

9500C

Oscilloscope Calibrator

Programmers Manual

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Table of Contents

Title	Page
Introduction.....	1
Contact Fluke	1
Safety Information	1
Product Use	1
Product Maintenance.....	1
Specifications	1
Remote Operations.....	2
Programming Options.....	2
IEEE 488.2 and SCPI Codes	3
IEEE 488.1 Compliance	3
Bus Addresses	4
GPIB Timeouts	4
IEEE 488.2 Compliance	4
*RST Conditions.....	6
Retrieval of Device Status.....	7
Status Summary Information and SRQ	7
Event Register Conditions	8
SCPI Commands	9
SCPI Syntax and Styles.....	9
Legend.....	9
CONFigure Subsystem	10
READ?	10
OUTput.....	10
REFerence.....	11
ROUTe.....	12
SOURCe Function	15
Status Function	22
SYSTem Function.....	23
DIAGnostic Function	24
CALibration Function.....	25
Error Messages	28
Reading the Error Queue.....	29
IEEE488.2 Command Errors	29
IEEE488.2 Execution Errors	29
IEEE488.2 Device Errors	30

IEEE488.2 Query Errors 30

Device Dependent Errors..... 30

Non-Fatal Limits and Ranges Errors 38

Non-Fatal Out-Guard Execution/Operation Errors..... 38

Non-Fatal Head/Channel Access Errors 39

Non-Fatal Instrument Adjust Errors 40

Fatal Device-Specific Errors 40

Introduction

The Fluke 9500C (the Product) is an oscilloscope calibrator that tests and calibrates from a single source. A computer can connect through any of the remote interface ports to change settings, read measurement data, and control the operation of the Product. Command syntax and names follow the IEEE-488.2 standards.

Contact Fluke

Fluke Corporation operates worldwide. For local contact information, go to our website: www.fluke.com.

To register your product, or to view, print, or download the latest manual or manual supplement, go to our website: www.fluke.com/productinfo.

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Safety Information

General Safety Information is in the printed Safety Information document that ships with the Product and at www.fluke.com. More specific safety information is listed where applicable.

Product Use

User instructions for Product operation are in the *9500C Users Manual* located at www.fluke.com.

Product Maintenance

Instructions for Product maintenance, verification, and calibration are in the *9500C Users Manual* located at www.fluke.com.

Specifications

Safety Specifications are located in the Safety Specifications section of the *9500C Safety Information*. Complete specifications are at www.fluke.com.

Remote Operations

The Product is fully programmable for use on the IEEE Standard 488.1 (GPIB) interface bus. The IEEE-488 interface complies with supplemental standard IEEE-488.2, which describes additional IEEE-488 features. Devices connected to the IEEE-488 bus are designated as talkers, listeners, talker/listeners, or controllers. Under remote control of an instrument, the Product operates as a talker/listener. This manual shows how the Product adopts the IEEE-488.2 message-exchange model and reporting structure, and defines the SCPI commands and syntax used to control the Product. Compatible software for IEEE-488 operation can be purchased from Fluke, this includes MET/CAL™.

The commands in this manual are the remote commands, both common and device-dependent. Definitions of the different types of messages used on the IEEE-488 bus are:

- Device-dependent commands - messages that transfer information directly between the Product and the IEEE-488 controller. Some commands cause an action to take place in the Product. Others, called queries in the IEEE-488.2 standards, ask for information, and always generate a response message from the Product. While message format is governed by IEEE-488.2 standards, message content can be unique to the Product. For example, use device-dependent commands to set the output mode and amplitude, and to switch from standby to operate.
- Common commands defined by IEEE-488.2 standards are for functions common to most bus devices. Examples include the command to reset a device (*RST) and the query for device identification (*IDN?). Common commands and queries are identified with an asterisk (*).
- Interface messages defined by IEEE-488.1 standards have their own control lines, and others are sent over the data lines by first asserting the control line ATN (Attention). Note that interface messages, unlike device-dependent and common commands, are not sent literally. For example, when a device-dependent query is sent to the Product, the controller automatically sends the interface message MTA (My Talk Address).

Programming Options

The *9500C Users Manual* details how to configure the Product for remote operation. Use the IEEE interface to:

- Change the operating state (Function, Source, Measurement)
- Transmit the status of the Product
- Request service from the system controller

IEEE 488.2 and SCPI Codes

The IEEE-488 interface is based on the IEEE Standards 488.1 (GPIB) and 488.2. For detailed information, refer to the standards IEEE-488.1 (GPIB) and IEEE-488.2.

IEEE-488.1 - (GPIB) the hardware portion of the interface.

- The parallel signal lines are divided into 8 lines for the data bus, 3 lines for the handshake, and 5 lines for bus management. The handshake lines are for the timing for data exchange. The bus management lines control the operation of data exchange.
- The ATN line indicates the use of the DIO lines for addresses or messages (true), or for DIO data (false).
- The EOI line is used with the data lines to mark the end of a message, and with the ATN line for polling.
- The SRQ line is used by the devices to indicate to the controller that they require service.
- The IFC line is used by the controller to quickly get all the devices on the bus to stop talking and start listening.
- The REN line is used to implement the remote/local states.

IEEE-488.2 - the software portion of the interface, that specifies data formats, common commands, message exchange protocol and the status register implementation.

SCPI - (Standard Commands for Programmable Instruments) is an instrument command language which goes beyond IEEE 488.2 to address a variety of functions in a standard manner. The Product implementation of SCPI conforms with all IEEE-488.2 Mandatory Commands but not all Optional Commands. The Product conforms with the SCPI approved Status Reporting method. Commands in SCPI language, prefaced by an asterisk (*CLS), are IEEE-488.2 standard-defined Common commands. For most specific commands, such as those relating to frequency and voltage, the SCPI approved command structure already exists and has been used wherever possible.

IEEE 488.1 Compliance

To conform to the IEEE 488.1 standard specification, the device does not need to encompass the full range of bus capabilities. For IEEE 488.2, the device must conform exactly to a specific subset of IEEE 488.1, with a minimal choice of optional capabilities.

The IEEE 488.1 document describes and codes the standard bus features, for manufacturers to give brief coded descriptions of the overall capability of their interfaces. For IEEE 488.2, this description is required to be part of the device documentation.

Applicable codes to the Product are in [Table 1](#).

Table 1. Supported IEEE-488 Interface Function Subsets

Subset	Function
SH1	Source handshake capability
AH1	Acceptor handshake capability
T6	Talker (basic talker, serial poll, unaddressed to talk if addressed to listen)
L4	Listener (basic listener, unaddressed to listen if addressed to talk)
SR1	Service request capability
RL1	Remote/local capability
PP0	No parallel poll capability
DC1	Device clear capability
DT0	No device trigger capability
C0	No controller capability
E2	Open-collector and three-state drivers

Bus Addresses

When an IEEE 488 system comprises several instruments, a unique Address is assigned to each to enable the controller to communicate with them individually.

See the *9500C Users Manual* for details on setting the bus address.

Communication between the controller and the Product takes place with commands established by IEEE-488.1 standards and commands specifically related to the Product.

GPB Timeouts

Fluke recommends that GPB timeouts are not set below 3 seconds. The *TST? command requires a long timeout (at least 3 minutes).

IEEE 488.2 Compliance

IEEE 488.2 common commands are in [Table 2](#).

Table 2. IEEE 488.2 Common Commands and Queries

Program Coding	Description
*CLS	Clears event registers and queues (not O/P queue).
*ESE Nrf	Enables standard-defined event bits.
*ESE?	Returns ESE register mask value.
*ESR?	Reads Event Status register.
*IDN?	Reports manufacturer, model, and other identification, for example: FLUKE, 9500C, 000000000,1.00, (manufacturer, model, serial number, version).

Table 2. IEEE 488.2 Common Commands and Queries (cont.)

Program Coding	Description
*OPC	Sets the Product to monitor the <i>No-Operations-Pending</i> flag. When TRUE, the analog output has settled to the final value.
*OPC?	For <i>No-Operations-Pending</i> flag TRUE, puts a 1 in the Output Queue. The analog output has settled to the final value when this command completes.
*OPT?	Recalls the option configuration
*PUD	Allows entry of user data to protected store
*PUD?	Recalls user-entered data. Default value: #210No message
*RST	Resets instrument to power on condition
*SRE Nrf	Enables Service Request Byte bits
*SRE?	Returns Service Request Byte mask value
*STB?	Non-destructively reads Service Request Byte
*TST?	Perform Full Test
*WAI	Wait for the operations to compete. This does not imply the analog output is settled.

The query responses for the '*' commands is defined by the IEEE488.2 specification:

- Numeric values are from 0 to 255, or for boolean operations: 0 or 1.
- *OPT? recalls the hardware fitment. The data in the response consists of a list of comma-separated characters, containing either value '1' or 'Ø', (<NR1>values) or <NR3>values.

Response Format: Ch1,Ch2,Ch3,Ch4,Ch5,x1,bf,mdc

Where:

- o Ch1 to Ch5: Active Head™ Fitment, where: ChX = Ø: No Active Head Fitted, ChX = 1: Active Head Fitted
- o x1: Option 100: High Stability Crystal Reference where: x1 always '1': Indicates that Product option 100 is fitted. (This is for backwards compatibility only.)
- o bf: Base Frequency Field of instrument - when the '*IDN?' response is set to **9500C** this is set to 4.2E9. When the '*IDN?' response is set to **9500/9500B** this is set to 3.2E9 for backwards compatibility. See the *IDN configuration* section of the users manual.
- o mdc: Indicates that enhanced multichannel DC is fitted - always set to 1. (For backwards compatibility only.)

For Example (with channel 1 fitted): 1,0,0,0,0,1,4.2E9,1

These GPIB 488.2 features are not applicable:

- *EMC (Enable Macro Command)
- *DDT (Define Device Trigger Command)

- *TRG (Trigger)
- PSC (Power-on Status Clear Flag)
- Parallel Poll

*RST Conditions

*RST resets the instrument to a defined condition, stated for each applicable command. The reset condition is not dependent on past-use history of the instrument except as noted below.

Table 3. *RST defaults

Keyword	Condition
CALibration	Disabled
OUTPut[:STATe]	OFF
[SOURce]:FUNCtion[:SHAPE](?)	SQUare
:SCOPE[:SHAPE](?)	SQUare
:PARAmeter:DC:GROund(?)	OFF
:PARAmeter:SQUare:POLarity(?)	POS
:PARAmeter:SQUare:GROund(?)	OFF
:PARAmeter:SKEW	Inactive
:PARAmeter:SKEW:ALIGNment(?)	DEFault
[SOURce]:VOLTage[:LEVEl]	20 mV
[SOURce]:FREQuency[:CW FIXed](?)	1 kHz

*RST does not affect:

- The selected address of the Product
- Calibration data that affect specifications
- SRQ mask conditions
- The contents of:
 - The Status Byte Register
 - The Status Byte Enable Register
 - The Standard Event Status Register
 - The Standard Event Status Enable Register
 - The SCPI Operation Status Register
 - The SCPI Operation Status Enable Register
 - The SCPI Questionable Status Register
 - The SCPI Questionable Status Enable Register
- The state of the IEEE 488.1 interface

- The Error Queue
- The Power-on Status Clear flag setting
- The Protected User Data Query response

Retrieval of Device Status

For any remotely-operated system, up-to-date information about the performance of the system is important. When systems operate under automatic control, the controller requires the necessary feedback. A break in the continuity of the process can have serious results.

When you develop an application program, the programmer tests and revises the program. The program elements must have correct grammar and syntax to reduce iterations needed to confirm and develop the viability of the whole program.

Status Summary Information and SRQ

The Status Byte consists of four summary bits which notify events in the Event Status Register (ESB), the SCPI-defined registers (OSS and QSS), and the Output Queue (MAV). Whenever one of these summary bits is enabled and set true, the Status Byte summary bit (MSS) is also set true. The buffered bit 'RQS' follows true when MSS goes true, and will set the IEEE-488 SRQ line true.

A subsequent serial poll by the Application Program will discover that the Product was the requesting device (while resetting RQS false again, MSS remaining true), and which of the summary bits is true. The *STB? command is an equivalent command to serial poll, where serial poll is not available.

An 8 bit Status Byte Register, (accessed through *STB?, and configured with *SRE <NRf>, and *SRE?). See [Table 4](#).

Table 4. Status Byte Register

Bit	Bit Name	Decimal Value	Definition
0	(not assigned)	1	Not used.
1	(not assigned)	2	Not used.
2	Error Queue	4	One or more errors have been queued, (accessed via SYSTem:ERRor?).
3	Questionable Data Summary	8	One or more bits are set in the Questionable Data Register, see STATus: QUESTionable:ENABLE.
4	Message Available	16	Data is available in the instrument's output buffer.
5	Standard Event Summary	32	One or more bits are set in the Standard Event Register. Enabled using *ESE.
6	Master Summary and RQS	64	One or more bits are set in the Status Byte Register and may generate a Request for Service (RQS). Enabled using *SRE.

Table 4. Status Byte Register (cont.)

Bit	Bit Name	Decimal Value	Definition
7	Operation Register	128	One or more bits are set in the Operation Status Register. See STATUS:OPERation:ENABle.

Event Register Conditions

The Status Byte summary bits direct the application program down the structure towards causal events.

ESB and MAV are standard IEEE-488 features.

OSS and QSS are features of the SCPI structure.

An 8 bit Event Status Register, (accessed through *ESR?, and configured with *ESE <NRf>, and *ESE?). See [Table 5](#).

Table 5. Event Status Register

Bit	Bit Name	Decimal Value	Definition
0	Operation Complete	1	All commands that effect the output have been executed and the output has settled to the final state.
1	RQC (request control)	2	Not used.
2	Query Error	4	The instrument tried to read the output buffer but it was empty. Or, a new command line was received before a previous query has been read. Or, both the input and output buffers are full.
3	Device-Specific Error	8	A device-specific error occurred.
4	Execution Error	16	An execution error occurred.
5	Command Error	32	A command error occurred, for example, incorrect syntax.
6	URQ, (User request)	64	Not used.
7	Power On	128	Power has been cycled since the last time the event register was read or cleared.

SCPI Commands

This section lists and describes the set of SCPI-compatible remote commands used to operate the Product.

SCPI Syntax and Styles

Where possible the syntax and styles used in this section follow those defined by the SCPI consortium.

Square brackets [] enclose a keyword that is optional when you program the command. The Product process the command to have the same effect whether the optional node is omitted by the programmer or not.

Letter case in tables is used to differentiate between the accepted shortform (upper case) and the long form (upper and lower case).

Parameter types are distinguished by enclosing the type in angle brackets (< >). If parameter form is enclosed by square brackets ([]) these are then optional (make sure that optional parameters are consistent with the intention of the associated keywords). The vertical bar (|) can be read as "or" and separates alternative parameter options.

Legend

<dnpd> = Decimal Numeric Program Data. Identifies numerical information needed to set controls to required values. The numbers should be in *Nrf* form as described in the IEEE 488.2 Standard Specification.

<cpd> = Character Program Data. This normally represents alternative groups of unique *iterate* parameter names, available for the same keyword. In the notation the set of alternatives will follow the <cpd> in the Parameter Form column of the Sub-System table, enclosed in a pair of braces. For example, in the OUTPut sub-system, the compound command header (keyword): OUTPut[:STATe] is followed by the parameter form <cpd>{ON|OFF|1|0}. The <cpd> gives the denomination of *Character* program data, and {ON|OFF|1|0} gives the actual characters to be used to command each unique parameter.

<spd> = String Program Data. This is a string of variable *iterate* characters which will be recognized by the internal Product software. They are used for such inputs as passwords and date/time.

? = Indicate query commands with no associated command form, and no attached parameters (for example: CALibration:TRIGger?).

[?] = All commands which may include parameters in the command form, but also have an additional query form without parameters. (For example: ROUTe:SIGNAL:[PATH](?)

<cpd>{CH1|CH2|CH3|CH4|CH5}

CONFigure Subsystem

Select the input resistance or input capacitance measurement mode.

Note

The Product can measure: the DUT (device under test) input capacitance and the DUT input resistance. These are simple measurements with no control over parameters like read rate, resolution, trigger timing.

Command Form		Description
:CONFigure[?]		Set a resistance (default) measurement. The query returns the measurement type setup: RES, CAP or NONE (not in a measurement function).
	[:RESistance]	Setup a resistance measurement.
	:CAPacitance	Setup a capacitance measurement.

READ?

Get the most-recent measurement for the resistance or capacitance function.

Command Form	Description
:READ?	Return the measurement from the selected head or NAN, if measurement is not available.

OUTput

Sets the Output state.

Command Form	Description
:OUTPut[:STATe] ON OFF 1 0 :OUTPut[:STATe]?	Sets the output state. ON or 1 - turns on the signal output. OFF or 0 - turns off the signal output. The query returns ON or OFF.

REference

Configure input and output reference frequencies.

Command Form		Description
:REference:INPut		Input reference frequency.
	:SOURce INTernal EXTernal :SOURce?	Determines if the frequency reference is internal (INT) or external (EXT). The query returns INT or EXT.
	:FREQuency <NRf> :FREQuency?	Set the input reference frequency between 1 MHz and 20 MHz at 1 MHz intervals. Frequencies within 1 % of a valid value are accepted as the closest 1 MHz value. The query returns the input reference frequency.
	:LOCK?	The query returns ON (locked) or OFF (unlocked).
:REference:OUTPut		Set the output reference frequency.
	:FREQuency <NRf> :FREQuency?	Enables and disables the reference frequency output. • Values <0.9 MHz disable output • Values <9 MHz enable output and round to 1 MHz • Values ≥9 MHz enable output and round to 10 MHz The query returns the output reference frequency: • 0 MHz (disabled) • 1 MHz • 10 MHz.

ROUTe

Configure output channels for signal and trigger outputs.

Command Form		Description
:ROUTe		
	:FITted CH1 CH2 CH3 CH4 CH5 :FITted?	The query returns comma-separated fields to describe the Active Head. - Field 1 - Type - 9540C CABL NONE - Field 2 - Serial Number - up to 9 characters - Field 3 - Date that the head was last calibrated, in the currently defined date format. - Field 4 - Date that the calibration of the head is due, in the currently defined date format. If you do not specify a channel, the system returns a semicolon (;) separated list of all the channels. Examples: A channel with an Active Head fitted: 9540C,123456789,2023/02/28,2023/02/27 A channel with no Active Head fitted: NONE,0,0000/0/00,0000/0/00 Use ROUT:TRIG[:PATH](?) to determine that a cable has been fitted.
:ROUTe:SIGNAL:		
	[:PATH] CH1 CH2 CH3 CH4 CH5 [:PATH]?	Activates a single channel, (deactivating all other non-trigger channels). The Product reports an error if the channel is already assigned as a Trigger channel. The query returns the active channel.
	:IMPedance <NRf> :IMPedance	Sets the impedance to 50 Ω or 1 MΩ. If the <NRf> value is ≤ 55 impedance is 50 Ω, if > 55 impedance is 1 MΩ. The query returns the selected impedance: 50 Ω or 1 MΩ.

Command Form		Description
	:MCHannel CH1 CH2 CH3 CH4 CH5, ON OFF 1 0 :MCHannel?	ON or 1 turns on the selected channel. OFF or 0 turns off the selected channel The query returns ON or OFF. The Product reports an error if a channel is already assigned as a Trigger channel.
	:SKEW CH1 CH2 CH3 CH4 CH5, ON OFF 1 0 :SKEW?	Enables a channel for skew. Use this command to choose a single channel, then use the ON OFF 1 0 element to turn the channel ON or OFF for Skew. Repeat for each channel. You must select at least two channels for signals to be generated. The Product reports a settings conflict error if the SKEW function is not selected. Other ROUTe:SIGNal commands and ROUTe:TRIGger commands are not valid in the Zero Skew function. The query returns the active channel(s) for skew. Example: ROUTe:SIGNal:SKEW? responds with <i>CH1,CH2,CH3,CH4,CH5</i> if all five channels are active.
	DUAL CH1 CH2 CH3 CH4 CH5, CH1 CH2 CH3 CH4 CH5 DUAL?	Outputs two signals simultaneously on different channels. This command only works when the SINusoid function is selected. This command is for backward compatibility - See MCHannel which provides full multi-channel support. The Product reports an error: • if SINusoid function shape is not selected • if $n1 = n2$ The query returns the two channels that have simultaneous output.
:ROUTe:TRIGger		

Command Form	Description
:IMPedance <NRf> :IMPedance?	Set the trigger impedance. This command selects 50 Ω or 1 MΩ scope impedance matching levels for the selected trigger channel. The value of <NRf> selects the required impedance: - values ≤ 55 select 50 Ω - values >55 select 1MΩ The values are: divide by 1, divide by 10, divide by 100. If the trigger path is set to CABLE, the command causes a settings conflict error. If the trigger is set to NONE, the command is ignored. The query returns the trigger impedance.
[:PATH] CH1 CH2 CH3 CH4 CH5, [ACTive CABLE] [:PATH] NONE [:PATH]?	Enables the generation of a trigger signal from one of the signal output channels. Use ACTive (Active Head) or CABLE (Cable) to set the trigger source. If not set, the command uses Active Head. NONE - Disables the generation of a trigger signal from one of the signal output channels. The query returns the channel identity with a trigger output or NONE.
:RATio <NRf> :RATio?	Sets the trigger frequency as a ratio of the selected function. The values are: divide by 1, divide by 10, divide by 100: A <NRf> value from 0.9 to 1.1 selects 1:1 ratio. A <NRf> value from 9 to 11 selects a 1:10 ratio. A <NRf> value from 90 to 110 shall selects a 1:100 ratio. The query returns the trigger frequency as a ratio of the selected function.

SOURCE Function

Configure the signal source parameters for the Product.

Command Form		Description
[:SOURce]:SCOpe		Use these commands for compatibility with the Wavetek Datron 9100 calibrator.
	[:SHAPE] DC SQUare EDGE MARKer SINusoid [:SHAPE]?	Set the wave shape of output signals. The query returns the wave shape of output signals.
	:UUT_Z <NRf> :UUT_Z?	Select the impedance matching for the signal channels. A <NRf> value ≤ 55 selects 50 Ω , if > 55 it will select 1 M Ω . The query retrieves the impedance matching for the signal channels: The response will be 50 Ω or 1 M Ω . <i>Note</i> <i>The scope function on the 9100 did not have a selectable impedance setting for 'trigger out' - the see :ROUT:TRIG:IMP command for an alternative solution.</i>
	:TRANsition RISing FALLing :TRANsition?	Set the direction of the active edge to RISing or FALLing. The query returns the direction of the important edge returning RIS or FALL. <i>Note</i> <i>For 9540C Active Heads, the FALLing option is only available if the HV edge is selected.</i>
[:SOURce]:FUNCtion		Commands for active signal generation function.
	[:SHAPE] DC SQUare EDGE MARKer SINusoid OPULse TELevision LEAKage RAMP SKEW PWIDth EXTernal [:SHAPE]?	Select the source function using the wave shape descriptor of the output signal. This command is equivalent to SOURce:SCOpe but offers access to all the Product functions, and not just a sub-set. The query returns the active source function. Options are: DC, SQU, EDGE, MARK, SIN, OPUL, TEL, LEAK, RAMP, SKEW, PWID, EXT or NONE.
	[:LEVel][:IMMediate] [:AMPLitude] <NRf> [:LEVel][:IMMediate][:AMP Litude]?	Sets required output current amplitude. The query returns output current amplitude.

Command Form		Description
[:SOURce]:VOLTage		
	[:LEVel][:IMMediate] [:AMPLitude] <NRf> [:LEVel][:IMMediate] [:AMPLitude]?	Sets the required output voltage amplitude. The query returns output voltage amplitude.
[:SOURce]:FREQuency		
	[:CW FIXed] <NRf> [:CW FIXed]?	Set required output frequency. The query returns the output frequency.
[:SOURce]:WIDTh		
	[:CW FIXed] <NRf> [:CW FIXed]?	Set required output pulse width. The query returns the output pulse width.
[:SOURce]:PERiod		
	[:CW FIXed] <NRf> [:CW FIXed]?	Set required output period. CW and FIXed nodes are optional. The query returns the output period: CW or FIX.
[:SOURce]:SPERiod		For backward compatibility with Option 250 of the Wavetek Datron 9100 calibrator.
	[:CW FIXed] <NRf> [:CW FIXed]?	The same as [:SOURce]:PERiod. Sets required output period. CW and FIXed nodes are optional. The query returns output period: CW or FIX.
[:SOURce]:PARAmeter		The settings of the primary and auxiliary functions.
[:SOURce]:PARAmeter:DC		Sets DC source.
	:GROund ON OFF 1 0 :GROund?	ON or 1 - sets the output of the DC signal to zero (0 Vpk-pk). If you change the function, ground selection turns OFF. If ground is set ON while in another function, there is a conflict error. OFF or 0 - sets the output to the previous setting. The query returns ON or OFF depending on the state.

Command Form		Description
	:MCHannel ON OFF 1 0 :MCHannel?	Multichannel capability is always on. This command is for backwards compatibility. ON or 1 (no effect). OFF or 0 returns a settings conflict error. The query returns ON.
	:POLarity POSitive NEGative :POLarity?	POS - sets positive going signal magnitude. NEG - sets a negative going signal magnitude. If you set the polarity while in another function, there is a settings conflict error. The query returns the polarity of the DC signal POS or NEG.
[:SOURce]:PARAmeter:SQUare		Sets the square function source.
	:GROund ON OFF 1 0 :GROund?	ON or 1 - sets the output of the square wave signal to zero (0 Vpk-pk). If you change this function, the ground selection turns off. If you set ground ON while in another function there is a settings conflict error. OFF or 0 - sets the output to its previous setting. The query returns ON or OFF.
	:MCHannel ON OFF 1 0 :MCHannel?	Multichannel capability is always on. This command is for backwards compatibility. ON or 1 (no effect). OFF or 0 returns a settings conflict error. The query returns ON.
	:POLarity POSitive NEGative SYMMetrical :POLarity?	POS - sets positive going signal magnitude. NEG - sets a negative going signal magnitude. SYMM - sets a symmetrical about ground signal magnitude. If you set the polarity while in another function, there is a settings conflict error. The query returns the polarity of the square wave: POS, NEG or SYMM.

Command Form		Description
[:SOURce]:PARAmeter:SINusoid		Sets sinusiod signal source.
	:MCHannel ON OFF 1 0 :MCHannel?	Multichannel capability is always on. This command is for backwards compatibility. ON or 1 (no effect). OFF or 0 returns a settings conflict error. The query returns ON.
[:SOURce]:PARAmeter:EDGE		Sets edge signal source.
	:SPEed <NRf> :SPEed?	Sets the edge speed. A value >600E-12 selects 100 ns edge (HV edge). A value between 200E-12 and 600E-12 selects the 500 ps edge. A value <200E-12 selects the 125 ps edge. The query returns the edge speed.
	:TRANsition RISing FALLing :TRANsition?	This command is equivalent to SOURCe:SCOpe. RIS - sets the direction of the important edge to RISing. FALL - set the direction of the important edge to FALLing. The query returns the direction of the important edge: RIS or FALL. <i>Note</i> <i>For 9540C Active Heads, the FALLing option is only available if the HV edge is selected.</i>
[:SOURce]:PARAmeter:MARKer		Sets the time marker source.
	:WAVEform SQUare PULSe TRIangle LINE :WAVEform?	Set the waveform of the marker function. Options are: SQUare, PULSe, TRIangle or LINE. The query returns the waveform of the marker function. When queried in a invalid context the command returns NONE. For backward compatibility, the command also accepts WAVE as well as WAV.

Command Form		Description
	:HIGHlight ON OFF 1 0 :HIGHlight?	ON or 1 - enable a highlight in the output signal. The highlight is created by increasing the amplitude of every 10th peak. If LINE marker wave shape is selected, there is a settings conflict error. OFF or 0 - disables the highlight in the output signal. The query returns ON or OFF.
[:SOURce]:PARAmeter:OPULse		Sets the overload test source.
	:AMPLitude <NRf> :AMPLitude?	Set the amplitude of overload test. If OPULse function is not selected, the Product reports an error. The query returns the overload pulse amplitude.
	:ENERgy <NRf> :ENERgy?	Set the overload pulse energy. If OPULse function is not selected, the Product reports an error. The query returns the overload pulse energy.
	:DURation?	The query returns the overload pulse duration. In native mode, a value of 200E33 is reported if OPULse function has not been selected.
	:POWer?	The query returns the overload pulse power. In native mode, a value of NAN (not a number) is reported if OPULse function is not selected.
	:EXECute	Apply the overload pulse. If OPULse function is not selected, or the output is not ON, the Product reports an error.
	:TRIGger SINGle CONTInuous :TRIGger?	SINGLE - generate one trigger coincident with the start of overload signal. CONTInuous - generates a free running 100 Hz trigger. If OPULse function is not selected, the Product reports an error. The query returns the overload pulse trigger type.
[:SOURce]:PARAmeter:RAMP		Sets the source for the linear ramp function.
	:TIME(?) <NRf> :TIME?	Set the rise time of the ramp. This command does not set the frequency of the signal (this is 3x the ramp time). The command accepts values from 1 ms to 1 s rounded to nearest decade point with a deviation of at most 10 % from the allowed values (1 ms, 10 ms, 100 ms, 1 s). If RAMP function is not selected, the Product reports an error. The query will return the rise time of the ramp.

Command Form		Description
	:TRIGger START MIDDLE :TRIGger?	START - sets the trigger type to START. If RAMP function is not selected, the Product reports an error. MIDDLE - sets the trigger type to MIDDLE. If RAMP function is not selected, the Product reports an error. The query returns the active trigger type: STAR or MIDD.
[:SOURce]:PARAmeter:SKEW		Sets sources for the skew function.
	:ALIGNment DEFAULT PRECision :ALIGNment?	DEFAULT - sets the inter-channel skew to default (± 50 ps). PRECision - set the inter-channel skew to previously defined precision adjustments. The query returns the active alignment type DEF or PREC.
	:OFFSet CH1 CH2 CH3 CH4 CH5,<NR1> OFFSet?	Set the inter-channel skew offset to a value between -127 and +127. The default is zero. If the Active Head is not fitted and enabled the Product reports an error. The query returns the alignment offset for the requested channel. If the Active Head is not fitted, the query returns zero (0).
	:STORE	Saves all the alignment offset values to the non-volatile storage area.
[:SOURce]:PARAmeter:TELevision		Sets the source for the composite video function.
	:LINE <NRf> :LINE?	Set the line frequency standard of the TV composite video function. A <NRf> value <600 rounds to 525 (NTSC) and a value ≥ 600 rounds to 625 (PAL). If the TELevision function is not selected, the Product reports an error. The query returns the active line frequency standard of the TV composite video function: 525 or 625.
	:SYNC COMPosite FRAMe :SYNC?	COMPosite - sets the full composite sync standard. If the TELevision function is not selected, the Product reports an error. SYNC FRAMe - sets the frame sync standard. If the TELevision function is not selected, the Product reports an error. The query returns the active sync standard: COMP or FRAM.

Command Form		Description
	:LEVel BLACK GREY WHITE :LEVel?	BLACK - sets the black level amplitude. GREY - sets the midl evel amplitude. WHITE - sets the whitel evel amplitude. The query returns: BLAC, GREY or WHIT.
	:POLarity POSitive NEGative :POLarity?	POSitive - sets the polarity of TV waveform in POS direction. NEGative - sets the polarity of TV waveform in NEG direction. The query returns the active amplitude level: POS or NEG.
[:SOURce]:PARAmeter:EXTernal		Select the auxiliary input signal.
[:SOURce]:PARAmeter:LEAKage		Select the leakage signal.
	:STATe OPEN CLOSe :STATe?	OPEN - set open-circuit output. If the LEAKage function is not selected the Product reports an error. CLOSe - set closed-circuit output. If the LEAKage function is not selected the Product reports an error. The query returns the active state: OPEN or CLOS.
	:TRIGger SINGle CONTInuous :TRIGger?	SINGle - set the Product to generate one trigger coincident with each change of state of the open or close. CONTInuous - sets the Product to generate a free running (100 Hz) trigger signal. The query returns the active trigger type: SING or CONT.
[:SOURce]:CURRent		
	[:LEVel][:IMMediate] [:AMPLitude] <NRf> [:LEVel][:IMMediate] [:AMPLitude]?	Sets required output current amplitude. The query returns output current amplitude.
[:SOURce]:WIDTh		
	[:CW FIXed] <NRf> [:CW FIXed]?	Set required output pulse width. The query returns the output pulse width.

Status Function

Functions related to system status.

Command Form		Description
:STATus:PRESet:OPERation		Clears all the EVENT:ENABLE registers of the OPERation and QUESTionable status structures, (The command sets all values to zero). The standard Event Enable registers are not affected.
	:CONDition?	The query returns the contents of the condition register associated with the status structure defined in the command. Reading the condition register is nondestructive.
	:ENABLE <NRf> :ENABLE?	Sets the enable mask which allows true conditions in the event register to be reported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition occurs in the associated summary bit. The command accepts parameter values of either format in the range 0 through 65535. The query returns the enable mask value in the form <NR1>.
	[:EVENT]?	The query returns the contents of the <i>operation event</i> register clearing the register.
:STATus:QUESTionable		
	:CONDition?	The query returns the contents of the <i>condition register</i> associated with the status structure defined in the command. Reading the condition register is nondestructive.
	:ENABLE <NRf> :ENABLE?	Sets the questionable mask which allows true conditions in the event register to be reported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition will occur in the associated summary bit. The command accepts parameter values of either format in the range 0 through 65535. The query returns the questionable mask value in the form <NR1>.
	[:EVENT]?	The query returns the contents of the <i>questionable event</i> register clearing the register.

SYSTem Function

Collects the functions that are not related to performance.

Command Form		Description
SYSTem:		
	:ERRor?	The query returns the next error on the queue. The queue is read destructively.
	:FORMat?	The query returns the date format as: DMY (day, month, year), MDY (month, day, year) or YMD (year, month, day). <i>Note</i> <i>This returns the date format displayed on-screen, plus the format used when you query calibration adjustment dates, (see the ROUTe:FITted? command). The SCPI 'SYSTem' command tree only uses the format specified by SCPI-99, (typically year,month,day).</i>
	:DATE yyyy,mm,dd	Sets the date in the format: yyyy,mm,dd.
	:DATE?	The query returns the date in the format: yyyy,mm,dd.
	:TIME hh,mm,ss	Sets the time with the format: hh,mm,ss.
	:TIME?	The query returns the time in the format: hh,mm,ss.
	:VERSion?	The query returns the SCPI version of the Product.
	:SKEW?	The query returns the SKEW data as a comma separated list: ● Field 1 - Total number of channels supported by base. ● Field 2 - Comma separated list of active channel flags: The length of the list is set by Field 1. ○ 1 - indicated channel is selected. ○ 0 - indicates channel inactive. ● Field 3 - Comma separated list of skew values: signed 8 bit integers representing skew timing correction, value is zero if channel inactive. The length of the list is set by Field 1. ● Field 4 - Comma separated list of head serial numbers: if channel is inactive the string is NO HEAD The length of the list is set by Field 1. For example, if all five channels are activated, but no heads fitted, SYSTem:SKEW? response is: 5,1,1,1,1,1,0,0,0,0,NO HEAD,NO HEAD,NO HEAD,NO HEAD,NO HEAD.

Command Form		Description
	SVOLTage <NRf> SVOLTage?	Set the Safety Voltage, an unused legacy value, to a floating point value of range 10 V to 110 V (100 V default). The query returns the Safety Voltage.

DIAGnostic Function

Contains fault and instrument condition diagnostic commands.

Command Form		Description
:DIAGnostic:BASE		
	:REVision?	Returns comma separated fields for: - Outguard firmware version - Outguard firmware build id, (a timestamp in YYYYMMDD) - Inguard firmware version - Frontpanel firmware version
	:MEMory?	Returns comma separated fields for: - Outguard firmware RAM used - Outguard firmware RAM available
:DIAGnostic:HEAD<NR1>		The value <NR1> selects the channel, (this value can be 1 to 5). If the requested channel is not fitted the Product displays an error. The query returns the total number of tests to be performed.
	:REVision?	Returns comma separated fields for: Active Head firmware version
:DIAGnostic:RELay		
	:GROups?	Returns the number of relay groups that can be queried for relay usage data. A group is a hardware module, for example, LF and DC board (A6) on the base unit or an Active Head assembly.
	:RESults?<NR1>	The query returns the usage data of the base unit as a comma separated list: - Field 1 - <SPD> the group name - Field 2 - <SPD> the relay name of the first relay - Field 3 - <NR1> shows the relay count of the first relay - The data format used by Field 1 and Field 2 is repeated for the remaining relay definitions in the group. The group list is terminated by a line terminator.

CALibration Function

Contains instrument-adjustment functions used to calibrate the hardware. Use this function to correct for any system errors due to drift or aging effects.

Command Form		Description
:CALibration:SECure		
	:PASSword <SPD>	Unlock the calibration commands. Use this to make and save calibration adjustments to non-volatile storage. You can only change the user calibration password in the setup UI menu.
:CALibration:EXIT		Disable adjustment mode, canceling any active adjustment commands and clearing any unsaved calibration store data. The remote user password used for adjustment is the same as the user interface, (defaults to 9500, but can be changed by the owner of the instrument).
:CALibration:STORe		
	:ACCept?	Applies the selected adjustment. After the adjustment set point parameters are set, (use :STEP and :ADJust), this command initiates the internal calibration process which applies the adjustment to the hardware configuration. 0 indicates success 1 indicates failure (an error message is put in the error queue)
:CALibration:STORe:BASE		
	:VERSion?	Returns the version number of the calibration store map as an <NR2> value, (for example "1.00").
	FIRMware[:VERSion]?	Returns comma separated fields representing: • Out-guard firmware version as an <SPD>string • In-guard firmware version as an <SPD>string
	:SERial <SPD> :SERial?	The query returns the serial number of the base unit as a <SPD>, for example 123456789. If a serial number has not been set the query returns 0.
	:DATE?	Returns the last stored adjustment date in the format: yyyy,mm,dd

Command Form		Description
	:SAVE	Saves the data modified by the last set of base unit adjusts. This includes updating the adjustment data stamp for the base unit calibration stores. The date used shall be read from the internal realtime clock. If there is a file system error, an error message is added to the error queue.
:CALibration:STORe:BASE[:TARGet]		
	:COUNT?	Returns the number of adjustment points available in the base unit's calibration map as an <NR1> value.
	:STEP <NR1> :STEP?	Set the active target point. The query returns the active adjustment step as an integer. If the step number is not in the calibration map, or there is a file system error, an error is added to the queue.
	:DESCRiption?	Returns a short description of the purpose of the target point as a <SPD> string. For example: 30 V DC Positive Range Gain
	:VALue?	Returns the target value as a <NRf>. The target value is typically an amplitude setting but can also be a trim DAC bit pattern, or a ratiometric value.
	:FREQuency?	Returns the target frequency. If the target point does not require a frequency setting the value SCPI <NAN> is returned.
	:ADJust <NRf> :ADJust?	Sets a new actual target value. The value is not applied to the hardware until the :CALibration:STORe:ACcept? command is sent. The value is not permanently recorded in the non-volatile calibration stores until the :CALibration:STORe:SAVE command is sent.
:CALibration:STORe :HEAD<NR1>		For ":HEAD<NR1>" The value <NR1> selects the channel, (From 1 to 5). If the requested channel is not fitted an error is posted to the error queue.
	:VERSion?	Returns the version number of the calibration store map of the selected head as an <NR2> value. For example: 1.00.
	:FIRMware[:VERSion]?	Returns the calibrated firmware version for the Active Head.

Command Form		Description
	:SERial <SPD> :SERial?	The query returns head serial number as a <SPD>, for example 123456789. If a serial number has not been set the query returns 0.
	:DATE?	Return the last stored adjustment date in the following SCPI format: yyyy,mm,dd
	:SAVE	Saves the data modified by the last set of head adjusts for the selected channel. This includes updating the adjustment data stamp for the head calibration stores. The date is read from the internal real-time clock.
	:CHARacterize? DAC	Executes the selected adjustment characterization operation. The command returns a 0 for success, and 1 for failure (and an error message is put in the error queue). The results of this operation are permanently recorded in the non-volatile calibration stores, so :CALibration:STORe:SAVE is not needed. :CALibration:STORe:ACcept? command is also not required.
	:CALibration:STORe :HEAD<NR1>[:TARGeT]	The value <NR1> selects the channel. Where NR1 is 1 to 5.
	:COUNT?	If the requested channel is not fitted a an error is added to the error queue. The command returns the number of adjustment points available in the head's calibration map as an <NR1> value.
	:STEP <NR1> :STEP?	Sets the active target point. The query returns an integer representing the active adjustment step. If the step number is not in the calibration map an error is posted to the error queue. If there is a file system error, an error message is added to the error queue.
	:DESCription?	Return a short description of the purpose of the target point as a <SPD> string. For example "LF Sine Amplitude Gain".

Command Form		Description
	:VALue?	Returns the target value as a <NRf>. The target value is typically an amplitude setting but can also be a trim DAC bit pattern, or a ratiometric value.
	:FREQuency?	Returns the target frequency. If the target point does not require a frequency setting the value SCPI <NAN> is returned.
	:ADJust <NRf> :ADJust?	Sets a new actual target value. This value is not applied to the hardware until the :CALibration:STORe:ACcept? command is sent. This value is not permanently recorded in the non-volatile calibration stores until the :CALibration:STORe:SAVE command is sent.
:CALibration:STORe:VREference		
	:SAVE	Save the date modified by the last set of voltage reference adjusts for the selected channel.
:CALibration:STORe :VREference[:TARGet]		
	:COUNT?	Returns the number of adjustment points available in the calibration map of the Active Head as an <NR1> value.
	:STEP <NR1> :STEP?	Sets the active target point. The query returns an integer representing the active adjustment step.
	:DESCription?	Return a short description of the purpose of the target point as a <SPD> string.
	:VALue?	Returns the target value as a <NRf>.
	:ADJust <NRf> :ADJust?	Sets a new actual target value.

Error Messages

As errors in the Product are detected, they are placed in a *first in, first out* queue, called the *Error Queue*. These error types are reported in the Error Queue, in the sequence that they are detected:

- Command errors
- Execution errors
- Device-Specific errors

Reading the Error Queue

The queue is read destructively. Use the query command `SYSTem ERRor?` to obtain a code number and error message. Use the query `SYSTem ERRor?` to read errors in the queue until it is empty, when the message '0, No Error' is returned.

IEEE488.2 Command Errors

(-199 to -100)

Table 6. IEEE 488.2 Command Errors

Error Code	Description
-100	Command error
-102	Syntax error
-103	Invalid separator
-104	Data type error
-105	GET not allowed
-108	Parameter not allowed
-109	Missing parameter
-113	Undefined header
-114	Header suffix out of range
-115	Unexpected number of parameters
-120	Numeric data error
-121	Invalid character in number
-123	Exponent too large
-150	String data error

IEEE488.2 Execution Errors

(-299 to -200)

Table 7. Execution Errors

Error Code	Description
-200	Execution error
-220	Parameter error
-221	Settings conflict
-222	Data out of range

IEEE488.2 Device Errors

(-399 to -300)

Table 8. Device Errors

Error Code	Description
-300	Device specific error
-310	System error

IEEE488.2 Query Errors

(-499 to -400)

Table 9. Query Errors

Error Code	Description
-400	Query error
-410	Query INTERRUPTED
-420	Query UNTERMINATED
-430	Query DEADLOCKED
-440	Query UNTERMINATED after indefinite response

Device Dependent Errors

In-guard operational errors are reported as non-fatal System errors (code -310), with the details of the error reported using the semi-colon ';' separator SCPI error style.

Outside frequency range

Outside frequency range for CH 1

Outside frequency range for CH 2

Outside frequency range for CH 3

Outside frequency range for CH 4

Outside frequency range for CH 5

Outside amplitude range

Outside amplitude range for CH 1

Outside amplitude range for CH 2

Outside amplitude range for CH 3

Outside amplitude range for CH 4

Outside amplitude range for CH 5

Unsupported function
Unsupported function for CH 1
Unsupported function for CH 2
Unsupported function for CH 3
Unsupported function for CH 4
Unsupported function for CH 5
Invalid DUT load
Invalid DUT load for CH 1
Invalid DUT load for CH 2
Invalid DUT load for CH 3
Invalid DUT load for CH 4
Invalid DUT load for CH 5
Invalid polarity
Invalid polarity for CH 1
Invalid polarity for CH 2
Invalid polarity for CH 3
Invalid polarity for CH 4
Invalid polarity for CH 5
Selected rising edge not available for CH 1
Selected rising edge not available for CH 2
Selected rising edge not available for CH 3
Selected rising edge not available for CH 4
Selected rising edge not available for CH 5
Selected falling edge not available for CH 1
Selected falling edge not available for CH 2
Selected falling edge not available for CH 3
Selected falling edge not available for CH 4
Selected falling edge not available for CH 5
Unsupported edge speed
Unsupported edge speed for CH 1
Unsupported edge speed for CH 2

Unsupported edge speed for CH 3
Unsupported edge speed for CH 4
Unsupported edge speed for CH 5
Invalid waveshape
Outside pulse width range
Invalid ramp time
Minimum limit
Maximum limit
Outside period range
Maximum frequency for waveform is 111.11 MHz
Maximum frequency for waveform is 1.11 MHz
Invalid parameter
Invalid parameter for CH 1
Invalid parameter for CH 2
Invalid parameter for CH 3
Invalid parameter for CH 4
Invalid parameter for CH 5
Unsupported Ext Ref In Frequency
Unsupported Ref Out Frequency
Trigger channel out of range
Signal channel out of range
Cable channel out of range
No head present on channel 1
No head present on channel 2
No head present on channel 3
No head present on channel 4
No head present on channel 5
Channel already in use
At least one signal channel must be selected
Wait safety delay
Unsupported trigger divider

Maximum amplitude for 50 Ohm load

Selected heads not compatible for multi-channel use

Output must be ON

The set-point is not adjustable for this step

A head must be fitted to adjust the base unit

Perform Voltage Reference setup before other adjustments

Base unit must be adjusted before adjusting heads

Operation only available in Adjust

Operation only available in Self-test

Not available

Unknown pathway

CH 1 load mismatch detected: DUT load <50 kOhm

CH 2 load mismatch detected: DUT load <50 kOhm

CH 3 load mismatch detected: DUT load <50 kOhm

CH 4 load mismatch detected: DUT load <50 kOhm

CH 5 load mismatch detected: DUT load <50 kOhm

CH 1 load mismatch detected: DUT load <5 kOhm

CH 2 load mismatch detected: DUT load <5 kOhm

CH 3 load mismatch detected: DUT load <5 kOhm

CH 4 load mismatch detected: DUT load <5 kOhm

CH 5 load mismatch detected: DUT load <5 kOhm

CH 1 load <50 kOhm detected, output forced off to avoid damage

CH 2 load <50 kOhm detected, output forced off to avoid damage

CH 3 load <50 kOhm detected, output forced off to avoid damage

CH 4 load <50 kOhm detected, output forced off to avoid damage

CH 5 load <50 kOhm detected, output forced off to avoid damage

CH 1 load <5 kOhm detected, output forced off to avoid damage

CH 2 load <5 kOhm detected, output forced off to avoid damage

CH 3 load <5 kOhm detected, output forced off to avoid damage

CH 4 load <5 kOhm detected, output forced off to avoid damage

CH 5 load <5 kOhm detected, output forced off to avoid damage

CH 1 load mismatch detected: DUT load >150 Ohm

CH 2 load mismatch detected: DUT load >150 Ohm

CH 3 load mismatch detected: DUT load >150 Ohm

CH 4 load mismatch detected: DUT load >150 Ohm

CH 5 load mismatch detected: DUT load >150 Ohm

Frequency range not found

Amplitude range not found

Amplitude range not found for CH 1

Amplitude range not found for CH 2

Amplitude range not found for CH 3

Amplitude range not found for CH 4

Amplitude range not found for CH 5

Warning: Base unit using default adjustment stores

Warning: Head 1 using default adjustment stores

Warning: Head 2 using default adjustment stores

Warning: Head 3 using default adjustment stores

Warning: Head 4 using default adjustment stores

Warning: Head 5 using default adjustment stores

Warning: Head 1 not characterized

Warning: Head 2 not characterized

Warning: Head 3 not characterized

Warning: Head 4 not characterized

Warning: Head 5 not characterized

Warning: Head 1 is neither characterized nor adjusted

Warning: Head 2 is neither characterized nor adjusted

Warning: Head 3 is neither characterized nor adjusted

Warning: Head 4 is neither characterized nor adjusted

Warning: Head 5 is neither characterized nor adjusted

Error when writing to NV stores

Head firmware update in progress

Head firmware update not in progress

Head firmware update already in progress

Invalid firmware record format

No response from head 1

No response from head 2

No response from head 3

No response from head 4

No response from head 5

Bad checksum from head 1

Bad checksum from head 2

Bad checksum from head 3

Bad checksum from head 4

Bad checksum from head 5

Communications overrun from head 1

Communications overrun from head 2

Communications overrun from head 3

Communications overrun from head 4

Communications overrun from head 5

Unknown Error from head 1

Unknown Error from head 2

Unknown Error from head 3

Unknown Error from head 4

Unknown Error from head 5

Head 1 reports checksum failure

Head 2 reports checksum failure

Head 3 reports checksum failure

Head 4 reports checksum failure

Head 5 reports checksum failure

Head 1 reports timeout

Head 2 reports timeout

Head 3 reports timeout

Head 4 reports timeout

Head 5 reports timeout

Head 1 reports unconfigured

Head 2 reports unconfigured

Head 3 reports unconfigured

Head 4 reports unconfigured

Head 5 reports unconfigured

Head 1 reports unconfigured

Head 2 reports unconfigured

Head 3 reports unconfigured

Head 4 reports unconfigured

Head 5 reports unconfigured

Head 1 reports unknown command

Head 2 reports unknown command

Head 3 reports unknown command

Head 4 reports unknown command

Head 5 reports unknown command

Head 1 reports bad command parameter

Head 2 reports bad command parameter

Head 3 reports bad command parameter

Head 4 reports bad command parameter

Head 5 reports bad command parameter

Head 1 reports invalid state

Head 2 reports invalid state

Head 3 reports invalid state

Head 4 reports invalid state

Head 5 reports invalid state

Head 1 reports unknown query type

Head 2 reports unknown query type

Head 3 reports unknown query type

Head 4 reports unknown query type

Head 5 reports unknown query type

Head 1 reports NV write failure
Head 2 reports NV write failure
Head 3 reports NV write failure
Head 4 reports NV write failure
Head 5 reports NV write failure
Head 1 firmware updater reports invalid address
Head 2 firmware updater reports invalid address
Head 3 firmware updater reports invalid address
Head 4 firmware updater reports invalid address
Head 5 firmware updater reports invalid address
Head 1 firmware updater reports invalid size
Head 2 firmware updater reports invalid size
Head 3 firmware updater reports invalid size
Head 4 firmware updater reports invalid size
Head 5 firmware updater reports invalid size
Head 1 firmware updater reports context error
Head 2 firmware updater reports context error
Head 3 firmware updater reports context error
Head 4 firmware updater reports context error
Head 5 firmware updater reports context error
Head 1 firmware updater reports erase failure
Head 2 firmware updater reports erase failure
Head 3 firmware updater reports erase failure
Head 4 firmware updater reports erase failure
Head 5 firmware updater reports erase failure
Head 1 firmware updater reports write failure
Head 2 firmware updater reports write failure
Head 3 firmware updater reports write failure
Head 4 firmware updater reports write failure
Head 5 firmware updater reports write failure
Head 1 firmware updater reports checksum fail

Head 2 firmware updater reports checksum fail

Head 3 firmware updater reports checksum fail

Head 4 firmware updater reports checksum fail

Head 5 firmware updater reports checksum fail

Non-Fatal Limits and Ranges Errors

Device-specific error range (1000 to 1999)

Table 10. Non-Fatal Limits and Ranges Errors

Error Code	Description
1000	Minimum limit
1001	Maximum limit
1002	Outside amplitude range
1003	Outside frequency range
1004	Outside deviation range
1005	Outside pulse width range
1006	Outside skew range
1007	Outside bus range
1008	Outside loop count range
1009	No further display ranges

Non-Fatal Out-Guard Execution/Operation Errors

Device-specific error range (2000 to 2999)

Table 11. Non-fatal Limits and Ranges Errors

Error Code	Description
2000	Operation unavailable in this context
2001	Operation only available for base adjustment
2002	Operation unavailable when in adjustment mode
2003	Password incorrect
2004	Failed to save changes
2005	Failed to retrieve setting
2006	You are already in Setup
2007	No USB device present, or is unreadable

Table 11. Non-fatal Limits and Ranges Errors (cont.)

Error Code	Description
2008	Data saved - the storage device can be removed...
2009	Please exit Selftest Pathway first
2010	Selftest configuration failed
2011	Head Firmware Update Failed
2012	Initialization Failed
2013	Check fans
2014	Skew data stored
2015	Skew configuration failed
2016	Relay count access failed
2017	Unable to update the real time clock
2018	Cannot locate the real time clock device
2019	Database access error
2020	Front panel communication error

Non-Fatal Head/Channel Access Errors

Device-specific error range (3000 to 3999)

Table 12. Non-fatal Head/Channel Access Errors

Error Code	Description
3000	No heads present to test
3001	Active head not present on channel 1
3002	Active head not present on channel 2
3003	Active head not present on channel 3
3004	Active head not present on channel 4
3005	Active head not present on channel 5
3011	Invalid channel requested
3012	Invalid internal channel state

Non-Fatal Instrument Adjust Errors

Device-specific error range (4000 to 4999)

Table 13. Non-fatal Head/Channel Access Errors

Error Code	Description
4000	Adjustment mode not enabled
4001	Adjustment not accepted
4002	Adjustment accepted
4003	Adjustment value invalid
4004	Failed to save adjustments
4005	Adjustments stored
4006	Failed to discard adjustment data
4007	Invalid adjustment point
4008	Invalid adjustment point record contents
4009	Invalid adjustment data request
4010	Failed to configure adjustment point
4011	Please exit instrument adjustment first
4012	Failed to start characterization

Fatal Device-Specific Errors

Device-specific error range (5000 to 5999)

Table 14. Fatal Device-Specific Errors

Error Code	Description
5001	State is not set
5002	Unable to create TCP/IP connection
5003	Unable to create internal serial connection
5004	Internal communications error
5005	CRC checksum error