example: CHANnel2:OVERload?
Queries the overload status of channel 2.

CHANnel2:OVERload OFF
Resets the overload status bit.

CHANnel<m>:SKEW <Skew>
Skew or deskew compensates delay differences between channels caused by the different length of cables, probes, and other sources. Correct deskew values are important for accurate triggering.

Suffix:
<m> Selects the input channel (1, 2).

Parameters:
<Skew> Deskew value in s.

CHANnel<m>:THReshold <Threshold>
Threshold value for digitization of analog signals. If the signal value is higher than the threshold, the signal state is high (1 or true for the boolean logic). Otherwise, the signal state is considered low (0 or false) if the signal value is below the threshold.

Suffix:
<m> Selects the input channel (1, 2).

Parameters:
<Threshold> Default values are:
TTL 1,4 V
ECL -1,3 V
CMOS 2,5 V

*RST: 5.00E-01

CHANnel<m>:THReshold:FINDlevel
Sets the appropriate threshold level automatically.

Suffix:
<m> Selects the input channel (1, 2).

Usage: Setting only

CHANnel<m>:THReshold:HYSTeresis <ThresholdHysteresis>
Defines the size of the hysteresis to avoid the change of signal states due to noise.

Suffix:
<m> Selects the input channel (1, 2).

Parameters:
<ThresholdHysteresis> SMALl | MEDium | LARGe

*RST: SMAL

CHANnel<m>:LABel <Label>
Set the label for the input channel.

Suffix:
<m> Selects the input channel (1, 2).

Parameters:
<Label> String value "xxxxxxxx" with maximum 8 ASCII characters.

CHANnel<m>:LABel:STATe <State>
Switches the label of the channel on or off

Suffix:
<m> Selects the input channel (1, 2).

Parameters:
<State> ON | OFF

*RST: OFF

2.2.5 Logic Channel

LOGic<I>:POSition <Position>
Set the position of a logic channel.

Suffix:
<I> Selects the logic channel (0...7).

Parameters:
<Position> Position value in divisions.

LOGic<I>:SIZE <Size>
Set the size of the display of the logic channel.

Suffix:
<I> Selects the logic channel (0...7).

Parameters:
<Size> SMALl | MEDium | LARGe

*RST: SMAL

LOGic<I>:STATe <state>
Switches the channel signal on or off.

Suffix:
<I> Selects the logic channel (0...7).

Parameters:
<State> ON | OFF

LOGic<I>:LABel <Label>
Set the label for the logic channel.

Suffix:
<I> Selects the logic channel (0...7).

Parameters:
<Label> String value “xxxxxxxx“ with maximum 8 ASCII characters.

LOGic<I>:LABel:State <Label>
Switches the label of the lagic channel on or off.

Suffix:
<I> Selects the logic channel (0...7).

Parameters:
<Label> ON | OFF

POD:THReshold <Threshold Mode>
Threshold Mode for Logic Pod. If the signal value is higher than the threshold, the signal state is high (1 or true for the boolean logic). Otherwise, the signal state is considered low (0 or false) if the signal value is below the threshold.

Parameters:
<Threshold Mode> TTL | ECL | CMOS | USER1 | USER2

TTL TTL level, set to 1.4V
ECL ECL level, set to -1.3V
CMOS CMOS level, set to 2.5V
USER1 USER1 level, can be set with POD:THReshold:UDLevel<u>.
USER2 USER2 level, can be set with POD:THReshold:UDLevel<u>.

POD:THReshold:UDLevel<u> <Threshold Level>
Set the user high level threshold for the pod.

Suffix:
<u> Select the User setting. (USER1, USER2)

Parameters:
<Threshold Level> Threshold level in V.
Range: -2 to 8

POD:State <State>
Switches the Pod on or off.

Parameters:
<State> ON | OFF

*RST: OFF

POD:DATA?
Returns the data of the specified digital channel. To set the export format, use FORMat[:DATA]. To set the range of samples to be returned, use POD:DATA:POINts.

Parameters:
<WaveformData> List of values according to the format settings.

Example: FORM ASC,0
POD:DATA?
1,1,1,1,1,1,0,0,0,0,0,0,...

Usage: Query only

POD:DATA:HEADer?
Returns information on the digital channel waveform.

Position	Meaning	Example
1	XStart in s	-9.477E-008 = - 94,77 ns
2	XStop in s	9.477E-008 = 94,77 ns
3	Record length of the waveform in Samples	200000
4	Number of values per sample interval, usually 1.	1

Table 2.1: Header data

Return values:
<Header> Comma-separated value list

Example: -9.477E-008,9.477E-008,200000,1

Usage: Query only

POD:DATA:POINts
As a setting, the command selects a range of samples that will be returned with POD:DATA?. As a query, the command returns the number of returned samples for the selected range. If ACQuire:WRATe is set to MSAMples (maximum sample rate), the memory usually contains more data samples than the screen can display. In this case, you can decide which data will be saved: samples stored in the memory or only the displayed samples.

NOTICE

The entire oscilloscope memory can only be read out in STOP mode if the maximum sampling has been activated in the ACQUIRE menu.

Parameters:
<PointSelection> DEFault | MAXimum | DMAXimum
Sets the range for data queries.

DEFault
Waveform samples displayed on the screen.

MAXimum
Range is the complete memory (only available with maximum sample rate and STOP mode).

DMAXimum (Display Maximum)
Number of samples in the current waveform record.

*RST: DEFault

Return values:
<Points> Number of data points in the selected range.
Default unit: Samples

See also: CHANnel<m>:DATA:POINts

POD:DATA:XINCrement?
Returns the time difference between two adjacent samples of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Return values:
<Xincrement> Time in s

Usage: Query only

POD:DATA:XORigin?
Returns the time of the first sample of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Return values:
<Xorigin> Time in s

Usage: Query only

POD:DATA:YINCrement?
Returns the voltage value per bit of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Return values:
<Yincrement> Voltage in V

Usage: Query only

POD:DATA:YORigin?
Returns the voltage value for binary value 0 of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Return values:
<Yorigin> Voltage in V

Usage: Query only

POD:DATA:YRESolution?
Return the vertical bit resolution of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Return values:
<Yresolution> For default waveforms, the resolution is 8 bit.
If high resolution, average or filter are set, the resolution is 16 bit.

Usage: Query only

POD:CURRent:STATe:MINimum?
POD:CURRent:STATe:MAXimum?
Both commands together return the current status of the digital channel regardless of the trigger settings and even without any acquisition.

POD:CURR:STAT:MIN returns	POD:CURR:STAT:MAX returns	Signal
0	0	Low
1	1	High
0	1	Toggle

Table 2.1: POD status

Return values:
<CurrentState> Range: 0 | 1

Usage: Query only

2.2.6 Waveform Data

CHANnel<m>:DATA?

Returns the data of the channel waveform points. The waveforms data can be used in MATLAB, for example. For envelope waveforms, use the CHANnel<m>:DATA:ENVelope command.

Suffix:

<m> Selects the input channel (1, 2).

Return values:

<Data> Comma-separated list of vertical values (voltages of recorded waveform samples.

Example: CHAN1:DATA?
-0.125000,-0.123016,-0.123016,-0.123016, -0.123016,-0.123016,...

Usage: Query only

CHANnel<m>:DATA:HEADer?
Returns information on the channel waveform. For envelope waveforms, use the CHANnel<m>:DATA:ENVelope:HEADer command.

Position	Meaning	Example
1	XStart in s	-9.477E-008 = - 94,77 ns
2	XStop in s	9.477E-008 = 94,77 ns
3	Record length of the waveform in Samples	200000
4	Number of values per sample interval, usually 1.	1

Table 2.1: Header data

Suffix:
<m> Selects the input channel (1, 2).

Return values:
<DataHeader> Comma-separated value list

Example: -9.477E-008,9.477E-008,200000,1

Usage: Query only

CHANnel<m>:DATA:XINCrement?
Returns the time difference between two adjacent samples of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Suffix:
<m> Selects the input channel (1, 2).

Return values:
<Xincrement> Time in s

Usage: Query only

CHANnel<m>:DATA:XORigin?
Returns the time of the first sample of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Suffix:
<m> Selects the input channel (1, 2).

Return values:
<Xorigin> Time in s

Usage: Query only

CHANnel<m>:DATA:YINCrement?
Returns the voltage value per bit of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Suffix:
<m> Selects the input channel (1, 2).

Return values:
<Yincrement> Voltage in V

Usage: Query only

CHANnel<m>:DATA:YORigin?
Returns the voltage value for binary value 0 of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Suffix:
<m> Selects the input channel (1, 2).

Return values:
<Yorigin> Voltage in V

Usage: Query only

CHANnel<m>:DATA:YRESolution?
Return the vertical bit resolution of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Suffix:
<m> Selects the input channel (1, 2).

Return values:
<Yresolution> For default waveforms, the resolution is 8 bit.
If high resolution, average or filter are set, the resolution is 16 bit.

Usage: Query only

CHANnel<m>:DATA:ENVelope?
Returns the data of the envelope. The envelope consists of two waveforms. Use this command only for envelope waveforms. for all other channel waveforms use CHANnel<m>:DATA.

Suffix:
<m> Selects the input channel (1, 2).

Return values:
<Data> Comma-separated list of vertical values (voltages of envelope points).
The list contains two values for each sample interval.

Usage: Query only

CHANnel<m>:DATA:ENVelope:HEADer?

Returns information on the envelope waveform. Use this command only for envelope waveforms. for all other channel waveforms use CHANnel<m>:DATA:HEADer.

Position	Meaning	Example
1	XStart in s	-9.477E-008 = - 94,77 ns
2	XStop in s	9.477E-008 = 94,77 ns
3	Number of Samples	1200
4	Number of values per sample interval. For envelope waveforms the value is 20.	2

Suffix:

<m> Selects the input channel (1, 2).

Return values:

<DataHeader> Comma-separated value list

Example: -9.477E-008,9.477E-008,1200,2

Usage: Query only

CHANnel<m>:DATA:ENVelope:XINCrement?

Returns the time difference between two adjacent samples of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Suffix:

<m> Selects the input channel (1, 2).

Return values:

<Xincrement> Time in s

Usage: Query only

CHANnel<m>:DATA:ENVelope:XORigin?

Returns the time of the first sample of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Suffix:

<m> Selects the input channel (1, 2).

Return values:

<Xorigin> Time in s

Usage: Query only

CHANnel<m>:DATA:ENVelope:YINCrement?
Returns the voltage value per bit of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Suffix:
<m> Selects the input channel (1, 2).

Return values:
<Yincrement> Voltage in V

Usage: Query only

CHANnel<m>:DATA:ENVelope:YORigin?
Returns the voltage value for binary value 0 of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Suffix:
<m> Selects the input channel (1, 2).

Return values:
<Yorigin> Voltage in V

Usage: Query only

CHANnel<m>:DATA:ENVelope:YRESolution?
Return the vertical bit resolution of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Suffix:
<m> Selects the input channel (1, 2).

Return values:
<Yresolution> For default waveforms, the resolution is 8 bit.
If high resolution, average or filter are set, the resolution is 16 bit.

Usage: Query only

CHANnel<m>:DATA:POINts <Points>

As a setting, the command selects a range of samples. As a query, it returns the number of samples for the selected range. To get correct results with settings MAX and DMAX, the acquisition must not run when the command is used. To acquire consistent and valid data, use the SINGle command before. Do not cancel a running acquisition with STOP because the waveform data might be incomplete or incorrect.

Suffix:

<m> Selects the input channel (1, 2).

Return values:

<Points> Number of data points in the selected range (samples). The number of data points is depending on the timebase and channel settings.

Setting Parameters:

<Points> DEFault | MAXimum | DMAXimum
Sets the range for the query.

DEFault
Waveform samples displayed on the screen.

MAXimum
Range is the complete memory (only available with maximum sample rate and STOP mode).

NOTICE

The entire oscilloscope memory can only be read out in STOP mode if the maximum sampling has been activated in the ACQUIRE menu.

DMAXimum (Display Maximum)
Number of samples in the current waveform record.

Example:

The instrument recorded 10000 samples. 6000 of these samples apply to the screen. To create the display points, every 6 points are combined to a MIN-MAX pair, and 1000 of these data pairs are displayed on the screen. For DEFault, 2000 is returned (1000 data pairs). DMAX returns 6000, and MAX 10000 (the complete memory).

Record mode „AUTOMATIC“ (ACQUIRE menu) in STOP mode
CHAN1:DATA:POIN MAX
CHAN1:DATA:POIN?
Suffix: 240000

Record mode „MAX.SA.RATE“ (ACQUIRE menu) in STOP mode
CHAN1:DATA:POIN MAX
CHAN1:DATA:POIN?
Suffix: 1048560

FORMat[:DATA] <DataFormat>,<Accuracy>
Defines the format for data export with:
CHANnel<m>:DATA?
CHANnel<m>:DATA:ENVelope?
REFCurve<m>:DATA?
CALCulate:QMATH:DATA?

Parameters:

<DataFormat> ASCii | REAL | UINTeger | CSV

ASCii
List of values, for example, 1.23,1.22,1.24,..
<Accuracy> is 0, which means that the instrument selects the number of digits to be returned. The query returns ASC,0.

REAL
Block data, 32 bit float values in 4 byte blocks.
<Accuracy> is always 32. The query returns REAL,32.

UINTeger
Unsigned integer format, binary values with length 8 or 16 bit (UINT,8 or UINT,16). The data range for UINT,8 is 0 to 255, the data range for UINT,16 is 0 to 65.535. For data conversion, you need the results of ...:DATA:XORigin?, ...:DATA:XINCrement?, ...:DATA:Yorigin?, ...:DATA:YINCrement? and ...:DATA:YRESolution? commands.

CSV
Comma separated value list.

*RST: ASC

<Accuracy> 0 | 8 | 16 | 32
Length of a data value in bit

*RST: 0

Example:
FORM ASC
FORM?
ASC,0

FORMat:BORDer <ByteOrder>
Defines the byte order for binary data export if FORMat[:DATA] is set to REAL or UINT.

Parameters:
<ByteOrder> MSBFirst | LSBFirst

MSBFirst
Big endian, most significant byte first, for example:
abcd,acbe,abcf, ...

LSBFirst
Little endian, least significant byte first, for example:
dcba,ebca,fcba, ...

*RST: MSBF

2.2.7 Waveform Data Export to File

EXPort:WAVeform:SOURce <WaveformSource>
Defines the waveform to be exported.

Parameters:
<WaveformSource> CH1 | CH2 | D0...7 | QMA | MA1...MA5 | RE1..4

CH1 | CH2:	Analog channels
D0...7:	Pod, digital channels D0 to D7 are exported together
QMA:	Quick Mathematics waveform
MA1...MA5:	Mathematics waveform (only with R&S®HMO1202 series)
RE1..4:	Reference waveforms RE1 | RE2 | RE3 | RE4

EXPort:WAVeform:NAME <FileName>
Defines the path and file name for a waveform data file that will be saved with EXPort:WAVeform:SAVE. Depending on which USB port the flash drive is connected to, you either choose "/USB_FRONT" or "/USB_REAR" to specify the correct location. Additionally, the format type via FORM {ASC, REAL, UINT, CSV} and the number of points to export via CHAN<n>:DATA:POIN <points> should be defined. Existing files will be overwritten. You can change the storage location, file name and/or file format manually in the HMO menu. Remote control uses the recent settings.

Parameters:
<FileName> String parameter

Example:
FORM CSV
EXP:WAV:SOUR CH1
EXP:WAV:NAME "/USB_FRONT/CHANNEL1.CSV"
EXP:WAV:SAVE
The waveform data is saved to CHANNEL1.CSV.

EXPort:WAVeform:SAVE
Saves the waveform and starts the export to USB drive.

Usage: Event

2.2.8 Probes

PROBe<m>:SETup:TYPE?
Queries the type of the probe.

Suffix:
<m> Selects the input channel (1, 2).

Return values:
<Type> NONE | ACTive | PASSive

NONE: Not detected
ACTive: Active probe
PASSive: Passive probe

Usage: Query only

PROBe<m>:SETup:ATTenuation:UNIT <Unit>
Selects the unit that the probe can measure.

Suffix:
<m> Selects the input channel (1, 2).

Parameters:
<Unit> V | A

PROBe<m>:SETup:ATTenuation:MANual <ManualAttenuation>
Sets the attenuation or gain of the probe if the probe was not detected by the instrument.

Suffix:
<m> Selects the input channel (1, 2).

Parameters:
<ManualAttenuation> Range: 0.001 to 10000

*RST: 1

PROBe<m>:SETup:ATTenuation[:AUTO]?
Returns the attenuation of an automatically detected probe.

Suffix:
<m> Selects the input channel (1, 2).

Return values:
<ProbeAttenuation> Range: 0.001 to 1000

Usage: Query only

2.3 Trigger

2.3.1 General A Trigger Settings

TRIGger:A:MODE <TriggerMode>
Sets the trigger mode. The trigger mode determines the behaviour of the instrument if no trigger occurs.

Parameters:
<TriggerMode> AUTO | NORMal

AUTO
The instrument triggers repeatedly after a time interval if the trigger conditions are not fulfilled. If a real trigger occurs, it takes precedence.

NORMal
The instrument acquires a waveform only if a trigger occurs.

*RST: AUTO

TRIGger:A:LEVel<n>[:VALue] <Level>
Sets the trigger treshold voltage for all A trigger types that require a trigger level.

Suffix:
<n> Selects the trigger input. 1, 2 selects the corresponding channel, 5 selects the external trigger input.

Parameters:
<Level> Trigger level in V.
Range: Depends on vertical scale

TRIGger:A:SOURce <Source>
Sets the trigger source for the selected A trigger type.

Parameters:
<Source> CH1 | CH2 | D0...D7 | EXTernanalog | LINE | PATTern | NONE

CH1 | CH2: Analog channels
D0...D7: Digital channels
EXTernanalog: External TRIG IN connector on the front panel
LINE: AC line for the edge trigger
PATTern: Pattern
NONE: No trigger source selected

*RST: CH1

TRIGger:EXTern:COUPling <ExternCoupling>
Sets the coupling for the external trigger input. The command is relevant if TRIGger:A:SOURce is set to EXTernanalog.

Parameters:
<ExternCoupling> AC | DC

*RST: AC

TRIGger:A:TYPE <Type>
Sets the trigger type for the A trigger.

Parameters:
<Type> EDGE | WIDTh | TV | LOGic | BUS

EDGE: Edge trigger
WIDTh: Pulse trigger
TV: Video trigger
LOGic: Logic trigger
BUS: BUS trigger require options

*RST: EDGE

TRIGger:A:HOLDoff:MODE
Sets the trigger hold off mode.

Parameters:
<HoldOff_Mode> TIME | OFF

*RST: OFF

TRIGger:A:HOLDoff:TIME
Defines the holdoff time. The next trigger only occurs after the holdoff time has passed.

Parameters:
<HoldOff_Time> Range: 5.00000E-08 to 1.00000E+01
Default unit: s

TRIGger:OUT:MODE
Sets the trigger output mode. Defines the trigger output mode wether and when a trigger out pulse is generated.

Parameters:
<Output_Mode> OFF | TRIGger | MASK | GENerator

TRIGger: Trigger event
MASK: Mask violation
GENerator: Generator signal

*RST: OFF

TRIGger:OUT:POLarity
Sets the trigger output polarity,

Parameters:
<Polarity> POSitive | NEGative

*RST: POS

TRIGger:OUT:PLENgth
Sets the trigger output pulse length.

Parameters:
<Pulse_Length> Numeric value
Default unit: s

*RST: 1E-6

2.3.2 Edge Trigger

TRIGger:A:EDGE:SLOPe <Slope>
Sets the slope for the edge trigger (A trigger).

Parameters:
<Slope> POSitive | NEGative | EITHer

POSitive: Rising edge (positive voltage change)
NEGative: Falling edge (negative voltage change)
EITHer: Rising as well as the falling edge

*RST: POS

TRIGger:A:EDGE:COUPling <Coupling>
Sets the coupling for the trigger source.

Parameters:
<Coupling> DC | AC | HF | ALEVel

DC
Direct Current coupling. The trigger signal remains unchanged.

AC
Alternating Current coupling. A 5 Hz high pass filter removes the DC offset voltage from the trigger signal.

HF
High frequency coupling. A 15 kHz high-pass filter removes lower frequencies from the trigger signal. Use this mode only with very high frequency signals.

ALEVel (Auto Level)

*RST: DC

TRIGger:A:EDGE:FILTer:LPASs <State>
Turns an additional 5 kHz low-pass filter in the trigger path on or off. This filter removes higher frequencies and is available with AC and DC coupling.

Parameters:
<State> ON | OFF

*RST: OFF

TRIGger:A:EDGE:FILTer:NREJect <State>
Turns an additional 100 MHz low-pass filter in the trigger path on or off. This filter removes higher frequencies and is available with AC and DC coupling.

Parameters:
<State> ON | OFF

*RST: OFF

2.3.3 Width (Pulse) Trigger

TRIGger:A:WIDTh:POLarity <Polarity>
Sets the polarity of the pulse triger function.

Parameters:
<Polarity> POSitive | NEGative

POSitive
Positive going pulse, the width is defined from the rising to the falling slopes.

NEGative
Negative going pulse, the width is defined from the falling to the rising slopes.

*RST: POS

TRIGger:A:WIDTh:RANGe <RangeMode>
Defines how the measured pulse width is compared with the given limit(s).

Parameters:
<RangeMode> WITHin | OUTSide | SHORter | LONGer

WITHin | OUTSide
Triggers on pulses inside or outside a range defined by time ± delta. The time is specified with TRIGger:A:WIDTh:WIDTh, the range around is defined with TRIGger:A:WIDTh:DELTa.

SHORter | LONGer
Triggers on pulses shorter or longer than a time set with TRIGger:A:WIDTh:WIDTh.

*RST: LONG

TRIGger:A:WIDTh:DELTa <Delta>
Defines a range around the width value specified using TRIGger:A:WIDTh:WIDTh.

Parameters:
<Delta> Range: ±Δt („Variation")
Value range depends on the defined pulse width

*RST: 3.2E-9

TRIGger:A:WIDTh:WIDTh <Time1>
For the ranges WITHin and OUTSide (defined using TRIGger:A:WIDTh:RANGe), the <Time1> defines the center of a range which is defined by the limits ±<Delta> (set with TRIGger:A:WIDTh:DELTa). For the ranges SHORter and LONGer, the width defines the maximum and minimum pulse width, respectively.

Parameters:
<Time1> Center value, maximum value or minimum value depending on the defined range type.

Range: 1.6E-08 to 3.435974E+01

2.3.4 Video/TV Trigger

TRIGger:A:TV:STANdard <Standard>
Selects the color television standard.

Parameters:
<Standard> PAL | NTSC | SECam | PALM | I576 | P720 | P1080 | I1080

*RST: PAL

TRIGger:A:TV:POLarity <Polarity>
Sets the polarity of the sync pulses. The edges of the sync pulses are used for triggering.

Parameters:
<Polarity> POSitive | NEGative

POSitive
If the video modulation is positve, the sync pulses are negative.

NEGative
If the modulation is negative, sync pulses are positive.

*RST: NEG

TRIGger:A:TV:FIELd <Field>
Sets the trigger on the beginning of the video signal fields or on the beginning of video signal lines.

Parameters:
<Field> EVEN | ODD | ALL | LINE | ALINe

EVEN
Triggers only on even half frames.

ODD
Triggers only on odd half frames.

ALL
Triggers on all frames.

LINE
Triggers on the beginning of a specified line in any field.
The line number is set with TRIGger:A:TV:LINE.

ALINe
Triggers on the beginning of all video signal lines.

*RST: ALL

TRIGger:A:TV:LINE <Line>
Sets an exact line number if TRIGger:A:TV:FIELd is set to LINE.

Parameters:
<Line> Range: 1 to 525, 625 , ... , 1080 depending on the TV standard

*RST: 1

2.3.5 Pattern (Logic) Trigger

TRIGger:A:PATTern:SOURce <SourceString>
Selects the state for each digital channel. The respective channel (CH1, CH2 or logic channels 0...7) has to be activated before state selecting.

Parameters:
<SourceString> String containing 0, 1, or X for each channel.

1: High, the signal voltage is higher than the trigger level.
0: Low, the signal voltage is lower than the trigger level.
X: Don't care. the channel does not affect the trigger.

Example: TRIG:A:PATT:SOUR „1X"
CH1 = High, CH2 = Don't care (POD deactivated)

TRIG:A:PATT:SOUR „00101X1X1X"
POD: 0 = High, 1 = Low, ... , 7 = Don't care (CH1 / CH2 deactivated)

TRIGger:A:PATTern:FUNCtion <Function>
Sets the logical combination of the trigger states of the channels.

Parameters:
<Function> AND | OR

AND
The required states of all channels must appear in the input signal at the same time.

OR
At least one of the channels must have the required state.

*RST: AND

TRIGger:A:PATTern:CONDition <Condition>
Sets the trigger point depending on the result of the logical combination of the channel states.

Parameters:
<Condition> „TRUE“ | „FALSE“

*RST: „TRUE“

TRIGger:A:PATTern:MODE <PatternMode>
Sets the duration function of the pattern trigger.

Parameters:
<PatternMode> OFF | TIMeout | WIDTh

OFF
Pattern trigger without duration.

TIMeout
Defines how long at least the result of the state pattern condition must be true or false.

WIDTh
Width duration and comparision of the logical combined channels. The range is defined using TRIGger:A:PATTern:WIDTh:RANGe.

*RST: OFF

TRIGger:A:PATTern:WIDTh[:WIDTh] <Numeric_Value>
For the ranges WITHin and OUTSide (defined using TRIGger:A:PATTern:WIDTh:RANGe), the <numeric_value> defines the center of a range which is defined by the limits ±<Delta> (set with TRIGger:A:PATTern:WIDTh:DELTa). For the ranges SHORter and LONGer, the width defines the maximum and minimum pulse width, respectively.

Parameters:

<Numeric_Value> Center value, maximum value or minimum value depending on the defined range type.
Range: 1.600E-08 to 3.435974E+01

*RST: 3.9999999E-04

TRIGger:A:PATTern:WIDTh:DELTa <PatternDelta>
Defines a range around the width value specified using TRIGger:A:PATTern:WIDTh[:WIDTh].

Parameters:

<Delta> Range: ±Δt („Variation")
Range: 8.00E-09 to maximum value depends on the defined pulse width

*RST: 1.5000000E-04

TRIGger:A:PATTern:WIDTh:RANGe <PatternRange>
Defines a range around the width value specified using TRIGger:A:PATTern:WIDTh:WIDTh.

Parameters:

<PatternRange> WITHin | OUTSide | SHORter | LONGer

WITHin | OUTSide
Triggers on pulses inside or outside a range defined by time ± delta. The time is specified with TRIGger:A:PATTern:WIDTh[:WIDTh], the range around is defined with TRIGger:A:PATTern:WIDTh:DELTa.

SHORter | LONGer
Triggers on pulses shorter or longer than a time set with TRIGger:A:PATTern:WIDTh[:WIDTh]

*RST: LONG

2.4 Display

2.4.1 Basic Display Settings

This chapter describes commands that configure the screen display.

General Display Settings:

XY-Setup:

Intensities

Waveform, Auxilary Cursors and Grid Settings

DISPlay:MODE <Mode>

Sets the diagram mode.

Parameters:

<Mode> YT | XY

YT

Default time diagram with a time axis in x-direction and the signal amplitudes displayed in y-direction.

XY
XY-diagram combines the voltage levels of two waveforms in one diagram.

*RST: YT

DISPlay:PALette <Palette>
Sets the color and brightness of the displayed waveform samples depending on their cumulative occurance.

Parameters:
<Palette> NORMal | INVerse | FCOLor | IFColor

NORMal
Values that occur frequently are brighter than rare values.

INVerse
Rare values are brighter than frequent values, inverse to the NORMal brightness.

FColor
Rare values are displayed in blue while more frequent values are red and very frequent values are displayed in yellow or white, with various colors inbetween.

IFColor
Inverses the FColor setting. Rare values are yellow or white while frequent values are blue.

*RST: NORM

DISPlay:VSCReen:ENABle <Enable>
Switches the virtual screen on or off.

Parameters:
<Enable> ON | OFF

*RST: OFF

DISPlay:VSCReen:POSition <Position>
Set the position of the virtual screen window.

Parameters:
<Position> Range: 2 to -10

*RST: 0

DISPlay:DIALog:CLOSe
Closes an open dialog box.

Usage: Event

DISPlay:DIALog:MESSage <MessageText>
Sends a message text to the instrument and displays it in a message box. To close the message box, use DISPlay:DIALog:CLOSe.

Parameters:
<MessageText> String that contains the message.

Example: DISP:DIAL:MESS ,My message

Usage: Setting only

DISPlay:DIALog:TRANsparency <Transparency>
Sets the transparency of result boxes that overlay the waveforms, for example, boxes with statistical results or digital voltmeter results.

Parameters:
<Transparency> Range: 0 to 100
Default unit: %

DISPlay:LANGuage
Sets the menu language. The *RST command does not reset the language setting.

Parameters:
<Language> ENGLish | GERMan | FRENch | SPANish | RUSSian | SCHinese | TCHinese | JAPanese | KORean

DISPlay:LANGuage:REMove
Removes an installed menu language file from internal memory.

Example: DISP:LANG:REM <language>
DISP:LANG:REM GERM

Usage: Setting only

DISPlay:LANGuage:ADD
Adds a saved menu language file from USB stick to internal memory.

Parameters:
<Language> ENGLish | GERMan | FRENch | SPANish | RUSSian | SCHinese | TCHinese | JAPanese | KORean

Example: DISP:LANG:ADD <language>,<path>
DISP:LANG:ADD GERM,"/USB_FRONT/HMO_LN00.HLU"

Usage: Setting only

DISPlay:LANGuage:CATalog?
Returns all installed menu language files.

Return values:
<Catalog> ENGLish | GERMan | FRENch | SPANish | RUSSian | SCHinese | TCHinese | JAPanese | KORean

Usage: Query only

DISPlay:XY:XSOurce <Source>
Defines the source to be displayed in x direction in an XY-diagram, replacing the usual time base.

Parameters:
<Source> CH1 | CH2

*RST: CH1

DISPlay:XY:Y1Source <Source>
Defines the (first) source to be displayed in y direction in an XY-diagram.

Parameters:
<Source> CH1 | CH2

*RST: CH2

DISPlay:INTensity:WAVeform <Intensity>
Defines the strength of the waveform line in the diagram. *RST does not change the intensity.

Parameters:
<Intensity> Value in percent
Range: 0 to 100

DISPlay:INTensity:BACKlight <Intensity>
Defines the intensity of the background lighting of the display. *RST does not change the intensity.

Parameters:
<Intensity> Value in percent
Range: 10 to 100

DISPlay:INTensity:GRID <Intensity>
Defines the intensity of the grid on the screen. *RST does not change the intensity.

Parameters:
<Intensity> Value in percent
Range: 0 to 100

DISPlay:PERSistence:STATe <State>
Defines whether the waveform persists on the screen or whether the screen is refreshed continuously.

Parameters:
<State> ON | OFF

ON
The waveform persists for the time defined using DISPlay:PERSistence:TIME.

OFF
The waveform does not persist on the screen. Only the currently measured values are displayed at any time.

*RST: OFF

DISPlay:PERSistence:TIME <Time>
Persistence time if persistence is active (see DISPlay:PERSistence:STATe). Each new data point in the diagram area remains on the screen for the duration defined here. To set infinite persistence, use DISPlay:PERSistence:INFinite.

Parameters:
<Time> Value in s
Range: 5E-2 to infinite

*RST: 5E-2

DISPlay:PERSistence:INFinite <InfPersistence>
Sets the persistence time to infinite if DISPlay:PERSistence:STATe is ON. each new data point remains on the screen infinitely until this setting is changed or the persistence is cleared.

Parameters:
<InfPersistence> ON | OFF

*RST: OFF

DISPlay:PERSistence:TIME:AUTO <Auto>
The optimal persistence time is determined automatically by the instrument.

Parameters:
<Auto> ON | OFF

DISPlay:PERSistence:CLEar
Removes the displayed persistent waveform from the screen.

Usage: Event

DISPlay:STYLe <Style>
Defines how the waveform data is displayed

Parameters:
<Style> VECTors | DOTS

VECTors
Individual data points are connected by a line.

DOTS
Only the data points are displayed.

*RST: VECT

DISPlay:GRID:STYLe <Style>
Defines how the grid is displayed.

Parameters:
<Style> LINes | RETicle | NONE

LINes: Displays the grid as horizontal and vertical lines.
RETicle: Displays crosshairs instead of a grid.
NONE: No grid

*RST: LIN

2.4.2 Zoom

TIMebase:ZOOM:STATe <ZoomState>
Switches the zoom window on or off.

Parameters:
<ZoomState> ON | OFF

*RST: OFF

TIMebase:ZOOM:SCALe <ZoomScale>
Defines the time base in the zoom diagram in seconds per division.

Parameters:
<ZoomScale> Scaling of the zoom time base in s/div depending on time base and channel settings

TIMebase:ZOOM:TIME <Time>
Defines the offset of the trigger point to the reference point of the zoom diagram.

Parameters:
<Time> Value in s

*RST: 0

TIMebase:ZOOM:POSition <Position>
Defines the position of the zoom reference point (the reference point of the zoom window) in relation to the reference point of original time base.

Parameters:
<Position> Value in %
Range: 0 to 100, depending on the zoom time base

*RST: 5.00E+01

2.4.3 Markers (Timestamps)

TSTamp:SET
Sets a new marker (timestamp) at the reference point of the display, unless an existing marker is already set there. The reference point is set with TIMebase:REFerence.

Usage: Event

TSTamp:NEXT
Moves the next marker (timestamp, to the right) to the reference point of the display or zoom area.

Usage: Event

TSTamp:PREVious
Moves the previous marker (timestamp, to the left) to the reference point of the display or zoom area.

Usage: Event

TSTamp:CLEar
Deletes the marker (timestamp) at the reference point. The reference point is set with TIMebase:REFerence.

Usage: Event

TSTamp:ACLear
Deletes all markers (timestamps).

Usage: Event

2.5 Measurements

This chapter describes functions that configure or perform cursor and automatic measurements.

2.5.1 Cursor

CURSor<m>:AOFF

Switches the cursor off.

Suffix:

<m> 1 (the numeric suffix is irrelevant)

Usage: Event

CURSor<m>:STATe <State>

Activates or deactivates the cursor measurement.

Suffix:

<m> 1 (the numeric suffix is irrelevant)

Parameters:

<State> ON | OFF

*RST: OFF

CURSor<m>:FUNCtion <Type>
Defines the cursor measurement type.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<Type> HORizontal | VERTical | PAIRed | HRATio | VRATio | PPCount | NPCount | RECount | FECount | MEAN | RMS | RTIMe | FTIMe | PEAK | UPEakvalue | LPEakvalue

HORizontal
Sets two horizontal cursor lines and measures the voltages at the two cursor positions and the delta of the two values.

VERTical
Sets two vertical cursor lines and measures the time from the trigger point to each cursor, the time between the two cursors and the fre quency calculated from that time.
PAIRed (V-Marker)

HRATio
Ratio of the x-values (e.g. a duty cycle) between the first and second cursors and the first and third cursors.

VRATio
Ratio of the y-values (e.g. overshooting) between the first and second cursors and the first and third cursors.
PPCount (Count positive pulses)
NPCount (Count negative pulses)
RECount (Count rising edges)
FECount (Count falling edges)
MEAN (Mean value)
RMS (Root mean square)
RTIMe (Rise time, t_r)

FTIMe (Fall time, t_f)
The reference level for rise and fall time measurement is set with REFLevel<m>:RELative:MODE.

PEAK
Absolute difference between the two peak values, Vpp.

UPEakvalue (Upper peak value, V_{p+})
LPEakvalue (Lower peak value, V_{p-})

*RST: PAIR

CURSor<m>:SOURce <Source>
Defines the cursor measurement source as one of the active signal, reference or math channel.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<Source> NONE | CH1 | CH2 | QMA | MA1...MA5 | RE1...RE4 | XY

CH1 | CH2:	Active signal channels CH1 to CH2.
QMA:	Active quick math channel.
MA1...MA5:	Mathematics waveform (only with R&S®HMO1202 series).
RE1...RE4:	Active reference channels RE1 to RE4.
XY:	Active XY-waveform.

*RST: CH1

CURSor<m>:SWAVe
Autoset for cursor lines, sets the cursor lines to typical points of the waveform depending on the selected measurement type. For example, for voltage measurement, the cursor lines are set to the upper and lower peaks of the waveform. For time measurement, the cursor lines are set to the edges of two consecutive positive or two consecutive negative pulses.

Usage: Event

CURSor<m>:SSCReen
Resets the cursors to their initial positions. This is helpful if the cursors have disappeared from the display or need to be moved for a larger distance.

Usage: Event

CURSor<m>:SNPeak<n>
For FFT analysis only: sets the selected cursor to the next (right) level peak.

Usage: Event

CURSor<m>:SPPeak<n>
For FFT analysis only: sets the selected cursor to the previous (left) level peak.

Usage: Event

CURSor<m>:TRACking[:STATe] <State>
If set to ON, the V-Marker cursor measurement is enabled.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<State> ON | OFF

*RST: OFF

CURSor<m>:X1Position <Xposition1>
Specifies the position of the first cursor on the time axis.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<Xposition1> Default unit: s

CURSor<m>:X2Position <Xposition2>
Specifies the position of the second cursor on the time axis.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<Xposition2> Default unit: s

CURSor<m>:X3Position <Xposition3>
Specifies the position of the third cursor on the time axis for the Ratio X measurement.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<Xposition3> Default unit: s

CURSor<m>:Y1Position <Yposition1>
Specifies the position of the first horizontal cursor on the y-axis.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<Yposition1> Default unit: V

CURSor<m>:Y2Position <Yposition2>
Specifies the position of the second horizontal cursor on the y-axis.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<Yposition2> Default unit: V

CURSor<m>:Y3Position <Yposition3>
Specifies the position of the third horizontal cursor on the y-axis for Ratio Y measurements.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<Yposition3> Default unit: V

CURSor<m>:TRACking:SCALe[:STATe] <State>
Enables the adjustment of cursor lines if the vertical or horizontal scales are changed.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<State> ON | OFF

ON
Cursor lines keep their relative position to the waveform.
OFF
Cursor lines remain on their position on the display if the scaling is changed.

*RST: OFF

CURSor<m>:YCOupling <Coupling>
CURSor<m>:XCOupling <Coupling>
If enabled, the cursors of a set are coupled so that the distance between the two remains the same if one cursor is moved.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<Coupling> ON | OFF

*RST: OFF

CURSor<m>:RESult?
Returns the cursor positions.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Return values:
<Value> Comma-separated list

Usage: Query only

CURSor<m>:XDELta:INVerse?
Returns the inverse time difference between the two cursors (1/Δt).

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Return values:
<DeltaInverse> Default unit: 1/s

Usage: Query only

CURSor<m>:XDELta[:VALue]?
Returns the time difference between the two cursors (Δt).

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Return values:
<Delta> Default unit: s

Usage: Query only

CURSor<m>:YDELta:SLOPe?
Returns the inverse value of the voltage difference - the reciprocal of the vertical distance of two horizontal cursor lines: 1/ΔV.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Return values:
<DeltyYslope> Inverse value

Usage: Query only

CURSor<m>:YDELta[:VALue]?
Returns the delta of the values in y-direction at the two cursors.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Return values:
<DeltaY> Delta value in V

Usage: Query only

CURsor<m>:XRATio:UNIT <Unit>
Sets the unit for X Ratio measurements with CURSor<m>:XRATio[:VALue].

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<Unit> RATio | PCT | GRD | PI

RATio: Floating value
PCT: Percent
GRD: Degree
PI: Radian

CURSor<m>:XRATio[:VALue]?
Returns the ratio of the x-values (e.g. a duty cycle) between the first and second cursors and the first and third cursors: (x2-x1)/(x3-x1). Set the unit of the result with CURsor<m>:XRATio:UNIT.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Return values:
<Ratio> Numeric value corresponding to the specified unit.

Usage: Query only

CURSor<m>:YRATio:UNIT <Unit>
Sets the unit for Y Ratio measurements with CURSor<m>:YRATio[:VALue].

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<Unit> RATio | PCT

RATio: Floating value
PCT: Percent

CURSor<m>:YRATio[:VALue]?
Provides three cursors and measures the ratio of the y-values (e.g. overshooting) between the first and second cursors and the first and third cursors: (y2-y1)/(y3-y1). Set the unit of the result with CURSor<m>:YRATio:UNIT.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Return values:
<Ratio> Numeric value corresponding to the specified unit.

Usage: Query only

2.5.2 Automatic Measurements

MEASurement<m>:AOFF
Stops the quick measurement.

Suffix:
<m> 1..6 (the numeric suffix is irrelevant)

Usage: Event

MEASurement<m>:AON
Starts the quick measurement.

Suffix:
<m> 1..6 (the numeric suffix is irrelevant)

Usage: Event

MEASurement<m>:ARESult?
Returns the results of the quick measurement.

Suffix:
<m> 1..6
Selects the measurement.

Return values:
<QuickMeasData> List of values
Quick measurement results are listed in the following order:
PEAK, UPE, LPE, CYCR, CYCM, PER, FREQ, RTIM , FTIM

Usage: Query only

MEASurement<m>[:ENABle] <State>
Activates or deactivates the selected measurement (1-6). Only the results of active measurements are displayed in the result table.

Suffix:
<m> 1..6
Selects the measurement.

Parameters:
<State> ON | OFF

*RST: OFF

MEASurement<m>:SOURce <SignalSource>[,<ReferenceSource>]
Selects one of the active signal, reference or math channels as the source of the selected measurement.

Suffix:
<m> 1..6

Parameters:
<SignalSource> NONE | CH1...CH2 | QMA | MA1...MA5 | RE1...RE4 | POD | D0..7 | TRIGger | EXTern

*RST: CH1

<ReferenceSource> NONE | CH1...CH2 | QMA | MA1...MA5 | RE1...RE4 | POD | D0..7 | TRIGger | EXTern

CH1 | CH2: Active signal channels 1 to 2.
QMA: Active quick math channel QMA.
MA1...MA5: Active math channels MA1 to MA5 (only with R&S®HMO1202 series).
RE1...RE4: Active reference channels RE1 to RE4.
POD: Active logic POD.
D0...D7: Active digital channels D0 to D7.
TRIGger: TRIG is returned, if the measurement type is a trigger measurement source (TFRequency, TPERiode).
EXTern: Active external signal.

MEASurement<m>:CATegory?
Returns the measurement category.

Suffix:
<m> 1..6
Selects the measurement.

Return values:
<Category> AMPTime | SPECtrum

AMPtime: Yt-measurements
SPECtrum: Spectrum measurements

*RST: AMPT

Usage: Query only

REFLevel<m>:RELative:MODE <RelativeMode>
Sets the lower and upper reference levels for rise and fall time mesurements (cursor and automatic mesurements), defined as percentages of the high signal level.

Suffix:
<m> 1..5
Measurement to which the reference level belongs.
Suffix 1...4 assign the measurement places 1 to 4 (auto measure).
Suffix 5 assigns the cursor mesurement.

Parameters:
<RelativeMode> TEN | TWENty

TEN: 10/90%
TWENty: 20/80%

*RST: TEN

Example:
REFL2:REL:MODE TWENty
MEAS2:MAIN RTIM
Sets the reference level for measurement place 2 and measures the rise time between these levels:
Lower reference level = 20% of high signal level
Upper reference level = 80% of high signal level

MEASurement<m>:MAIN <MeasType>

Defines the measurement type to be performed on the selected source. To query the results, use MEASurement<m>:RESult.

Suffix:

<m> 1..6
Selects the measurement type.

Parameters:

<MeasType> FREQuency | PERiod | PEAK | UPEakvalue | LPEakvalue | PPCount | NPCount | RECount | FECount | HIGH | LOW | AMPLitude | CRESt | MEAN | RMS | RTIMe | FTIMe | PDCYcle | NDCYcle | PPWidth | NPWidth | CYCMean | CYCRms | STDDev | TFRequency | TPERiode | DELay | PHASe | BWIDth | POVershoot | NOVershoot |

FREQuency
Frequency of the signal. The result is based on the length of the left-most signal period within the displayed section of the waveform of the selected channel.

PERiod
Length of the left-most signal period within the displayed section of the waveform of the selected channel.

PEAK
Peak-to-peak value within the displayed section of the waveform of the selected channel.

UPEakvalue
Maximum value within the displayed section of the waveform of the selected channel.

LPEakvalue
Minimum value within the displayed section of the waveform of the selected channel.

PPCount (Counts positive pulses**)**
NPCount (Counts negative pulses)

RECount
Counts the number of rising edges.

FECount
Counts the number of falling edges.

HIGH
Mean value of the high level of a square wave.

LOW
Mean value of the low level of a square wave.

AMPLitude
Amplitude of a square wave.

CRESt
The crest factor (peak-to-average ratio) is calculated from the maximum value divided by the RMS value of the waveform (Crest).

MEAN
Mean value of complete displayed waveform of the selected channel.

RMS
RMS (Root Mean Square) value of the voltage of the complete displayed waveform of the selected channel.

RTIMe | FTIMe
Rise or falling time of the left-most rising edge within the displayed section of the waveform of the selected channel. The reference level for this mesurement is set with REFLevel<m>:RELative:MODE.

PDCycle | NDCycle
Measure the positive or negative duty cycle.
PPWidth | NPWidth
Measure the width of positive or negative pulses.

CYCMean
Mean value of the left-most signal period of the waveform of the selected channel.

CYCRms
RMS (Root Mean Square) value of the voltage of the left-most signal period of the waveform of the selected channel.

STDDev
Measures the standard deviation of the waveform.

TFRequency
Measures the frequency of the trigger signal based on the length of its period.

TPERiode
Measures the length of the trigger signal periods (hardware counter).

Delay
Time difference between two edges of the same or different wave forms. The waveforms are selected with MEASurement<m>:SOURce, and the edges with MEASurement<m>:DELay:SLOPe.

Phase
Phase difference between two waveforms [(time difference/period) x 360].

BWIDth
Duration of one burst, measured from the first edge to the last.

POVershoot
Measures the positive overshoot of the waveform.

NOVershoot
Measures the negative overshoot (undershoot) of the waveform.

The waveforms are selected with MEASurement<m>:SOURce.

*RST: NONE (measurement is off)

MEASurement<m>:RESult? [<MeasType>]
Returns the result of the specified measurement type.

Suffix:
<m> 1..6
Selects the measurement type.

Return values:
<Value> Measurement result

Query Parameters:
<MeasType> FREQuency | PERiod | PEAK | UPEakvalue | LPEakvalue | PPCount | NPCount | RECount | FECount | HIGH | LOW | AMPLitude | CRESt | MEAN | RMS | RTIMe | FTIMe | PDCYcle | NDCYcle | PPWidth | NPWidth | CYCMean | CYCRms | STDDev | TFRequency | TPERiode | DELay | PHASe | BWIDth | POVershoot | NOVershoot |

Specifies the measurement type (see MEASurement<m>:MAIN).

Usage: Query only

MEASurement<m>:DELay:SLOPe <SignalSlope>,<ReferenceSlope>
Sets the edges to be used for delay measurement. The associated waveforms are defined with MEASurement<m>:SOURce.

Parameters:
<SignalSlope> POSitive | NEGative
Slope of source 1 (first waveform)

<ReferenceSlope> POSitive | NEGative
Slope of source 2 (second waveform)

*RST: POS

2.6 Quickmath, Math Formularies and Reference Waveforms

2.6.1 Quickmath

This chapter describes commands that configure or perform basic math functions using Quickmath.

CALCulate:QMATh:STATe <State>

Defines whether the Quickmath waveform is active or not. Only if a channel is active it is visible on the screen and can be selected as a source for analysis and display functions. Quickmath is only available in YT and Zoom mode.

Parameters:

<State> ON | OFF

*RST: OFF

CALCulate:QMATh:SOURce <m>

Defines the source of the Quickmath waveform.

Parameters:

<m> 1, 2
Selects the source.

<Source> CH1 | CH2

Example: CALC:QMAT:SOUR1 CH2

*RST: 1

CALCulate:QMATh:OPERation <Operation>
Defines the operation of the Quickmath waveform.

Parameters:
<Operation> ADD | SUB | MUL | DIV

Example:
CALC:QMAT:OPER ADD
CALC:QMAT:OPER SUB
CALC:QMAT:OPER MUL
CALC:QMAT:OPER DIV

*RST: ADD

CALCulate:QMATh:SCALe
Sets the vertical scale for the Quickmath waveform.

Parameters:
<Scale> Range: -1.0E-24 to 5.0E+25
Scale value, given in Volts per division.

*RST: 1

CALCulate:QMATh:POSition
Sets the vertical position of the Quickmath waveform in the window.

Parameters:
<Position> Position value, given in divisions.

*RST: 0

CALCulate:QMATh:DATA?
Returns the data of the quick math waveform. The waveform data can be used in MATHLAB, for example. To set the export format, use FORMat[:DATA].

Return values:
<Data> List of values according to the format settings.

Usage: Query only

CALCulate:QMATh:DATA:HEADer?
Returns information on the quick math waveform.

Position	Meaning	Example
1	XStart in s	-9.477E-008 = - 94,77 ns
2	XStop in s	9.477E-008 = 94,77 ns
3	Record length of the waveform in Samples	200000
4	Number of values per sample interval, usually 1.	1

Table 2.1: Header data

Return values:
<DataHeader> Comma-separated value list

Example: -9.477E-008,9.477E-008,200000,1

Usage: Query only

CALCulate:QMATh:DATA:XINCrement?
Returns the time difference between two adjacent samples of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Return values:
<Xincrement> Time in s

Usage: Query only

CALCulate:QMATh:DATA:XORigin?
Returns the time of the first sample of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Return values:
<Xorigin> Time in s

Usage: Query only

CALCulate:QMATh:DATA:YINCrement?
Returns the voltage value per bit of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Return values:
<Yincrement> Voltage in V

Usage: Query only

CALCulate:QMATh:DATA:YORigin?
Returns the voltage value for binary value 0 of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Return values:
<Yorigin> Voltage in V

Usage: Query only

CALCulate:QMATh:DATA:YRESolution?
Return the vertical bit resolution of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Return values:
<Yresolution> For default waveforms, the resolution is 8 bit.
If high resolution, average or filter are set, the resolution is 16 bit.

Usage: Query only

2.6.2 Mathematics (only with R&S®HMO1202 series)

CALCulate:MATH<m>:STATe <State>

Defines whether the selected mathematical channel is active or not. Only if a channel is active it is visible on the screen and can be selected as a source for analysis and display functions.

Suffix:

<m> 1...5
Selects the math waveform.

Parameters:

<State> ON | OFF

*RST: OFF

CALCulate:MATH<m>:SCALe <Scale>

Sets the vertical scale for the specified math waveform.

Suffix:

<m> 1...5
Selects the math waveform.

Parameters:

<Scale> Range: -1.0E-24 to 5.0E+25
Scale value, given in Volts per division.

*RST: 1

CALCulate:MATH<m>:POSition <Position>
Sets the vertical position of the specified math waveform in the window.

Suffix:
<m> 1...5
Selects the math waveform.

Parameters:
<Position> Position value, given in divisions.

*RST: 0

CALCulate:MATH<m>[:EXPRession][:DEFine] <RemComplExpr>
Defines the equation to be calculated for the selected math channel as a regular expression.

Suffix:
<m> 1...5
Selects the math waveform.

Parameters:
<RemComplExpr> String with regular expression

Example:
Multiplication CALC:MATH1:EXPR:DEF "MUL(CH1,CH2)"
Integral CALC:MATH2:EXPR:DEF "INT(MA1)"
IIR low pass CALC:MATH3:EXPR:DEF "IIRL(MA2,1E6)"

The mathematical expression is a string parameter, consisting of a keyword which represents the math function, followed by the respective sources. These may be separated by comma and written in brackets. A query of the math function always returns the string, which is listed under string expression.

Function	ExpressionString	Comment
Addition	"ADD(CH1,CH2)"	Alternative "CH1+CH2"
Subtraction	"SUB(CH1,CH2)"	Alternative "CH1-CH2"
Multiplication	"MUL(CH1,CH2)"	Alternative "CH1*CH2"
Division	"DIV(CH1,CH2)"	Alternative "CH1/CH2"
Max. amplitude	"MAX(CH1,CH2)"	
Min. amplitude	"MIN(CH1,CH2)"	
Square	"SQR(CH1)"	
Square root	"SQRT(CH1)"	
Absolute value	"ABS(CH1)"	
Positive wave	"POS(CH1)"	
Negative wave	"NEG(CH1)"	
Reciprocal 1/x	"REC(CH1)"	
Inverse	"INV(CH1)"	
Common logarithm	"LOG(CH1)"	
Natural logarithm	"LN(CH1)"	
Derivative	"DERI(CH1)"	

Function	ExpressionString	Comment
Integral	"INT(CH1)"	
IIR low pass	"IIRL(CH1,1E6)"	CH1 – Source 1e6 – Constant, limit frequency of the low pass
IIR high pass	"IIRH(CH1,1E6)"	CH1 – Source 1e6 – Constant, limit frequency of the high pass
FFT	"FFTMAG(CH1)"	FFT function of the source waveform

Table 2.4: Math expression

CALCulate:MATH<m>:DATA?
Returns the data of the math waveform. To set the export format, use FORMat[:DATA].

Suffix:
<m> 1...5
Selects the math waveform.

Return values:
<Data> List of values depending on defined data format.

Usage: Query only

CALCulate:MATH<m>:DATA:HEADer?
Returns information on the math waveform.

Position	Meaning	Example
1	XStart in s	-9.477E-008 = - 94,77 ns
2	XStop in s	9.477E-008 = 94,77 ns
3	Record length of the waveform in Samples	200000
4	Number of values per sample interval, usually 1.	1

Table 2.5: Header data

Suffix:
<m> 1...5
Selects the math waveform.

Return values:
<Header> Comma-separated value list

Example: -9.477E-008,9.477E-008,200000,1

Usage: Query only

CALCulate:MATH<m>:LABel <Label>
Sets the label for the math waveform.

Suffix:
<m> 1...5
Selects the math waveform.

Parameters:
<Label> String value
"xxxxxxxx" (maximum 8 characters)

Example: „Power"

CH1=Voltage
CH2=Current
CH1*CH2=POWER

CALCulate:MATH<m>:LABel:STATe <State>
Switches the label of the math channel on or off.

Suffix:
<m> 1...5
Selects the math waveform.

Parameters:
<State> ON | OFF

*RST: OFF

CALCulate:MATH<m>:DATA:ENVelope?
Returns the math data of the envelope.

Suffix:
<m> 1...5
Selects the math waveform.

Return values:
<Data> List of values

Usage: Query only

CALCulate:MATH<m>:DATA:ENVelope:HEADer?
Returns information of the math data envelope.

Suffix:
<m> 1...5
Selects the math waveform.

Return values:
<Header> String data

Usage: Query only

CALCulate:MATH<m>:DATA:ENVelope:XINCrement?
Returns the time difference between two adjacent samples of the indicated waveform of the envelope. The commands are relevant for data conversion, if binary data format is defined (FORM UINT, 8 | 16).

Suffix:
<m> 1...5
Selects the math waveform.

Return values:
<Xincrement> <Numeric Value>

Usage: Query only

CALCulate:MATH<m>:DATA:ENVelope:XORigin?
Returns the time of the first sample of the indicated waveform of the envelope. The commands are relevant for data conversion, if binary data format is defined (FORM UINT, 8 | 16).

Suffix:
<m> 1...5
Selects the math waveform.

Return values:
<Xorigin> <Numeric_Value>

Usage: Query only

CALCulate:MATH<m>:DATA:ENVelope:YINCrement?
Returns the voltage value per bit of the indicated waveform of the envelope. The commands are relevant for data conversion, if binary data format is defined (FORM UINT, 8 | 16).

Suffix:
<m> 1...5
Selects the math waveform.

Return values:
<Yincrement> <Numeric_Value>

Usage: Query only

CALCulate:MATH<m>:DATA:ENVelope:YORigin?
Returns the voltage value for binary value 0 of the indicated waveform of the envelope. The commands are relevant for data conversion, if binary data format is defined (FORM UINT, 8 | 16).

Suffix:
<m> 1...5
Selects the math waveform.

Return values:
<Yorigin> <Numeric_Value>

Usage: Query only

CALCulate:MATH<m>:DATA:ENVelope:YRESolution?
Returns the vertical bit resolution of the indicated waveform of the envelope. The commands are relevant for data conversion, if binary data format is defined (FORM UINT, 8 | 16).

Suffix:
<m> 1...5
Selects the math waveform.

Return values:
<Yresolution> <Numeric_Value>

Usage: Query only

CALCulate:MATH<m>:DATA:XINCrement?
Returns the time difference between two adjacent samples of the indicated waveform. The commands are relevant for data conversion if binary data format is defined (FORM UINT, 8 | 16).

Suffix:
<m> 1...5
Selects the math waveform.

Return values:
<Xincrement> Time in s

Usage: Query only

CALCulate:MATH<m>:DATA:XORigin?
Returns the time of the first sample of the indicated waveform. The commands are relevant for data conversion if binary data format is defined (FORM UINT, 8 | 16).

Suffix:
<m> 1...5
Selects the math waveform.

Return values:
<Xorigin> Time in s

Usage: Query only

CALCulate:MATH<m>:DATA:YINCrement?
Returns the voltage value per bit of the indicated waveform. The commands are relevant for data conversion, if binary data format is defined (FORM UINT, 8 | 16).

Suffix:
<m> 1...5
Selects the math waveform.

Return values:
<Yincrement> Voltage in V

Usage: Query only

CALCulate:MATH<m>:DATA:YORigin?

Returns the voltage value for binary value 0 of the indicated waveform. The commands are relevant for data conversion, if binary data format is defined (FORM UINT, 8 | 16).

Suffix:

<m> 1...5
Selects the math waveform.

Return values:

<Yorigin> Voltage in V

Usage: Query only

CALCulate:MATH<m>:DATA:YRESolution?

Returns the vertical bit resolution of the indicated waveform. The commands are relevant for data conversion, if binary data format is defined (FORM UINT, 8 | 16).

Suffix:

<m> 1..5
Selects the math waveform.

Return values:

<Yresolution> For default waveforms, the resolution is 16 bit.

Usage: Query only

2.6.3 Reference Waveforms

REFCurve<m>:STATe
Displays or hides the selected reference waveform.

Suffix:
<m> 1..4
Selects the reference waveform, the internal reference storage.

Parameters:
<State> ON | OFF

*RST: OFF

REFCurve<m>:SOURce <Source>
Defines the source of the reference waveform.

Suffix:
<m> 1..4
Selects the reference waveform, the internal reference storage.

Parameters:
<Source> CH1 | CH2 | POD | QMA | MA1...MA5 | RE1...RE4

CH1 | CH2: Signal channels 1 to 2.
POD: Logic POD.
QMA: Quick math channel.
MA1...MA5: Math channels 1 to 5 (only with R&S®HMO1202 series).
RE1...RE4: Reference channels 1 to 4.

*RST: CH1

REFCurve<m>:SOURce:CATalog?
Returns the source waveform - channel, math or reference waveform.

Suffix:
<m> 1..4
Selects the reference waveform, the internal reference storage.

Return values:
<Catalog> CH1 | CH2 | POD | QMA | MA1...MA5 | RE1...RE4

Usage: Query only

REFCurve<m>:UPDate
Updates the selected reference by the waveform defined with REFCurve<m>:SOURce.

Suffix:
<m> 1..4
Selects the reference waveform, the internal reference storage.

Usage: Event

REFCurve<m>:SAVE <FileName>
Stores the reference waveform the specified file.

Suffix:
<m> 1..4
Selects the reference waveform, the internal reference storage.

Setting Parameters:
<FileName> String with path and file name

Usage: Setting only

REFCurve<m>:LOAD <FileName>
Loads the waveform data from the indicated reference file to the reference storage. To load the instrument settings, use REFCurve<m>:LOAD:STATe.

Suffix:
<m> 1..4
Selects the reference waveform, the internal reference storage.

Setting Parameters:
<FileName> String with path and file name

Usage: Setting only

REFCurve<m>:LOAD:STATe
Loads the instrument settings in addition to the reference waveform data. The waveform data must be loaded before the settings, see REFCurve<m>:LOAD. The settings are only available if the file was stored to the internal storage /INT/REFERENCE and never written to an external storage (USB stick).

Suffix:
<m> 1..4
Selects the reference waveform.

Usage: Event

REFCurve<m>:HORizontal:SCALe <Scale>
Changes the horizontal scale (timebase) of the reference waveform independent of the channel waveform settings.

Suffix:
<m> 1..4
Selects the reference waveform, the internal reference storage.

Parameters:
<Scale> Default unit: s/div

REFCurve<m>:HORizontal:POSition <Position>
Changes the horizontal position of the reference waveform independent of the channel waveform settings.

Suffix:
<m> 1..4
Selects the reference waveform, the internal reference storage.

Parameters:
<Position> Default unit: s

REFCurve<m>:VERTical:SCALe <Scale>
Changes the vertical scale of the reference waveform.

Suffix:
<m> 1..4
Selects the reference waveform, the internal reference storage.

Parameters:
<Scale> Default unit: V/div

REFCurve<m>:VERTical:POSition <Position>
Changes the vertical position of the reference waveform.

Suffix:
<m> 1..4
Selects the reference waveform, the internal reference storage.

Parameters:
<Position> Default unit: div

REFCurve<m>:DATA?
Returns the data of the reference waveform.

Suffix:
<m> 1..4
Selects the reference waveform, the internal reference storage.

Return values:
<Data> Comma-separated value list

Usage: Query only

REFCurve<m>:DATA:HEADer?
Returns information on the reference waveform.

Position	Meaning	Example
1	XStart in s	-9.477E-008 = - 94,77 ns
2	XStop in s	9.477E-008 = 94,77 ns
3	Record length of the waveform in Samples	200000
4	Number of values per sample interval, usually 1.	1

Table 2.4: Header data

Suffix:
<m> 1..4
Selects the reference waveform, the internal reference storage.

Parameters:
<Header> Comma-separated value list

Example: -9.477E-008,9.477E-008,200000,1

Usage: Query only

REFCurve<m>:DATA:XINCrement?
Returns the time difference between two adjacent samples of the indicated waveform. The commands are relevant for data conversion if binary data format is defined (FORM UINT, 8 | 16).

Suffix:
<m> 1...4
Selects the reference waveform, the internal reference storage.

Return values:
<Xincrement> Time in s

Usage: Query only

REFCurve<m>:DATA:XORigin?
Returns the time of the first sample of the indicated waveform. The commands are relevant for data conversion if binary data format is defined (FORM UINT, 8 | 16).

Suffix:
<m> 1...4
Selects the reference waveform, the internal reference storage.

Return values:
<Xorigin> Time in s

Usage: Query only

REFCurve<m>:DATA:YINCrement?
Returns the voltage value per bit of the indicated waveform. The commands are relevant for data conversion, if binary data format is defined (FORM UINT, 8 | 16).

Suffix:
<m> 1...4
Selects the reference waveform, the internal reference storage.

Return values:
<Yincrement> Voltage in V

Usage: Query only

REFCurve<m>:DATA:YORigin?
Returns the voltage value for binary value 0 of the indicated waveform. The commands are relevant for data conversion, if binary data format is defined (FORM UINT, 8 | 16).

Suffix:
<m> 1...4
Selects the reference waveform, the internal reference storage.

Return values:
<Yorigin> Voltage in V

Usage: Query only

REFCurve<m>:DATA:YRESolution?
Returns the vertical bit resolution of the indicated waveform. The commands are relevant for data conversion, if binary data format is defined (FORM UINT, 8 | 16).

Suffix:
<m> 1...4
Selects the reference waveform, the internal reference storage.

Return values:
<Yresolution> For default waveforms, the resolution is 8 bit. Its resolution is depending on the source waveform. The maximum is 16 bit.

Usage: Query only

2.7 FFT

CALCulate:MATH<m>:ARIThmetics <Arithmetics>
Defines the mode for FFT calculation and display.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<Arithmetics> OFF | ENVelope | AVERage

OFF
The FFT is performed without any additional weighting or postproces sing of the acquired data. The new input data is acquired and displayed, and thus overwrites the previously saved and displayed data.

ENVelope
In addition to the normal spectrum, the maximal oscillations are saved separately and updated for each new spectrum. The maximum values are displayed together with the newly acquired values and form an envelope. This envelope indicates the range of all FFT trace values that occurred.

AVERage
The average of several spectrums is calculated. The number of spectrums used for the averaging is defined using the command. This mode is useful for noise rejection.

*RST: OFF

CALCulate:MATH<m>:FFT:AVERage:COUNt
Defines the number of spectrums used for averaging if CALCulate:MATH<m>:ARIThmetics is set to AVERage.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<AverageCount> Integer value
Range: 2 to 512

*RST: 2

CALCulate:MATH<m>:FFT:MAGNitude:SCALe
Defines the scaling of the y-axis.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<Magnitude Scale> LINear | DBM | DBV

LINear: Linear scaling; displays the RMS value of the voltage.
DBM: Logarithmic scaling; related to 1 mW
DBV: Logarithmic scaling; related to 1 Veff

*RST: DBM

CALCulate:MATH<m>:FFT:BANDwidth[:RESolution]:ADJusted?
Returns the effective resolution bandwidth.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Return values:
<AdjResBW> Range: -100E+24 to 100E+24
Default unit: Hz

*RST: 1.525E+3

Usage: Query only

CALCulate:MATH<m>:FFT:BANDwidth[:RESolution]:AUTO <SpanRBWCoupling>
Couples the frequency span to the RBW.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<SpanRBWCoupling> ON | OFF

CALCulate:MATH<m>:FFT:BANDwidth[:RESolution]:RATio <SpanRBWRatio>
Defines the ratio resolution bandwidth (Hz) / span (Hz).

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<SpanRBWRatio> Range: 2048 to 131072

*RST: 4096

CALCulate:MATH<m>:FFT:BANDwidth[:RESolution][:VALue] <ResolutionBW>
Defines the resolution bandwidth.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<ResolutionBW> Default unit: Hz

CALCulate:MATH<m>:FFT:CFRequency <CenterFreq>
Defines the position of the displayed frequency domain, which is (Center - Span/2) to (Center + Span/2). The width of the domain is defined using the CALCulate:MATH<m>:FFT:SPAN command.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<CenterFreq> Default unit: Hz

CALCulate:MATH<m>:FFT:FULLspan
Performs FFT calculation for the full frequency span.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Usage: Event

CALCulate:MATH<m>:FFT:SPAN <FreqSpan>
The span is specified in Hertz and defines the width of the displayed frequency range, which is (Center - Span/2) to (Center + Span/2). The position of the span is defined using the CALCulate: MATH<m>:FFT:CFRequency command.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<FreqSpan> Default unit: Hz

CALCulate:MATH<m>:FFT:STARt <StartFreq>
Defines the start frequency of the displayed frequency domain (instead of defining a center frequency and span).

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<StartFreq> Default unit: Hz

CALCulate:MATH<m>:FFT:STOP <StopFreq>
Defines the stop frequency of the displayed frequency domain (instead of defining a center frequency and span).

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<StopFreq> Default unit: Hz

CALCulate:MATH<m>:FFT:WINDow:TYPE <WindowType>
Window functions are multiplied with the input values and thus can improve the FFT display.

Suffix:
<m> 1 (the numeric suffix is irrelevant)

Parameters:
<WindowType> RECTangular | HAMMing | HANNing | BLACkmanharris

RECTangular
The rectangular window multiplies all points by one. The result is a high frequency accuracy with thin spectral lines, but also with increased noise. Use this function preferably with pulse response tests where start and end values are zero.

HAMMing
The Hamming window is bell shaped. Its value is not zero at the borders of the measuring interval. Thus, the noise level inside the spectrum is higher than Hanning or Blackman, but smaller than the rectangular window. The width of the spectral lines is thinner than the other bell-shaped functions. Use this window to measure amplitudes of a periodical signal precisely.

HANNing
The Hanning window is bell shaped. Unlike the Hamming window, its value is zero at the borders of the measuring interval. Thus, the noise level within the spectrum is reduced and the width of the spectral lines enlarges. Use this window to measure amplitudes of a periodical signal precisely.

BLACkmanharris
The Blackman window is bell shaped and has the steepest fall in its wave shape of all other available functions. Its value is zero at both borders of the measuring interval. In the Blackman window the amplitudes can be measured very precisely. However, determining the frequency is more difficult. Use this window to measure amplitudes of a periodical signal precisely.

*RST: HANN

CALCulate:MATH<m>:FFT:TIME:RANGe <Window_Width>
Defines the width of the time base extract from the Y(t)-window for which the FFT is calculated.

Parameters:
<Window_Width> Range: depends on the time base
Default unit: s

CALCulate:MATH<m>:FFT:TIME:POSition <Window_Position>
Defines the position of the time base extract in the Y(t)-window for which the FFT is calculated.

Parameters:
<Window_Position> Range: depends on the time base and the width of the FFT time base
Default unit: s

CALCulate:MATH<m>:FFT:SRATe? <Sample_Rate>
Returns the sample rate of data used in an FFT analysis.

Return values:
<Sample_Rate> Default unit: Sa/s

Usage: Query only

CALCulate:MATH<m>:FFT:TIME:POSition <Window_Width>

Defines the position of the time base extract in the Y(t)-window for which the FFT is calculated.

Parameters:

<Window_Width> Range: depends on the time base and the width of the FFT time base
Default unit: s

CALCulate:MATH<m>:FFT:TIME:Range <Window_Position>

Defines the width of the time base extract from the Y(t)-window for which the FFT is calculated.

Parameters:

<Window_Position> Range: depends on the time base
Default unit: s

2.8 Masks

MASK:STATe <State>
Turns the mask test mode on or off. When turning off, any temporarily stored new masks are deleted.

Parameters:

<State> ON | OFF

*RST: OFF

MASK:TEST <Test>
Starts, finishes or interrupts a mask test.

Parameters:

<Test> RUN | STOP | PAUSE

*RST: STOP

MASK:LOAD <FileName>
Loads a stored mask from the specified file.

Setting Parameters:
<FileName> String parameter (path and file name)

Usage: Setting only

MASK:SAVE <FileName>
Saves the current mask in the specified file.

Setting Parameters:
<FileName> String parameter (path and file name)

Usage: Setting only

MASK:SOURce <Source>
Defines the channel to be compared with the mask.

Parameters:
<Source> CH1 | CH2

*RST: CH1

MASK:CHCopy
Creates a mask from the envelope waveform of the test source set with MASK:SOURce.

Usage: Event

MASK:YPOSition <Yposition>
Moves the mask vertically within the display.

Parameters:
<Yposition> Mask offset from the vertical center
Range: -200 to 200
Default unit: div

*RST: 0

MASK:YSCALe <Yscale>
Changes the vertical scaling to stretch or compress the mask in y-direction.

Parameters:

<Yscale> A value over 100% stretches the amplitudes; a value less than 100% compresses the amplitudes.
Range: 10 to 1000
Default unit: %

*RST: 100

MASK:YWIDth <Yaddition>
Changes the width of the mask in vertical direction.

Parameters:

<Yaddition> The value is added to the y-values of the upper mask limit and subtracted from the y-values of the lower mask limit.
Range: 0 to 5.12
Default unit: div

*RST: 0

MASK:XWIDth <Xaddition>
Changes the width of the mask in horizontal direction.

Parameters:

<Xaddition> The value is added to the positive x-values and subtracted from the negative x-values of the mask limits in relation to the mask center.
Range: 0 to 10
Default unit: div

*RST: 0

MASK:COUNt?
Returns the number of tested acquisitions.

Return values:

<TotalCount> Total number of tested acquisitions

Usage: Query only

MASK:VCOunt?
Returns the number of acquistions that hit the mask.

Return values:

<ViolationCount> Acquisition count

Usage: Query only

MASK:DATA?
Returns the data of the mask waveform.

Return values:
<Data> List of values

Usage: Query only

MASK:DATA:HEADer?
Returns information on the mask waveform.

Return values:
<Data_Header> Comma-separated value list

Position	Meaning	Example
1	XStart in s	0.000E+00
2	XStop in s	5.990E+02
3	Number of Samples	600
4	Number of values per sample interval. For envelope waveforms the value is 2.	2

Table 2.7: Header data

Example: 0.000E+00,5.990E+02,600,2

Usage: Query only

MASK:DATA:XINCrement?
Return the time difference between two adjacent samples of the mask waveform.

Return values:
<Xincrement> Time in s

Usage: Query only

MASK:DATA:XORigin?
Return the time of the first sample of the indicated mask waveform.

Return values:
<Xorigin> Time in s

Usage: Query only

MASK:DATA:YINCrement?
Return the voltage value per bit of the indicated mask waveform.

Return values:
<Yincrement> Voltage in V

Usage: Query only

MASK:DATA:YORigin?
Return the voltage value for binary value 0 of the indicated mask waveform.

Return values:
<Yorigin> Voltage in V

Usage: Query only

MASK:DATA:YRESolution
Return the vertical bit resolution of the indicated waveform.

Return values:
<Yresolution> For default waveforms, the resolution is 8 bit.

Usage: Query only

MASK:ACTion:YOUT:ENABle <Yout>
Enable or disable of pulses at the AUX-OUTput if mask is distorted.

Parameters:
<Yout> ON | OFF

*RST: OFF

MASK:ACTion:SOUNd:EVENt:MODE <Event_Mode>
MASK:ACTion:STOP:EVENt:MODE <Event_Mode>
MASK:ACTion:PULSe:EVENt:MODE <Event_Mode>
MASK:ACTion:SCRSave:EVENt:MODE <Event_Mode>
MASK:ACTion:PRINt:EVENt:MODE <Event_Mode>
MASK:ACTion:WFMSave:EVENt:MODE <Event_Mode>
Defines when and how often the action will be executed.

- **SOUNd:** Generates a beep sound.
- **STOP:** Stops the waveform acquisition.
- **PULSe:** Emits an impulse.
- **PRINt:** Prints a screenshot to a printer connected to the USB connector on the front or rear panel.
- **SCRSave:** Saves a screenshot according to printer output settings.
- **WFMSave:** Saves the waveform data according to the screenshot output settings.

Parameters:
<Event_Mode> OFF | EACH

OFF: No action is executed.
EACH: The selected action is executed on each violation of the mask.

*RST: OFF

MASK:ACTion:STOP:EVENt:COUNt
Sets the number of mask violations after which the action is executed.

Parameters:
<Event_Count> Integer value, number of mask violations

MASK:ACTion:SCRSave:DESTination
Defines the storage location whether the violated mask screenshot is saved. For output settings, see chapter „Data and File Management".

MASK:ACTion:WFMSave:DESTination
Defines whether the violated mask trace (waveform) is printed. For output settings, see chapter „Data and File Management".

MASK:RESet:COUNter
Sets the counters of passed and failed acquisitions to Zero.

Usage: Event

2.9 Function Generator

GENerator:FUNCtion <Function>
Selects the generator function.

Parameters:
<Function> DC | SINusoid | SQUare | PULSe | TRIangle | RAMP

*RST: SIN

GENerator:VOLTage <Amplitude>
Defines the amplitude value (peak-peak value) of the selected generator function.

Parameters:
<Amplitude> Numeric value
Range: 6.0000E-02 to 6.00000E+00
Default unit: V_{pp}

*RST: 5.0000E-01

GENerator:VOLTage:OFFSet <Offset>
Sets the DC offset of the selected generator function.

Parameters:
<Offset> Numeric value
Range: -3.00000E+00 to 3.00000E+00
Default unit: V

*RST: 0.00E+00

GENerator:FREQuency <Frequency>
Defines the frequency value of the selected generator function.

Parameters:
<Frequency> Numeric value depending on the selected generator function
Range: 1.000E-01 to 5.000000000E+04 (sine / square)
1.000E-01 to 1.000000000E+04 (triangle / ramp / pulse)
Default unit: Hz

*RST: 1.00000000E+03

GENerator:FUNCtion:RAMP:POLarity <Polarity>
Sets the polarity of the generator function ramp.

Parameters:
<Polarity> POSitive | NEGative

*RST: NEG

GENerator:FUNCtion:PULSe:DCYCle
Defines the duty cycle value of the generator function pulse.

Parameters:
<DutyCycle> Numeric value
Range: 1.000E+01 to 9.000E+01
Default unit: %

*RST: 2.500E+01

GENerator:OUTPut[:ENABle]
Activates or deactivates the function generator output.

Parameters:
<OutputEnable> ON | OFF

*RST: OFF

2.10 Pattern Generator

PGENerator:FUNCtion
Selects the pattern generator function.

Parameters:
<Function> SQUarewave | COUNter | ARBitrary | SPI | I^2C | UART | CAN | LIN | MANual

SQUarewave
Square wave function (e.g. for manual probe compensation):

COUNter
Definition of a 4 bit wide counter pattern.

ARBitrary
Definition of a 4 bit wide and 2048 samples deep pattern.

SPI
SPI BUS signals for measurements without measurement object.
Data rate 100 kBit/s, 250 kBit/s or 1 MBit/s.

I²C
I²C BUS signals for measurements without measurement object.
Data rate 100 kBit/s, 400 kBit/s, 1 MBit/s or 3.4 MBit/s.

UART
UART BUS signals for measurements without measurement object.
Data rate 9600 Bit/s, 115.2 kBit/s and 1 MBit/s.

CAN
CAN BUS signals for measurements without measurement object up to 50 MBit/s.

LIN
LIN BUS signals for measurements without measurement object up to 50 MBit/s.

MANual
Manual pattern mode.

PGENerator:PATTern:STATe
Activates or deactivates the pattern.

Parameters:
<State> ON | OFF

*RST: OFF

PGENerator:PATTern:STIMe
Defines the sample time of the pattern generator function.

Parameters:
<SampleTime> Numeric value
Range: 2.000E-08 to 4.200E+01
Default unit: s

*RST: 2.000E-08

PGENerator:PATTern:PERiod
Defines the period of the pattern generator function.

Parameters:
<PatternPeriod> Numeric value (Period = Pattern length * Bit time)
Range: MIN 1Sample * 20ns = 20ns
MAX 2048 Samples * 42s = 10416s (approx. 2.89h)
Default unit: s

*RST: 2.000E-06

PGENerator:PATTern:FREQuency
Defines the frequency (period) value of the pattern generator function.

Parameters:
<PatternFrequency> Numeric value

PGENerator:PATTern:ITIMe
Defines the idle time of the pattern generator function. The idle time can be only defined with activated BURST function.

Parameters:
<IdleTime> Numeric value
Range: 2.000E-08 to 4.200000000000E+01

*RST: 2.5000000000E-01

PGENerator:PATTern:BURSt:STATe
Turns the BURST function on or off.

Parameters:
<BurstState> ON | OFF

*RST: OFF

PGENerator:PATTern:BURSt:NCYCle
Defines the BURST pattern cycles. The cycles can be only defined with activated BURST function.

Parameters:
<PatternCycles> Numeric value
Range: 1 to 4096

*RST: 1

PGENerator:PATTern:TRIGger:MODE
Defines the arbitrary trigger mode of the pattern generator function.

Parameters:
<TriggerMode> CONTinuous | SINGle | EXTern

CONTinuous
The CONT function (continuous trigger) issues the pattern continuously.

SINGle
If the SING setting is activated, the pattern is issued manually.

EXTern
For the EXT (external trigger) setting the pattern is issued by an edge at the external input of the oscilloscope (TRIG.EXT.).

*RST: CONT

PGENerator:PATTern:TRIGger:SINGle
Manual output of a pattern (single trigger).

Usage: Event

PGENerator:PATTern:TRIGger:EXTern:SLOPe
Defines the slope of the external arbitrary pattern trigger.

Parameters:
<Slope> POSitive | NEGative | EITHer

POSitive
Rising edge (rise).

NEGative
Falling edge (fall).

EITHer
Rising as well as the falling edge (both).

*RST: POSitive

PGENerator:PATTern:ARBitrary:DATA[:SET]
Defines the arbitrary pattern.

Parameters:
<ArbitraryData> List of values

Example: PGEN:PATT:ARB:DATA 0,1,1,1,2,0,3,1,4,0

PGENerator:PATTern:ARBitrary:DATA:APPend
Defines the arbitrary pattern.

Parameters:
<AppendData> List of Values

Example: PGEN:PATT:ARB:DATA:APP 4
From index = n the oscilloscope appends a 4 in HEX to the pattern.

Usage: Setting only

PGENerator:PATTern:ARBitrary:DATA:APPend:BOR

Parameters:
<AppendData> List of values
From index = n data will be integrated in existing pattern via OR combination.

PGENerator:PATTern:ARBitrary:DATA:APPend:BAND

Parameters:
<AppendData> List of values
From index = n data will be integrated in existing pattern via AND combination.

PGENerator:PATTern:ARBitrary:DATA:APPend:INDex
Defines the index of the arbitrary pattern.

Parameters:
<AppendIndex> Numeric value

Example: PGEN:PATT:ARB:DATA:APP:IND 5
PGEN:PATT:ARB:DATA:APP 4
From index = n a pattern length of 6 will be defined with last high bit 4.

PGENerator:PATTern:ARBitrary:DATA:LENGth
Defines the arbitrary pattern length.

Parameters:
<PatternLength> Numeric value
Range: 1 to 2048

*RST: 1

PGENerator:PATTern:COUNter:FREQuency

Defines the frequency value of the pattern generator counter function. The user frequency always refers to the switching of the pattern condition. This results in square waveforms for individual pins.

Pin	Frequency
S0	f/2
S1	f/4
S2	f/8
S3	f/16

Parameters:

<Period> Numeric value
Range: 2.380952425301E-02 to 2.500000000000E+07

*RST: 1.000000000000E+05

PGENerator:PATTern:COUNter:DIRection

Sets the pattern generator counter direction.

Parameters:

<CountDirection> UPWard | DOWNward

*RST: UPW

PGENerator:PATTern:SQUarewave:POLarity

Defines the polarity of the pattern generator square wave function.

Parameters:

<Polarity> NORMal | INVerted

*RST: NORM

PGENerator:PATTern:SQUarewave:DCYCle

Parameters:

<DutyCycle> Numeric value
Range: 1.00E+00 to 9.900E+01
Default unit: %

*RST: 5.000E+01

Example: PGEN:PATT:SQU:DCYC 20
Sets the duty cycle of the square wave function to 20%.

PGENerator:MANual:STATe<s>

Suffix:
<s> 0...3
Selects the pins S0 to S3 manually.

Parameters:
<State> ON | OFF

ON: Pin state is set to high (H).
OFF: Pin state is set to low (L).

*RST: OFF

Example: PGEN:MAN:STAT2 ON
Pin state of S2 is set to high (H).

2.11 Digital Voltmeter

DVM<m>:TYPE
Selects the measurement type of the digital voltmeter function.

Suffix:
<m> 1...2
Selects the channel resp. the secondary measurement type.

Parameters:
<MeasurementType> MEAN | DCRMs | STDD | UPEakvalue | LPEakvalue | PEAK | CRESt | OFF

MEAN: DC
DCRMs: RMS
STDDeviation: Standard deviation
UPEakvalue: Peak +
LPEakvalue: Peak -
PEAK: Peak peak value (Maximum-Minimum)

CRESt: Crest factor ($|X|_{max}/X_{RMS}$)
OFF: Measurement display deactivated

Example: DVM1:TYPE PEAK
Selects the DVM type PEAK for channel 1 (CH1).

DVM<m>:SOURce
Selects the source for the digital voltmeter function.

Suffix:
<m> 1...2
Selects the channel resp. the secondary measurement type.

Parameters:
<Source> CH1 | CH2

DVM1 = primary measurement value CH1
DVM2 = secondary measurement value CH1
DVM3 = primary measurement value CH2
DVM4 = secondary measurement value CH2

Example: DVM2:SOUR CH2

DVM:ENABle
Activates or deactivates the digital voltmeter function.

Parameters:
<VoltmeterEnable> ON | OFF

*RST: OFF

DVM<m>:RESult[:ACTual]?
Returns the current value of the indicated measurement.

Suffix:
<m> 1...2
Selects the channel resp. the secondary measurement type.

Return values:
<CurrentValue> Numeric value

Example: DVM2:SOUR CH2
DVM2:TYPE DCRM
DVM2:RES?

Response: 7.089E-01

An RMS measurement is performed on measurement place 2, on channel 2. The result is 708,9 mV.

Usage: Query only

DVM<m>:RESult[:ACTual]:STATus?
Returns the result value and the status of the result. The status is the decimal representation of a 4-bit register value:

- Bit 0 = 1: result is valid
- Bit 1 = 1: no result available
- Bit 2 = 1: clipping occurs
- Bit 3 = 1: no period found

Suffix:
<m> 1...2
Selects the channel resp. the secondary measurement type.

Return values:
<ResultAndStatus> <Value>,Status

Example: DVM:SOUR CH1
DVM:TYPE MEAN
DVM:RES:STAT?

Response: 4.968E-01,5

The result value of the mean measurement on channel 1 is 496.1 mV. The result status is 5 (decimal) = 0101 (binary). That means, the result is valid (bit 0 = 1), and the signal is clipped by the limits of the ADC range (bit 3 = 1).

Usage: Query only

DVM<m>:RESult:RESet
Resets the digital voltmeter function.

Suffix:
<m> 1...2
Selects the channel resp. the secondary measurement type.

Usage: Event

DVM<m>:RESult[:ACTual]?

Suffix:
<m> 1...2
Selects the channel resp. the secondary measurement type.

Response:
<CurrentValue> Numeric value

Example: DVM1:RES?
Received the voltmeter value of CH1.

Usage: Query only

DVM:POSition
Selects the display position of the digital voltmeter values.

Parameters:
<Position> TLEFt | TRIGht | BLEFt | BRIGht

TLEFt: Display position top left.
TRIGht: Display position top right.
BLEFt: Display position bottom left.
BRIGht: Display position bottom right.

*RST: TLEF

2.12 Counter

TCOunter:ENAB <Enable>
Enables or disables the trigger counter measurement.

Parameters:
<Enable> ON | OFF

*RST: OFF

TCOunter:RESult[:ACTual]:FREQuency?
Returns the frequency of the trigger source.

Return values:
<FrequencyValue> Default unit: Hz

Usage: Query only

TCOunter:RESult[:ACTual]:PERiod?
Returns the period of the trigger source.

Return values:
<PeriodValue> Default unit: s

Usage: Query only

2.13 Component Tester

COMPonenttest:STATe <State>
Switches the compoenent tester mode on or off.

Parameters:
<State> ON | OFF

*RST: OFF

COMPonenttest:FREQuency <Frequency>
Sets the frequency of the component tester source.

Parameters:
<Frequency> F50 | F200

F50: 50Hz
F200: 200Hz

2.14 External input

EXTern[:STATe]
Activates or deactivates the external input functionality.

Parameters:
<State> ON | OFF

*RST: OFF

EXTern:POSition
Sets the vertical position of the external input signal and its horizontal axis in the window.

Parameters:
<Position> Position value, given in divisions.

Range: -4 to 4
Default unit: DIV

EXTern:COUPling
Selects the connection of the external input signal.

Parameters:
<Coupling> DC | AC

*RST: DC

EXTern:SIZE
Defines the display size of the external input signal.

Parameters:
<Size> SMALl | MEDium | LARGe

*RST: SMAL

EXTern:THReshold
Defines the threshold level. If the signal value is higher than the threshold, the signal state is high (1 or true for the boolean logic). Otherwise, the signal state is considered low (0 or false), if the signal value is below the threshold.

Parameters:
<Threshold> Range: -5.49 to 5.49
Default unit: V

*RST: 4.90E-01

EXTern:TYPE
Selects the method to reduce the data stream of the ADC to a stream of waveform points with lower sample rate.

Parameters:
<DecimationMode> SAMPle | PDETect | HRESolution

SAMPle
Input data is acquired with a sample rate which is aligned to the time base (horizontal scale) and the record length.

PDETect
The minimum and the maximum of n samples in a sample interval are recorded as waveform points (Peak Detect).

HRESolution
The average of n sample points is recorded as waveform point (High Resolution).

*RST: SAMP

EXTern:DATA?
Returns the data of the external input signal waveform. To set the export format, use FORMat[:DATA]. To set the range of samples to be returned, use EXTern:DATA:POINts.

Return values:
<Data> List of values according to the format settings - the voltages of recorded waveform samples.

Usage: Query only

EXTern:DATA:POINts
As a setting, the command selects a range of samples. As a query, it returns the number of samples for the selected range. To get correct results with settings MAX and DMAX, the acquisition must not run when the command is used. To acquire consistent and valid data, use the SINGle command before. Do not cancel a running acquisition with STOP because the waveform data might be incomplete or incorrect.

Return values:
<Points> Number of data points in the selected range (samples).

Setting Parameters:
<Points> DEFault | MAXimum | DMAXimum
Sets the range for the query.

DEFault
Waveform samples displayed on the screen.

MAXimum
Range is the complete memory (only available with maximum sample rate and STOP mode).

NOTICE

The entire oscilloscope memory can only be read out in STOP mode if the maximum sampling has been activated in the ACQUIRE menu.

DMAXimum (Display Maximum)
Number of samples in the current waveform record.

Example:
EXT:DATA:POIN MAX
EXT:DATA:POIN?
Suffix: 20000

EXTern:DATA:HEADer?
Returns information on the external input signal waveform.

Position	Meaning	Example
1	XStart in s	-9.477E-008 = - 94,77 ns
2	XStop in s	9.477E-008 = 94,77 ns
3	Record length of the waveform in Samples	20000
4	Number of values per sample interval, usually 1.	1

Table 2.1: Header data

Return values:
<Header> Comma-separated value list

Example: -9.477E-008,9.477E-008,20000,1

Usage: Query only

EXTern:DATA:XINCrement?
Returns the time difference between two adjacent samples of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Return values:
<Xincrement> Time in s

Usage: Query only

EXTern:DATA:XORigin?
Returns the time of the first sample of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Return values:
<Xorigin> Time in s

Usage: Query only

EXTern:DATA:YINCrement?
Returns the voltage value per bit of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Return values:
<Yincrement> Voltage in V

Usage: Query only

EXTern:DATA:YORigin?
Returns the voltage value for binary value 0 of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Return values:
<Yorigin> Voltage in V

Usage: Query only

EXTern:DATA:YRESolution?
Return the vertical bit resolution of the indicated waveform. The command is relevant for data conversion, if binary data format is defined (FORM UINT,8|16|32).

Return values:
<Yresolution> For default waveforms, the resolution is 8 bit.
If high resolution, average or filter are set, the resolution is 16 bit.

Usage: Query only

2.15 Protocol Analysis

2.15.1 General

BUS<b>:STATe <State>
Switches the protocol display on or off.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:

<State> ON | OFF

*RST: OFF

BUS<b>:TYPE <Type>

Defines the bus or interface type for analysis. For most types, a special option to the instrument is required.

Suffix:

<b> 1, 2
Selects the bus.

Parameters:

<Type> PARallel | CPARallel | I2C | SPI | SSPI | UART | CAN | LIN

*RST: PAR

BUS<b>:FORMat <Format>

Sets the decoding format for the display on the screen.

Suffix:

<b> 1, 2
Selects the bus.

Parameters:

<Format> ASCii | HEXadecimal | BINary | DECimal

*RST: HEX

BUS<b>:DSIZe <DisplaySize>

Sets the height of the decoded bus signal on the sreen.

Suffix:

<b> 1, 2
Selects the bus.

Parameters:

<DisplaySize> SMALl | MEDium | LARGe

*RST: MED

BUS<b>:DSIGnals <BitsSignals>
Displays the individual bit lines above the decoded bus line.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<BitsSignals> ON | OFF

*RST: ON

BUS<b>:POSition <Position>
Sets the vertical position of the decoded bus signal in divisions on the sreen.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<Position> Range: -4.0000E+00 to 4.0000E+00
Default unit: div

*RST: 1.0000E+00

BUS<b>:LABel <Label>
Sets the label for the Bus.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<Label> String value
" xxxxxxxx" (maximum 8 characters)

BUS<b>:LABel:STATe <State>
Swichtes the label of the bus on or off.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<State> ON | OFF

*RST: ON

2.15.2 Parallel / Parallel Clocked Bus

BUS<b>:PARallel:DATA<m>:SOURce <Source>
Defines the digital channel that is assigned to the selected bit. Use the command for each bit of the bus.

Suffix:
<b> 1, 2
Selects the bus.

<m> Selects the bit line

Parameters:
<Source> D0 .... D7

*RST: D0

Example: BUS:PAR:WIDT 4
BUS:PAR:DATA0:SOUR D2
BUS:PAR:DATA1:SOUR D3
BUS:PAR:DATA2:SOUR D4
BUS:PAR:DATA3:SOUR D5

BUS<b>:PARallel:WIDTh <BusWidth>
Sets the number of lines to be analyzed.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<BusWidth> Range: 1 to 6
Default unit: Bit

*RST: 6

BUS<b>:CPARallel:DATA<m>:SOURce

Defines the digital channel that is assigned to the selected bit. Use the command for each bit of the bus.

Suffix:

<b> 1, 2
Selects the bus.

<m> Selects the bit line

Parameters:

<Source> D0 .... D7

*RST: D0

Example: BUS:CPAR:WIDT 4
BUS:CPAR:DATA0:SOUR D2
BUS:CPAR:DATA1:SOUR D3
BUS:CPAR:DATA2:SOUR D4
BUS:CPAR:DATA3:SOUR D5

BUS<b>:CPARallel:CLOCk:SOURce

Selects the digital channel that is used as clock line.

Suffix:

<b> 1, 2
Selects the bus.

Parameters:

<ClockSource> D0...D7

*RST: D7

BUS<b>:CPARallel:CLOCk:SLOPe

Selects if the data is sampled on the rising or falling slope of the clock, or on both edges (EITHer). The clock slope marks the begin of a new bit.

Suffix:

<b> 1, 2
Selects the bus.

Parameters:

<ClockSlope> POSitive | NEGative | EITHer

BUS<b>:CPARallel:CS:SOURce
Selects the digital channel that is used as chip select line.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<ChipSelectSource> D0...D7

*RST: D6

BUS<b>:CPARallel:CS:POLarity
Selects wether the chip select signal is high active (high = 1) or low active (low = 1).

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<Polarity> POSitive | NEGative

POSitive: High active
NEGative: Low active

BUS<b>:CPARallel:WIDTh
Sets the number of lines to be analyzed.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<BusWidth> Range: 1 to 6
Default unit: Bit

*RST: 6

2.15.3 SPI Bus

SPI - Configuration

Trigger

Decode

BUS<b>:SPI:CS:SOURce <Source>

Selects the input channel of the chip select line.

Suffix:

<b> 1, 2
Selects the bus.

Parameters:

<Source> CH1 | CH2 | D0 .... D7 | EXTern

*RST: EXT

BUS<b>:SPI:CS:POLarity <Polarity>
Selects whether the chip select signal is high active (high = 1) or low active (low = 1).

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<Polarity> POSitive | NEGative

POSitive: High active
NEGative: Low active

*RST: POS

BUS<b>:SPI:CLOCk:SOURce <Source>
Selects the input channel of the clock line.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<Source> CH1 | CH2 | D0 .... D7

*RST: CH1

BUS<b>:SPI:CLOCk:POLarity <Polarity>
Selects if data is stored with the rising or falling slope of the clock. The slope marks the begin of a new bit.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<Polarity> POSitive | NEGative

POSitive: Rising slope
NEGative: Falling slope

*RST: NEG

BUS<b>:SPI:DATA:SOURce <Source>
Selects the input channel of the data line.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<Source> CH1 | CH2 | D0 .... D7

*RST: CH1

BUS<b>:SPI:DATA:POLarity <Polarity>
Selects whether transmitted data is high active (high = 1) or low active (low = 1).

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<Polarity> POSitive | NEGative

POSitive: High active
NEGative: Low active

*RST: POS

BUS<b>:SPI:BORDer <BitOrder>
Defines if the data of the messages starts with MSB (most significant bit) or LSB (least significant bit).

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<BitOrder> MSBFirst | LSBFirst

*RST: MSBFirst

BUS<b>:SPI:SSIZe <SymbolSize>
Sets the word length, the number of bits in a message.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<SymbolSize> Range: 4 to 32
Default unit: Bit

*RST: 8

TRIGger:A:SPI:MODE <Mode>
Specifies the trigger mode for SPI/SSPI protocols.

Parameters:
<Mode> BSTart | BEND | NTHBit | PATTern

BSTart
Burst start, sets the trigger event to the start of the frame. The frame starts when the chip select signal CS changes to the active state.

BEND
Burst end, sets the trigger event to the end of the message.

NTHBit
Sets the trigger event to the specified bit number. To define the bit number, use TRIGger:A:SPI:POFFset.

PATTern
Sets the trigger event to a serial pattern. To define the pattern, use TRIGger:A:SPI:PATTern. For a complete configuration of the pattern mode, you also have to set TRIGger:A:SPI:PLENgth and TRIGger:A:SPI:POFFset.

*RST: BST

TRIGger:A:SPI:PATTern <DataPattern>
Defines the bit pattern as trigger condition.

Parameters:
<DataPattern> Binary pattern with max. 32 bit. Characters 0, 1, and X are allowed.

Example: TRIGger:A:SPI:PATTern “0011XXXX0110”
Sets a 12bit pattern.

TRIGger:A:SPI:PLENgth <PatternLength>
Defines how many bits build up the serial pattern.

Parameters:
<PatternLength> Range: 1 to 32

*RST: 4

TRIGger:A:SPI:POFFset <PatternBitOffset>
Sets the number of bits before the first bit of the pattern.

Parameters:
<PatternBitOffset> Number of ignored bits
Range: 0 to 4095

*RST: 0

BUS<b>:SPI:FCOunt?
Returns the number of frames.

Suffix:
<b> 1, 2
Selects the bus.

Return values:
<FrameCount> Total number of decoded frames.

Usage: Query only

BUS<b>:SPI:FRAMe<n>:STATus?
Returns the status of frames.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<Status> OK | INCFirst | INCLast | INSufficient

OK: frame is o.k.
INCFirst: first frame is incomplete
INCLast: last frame is incomplete
INSufficient: frame is insufficient

Usage: Query only

BUS<b>:SPI:FRAMe<n>:STARt?
Returns the start time of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<StartTime> Range: depends on sample rate and time base
Unit: s

Usage: Query only

BUS<b>:SPI:FRAMe<n>:STOP <StopTime>
Returns the stop time of a frames.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<StopTime> Range: depends on sample rate and time base
Unit: s

Usage: Query only

BUS<b>:SPI:FRAMe<n>:DATA?
Returns the comma separeted frame data.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<Data> List of decimal values of data bytes

Example: BUS:SPI:FRAM3:DATA?

Usage: Query only

BUS<b>:SPI:FRAMe<n>:WCOunt?
Returns the number of words of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<WordCount> Number of words (numeric value).

Usage: Query only

BUS<b>:SPI:FRAMe<n>:WORD<o>STARt?
Returns the start time of a word of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

<o> Selects the word number.

Return values:
<StartTime> Numeric Value
Range: depends on sample rate and time base
Unit: s

Usage: Query only

BUS<b>:SPI:FRAMe<n>:WORD<o>STOP?
Returns the stop time of a word of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

<o> Selects the word number.

Return values:
<StopTime> Numeric Value
Range: depends on sample rate and time base.
Unit: s

Usage: Query only

BUS<b>:SPI:FRAMe<n>:WORD<o>MISO?
Returns the decimal value of a data word of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

<o> Selects the word number.

Return values:
<Data> Decimal value of a data word

Usage: Query only

BUS<b>:SPI:FRAMe<n>:WORD<o>MOSI?
Returns the decimal value of a data word of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

<o> Selects the word number.

Return values:
<Data> Decimal value of a data word.

Usage: Query only

2.15.4 SSPI Bus

BUS<b>:SSPI:CLOCk:SOURce <Source>
Selects the input channel of the clock line.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<Source> CH1 | CH2 | D0 .... D7

*RST: CH1

BUS<b>:SSPI:CLOCk:POLarity <Polarity>
Selects if data is stored with the rising or falling slope of the clock. The slope marks the begin of a new bit.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<Polarity> POSitive | NEGative

POSitive: Rising slope
NEGative: Falling slope

BUS<b>:SSPI:DATA:SOURce <Source>
Selects the input channel of the data line.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<Source> CH1 | CH2 | D0 .... D7

*RST: CH1

BUS<b>:SSPI:DATA:POLarity <Polarity>
Selects whether transmitted data is high active (high = 1) or low active (low = 0).

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<Polarity> POSitive | NEGative

POSitive: High active
NEGative: Low active

*RST: POS

BUS<b>:SSPI:BITime <BurstIdleTime>
Within the idle time the data and clock lines are low. A new frame begins when the idle time has expired and the clock line has been inactive during that time. If the time interval between the data words is shorter than the idle time, the words are part of the same frame.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<BurstIdleTime> Range: 16E-9 to 1E-3
Default unit: s

*RST: 100E-6

BUS<b>:SSPI:BORDer <BitOrder>
Defines if the data of the messages starts with MSB (most significant bit) or LSB (least significant bit).

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<BitOrder> MSBFirst | LSBFirst

*RST: MSBF

BUS<b>:SSPI:SSIZe <SymbolSize>
Sets the word length, the number of bits in a message.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<SymbolSize> Range: 4 to 32
Default unit: Bit

*RST: 8

2.15.5 I²C Bus

I²C - Configuration

Trigger

Decode

BUS<b>:I2C:CLOCk:SOURce <Source>
Sets the input channel to which the clock line is connected.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<Source> CH1 | CH2 | D0 .... D7

*RST: CH1

BUS<b>:I2C:DATA:SOURce <Source>
Sets the input channel to which the data line is connected.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<Source> CH1 | CH2 | D0 .... D7

*RST: CH1

BUS<b>:I2C:AMODe
Defines if the R/W bit of a 7-bit address is considered separately or as part of the address. The setting defines which address lengths are available with TRIGger:A:I2C: AMODe .

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<BusConfig> ARWRite | AONLy

ARWRite: Address + R/W bit
AONLy: Address only

*RST: AONL

TRIGger:A:I2C:MODE <Mode>
Specifies the trigger mode for I^2C.

Parameters:
<Mode> STARt | RESTart | STOP | MACKnowledge | PATTern

STARt
Start of the message. The start condition is a falling slope on SDA while SCL is high.

RESTart
Restarted message. The restart is a repeated start condition.

STOP
End of the message. The stop condition is a rising slope on SDA while SCL is high.

MACKnowledge
Missing acknowledge. If the transfer failed, at the moment of the acknowledge bit the SCL and the SDA lines are both on high level.

PATTern
Triggers on a set of trigger conditions: read or write access of the ma ster, to an address, or/and to a bit pattern in the message.

For a complete configuration of the pattern mode, you have to set:
TRIGger:A:I2C:ACCess (read/write access), and
TRIGger:A:I2C:AMODe and TRIGger:A:I2C:ADDRess (address), and/or
TRIGger:A:I2C:POFFset and TRIGger:A:I2C:PLENgth and
TRIGger:A:I2C:PATTern (pattern)

*RST: STAR

TRIGger:A:I2C:ACCess <Access>
Toggles the trigger condition between Read and Write access of the master.

Parameters:
<Access> READ | WRITe

*RST: READ

TRIGger:A:I2C:AMODe <AdrMode>
Sets the lenght of the slave address.

Parameters:
<AdrMode> NORMal | EXTended

NORMal: 7 bit address
EXTended: 10 bit address

*RST: NORM

TRIGger:A:I2C:ADDRess <AddressString>
Sets the address of the slave device. The address can have 7 bits or 10 bits.

Parameters:
<AddressString> Binary pattern with max. 10 bit. Characters 0, 1, and X are allowed.

Example: TRI:A:I2C:ADDR "10X1"

TRIGger:A:I2C:PATTern
Defines the bit pattern as trigger condition.

Parameters:
<DataPattern> Binary pattern with max. 24 bit. Characters 0, 1, and X are allowed.

TRIGger:A:I2C:PLENgth <PatternLength>
Defines how many bytes are considered in the trigger condition. To set the pattern for these bytes, use TRIGger:A:I2C:PATTern.

Parameters:
<PatternLength> Number of bytes
Range: 1 to 3

*RST: 1

TRIGger:A:I2C:POFFset <PatternByteOffset>
Sets the number of bytes before the first byte of interest, relating to the end of the address bytes.

Parameters:
<PatternByteOffset> Number of ignored bytes
Range: 0 to 4095

*RST: 0

BUS<b>:I2C:FCOunt?
Returns the number of frames.

Suffix:
<b> 1, 2
Selects the bus.

Return values:
<FrameCount> Total number of decoded frames.

Usage: Query only

BUS<b>:I2C:FRAMe<n>:STATus?
Returns the status of frames.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<State> INComplete | OK | UNEXpstop | INSufficient | ADDifferent

INComplete: frame is incomplete
OK: frame is o.k.
UNEXpstop: frame stop is unexpected
INSufficient: frame is insufficient
ADDifferent: frame is different

Usage: Query only

BUS<b>:I2C:FRAMe<n>:STARt?
Returns the start time of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<StartTime> Range: depends on sample rate and time base
Unit: s

Usage: Query only

BUS<b>:I2C:FRAMe<n>:STOP?
Returns the stop time of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<EndTime> Range: depends on sample rate and time base
Unit: s

Usage: Query only

BUS<b>:I2C:FRAMe<n>:ACCess?
Returns the read/write access.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<Access> INComplete | READ | WRITE | EITHer | UNDF

INComplete: frame is incomplete
READ: read frame
WRITE: write frame
EITHer: either write or read frame
UNDF: frame is undefined

Usage: Query only

BUS<b>:I2C:FRAMe<n>:AMODe?
Returns the adress mode.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<AddressMode> BIT7 | BIT10

BIT7: 7 Bit address
BIT10: 10 Bit address

Usage: Query only

BUS<b>:I2C:FRAMe<n>:AACCess?
Returns the address acknowledge of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<Acknowledge> INComplete | ACK | NACK | EITHer

INComplete: Acknowledge is incomplete
ACK: Acknowledge
NACK: not Acknowledge
EITHer: ACK or NACK

Usage: Query only

BUS<b>:I2C:FRAMe<n>:ADDRess?
Returns the read/write address as a decimal value (including RW bit).

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<AddressValue> Range: 0 to 2047

Usage: Query only

BUS<b>:I2C:FRAMe<n>:ADEVice?
Returns the read/write address as a decimal value (excluding RW bit).

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<SlaveAddress> Range: 0 to 1023

Usage: Query only

BUS<b>:I2C:FRAMe<n>:ASTart?
Returns the start time of a address of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<StartTime> Range: depends on sample rate and time base
Unit: s

Usage: Query only

BUS<b>:I2C:FRAMe<n>:ADBStart?
Returns the start time of a address acknowledge of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<AckStartTime> Range: depends on sample rate and time base
Unit s

Usage: Query only

BUS<b>:I2C:FRAMe<n>:ACOMplete?
Returns the info whether an address was received complete.

Suffix:

<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<AddressComplete> ON | OFF

Usage: Query only

BUS<b>:I2C:FRAMe<n>:BCOunt?
Returns the number of data bytes of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<ByteCountInFrame> Number of words (bytes)

Example: BUS1:I2C:FRAM2:BCO?

Usage: Query only

BUS<b>:I2C:FRAMe<n>:DATA?
Returns the number of data bytes of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<DataWordsInFrame> List of decimal values of data bytes of a frame.

BUS<b>:I2C:FRAMe<n>:BYTE<o>VALue?
Returns the value of a data byte of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

<o> Selects the byte number.

Return values:
<ByteValue> Decimal value
Range: 0 to 255

Usage: Query only

BUS<b>:I2C:FRAMe<n>:BYTE<o>STARt?
Returns the start time of data byte of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

<o> Selects the byte number.

Return values:
<StartTime> Range: depends on sample rate and time base
Default unit: s

Usage: Query only

BUS<b>:I2C:FRAMe<n>:BYTE<o>ACKStart?
Returns the start time of the acknowledge bit of a data byte of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

<o> Selects the byte number.

Return values:
<AckStartTime> Range: depends on sample rate and time base
Default unit: s

Usage: Query only

BUS<b>:I2C:FRAMe<n>:BYTE<o>ACCess?
Returns the acknowledge bit of a data byte of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

<o> Selects the byte number.

Return values:
<Acknowledge> INComplete | ACK | NACK | EITHer

INComplete: Acknowledge is incomplete
ACK: Acknowledge
NACK: Not Acknowledge
EITHer: ACK or NACK

Usage: Query only

BUS<b>:I2C:FRAMe<n>:BYTE<o>COMPlete?
Returns the information whethera data byte of a frame is received complete.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

<o> Selects the byte number.

Return values:
<ByteComplete> ON | OFF

ON: Data byte was received completely.

Usage: Query only

2.15.6 UART

UART - Configuration

Trigger

Decode

BUS<b>:UART:DATA:SOURce <Source>

Selects the input channel of the UART signal.

Suffix:

<b> 1, 2
Selects the bus.

Parameters:

<Source> CH1 | CH2 | D0 .... D7

*RST: CH1

BUS<b>:UART:DATA:POLarity <Polarity>

Defines if the transmitted data on the bus is high (high = 1) or low (low = 1) active.

Suffix:

<b> 1, 2
Selects the bus.

Parameters:

<Polarity> POSitive | NEGative

POSitive: High active
NEGative: Low active

*RST: POS

BUS<b>:UART:SSIZe <SymbolSize>
Sets the number of data bits in a message.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<SymbolSize> Range: 5 to 9
Default unit: Bit

*RST: 8

BUS<b>:UART:PARity <Parity>
Defines the optional parity bit that is used for error detection.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<Parity> ODD | EVEN | NONE

*RST: NONE

BUS<b>:UART:SBIT <StopBitNumber>
Sets the stop bits.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<StopBitNumber> B1 | B1_5 | B2

1; 1.5 or 2 stop bits are possible.

*RST: B1

BUS<b>:UART:BAUDrate <Baudrate>
Sets the user defined number of transmitted bits per second.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<Baudrate> Range: 6.0E+01 to 1.56E+07
Default unit: Bit

*RST: 1.15200E+05

BUS<b>:UART:BITime <BurstIdleTime>
Sets the minimal time between two data frames (packets), that is, between the last stop bit and the start bit of the next frame.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<BurstIdleTime> Range: 9.54880E-05 to 2.6843137E-01
Default unit: s

*RST: 1.1458333E-03

TRIGger:A:UART:MODE <Mode>
Specifies the trigger mode for UART/RS-232 interfaces.

Parameters:
<Mode> BSTart | SBIT | NTHSymbol | SYMBol | PATTern | PERRor | FERRor | BREak

BSTart
Burst start. Sets the trigger to the begin of a data frame. The frame start is the first start bit after the idle time.

SBIT
The start bit is the first low bit after a stop bit.

NTHSymbol
Sets the trigger to the n-th symbol of a burst.

SYMBol
Triggers if a pattern occurs in a symbol at any position in a burst.

PATTern
Triggers on a serial pattern at a defined position in the burst. To define the pattern, use TRIGger:A:UART:PLENgth and TRIGger:A:UART:PATTern. To define the position, use TRIGger:A:UART:POFFset.

PERRor
Parity Error: Triggers if a bit error occured in transmission.

FERRor
Triggers on frame error.

BREak
Triggers if a start bit is not followed by a stop bit within a defined time. During the break the stop bits are at low state.

*RST: SBIT

TRIGger:A:UART:PATTern <DataPattern>
Defines the bit pattern as trigger condition.

Parameters:
<DataPattern> Binary pattern with max. 32 bit. Characters 0, 1, and X are allowed.

*RST: 1 (= „00000001“)

TRIGger:A:UART:PLENgth <PatternLength>
Defines how many symbols build up the serial pattern.

Parameters:
<PatternLength> Number of symbols
Range: 1 to 3

*RST: 1

TRIGger:A:UART:POFFset <PatternByteOffset>
Sets the number of symbols before the first symbol of the pattern.

Parameters:
<PatternByteOffset> Number of ignored symbols
Range: 0 to 4095

BUS<b>:UART:FCOunt?
Returns the number of frames.

Suffix:
<b> 1, 2
Selects the bus.

Return values:
<FrameCount> Total number of decoded frames.

BUS<b>:UART:FRAMe<n>:WCOunt?
Returns the number of words of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<WordCount> Number of words (symbols, characters)

Usage: Query only

BUS<b>:UART:FRAMe<n>:WORD<o>:VALue?
Returns the value of TX.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

<o> Selects the word number.

Return values:
<Value> Decimal value
Range: 0 to 511

Usage: Query only

BUS<b>:UART:FRAMe<n>:WORD<o>:STARt?
Returns the start time of a word of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

<o> Selects the word number.

Return values:
<StartTime> Range: depends on sample rate and time base
Default unit: s

Usage: Query only

BUS<b>:UART:FRAMe<n>:WORD<o>:STOP?
Returns the stop time of a word of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

<o> Selects the word number.

Return values:
<StopTime> Range: depends on sample rate and time base
Default unit: s

Usage: Query only

BUS<b>:UART:FRAMe<n>:WORD<o>:STATe?
Returns the status of frames.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

<o> Selects the word number.

Return values:

<FrameStatus> OK | FRSTart | FRENd | FRMError | STERror | SPERror | PRERror | INSufficient

OK: Frame is o.k.
FRSTart: Frame start
FRENd: Frame end
FRMError: Frame error
STERror: Startbit error
SPERror: Stopbit error
PRERror: Parity error
INSufficient: Frame is insufficient

*RST: OK

Usage: Query only

2.15.7 CAN

CAN - Configuration

Trigger

Decode

BUS<b>:CAN:DATA:SOURce <Source>
Sets the input channel to which the data line is connected.

Parameters:

<b> 1, 2
Selects the bus.

<Source> CH1 | CH2 | D0 .... D7

*RST: CH1

BUS<b>:CAN:TYPE <SignalType>
Sets the signal type of the CAN.

Parameters:

<b> 1, 2
Selects the bus.

<SignalType> CANH | CANL

CANH: CAN High
CANL: CAN Low

*RST: CANH

BUS<b>:CAN:SAMPlepoint <SamplePoint>
Sets the sample point for the CAN Decoder within the bit period.

Parameters:

<b> 1, 2
Selects the bus.

<SamplePoint> Range: 25 to 90
Unit: %

*RST: 50

BUS<b>:CAN:BITRate <BitRate>
Sets the user defined bit rate for the CAN Decoder.

Parameters:

<b> 1, 2
Selects the bus.

<BitRate> Range: 1.00E+02 to 1.0081E+06
Unit: Bit/s

*RST: 5.0000E+04

TRIGger:A:CAN:TYPE <TriggerType>
Specifies the trigger type for CAN.

Parameters:

<TriggerType> STOFrame | EOFrame | ID | IDDT | FTYPe | ERRCondition

STOFrame: Sets the trigger to the start of a frame.
EOFrame: Sets the trigger to the end of a frame.
ID: Sets the trigger to the ID of a frame.
IDDT: Sets the trigger to the ID and data of a frame.
FTYPe: Sets the trigger to the frame type.
ERRCondition: Sets the trigger to the error condition of a frame.

*RST: STOF

TRIGger:A:CAN:FTYPe <FrameType>
Specifies the frame type for CAN.

Parameters:
<FrameType> DATA | REMote | ERRor | OVERload | ANY

DATA: Sets the frame type to data.
REMote: Sets the frame type to remote.
ERRor: Sets the frame type to error.
OVERload: Sets the frame type to overload.
ANY: Sets the frame type to any.

*RST: ERR

TRIGger:A:CAN:ITYPe <IdentifierType>
Specifies the identifier type for CAN. If the trigger type ID is set, only B11 or B29 are allowed.

Parameters:
<IdentifierType> B11 | B29

B11: Sets the identifier type 11Bit.
B29: Sets the identifier type 29Bit.

*RST: B11

TRIGger:A:CAN:ICONdition <IdentifierCondition>
Specifies the condition for the identifier.

Parameters:
<IdentifierCondition> EQUual | NEQual | GTHan | LTHan

EQUual: Sets the condition for identifier to equal.
NEQual: Sets the condition for identifier to not equal.
GTHan: Sets the condition for identifier to greater than.
LTHan: Sets the condition for identifier to less than.

*RST: EQU

TRIGger:A:CAN:IDENtifier <Identifier>
Specifies the identifier, depending of TRIGger:A:CAN:ITYPe <IdentifierType> setting only string with 11 or 29 characters is possible.

Parameters:
<Identifier> String containing binary pattern with max. 29 bit.
Characters 0, 1 and X are allowed.

TRIGger:A:CAN:DCONdition <DataCondition>
Specifies the condition for the data.

Parameters:
<DataCondition> EQUual | NEQual | GTHan | LTHan

EQUual: Sets the condition for identifier to equal.
NEQual: Sets the condition for identifier to not equal.
GTHan: Sets the condition for identifier to greater than.
LTHan: Sets the condition for identifier to less than.

*RST: EQU

TRIGger:A:CAN:DATA <Data>
Specifies the data for CAN trigger. Depending of TRIGger:A:CAN:DLENgth <DataLength> setting the number of characters is fixed, all bytes need to be complete.

Parameters:
<Data> String containing binary pattern with max. 64 bit.
Characters 0, 1 and X are allowed. Make sure to enter complete bytes.

Example: TRIG:A:CAN:DATA „10010110“

TRIGger:A:CAN:DLENgth <DataLength>
Specifies the data length for the CAN trigger.

Parameters:
<DataLength> Range: 0 to 8
Unit: Byte

*RST: 1

TRIGger:A:CAN:ACKerror <AcknowledgeError>
Specifies the trigger on acknowledge error when trigger type is set to error, using TRIGger:A:CAN:TYPE <TriggerType>. An acknowledgement error occurs when the transmitter does not receive an acknowledgment - a dominant bit during the Ack Slot.

Parameters:
<AcknowledgeError> ON | OFF

*RST: OFF

TRIGger:A:CAN:CRCerror <CRCerror>
Specifies the trigger on checksum error when trigger type is set to error, using TRIGger:A:CAN:TYPE <TriggerType>.

Parameters:
<CRCerror> ON | OFF

*RST: OFF

TRIGger:A:CAN:FROMerror <FormError>
Specifies the trigger on form error when trigger type is set to error, using TRIGger:A:CAN:TYPE <TriggerType>. A form error occurs when a fixed-form bit field contains one or more illegal bits.

Parameters:
<FormError> ON | OFF

*RST: OFF

TRIGger:A:CAN:BITSterror <BitStuffingError>
Specifies the trigger on stuff bit error when trigger type is set to error, using TRIGger:A:CAN:TYPE <TriggerType>.

Parameters:
<BitStuffingError> ON | OFF

*RST: ON

BUS<b>:CAN:FCOunt?
Returns the number of frames.

Suffix:
<b> 1, 2
Selects the bus.

Return values:
<FrameCount> Total number of decoded frames.

Usage: Query only

BUS<b>:CAN:FRAMe<n>:STATus?
Returns the status of frames.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<State> OK | BTST | CRC | FORM | NACK | INSufficient

OK: Frame is valid.
BTST: Bit stuff error occured.
CRC: Cyclic redundancy check failed.
FORM: Wrong CRC, ACK delimiter or end of frame occured.
NACK: Acknowledge is missing.
INSufficient: Frame is incomplete.

BUS<b>:CAN:FRAME<n>:STARt?
Returns the start time of a frames.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<StartTime> Range: depends on sample rate and time base
Default unit: s

Usage: Query only

BUS<b>:CAN:FRAME<n>:STOP?
Returns the stop time of a frames.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<StopTime> Range: depends on sample rate and time base
Default unit: s

Usage: Query only

BUS<b>:CAN:FRAME<n>:TYPE?
Returns the frame type.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<FrameType> DATA | REMote | ERR | OVLD

DATA: Frame type is data.
REMote: Frame type is remote.
ERR: Frame type is error.
OVLD: Frame type is overload.

Usage: Query only

BUS<b>:CAN:FRAME<n>:DATA?
Returns a comma separated list of decimal values.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<FrameData> Comma separated list of decimal values of data bytes of a frame:

BUS<b>:CAN:FRAME<n>:ACKState?
Returns the status of the acknowledge field of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<AcknowledgeState> OK | UNDF

OK: Acknowledge state is o.k.
UNDF: Acknowledge state is undefined.

Usage: Query only

BUS<b>:CAN:FRAME<n>:CSState?
Returns the status of the checksum field of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<ChecksumState> OK | UNDF

OK: Acknowledge state is o.k.
UNDF: Acknowledge state is undefined.

Usage: Query only

BUS<b>:CAN:FRAME<n>:DLCState?
Returns the status of the data length code of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<DataLengthCodeState> OK | UNDF

OK: Data length code state is o.k.
UNDF: Data length code state is undefined.

Usage: Query only

BUS<b>:CAN:FRAME<n>:IDSTate?
Returns the status of the identifier field of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<IdentifierState> OK | UNDF

OK: Identifier state is o.k.
UNDF: Identifier state is undefined.

Usage: Query only

BUS<b>:CAN:FRAME<n>:ACKValue?
Returns the value of the acknowledge bit of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<AcknowledgeValue> Decimal value

Usage: Query only

BUS<b>:CAN:FRAME<n>:CSValue?
Returns the value of the checksum of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<ChecksumValue> Decimal value

Usage: Query only

BUS<b>:CAN:FRAME<n>:DLCValue?
Returns the value of the data length code field of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<DataLengthCodeValue> Non-negative integer

Usage: Query only

BUS<b>:CAN:FRAME<n>:IDTYpe?
Returns the length of the identifier: 11 bit for CAN base frames, or 29 bits for CAN extended frames.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<IdentifierType> B11 | B29

B11: Identifier type is 11 bit
B29: Identifier type is 29 bit

Usage: Query only

BUS<b>:CAN:FRAME<n>:IDValue?
Returns the value of the identifier of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<IdentifierValue> Decimal value

Usage: Query only

BUS<b>:CAN:FRAME<n>:BSEPosition?
Returns the position time of the bit stuffing error in the specified frame (if available).

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<BitStuffingErrorPosition> Default unit: s

*RST: 0

Usage: Query only

BUS<b>:CAN:FRAME<n>:BCOunt?
Returns the number of data bytes of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<ByteCount> Number of words (bytes)

Usage: Query only

BUS<b>:CAN:FRAME<n>:BYTE<o>:STATe?
Returns the state of the a data byte of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

<o> Selects the byte number.

Return values:
<ByteStatus> OK | UNDF

OK: Data byte state is o.k.
UNDF: Data byte state is undefined.

Usage: Query only

BUS<b>:CAN:FRAME<n>:BYTE<o>:VALue?
Returns the value of the data byte of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

<o> Selects the byte number.

Return values:
<ByteValue> Decimal value

Usage: Query only

2.15.8 LIN

LIN - Configuration

Trigger

Decode

BUS<b>:LIN:DATA:SOURce <Source>

Sets the input channel to which the data line is connected.

Suffix:

<b> 1, 2
Selects the bus.

Parameters:

<Source> CH1 | CH2 | D0 .... D7

*RST: CH1

BUS<b>:LIN:POLarity <Polarity>
Sets the polarity of the LIN.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<Polarity> POSitive | NEGative

*RST: POS

BUS<b>:LIN:STANdard <Standard>
Selects the version of the LIN standard that is used in the DUT. The setting mainly defines the checksum version used during decoding. The most common version is LIN 2.x. For mixed networks, or if the standard is unknown, set the LIN standard to AUTO.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<Standard> V1X | V2X | J2602 | AUTO

V1X: LIN Standard V1.x
V2X: LIN Standard V2.x
J2602: LIN Standard J206 (sets also BitRate to 10.417 KBit/s)
AUTO: Any standard

*RST: V1X

BUS<b>:LIN:BITRate <BitRate>
Sets the user defined bit rate for the CAN Decoder.

Suffix:
<b> 1, 2
Selects the bus.

Parameters:
<BitRate> Range: 1.00E+02 to 1.0081E+06
Unit: Bit/s

*RST: 9.6E+03

TRIGger:A:LIN:TYPE <TriggerType>
Specifies the trigger type for LIN.

Parameters:
<TriggerType> SYNC | WKFRame | ID | IDDT | ERRCondition

SYNC: Sets the trigger to the synchronisation.
WKFRame: Sets the trigger to the wake up frame.
ID: Sets the trigger to the ID of a frame.
IDDT: Sets the trigger to the ID and data of a frame.
ERRCondition: Sets the trigger to the error condition of a frame.

*RST: SYNC

TRIGger:A:LIN:ICONdition <IdentifierCondition>
Specifies the condition for the identifier.

Parameters:
<IdentifierCondition> EQUual | NEQual | GTHan | LTHan

EQUual: Sets the condition for identifier to equal.
NEQual: Sets the condition for identifier to not equal.
GTHan: Sets the condition for identifier to greater than.
LTHan: Sets the condition for identifier to less than.

*RST: EQU

TRIGger:A:LIN:IDENtifier <Identifier>
Specifies the identifier, only 6 character are allowed.

Parameters:
<Identifier> String containing binary pattern. Characters 0, 1, and X are allowed.
Enter the 6 bit identifier without parity bits, not the protected identifier.

Example: TRIG:A:LIN:IDEN „100001“

TRIGger:A:LIN:DCONdition <DataCondition>
Specifies the condition for the data.

Parameters:
<DataCondition> EQUual | NEQual | GTHan | LTHan

EQUual: Sets the condition for identifier to equal.
NEQual: Sets the condition for identifier to not equal.
GTHan: Sets the condition for identifier to greater than.
LTHan: Sets the condition for identifier to less than.

*RST: EQU

TRIGger:A:LIN:DATA <Data>
Specifies the data for LIN trigger. Depending of TRIGger:A:LIN:DLENgth <DataLength> setting the number of characters is fixed, all bytes need to be complete.

Parameters:
<Data> String containing binary pattern with max. 64 bit.
Characters 0, 1 and X are allowed.

Example: TRIG:A:LIN:DATA „10100101“

TRIGger:A:LIN:DLENgth <DataLength>
Defines the length of the data pattern - the number of bytes in the pattern.

Parameters:
<DataLength> Range: 1 to 8

*RST: 1

TRIGger:A:LIN:CHKSerror <ChecksumError>
Triggers on a checksum error when trigger type is set to error condition, using TRIGger:A:LIN:TYPE <TriggerType>. The checksum verifies the correct data transmission. It is the last byte of the frame response.

Parameters:
<ChecksumError> ON | OFF

*RST: ON

TRIGger:A:LIN:IPERerror <IdentifierParityError>
Triggers on a parity error when trigger type is set to error condition, using TRIGger:A:LIN:TYPE <TriggerType>. Parity bits are the bits 6 and 7 of the identifier. They verify the correct transmission of the identifier.

Parameters:
<IdentifierParityError> ON | OFF

*RST: OFF

TRIGger:A:LIN:SYERror <SynchronisationError>
Specifies the trigger on synchronisation error when trigger type is set to error, using TRIGger:A:LIN:TYPE <TriggerType>.

Parameters:
<SynchronisationError> ON | OFF

*RST: OFF

BUS<b>:LIN:FCOunt?
Returns the number of received frames of the active LIN bus.

Suffix:
<b> 1, 2
Selects the bus.

Return values:
<FrameCount> Total number of decoded frames.

Usage: Query only

BUS<b>:LIN:FRAMe<n>:BCOunt?
Returns the number of data bytes in the specified frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<ByteCount> Number of words (bytes)

Usage: Query only

BUS<b>:LIN:FRAME<n>:STATus?
Returns the status of frames.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<State> OK | CHKS | WAKeup | SYER | INS | ERR | UNDF | IPER

OK: Frame is valid.
CHKS: Checksum error occured.
WAKeup: Wake up occured.
SYER: Synchronisation
INSufficient: Identifier is insufficient.
ERRor: Error
UNDF: Undefined

Usage: Query only

BUS<b>:LIN:FRAME<n>:STARt?
Returns the start time of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<StartTime> Range: depends on sample rate and time base
Default unit: s

Usage: Query only

BUS<b>:LIN:FRAME<n>:STOP?
Returns the stop time of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<StopTime> Range: depends on sample rate and time base
Default unit: s

Usage: Query only

BUS<b>:LIN:FRAME<n>:VERSion?
Returns the version of LIN.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<FrameVersion> V1X | V2X | J2602 | UNK

V1X: LIN version is 1.x
V2X: LIN version is 2.x
J2602: LIN version is J2602
UNK: LIN version is unknown

Usage: Query only

BUS<b>:LIN:FRAME<n>:DATA?
Returns a comma separated list of decimal values of the data bytes.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<FrameData> Comma separated list of decimal values of data bytes of a frame.

Usage: Query only

BUS<b>:LIN:FRAME<n>:IDSTate <IdentifierState>
Returns the status of the identifier field of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<IdentifierState> OK | PRERror | UNDF | INSufficient

OK: Identifier state is o.k.
PRERror: Parity error at the identifier.
UNDF: Address is undefined.
INSufficient: Identifier is insufficient.

Usage: Query only

BUS<b>:LIN:FRAME<n>:IDValue?
Returns the value of the identifier of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<IdentifierValue> Decimal value

Usage: Query only

BUS<b>:LIN:FRAME<n>:IDPValue?
Returns the value of the parity of the identifier of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<IdentifierParityValue> Decimal value

Usage: Query only

BUS<b>:LIN:FRAME<n>:SYSTate?
Returns the status of synchronization field of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<SyncFieldState> OK | ERR | UNDF

OK: Sync field state is o.k.
ERR: Sync error.
UNDF: Sync field state is undefined.

Usage: Query only

BUS<b>:LIN:FRAME<n>:CSSTate?
Returns the state of the checksum of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<ChecksumState> OK | ERR | UNDF

OK: Checksum field state is o.k.
ERR: Checksum error.
UNDF: Checksum state is undefined.

Usage: Query only

BUS<b>:LIN:FRAME<n>:CSValue?
Returns the value of the checksum of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<ChecksumValue> Decimal value

Usage: Query only

BUS<b>:LIN:FRAME<n>:BCOunt?
Returns the number of bytes of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

Return values:
<ByteCount> Number of words (bytes)

Usage: Query only

BUS<b>:LIN:FRAME<n>:BYTE<o>:STATe?
Returns the status of a data byte of a frame.

Suffix:
<b> 1, 2
Selects the bus.

<n> Selects the frame.

<o> Selects the byte number.

Return values:
<ByteStatus> OK | INS | UART

OK: Byte status is o.k.
INS: Byte status is insufficient.
UART: Error within the byte.

Usage: Query only

BUS<b>:LIN:FRAME<n>:BYTE<o>:VALue?
Returns the value of the byte of a frame.

Suffix:

<b>	1, 2 Selects the bus.
<n>	Selects the frame.
<o>	Selects the byte number.

Return values:

<ByteValue>	Decimal value

Usage: Query only

2.16 Data and File Management

This chapter describes commands that store or restore data and measurement results.

2.16.1 Output Control

HCOPy:DATA?
Returns the actual display content (screenshot) in binary format.

Example: - Stopping the waveform acquisition and send HCOP:DATA?
- Reading the screenshot data bytes until the whole capture is received
- Removing the specific header and saving the data stream

#47609PNG
#4 = 4 letters following
7609 = number of bytes to be transmitted
PNG = PNG file format

In order to get a valid PNG which can be opened by any standard image viewer, the header information must be stripped down and removed until the file starts with „**PNG**".

Usage: Query only

HCOPy:FORMat
Defines the data format of the screenshot.

Parameters:
<Format> BMP | PNG

BMP: Windows Bitmap Format
PNG: Portable Network Graphic

HCOPy:SIZE:X?
Returns the horizontal expansion of the screenshots.

Usage: Query only

HCOPy:SIZE:Y?
Returns the vertical expansion of the screenshots.

Usage: Query only

HCOPy:DESTination <Medium>
Defines whether the screenshot is saved or printed.

Parameters:
<Medium> „MMEM" | „SYST:COMM:PRIN"

„MMEM"
Saves the screenshot to a file. Specify the file name and location with MMEMory:NAME.

„SYST:COMM:PRIN"
Prints on the printer specified with SYSTem:COMMunicate:PRINter:SELect. The printer must be specified before the HCOPy:DESTination is sent.

*RST: „MMEM"

MMEMory:NAME <FileName>
Defines the file name to store an image of the display with HCOPy[:IMMediate].

Parameters:
<FileName> String parameter

HCOPy[:IMMediate]
Prints an image of the display to the printer or saves an image to a file or the clipboard, depending on the HCOPy:DESTination setting.

The printer is defined by SYSTem:COMMunicate:PRINter:SELect.

The file name for storage is defined by MMEMory:NAME.

Usage: Event

HCOPy:LANGuage <Format>
Defines the format of the printed or saved screenshot.

Parameters:
<Format> GDI | BMP | PNG | GIF

GDI: For output on printer
BMP | PNG | GIF: File formats for saved screenshots

*RST: PNG

HCOPy:PAGE:SIZE <Size>
Defines the page size to be used.

Parameters:
<Size> A4 | A5 | B5 | B6 | EXECutive

HCOPy:PAGE:ORIentation <Orientation>
Defines the page orientation.

Parameters:
<Orientation> LANDscape | PORTrait

HCOPy:COLOR:SCHeme <ColorScheme>
Defines the color mode for saved and printed screenshots.

Parameters:
<ColorScheme> COLor | GRAYscale | INVerted

INVerted
Inverts the colors of the output, i.e. a dark waveform is printed on a white background.

*RST: COLor

SYSTem:COMMunicate:PRINter:SELect <PrinterName>
Selects a configured printer.

Parameters:
<PrinterName> String parameter
Enter the string as it is returned with
SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt or
SYSTem:COMMunicate:PRINter:ENUMerate[:NEXT].

SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt?
Queries the name of the first printer in the list of printers. The names of other installed printers can be queried with the SYSTem:COMMunicate:PRINter:ENUMerate[:NEXT] command.

Return values:
<PrinterName> String parameter
Enter the string as it is returned with
SYSTem: COMMunicate:PRINter: ENUMerate: FIRSt? or
SYSTem: COMMunicate:PRINter: ENUMerate[: NEXT]?:
If no printer is configured an empty string is returned.

Usage: Query only

SYSTem:COMMunicate:PRINter:ENUMerate[:NEXT]?
Queries the name of the next printer installed.
The SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt command should be sent previously to return to the beginning of the printer list and query the name of the first printer.

Return values:
<PrinterName> String parameter
After all available printer names have been returned, an empty string enclosed by quotation marks („) is returned for the next query. Further queries are answered by a query error.

Usage: Query only

SYSTem:COMMunicate:PRINter:CSET
Sets the printer language that is supported by the printer.

Parameters:
<CommandSet> PCL5 | PCLXl | PS

PCLXl: PCL XL
PS: Postscript

2.16.2 MMEMory Commands

The Mass MEMomory subsystem provides commands to access the storage media and to save and reload instrument settings.

The oscilloscope has two storage devices indicated as drives:

- /INT: internal storage with default directories for each data type
- /USB_FRONT: USB connector on the front panel

Common computer and network drives like C:, D:, \\server\share are not available.

Name conventions

The names of files and directories have to meet the following rules:

- Only the 8.3 format with ASCII characters is supported.
- No special characters are allowed.
- Use / (slash) instead of \ (backslash).

MMEMory:DRIVes?

Returns the storage devices available on the oscilloscope.

Return values:

<Drive> List of strings

/INT: Internal storage
/USB_FRONT: USB connector on the front panel

Usage: Query only

MMEMory:MSIS [<MassStorageIS>]
Changes the storage device (drive).

Parameters:
<MassStorageIS> One of the available drives: /INT or /USB_FRONT

Example: MMEM:MSIS ,/USB_FRONT'
Sets USB stick connected to the front panel as storage device.

MMEMory:DCATalog?
Returns the subdirectories of the specified directory. The result corresponds to the number of strings returned by the MMEMory:DCATalog:LENgth? command.

Query Parameters:
<PathName> String parameter
Specifies the directory.

Return values:
<FileEntry> String parameter
List of subdirectories separated by colons.

Example: MMEM:DCAT? "/USB_FRONT"
received "SCREENSHOTS", "DATA"

Usage: Query only

MMEMory:DCATalog:LENGth? <PathName>
Returns the number of directories in specified directory. The result corresponds to the number of strings returned by the MMEMory:DCATalog? command.

Query Parameters:
<PathName> String parameter
Specifies the directory.

Return values:
<FileEntryCount> Number of directories.

Example: MMEM:DCAT:LENG? "/USB_FRONT"
received 2

Usage: Query only

MMEMory:MDIRectory <DirectoryName>
Creates a new directory with the specified name.

Setting Parameters:
<DirectoryName> String parameter
Complete path including the storage device.

Example: Create directory DATA on the front USB flash device, with absolute path:
MMEM:MDIR "/USB_FRONT/DATA"

Usage: Setting only

MMEMory:CDIRectory [<DirectoryName>]
Changes the default directory for file access.

Setting Parameters:
<DirectoryName> String parameter to specify the directory.
If the string also contains the storage device, the command MMEM:MSIS is executed implicitely.

Example: MMEM:CDIR "/USB_FRONT/DATA"

MMEMory:RDIRectory <DirectoryName>
Deletes the specified directory. All subdirectories and all files in the specified directory and in the subdirectories will be deleted. You cannot delete the current directory or a superior directory.

Setting Parameters:
<DirectoryName> String parameter

Example: MMEM:RDIR "/INT/TEST"

Usage: Setting only

MMEMory:CATalog? <PathName>[,<Format>]
Returns the a list of files contained in the specified directory. The result corresponds to the number of files returned
by the MMEMory:CATalog:LENgth? command.

Query Parameters:
<PathName> String parameter
Specifies the directory.

<Format> ALL | WTIMe

ALL: Extended result including file, date, time and attributes
WTIMe: Extended result including file, date, time

Return values:

<UsedMemory> Total amount of storage currently used in the directory, in bytes.

<FreeMemory> Total amount of storage available in the directory, in bytes.

<FileEntry> String parameter
All files of the directory are listed with their file name, format and size in bytes.

Example: MMEM:CAT? ‚/INT/HELP/ENGLISH/*.HTM'
Returns all english help files

Usage: Query only

MMEMory:CATalog:LENGth? <PathName>

Returns the number of files in the specified directory. The result corresponds to the number of files returned by the MMEMory:CATalog? command.

Query Parameters:

<PathName> String parameter
Directoty to be queried

Return values:

<Count> Number of files.

Usage: Query only

MMEMory:COPY <FileSource>,<FileDestination>

Copies data between the instrument and a USB stick.

Setting Parameters:

<FileSource> String parameter
Name and path of the file to be copied.

<FileDestination> String parameter
Name and path of the new file. If the file already exists, it is overwritten without notice.

Example: MMEM:COPY "/INT/SETTINGS/SET001.SET",
"/USB_FRONT/SETTINGS/TESTSET1.SET"

Usage: Setting only

MMEMory:MOVE <FileSource>,<FileDestination>
Moves an existing file to a new location.

Setting Parameters:
<FileSource> String parameter
Path and name of the file to be moved.

<FileDestination> String parameter
Path and name of the new file.

Example: MMEM:MOVE "/INT/SETTINGS/SET001.SET", "/USB_FRONT/SETTINGS"

Usage: Setting only

MMEMory:DELete <FileSource>
Removes a file from the specified directory.

Setting Parameters:
<FileSource> String parameter
Name and directory of the file to be removed.

Usage: Setting only

MMEMory:DATA <FileName>,<Data>
Stores data to the storage location specified using MMEMory:CDIRectory.

Parameters:
<Data> 488.2 block data
The block begins with character ‚#'. The next digit is the length of the length information, followed by this given number of digits providing the number of bytes in the binary data attached.

Parameters for setting and query:
<FileName> String parameter
The name of the file the data is stored to.

Example: MMEM:DATA ‚abc.txt' #216This is the file
#2: the length infomation has two digits
16: the binary data has 16 bytes.
MMEM:DATA? „abc.txt"
received: This is the file

MMEMory:STORe:STATe <StateNumber>,<FileName>[,<msus>]
Saves the current device settings to the specified file.

Setting Parameters:

<StateNumber>	State 0 (low) or 1 (high)1
<FileName>	String parameter Path and file name
<msus>	Storage device (drive), see also MMEMory:MSIS
Usage:	Setting only

MMEMory:LOAD:STATe <StateNumber>,<FileName>[,<msus>]
Loads the device settings from the specified file.

Setting Parameters:

<StateNumber>	State 0 (low) or 1 (high)
<FileName>	String parameter Path and file name
<msus>	Storage device (drive), see also MMEMory:MSIS
Usage:	Setting only

2.17 General Instrument Setup

CALibration

Calibration starts the self-alignment process. It can take several minutes. Calibration? returns information on the state of the self-alignment. Return values ≠ 0 indicate an error.
Same as *CAL?.

Return values:

<SelfAlignment> Numeric status indicator

CALibration:STATe?

Returns the overall state of the self-alignment.

Return values:

<SelfAlignmentState> NOALignment | RUN | ERRor | OK | ABORt

NOALignment: No self-aligment was performed.
RUN: Self-aligment is running.
ERRor: Error occured.
OK: Self-aligment has been performed successfully.
ABORt: Self-aligment has been cancelled.

Usage: Query only

DISPlay:LANGuage <Language>
Sets the language in which the softkey labels, help and other screen information can be displayed. Supported languages are listed in the „Specifications“ data sheet.

Parameters:

<Language> ENGLish | GERMan | FRENch | SPANish | RUSSian | SCHinese | TCHinese

*RST: Reset does not change the language

SYSTem:NAME
Defines an instrument name.

Parameters:

<Name> String with max. 20 characters

SYSTem:DATE <Year>,<Month>,<Day>
Specifies the internal date for the instrument.

Parameters:

<Year> Default unit: a

<Month> Range: 1 to 12

<Day> Range: 1 to 31
Default unit: d

Usage: SCPI confirmed

SYSTem:TIME <Hour>,<Minute>,<Second>
Specifies the internal time for the instrument.

Parameters:

<Hour> Range: 0 to 23
Default unit: h

<Minute> Range: 0 to 59
Default unit: min

<Second> Range: 0 to 59
Default unit: s

Usage: SCPI confirmed

SYSTem:TREE?
Returns a list of implemented remote commands.

Usage: Query only

SYSTem:SET <Setup>
Defines or queries the device settings that can be saved and load manually with SAVE/RECALL --> Device Settings.

Parameters:
<Setup> 488.2 block data

Usage: SCPI confirmed

SYSTem:ERRor:[NEXT]?
Queries the error/event queue for the oldest item and removes it from the queue. The response consists of an error number and a short description of the error. Positive error numbers are instrument-dependent. Negative error numbers are reserved by the SCPI standard.

Return values:
<Error> Error/event_number,"Error/event_description>[;Devicedependent info]"
If the queue is empty, the response is 0,"No error"

Usage: Query only
SCPI confirmed

SYSTem:ERRor:ALL?
Queries the error/event queue for all unread items and removes them from the queue.
The response is a comma separated list of error number and a short description of the error in FIFO order. Positive error numbers are instrument-dependent. Negative error numbers are reserved by the SCPI standard.

Return values:
<Error> List of:
Error/event_number,"Error/event_description>[;Devicedependent info]"
If the queue is empty, the response is 0,"No error"

Usage: Query only
SCPI confirmed

SYST:PRESet
Resets the instrument to the default state, has the same effect as *RST.

Usage: Event

SYSTem:COMMunicate:PRINter:CSET
Sets the printer language that is supported by the printer.

Parameters:
<CommandSet> PCL5 | PCLXI | PS

PCLXI: PCL XL
PS: Postscript

SYSTem:BEEPer[:IMMediate]
Generates an immediate beep.

Usage: Event

SYSTem:BEEPer:TRIG:STATe
Enables or disables the beep if a trigger occurs.

Parameters:
<TriggerBeep> ON | OFF

SYSTem:BEEPer:CONTrol:STATe
Enables or diables a sound for general control events, e.g. reaching the rotary encoder end or changing the measuring mode in the „Auto Measure“ menu.

Parameters:
<ControlBeep> ON | OFF

SYSTem:BEEPer:ERRor:STATe
Enables or disables the beep if an error occurs.

Parameters:
<ErrorBeep> ON | OFF

SYSTem:EDUCation:PRESet
Deletes the password of the education mode.

Usage: Event

2.18 Status Reporting

2.18.1 STATus:OPERation Register

The commands of the STATus:OPERation subsystem control the status reporting structures of the STATus:OPERation register:
See also:

- chapter 1.6.1, „Structure of a SCPI Status Register“
- „STATus:OPERation Register“

The following commands are available:

STATus:OPERation:CONDition?
Returns the of the CONDition part of the operational status register.

Return values:

<Condition> Condition bits in decimal representation. ALIGnment (bit 0) , SELFtest (bit 1),
AUToset (bit 2), WTRigger (bit 3).
Range: 1 to 65535

Usage: Query only

STATus:OPERation:ENABle <Enable>

Parameters:

<Enable> Range: 1 to 65535

STATus:OPERation:NTRansition <NegativeTransition>

Parameters:

<NegativeTransition> Range: 1 to 65535

STATus:OPERation:PTRansition <PositiveTransition>

Parameters:

<PositiveTransition> Range: 1 to 65535

STATus:OPERation[:EVENt]?

Return values:
<Event> Range: 1 to 65535

Usage: Query only

2.18.2 STATus:QUEStionable Registers

The commands of the STATus:QUEStionable subsystem control the status reporting structures of the STATus:QUEStionable registers:

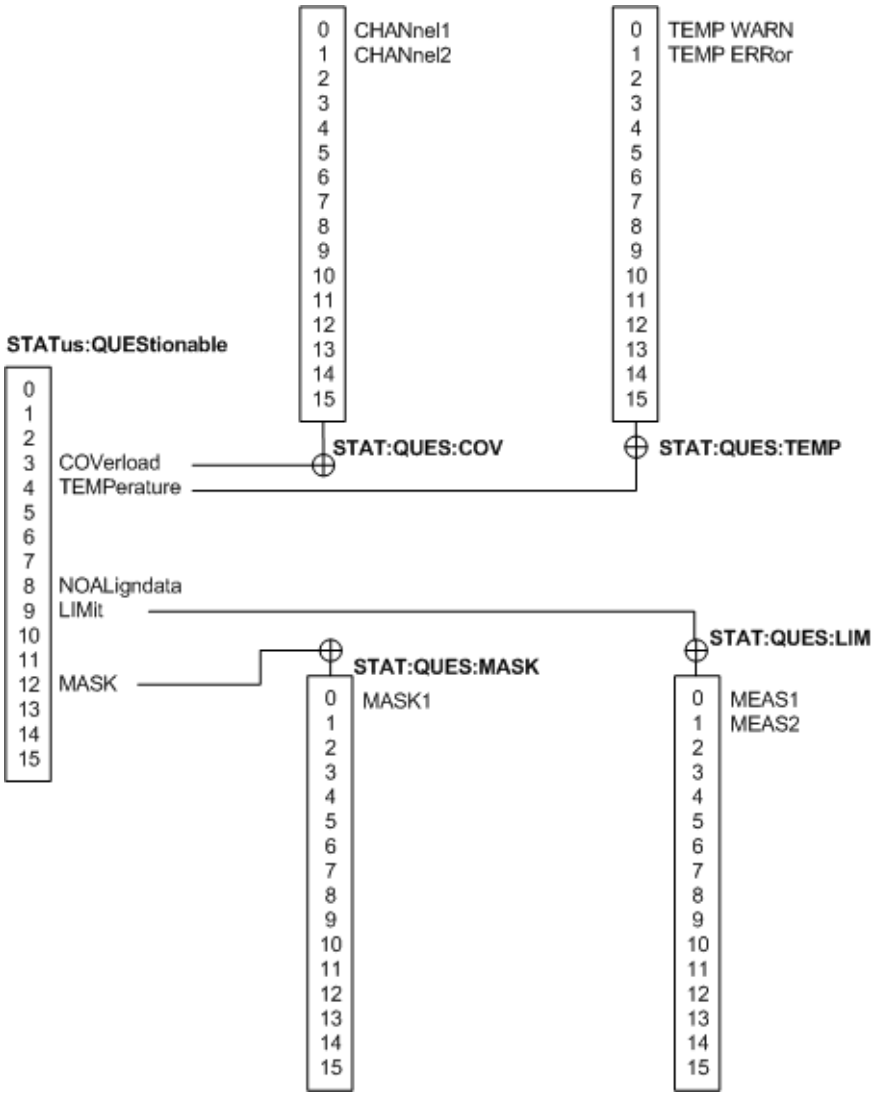

Fig. 2.1: Structure of the STATus:QUEStionable register

See also:
- chapter 1.6.1, „Structure of a SCPI Status Register“
- „STATus:QUEStionable Register“

The following commands are available:

STATus:PRESet

Resets all STATUS:QUESTIONALBLE registers.

Usage: Event

STATus:QUEStionable:CONDition?
STATus:QUEStionable:COVerload:CONDition?
STATus:QUEStionable:LIMit:CONDition?
STATus:QUEStionable:MASK:CONDition?

Returns the contents of the CONDition part of the status register to check for questionable instrument or measurement states. Reading the CONDition registers does not delete the contents.

Return values:

<Condition> Condition bits in decimal representation
Range: 1 to 65535

Usage: Query only

STATus:QUEStionable:ENABle <Enable>
STATus:QUEStionable:COVerload:ENABle <Enable>
STATus:QUEStionable:LIMit:ENABle <Enable>
STATus:QUEStionable:MASK:ENABle <Enable>

Sets the enable mask that allows true conditions in the EVENt part to be reported in the summary bit. If a bit is set to 1 in the enable part and its associated event bit transitions to true, a positive transition occurs in the summary bit and is reported to the next higher level.

Parameters:

<Enable> Bit mask in decimal representation
Range: 1 to 65535

Example: STATus:QUEStionable:MASK:ENABle 24
Set bits no. 3 and 4 of the STATus:QUEStionable:MASK:ENABle register part: 24 = 8 + 16 = 23 + 24

STATus:QUEStionable[:EVENt]?
STATus:QUEStionable:COVerload[:EVENt]?
STATus:QUEStionable:LIMit[:EVENt]?
STATus:QUEStionable:MASK[:EVENt]?
Returns the contents of the EVENt part of the status register to check whether an event has occurred since the last reading. Reading an EVENt register deletes its contents.

Return values:

<Event> Event bits in decimal representation
Range: 1 to 65535

Usage: Query only

STATus:QUEStionable:NTRansition <NegativeTransition>
STATus:QUEStionable:COVerload:NTRansition <NegativeTransition>
STATus:QUEStionable:LIMit:NTRansition <NegativeTransition>
STATus:QUEStionable:MASK:NTRansition <NegativeTransition>
Sets the negative transition filter. If a bit is set, a 1 to 0 transition in the corresponding bit of the condition register causes a 1 to be written in the corresponding bit of the event register.

Parameters:

<NegativeTransition> Bit mask in decimal representation
Range: 1 to 65535

Example: STATus:QUEStionable:MASK:NTRansition 24
Set bits no. 3 and 4 of the STATus:QUEStionable:MASK:NTRansition register part: 24 = 8 + 16 = 23 + 24

STATus:QUEStionable:PTRansition <PositiveTransition>
STATus:QUEStionable:COVerload:PTRansition <PositiveTransition>
STATus:QUEStionable:LIMit:PTRansition <PositiveTransition>
STATus:QUEStionable:MASK:PTRansition <PositiveTransition>
Sets the positive transition filter. If a bit is set, a 0 to 1 transition in the corresponding bit of the condition register causes a 1 to be written in the corresponding bit of the event register.

Parameters:

<PositiveTransition> Bit mask in decimal representation
Range:1 to 65535

Example: STATus:QUEStionable:MASK:PTRansition 24
Set bits no. 3 and 4 of the STATus:QUEStionable:MASK:PTRansition register part: 24 = 8 + 16 = 23 + 24

3 SCPI Commands

in alphabetic order