FLUKE®
Calibration

9500B

High Performance Oscilloscope Calibrator

Remote Commands Manual

November 2019

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11/99

Table of Contents

Title **Page**

Introduction

The Model 9500B is a state-of-the-art calibrator offering oscilloscope test and calibration capabilities from a single source, providing wide functionality (shown in Figure 1). (Variant 9500B/1100 is described—for other variants, refer to the *9500B Extended Specifations*. See *Specifications*.)

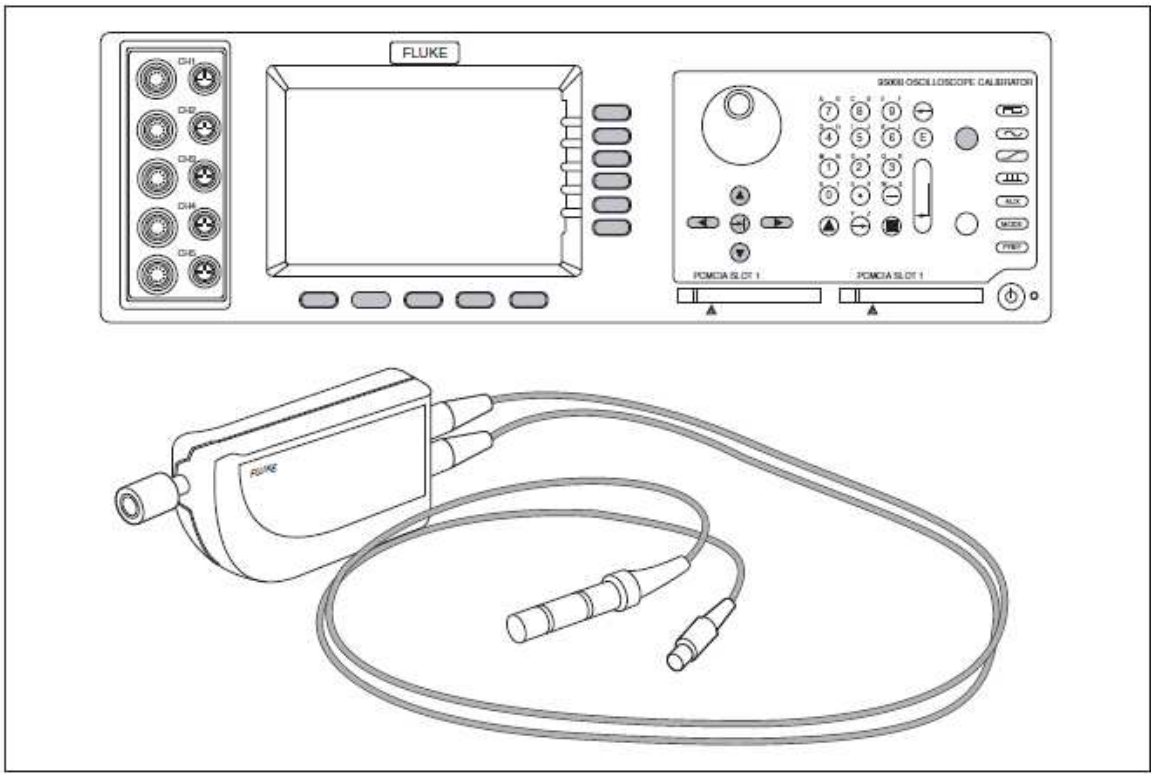

Figure 1. General View of Model 9500B with an Active Head

Contact Fluke Calibration Calibration

To contact Fluke Calibration Calibration, call one of the following telephone numbers:

- Technical Support USA: 1-877-355-3225
- Calibration/Repair USA: 1-877-355-3225
- Canada: 1-800-36-FLUKE (1-800-363-5853)
- Europe: +31-40-2675-200
- Japan: +81-3-6714-3114
- Singapore: +65-6799-5566
- China: +86-400-810-3435
- Brazil: +55-11-3759-7600
- Anywhere in the world: +1-425-446-6110

To see product information and download the latest manual supplements, visit Fluke Calibration Calibration's website at www.flukecal.com.

To register your product, visit http://flukecal.com/register-product.

Safety Information

A **Warning** identifies conditions and procedures that are dangerous to the user. A **Caution** identifies conditions and procedures that can cause damage to the Product or the equipment under test.

General Safety Information is located in the printed Safety Information document that ships with the Product. It can also be found online at www.flukecal.com. More specific safety information is listed where applicable.

Product Use

User instructions for Product operation are located in these manuals at www.flukecal.com:

- *9500B Operators Manual*
- *9500B Users Guide*

Product Maintenance

Instructions for Product maintenance, verification, and calibration are located in this manual at www.flukecal.com:

- *9500B Calibration Manual*

Specifications

Safety Specifications are located in the Safety Specifications section of the *9500B Safety Sheet*. Complete specifications are at www.flukecal.com. See the *9500B Extended Specifications.*

About this Manual

This manual describes the environment in which the Model 9500B will operate in remote applications, using the SCPI (Standard Commands for Programmable Instruments) language, within the IEEE-488.1 remote interface. We shall show how the 9500B adopts the IEEE-488.2 message-exchange model and reporting structure, and define the SCPI commands and syntax used to control the 9500B.

Index of IEEE 488.2 and SCPI Codes used in the 9500B

Common IEEE 488.2 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, etc
*OPC	Sets the 9500B to monitor the 'No-Operations-Pending' flag
*OPC?	For 'No-Operations-Pending' flag 'TRUE', places a 1 in the Output Queue
*OPT?	Recalls the instrument's option configuration
*PSC 0/1	Sets/resets power-on status clear flag
*PSC?	Recalls power-on status clear flag
*PUD	Allows entry of user data to protected store
*PUD?	Recalls user-entered data
*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	Conforms, but little relevance to 9500B application

9500B SCPI Subsystems

CALibration:	Used to calibrate the functions and hardware ranges of the 9500B, correcting for system errors which have accumulated due to drift and aging effects	
	SECure	:PASSword. Gains access to Calibration operations, using 'Cal Enable' switch and Password
		:EXIT. Permits clean exit from calibration operation
	TARGet	Sets up the calibration target point
	TRIGger?	Initiates the calibration at a single point (TARGet), once the target and levels have been set up, and returns '0' for pass, and '1' for fail
	SPECial	Runs various calibration characterizations, calculations and procedures
	HEAD:STORe?	Initiates storage of head calibration data
OUTPut	Used to control parameters associated with output connections:	
	[STATe] (?)	Controls output on/off switching
ROUTe	Used to define the output channels which are associated with signal and trigger outputs:	
	FITTed?	Returns the type of head or cable or neither, associated with each channel
	SIGNal[:PATH]	Defines the channel to be used as signal output path
	SIGNal:IMPedance	Defines the expected load impedance of the selected signal channel
	SIGNal:SKEW	Defines and selects the signal channels to be used in Skew function
	SIGNal:DUAL	Used in Sine function. Selects the two signal channels to be used in Dual operation
	TRIGger[:PATH]	Defines the channel to be used as trigger output path
	TRIGger:IMPedance	Defines the expected load impedance of the selected trigger channel
	TRIGger:RATio(?)	Sets the ratio of trigger to signal frequency: ÷1, ÷10, ÷100

[SOURce]	Used to select the main 9500B Function to be output:		
	:FUNCtion	Selects the Waveshape of output signals	
	:SCOPe	Backward compatibility with 9100 Opt. 250	
		[:SHAPe](?)	Selects the Waveshape of output signals
		:TRANsition(?)	Selects the direction of the important edge
		:UUT_Z(?)	Selects impedance matching for signal and trigger channels
		:SPERiod(?)[:CW|FIXed](?)	Sets the period of the currently-selected waveform
	:PARameter	:DC	Subsequent selection of VOLT or CURR will have DC component only
		:DC:GROund	Subsequent output of VOLT or CURR will be grounded
		:DC:MCHannel	Enables/disables multichannel output
		:SQUare	Subsequent selection of VOLT or CURR will have square waveshape
		:SQUare:POLarity	Sets the polarity of the selected squarewave
		:SQUare:GROund	Subsequent output of VOLT or CURR will be grounded

:EDGE	Sets edge direction and speed in 'Edge' function
:MARKer	Sets waveforms in 'Timing Marker' function
:OPULse	Sets the pulse amplitude and energy used to test overload protection of oscilloscopes and executes transmission
:RAMP	Sets ramp time and trigger point in 'Linear Ramp' function
:SKEW	Enables/disables precision alignment in Zero Skew function
:TELevision	Selects TV line standard, sync standard, video level and polarity in Composite Video function
:LEAKage	Selects open/closed conditions and triggers used to determine the UUT oscilloscope's input leakage current
:EXTernal	Selects the 'Auxiliary Input' signal

	VOLTage	Selects the Voltage source, and sets output amplitude
	CURRent	Selects the Current source, and sets output amplitude
	FREQuency	Controls the Output Frequency value for AC functions
	PERiod	Controls the Output Period value for AC functions
	WIDTh	Controls the width of the pulse for Pulse Width functions
CONFigure	Selects the resistance or capacitance measurement function	
READ?	Returns the most-recent resistance or capacitance measurement value	
STATus	Gives access to the 9500B SCPI-defined Status Reporting Structure:	
	OPERation	Reads from, or writes to, the OPERation Status Register
	QUEStionable	Reads from, or writes to, the QUEStionable Status Register
	PRESet	Presets a default status reporting condition
SYSTem	Collects general functions that are not related to 9500B performance:	
	ERRor?	Requests the next entry from the 9500B error queue
	DATE(?)	Reads or writes the present date
	TIME(?)	Reads or writes the present time
	SVOLtage(?)	Reads or writes the Safety Threshold Voltage in DC or AC Voltage function
	VERSion?	Returns a numeric value corresponding to the SCPI version for which the instrument complies
	FORMat?	Returns the present date format, as programmed locally
REFerence	Configures the input and output reference frequencies	

Introduction

This first section gives the information necessary to put the 9500B into operation on the IEEE 488 bus. For more detailed information, refer to the standard specification in the publications ANSI/IEEE Std. 488.1-1987 and IEEE Std. 488.2-1988.

Interface Capability

IEEE Standards 488.1 and 488.2

The 9500B conforms to the Standard Specification IEEE 488.1-1987: 'IEEE Standard Digital Interface for Programmable Instrumentation', and to IEEE 488.2-1988: 'Codes, Formats, Protocols and Common Commands'.

The 9500B in IEEE 488.2 Terminology

In IEEE 488.2 terminology the 9500B is a device containing a system interface. It can be connected to a system via its system bus and set into programmed communication with other bus-connected devices under the direction of a system controller.

Programming Options

The instrument can be programmed via the IEEE Interface, to:

- Change its operating state (Function, Source, etc)
- Transmit its own status data over the bus
- Request service from the system controller

Capability Codes

To conform to the IEEE 488.1 standard specification, it is not essential for a device 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 their own interfaces' overall capability. For IEEE 488.2, this description is required to be part of the device documentation. A code string is often printed on the product itself.

The codes which apply to the 9500B are given in Table 1, together with short descriptions.

They also appear on the rear of the instrument next to the interface connector. These codes conform to IEEE 488.2 requirements.

Table 1. 9500B IEEE 488.1 Interface Capability

IEEE 488.1 Subset	Interface 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 (incl. Local Lockout)
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

IEEE 488.2 Common Commands and Queries Implemented in the Model 9500B of the IEEE 488.1 document contains a fuller description of each code.

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.

The 9500B has two primary addresses (refer to *Model 9500B — Emulation of Tektronix SG5030 and CG5010/5011, Change the Bus Address*), which can be set by the user to exclusive values within the range from 0 to 30 inclusive. They cannot be made to respond to any address outside this range. Secondary addressing is not available. The application program adds data to the active address, to define 'talk' or 'listen'. The method of setting addresses, and the point at which the new user-initiated address is recognized by the 9500B, is given in section Addressing the 9500B.

Limited Access

The 9500B has five main modes, which are described briefly in the *9500B Users Guide, Operating Modes*. Remote operation is subject to the following limitations:

- Procedure Mode: When the 9500B is in Procedure Mode, it is driven essentially from the front panel. Remote Operation will not be allowed in this mode.

Note

The 9500B can be powered up in either Manual mode or Procedure mode, as set locally in Configuration mode.

- Manual Mode: Remote operation is available for each Manual mode function, but for ease of programming, some remote commands do not mirror front panel operations exactly.
- Configuration Mode: Remote operation is not available, and configuration commands have not been included in the SCPI commands for the 9500B.
- Calibration Mode: Remote operation is available, but refer to CALibration Subsystem for details of entry protection.

- Test Mode: Remote operation is not available, but the 'Full' selftest can be initiated by a SCPI command. The 9500B will give a Pass/Fail response, but to investigate further, it is necessary to re-run Test mode from the front panel.

Interconnections

Instruments fitted with an IEEE 488 interface communicate with each other through a standard set of interconnecting cables, as specified in the IEEE 488.1 Standard document.

The IEEE-488 interface socket is fitted on the rear panel. It accommodates the specified connector, whose pin designations are also standardized as shown in Table 2

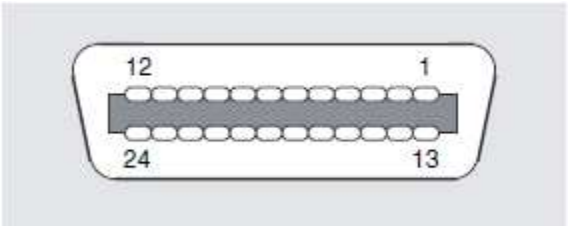

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Figure 2. IEEE-488 Interface Socket - Pin Layout

Table 2. Connector J101 - Pin Designations

Pin No.	Name	Description
1	DIO 1	Data Input/Output Line 1
2	DIO 2	Data Input/Output Line 2
3	DIO 3	Data Input/Output Line 3
4	DIO 4	Data Input/Output Line 4
5	EOI	End or Identify
6	DAV	Data Valid
7	NRFD	Not Ready For Data
8	NDAC	Not Data Accepted
9	IFC	Interface Clear
10	SRQ	Service Request
11	ATN	Attention
12	SHIELD	Screening on cable (connected to 9500B safety ground)
13	DIO 5	Data Input/Output Line 5
14	DIO 6	Data Input/Output Line 6
15	DIO 7	Data Input/Output Line 7
16	DIO 8	Data Input/Output Line 8
17	REN	Remote Enable
18	GND 6	Gnd wire of DAV twisted pair
19	GND 7	Gnd wire of NRFD twisted pair
20	GND 8	Gnd wire of NDAC twisted pair
21	GND 9	Gnd wire of IFC twisted pair
22	GND 10	Gnd wire of SRQ twisted pair
23	GND 11	Gnd wire of ATN twisted pair
24	GND	9500B Logic Ground (internally connected to Safety Ground)

SCPI Programming Language

Instruments (SCPI) is an instrument command language which goes beyond IEEE 488.2 to address a wide variety of instrument functions in a standard manner.

IEEE 488.2 defines sets of Mandatory Common Commands and Optional Common Commands along with a method of Standard Status Reporting. The 9500B implementation of SCPI language conforms with all IEEE-488.2 Mandatory Commands but not all Optional Commands. It conforms with the SCPI approved Status Reporting method.

Note

*Commands in SCPI language, prefaced by an asterisk (eg: *CLS), are IEEE-488.2 standard-defined 'Common' commands.*

Conformance of the 9500B remote programming commands to SCPI ensures that the 9500B has a high degree of consistency with other conforming instruments. 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.

SCPI commands are easy to learn, self explanatory and account for a wide variety of usage skills. A summary of the 9500B commands is given in Index of IEEE 488.2 and SCPI Codes used in the 9500B. The full range of 9500B commands, with their actions and meanings in the 9500B, is detailed in alphabetical order in 9500B SCPI Language - Commands and Syntax, with conformance information in *IEEE 488.2 Common Commands and Queries Implemented in the Model 9500B* to this section. The IEEE-488 Common Commands implemented in the 9500B, together with their operating information are given in *IEEE 488.2 Common Commands and Queries Implemented in the Model 9500B*.

Using the 9500B in a System

Addressing the 9500B

Accessing the Bus Address

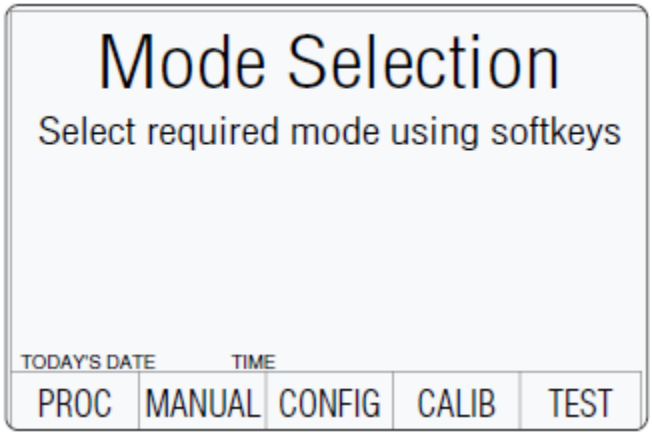
The instrument address can only be set manually; using the Bus Address menu, which is accessed via the Configuration menus.

Note

A password is required for access to change the bus address.

Select 'Configuration' Mode

1. Press the Mode key on the right of the front panel to obtain the 'Mode Selection' menu screen:



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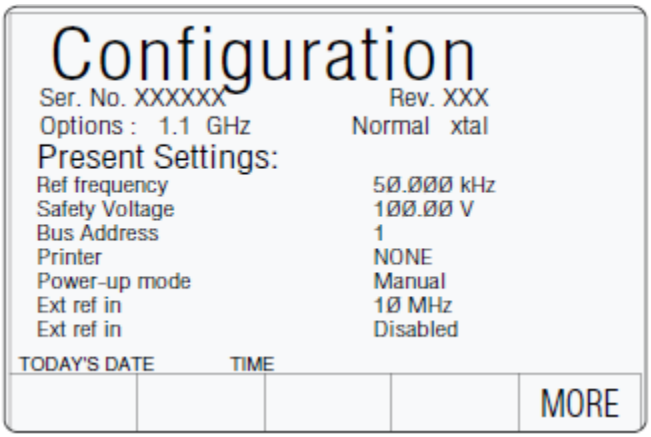
2. Press the CONFIG screen key at the center of the bottom row to progress into 'Configuration' mode. The 9500B will transfer to the open 'Configuration' information screen:



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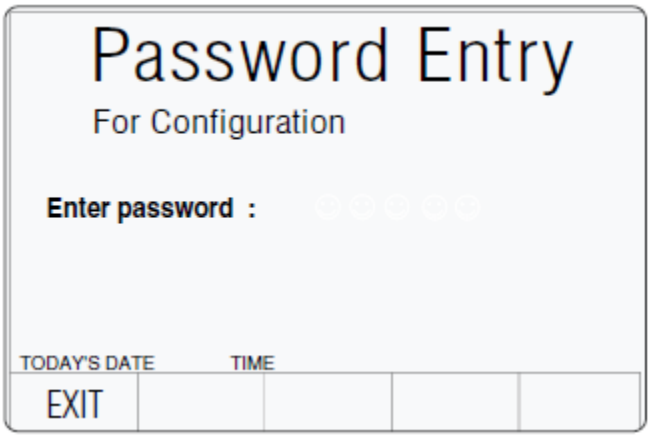
Select 'MORE' Parameters

The bus address is accessed by pressing the 'MORE' soft key. By trying to select 'MORE', the 'Configuration' password will be required. The 9500B will transfer to the 'Password Entry' screen. (Refer to the *9500B Users Guide, Passwords and Access*, and Configuration Mode).



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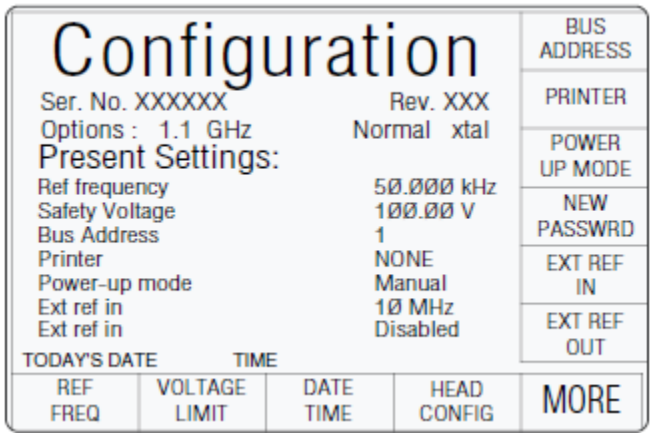
Enter Your Password

1. When you enter your password using the alpha-numeric keyboard, security icons will appear on the screen as you type. Finally press the ↵ (return) key.

   If the password is incorrect: an error message will be given and the security icons will be removed, enabling a new attempt to enter the password.

   The 'EXIT' screen key acts to escape, back to the previous screen.

2. The correct password, followed by ↵, will provide entry to the main 'Configuration' menu screen, which shows the present settings of the parameters which can be changed using screen keys on this display:



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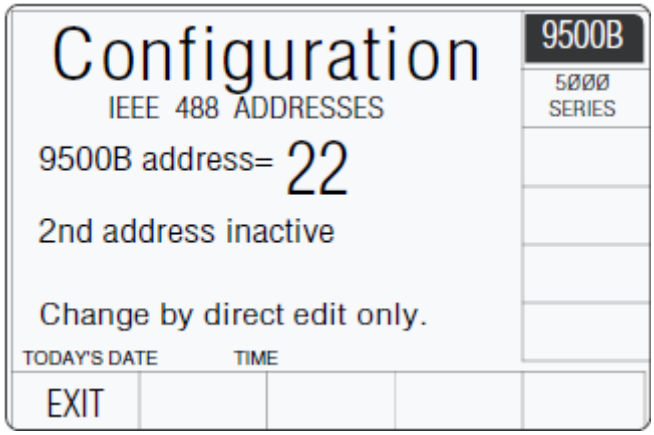
3. In this case we are interested in 'BUS ADDRESS'.

Change the Bus Address

1. For access from the 'Present Settings' screen, press the BUS ADDRESS screen key on the right. This action will transfer to the 'IEEE 488 ADDRESSES' screen:



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The 9500B IEEE-488 bus address can be set to any number within the range 0 to 30.

2. Use Digit edit or Direct edit to set the required bus address number. If using Direct edit, after typing the number press the ↵ key.
3. Press EXIT to return to the 'Present Settings' screen.

For second address (5000-series emulation), refer to *Model 9500B — Emulation of Tektronix SG5030 and CG5010/5011*.

Note

With an address selected in the range 0 to 30; control may be manual, or remote as part of a system on the Bus. The address must be the same as that used in the controller program to activate the 9500B. The 9500B is always aware of its stored address, responding to Talk or Listen commands from the controller at that address. When the address is changed by the user, the 9500B recognizes its new address and ignores its old address, as soon as it is stored by the user pressing the EXIT key in the Configuration—Bus Address menu.

Operation via the IEEE-488 Interface

General

The power-up sequence is performed as in local operation. The 9500B can be programmed to generate an SRQ at power-up, also preparing a status response for transmission to the controller when interrogated by a subsequent serial poll.

Operating Conditions

When the 9500B is operating under the direction of the application program, there are two main conditions, depending on whether the application program has set the 'REN' management line 'true' or 'false':

1. REN True ('REN' line low):

   The 9500B can be addressed and commanded if in either 'Manual' or 'Calibration' mode. All access to front panel control will be removed, except for the bottom

right screen key, labeled 'Enable Local Usage'. The cursor controls will not be present.

If LLO (Local Lockout) has been sent with REN true, then the 'Enable Local Usage' screen key will be inoperative. If LLO has not been sent, the 'Enable Local Usage' screen key will return to local control as if REN were false (see 2 below).

The 9500B will act in response to valid commands, performing any changes in output, etc. The display presentation will track the changes.

Remote control cannot command 'Configuration' mode or 'Procedure' mode. These are Local Modes only. Remote control cannot break into locally-entered 'Configuration' mode, 'Procedure' mode or 'Test' mode. However, 'Test' can be run remotely.

2. REN False ('REN' line high):

   The 9500B will remain in Local Operation, but can be addressed and commanded, while full access to front panel control is also retained.

   The 9500B will act in response to the commands, performing any changes in output, etc. No visible effect will be observed, other than the display presentation tracking the changes.

Programmed Transfer to Local Control (GTL or REN False)

The application program can switch the 9500B into 'Local' Control (by sending Command GTL, or by setting the REN line false), permitting a user to take manual control from the front panel.

The application program can regain 'Remote' control by sending the overriding command:

Listen Address with REN true (addressing the 9500B as a listener with the Remote Enable management line true {Low}). This will reimpose remote control, unless the 9500B is in Configuration, Procedure or Test Mode.

'Device Clear'

Either of the commands DCL or SDC will force the following instrument states:

- All IEEE 488 input and output buffers cleared.
- With 'IFC' (Interface Clear), any device dependent message bus holdoffs cleared.
- The status byte is changed by clearing the MAV bit.

These commands will not:

- Change any settings or stored data within the device except as listed above.
- Interrupt analog output.
- Interrupt or affect any functions of the device not associated with the IEEE 488 system.

Levels of Reset

Three levels of reset are defined for IEEE 488.2 application programs, a complete system reset being accomplished by resetting at all three levels, in order, to every device. In other circumstances they may be used individually or in combination:

IFC	Bus initialization
DCL	Message exchange initialization
*RST	Device initialization

The effects of the *RST command are described in *Model 9500B — Device Settings after *RST and Power On*.

Message Exchange

IEEE 488.2 Model

The IEEE 488.2 Standard document illustrates its Message Exchange Control Interface model at the detail level required by the device designer. Much of the information at this level of interpretation (such as the details of the internal signal paths etc.) is transparent to the application programmer. However, because each of the types of errors flagged in the Event Status Register is related to a particular stage in the process, a simplified 9500B interface model can provide helpful background. This is shown below in Figure 3, together with brief descriptions of the actions of its functional blocks.

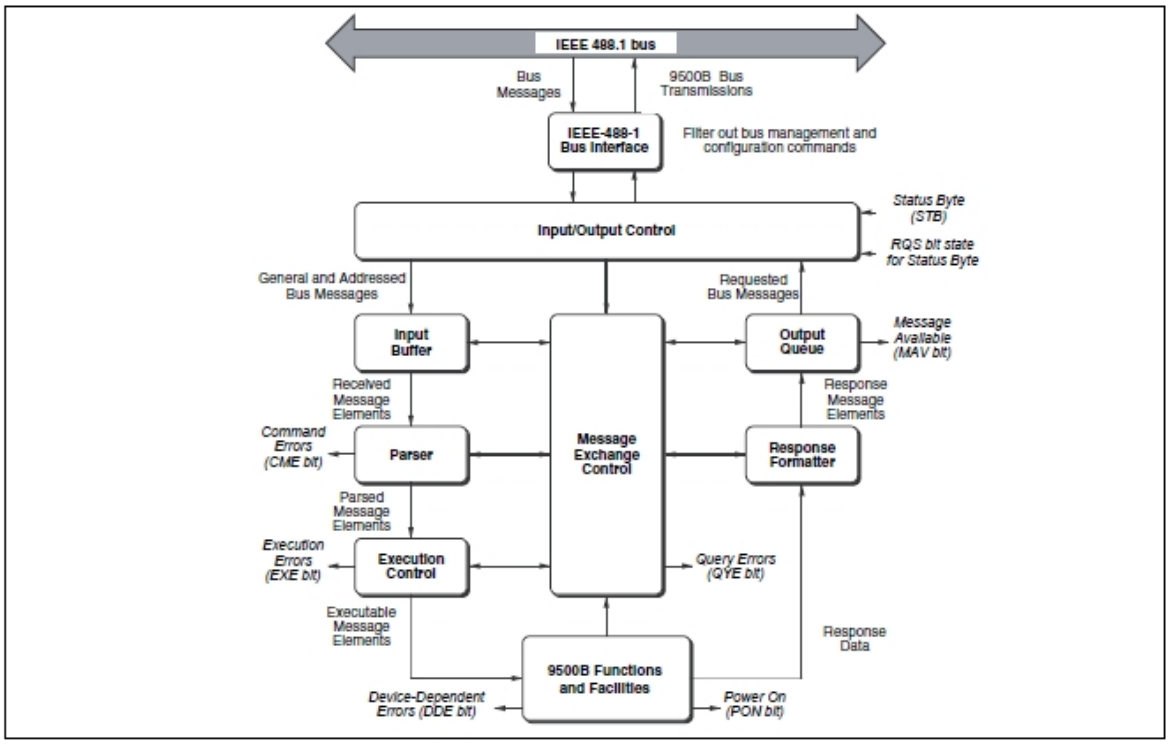


Figure 3. 9500B Message Exchange Model

9500B STATUS Subsystem

Input/Output Control transfers messages from the 9500B output queue to the system bus; and conversely from the bus to either the input buffer, or other predetermined destinations within the device interface. It receives the Status Byte from the status reporting system, as well as the state of the Request Service bit which it imposes on bit 6 of the Status Byte response. Bit 6 reflects the ‘Request Service state true’ condition of the interface.

Incoming Commands and Queries

The Input Buffer is a first in - first out queue, which has a maximum capacity of 128 bytes (characters).

Each incoming character in the I/O Control generates an interrupt to the instrument processor which places it in the Input Buffer for examination by the Parser. The characters are removed from the buffer and translated with appropriate levels of syntax checking. If the rate of programming is too fast for the Parser or Execution Control, the buffer will progressively fill up. When the buffer is full, the handshake is held.

The Parser checks each incoming character and its message context for correct Standard-defined generic syntax, and correct device-defined syntax. Offending syntax is reported as a Command Error, by setting true bit 5 (CME) of the Standard-defined Event Status register (refer to section Retrieval of Device Status Information).

Execution Control receives successfully parsed messages, and assesses whether they can be executed, given the currently programmed state of the 9500B functions and facilities. If a message is not viable then an Execution Error is reported, by setting true bit 4 (EXE) of the Standard-defined Event Status register. Viable messages are executed in order, altering the 9500B functions, facilities, etc. Execution does not ‘overlap’ commands; instead, the 9500B Execution Control processes all commands ‘sequentially’ (for example, waits for actions resulting from the previous command to complete before executing the next).

9500B Functions and Facilities

The 9500B Functions and Facilities block contains all the device-specific functions and features of the 9500B, accepting Executable Message Elements from Execution Control and performing the associated operations. It responds to any of the elements which are valid Query Requests (both IEEE 488.2 Common Query Commands and 9500B Device-specific Commands) by sending any required Response Data to the Response Formatter (after carrying out the assigned internal operations).

Device-dependent errors are detected in this block. Bit 3 (DDE) of the Standard Event Status register is set true when an internal operating fault is detected. Each reportable error number is appended to the Error Queue as the error occurs.

Outgoing Responses

The Response Formatter derives its information from Response Data (being supplied by the Functions and Facilities block) and valid Query Requests. From these it builds Response Message Elements, which are placed as a Response Message into the Output Queue.

The Output Queue acts as a store for outgoing messages until they are read over the system bus by the application program. For as long as the output queue holds one or more bytes, it reports the fact by setting true bit 4 (Message Available - MAV) of the Status Byte register. Bit 4 is set false when the output queue is empty (refer to *Retrieval of Device Status Information*).

'Query Error'

This is an indication that the application program is following an inappropriate message exchange protocol, resulting in the Interrupted, Unterminated or Deadlocked condition:

Refer to 'Bit 2' in IEEE 488.2-defined Event Status Register.

The Standard document defines the 9500B's response, part of which is to set true bit 2 (QYE) of the Standard-defined Event Status register.

Request Service (RQS)

Reasons for Requesting Service

There are two main reasons for the application program to request service from the controller:

- When the 9500B message exchange interface is programmed to report a system programming error
- When the 9500B is programmed to report significant events by RQS

The significant events vary between types of devices; thus there is a class of events which are known as 'Device-Specific'. These are determined by the device designer.

RQS in the IEEE 488.2 Model

The application programmer can enable or disable the event(s) which are required to originate an RQS at particular stages of the application program. The IEEE 488.2 model is extended to incorporate a flexible SCPI status reporting structure in which the requirements of the device designer and application programmer are both met.

This structure is described in *Retrieval of Device Status Information*.

Retrieval of Device Status Information

General

For any remotely-operated system, the provision of up-to-date information about the performance of the system is of major importance. In the case of systems which operate under automatic control, the controller requires the necessary feedback to enable it to progress the task; any break in the continuity of the process can have serious results.

When developing an application program, the programmer needs to test and revise it, knowing its effects. Confidence that the program elements are couched in the correct grammar and syntax (and that the program commands and queries are thus being accepted and acted upon), helps to reduce the number of iterations needed to confirm and develop the viability of the whole program. So any assistance which can be given in closing the information loop must benefit both program compilation and subsequent use.

Such information is given in the following pages.

IEEE-488 and SCPI Standard-Defined Features

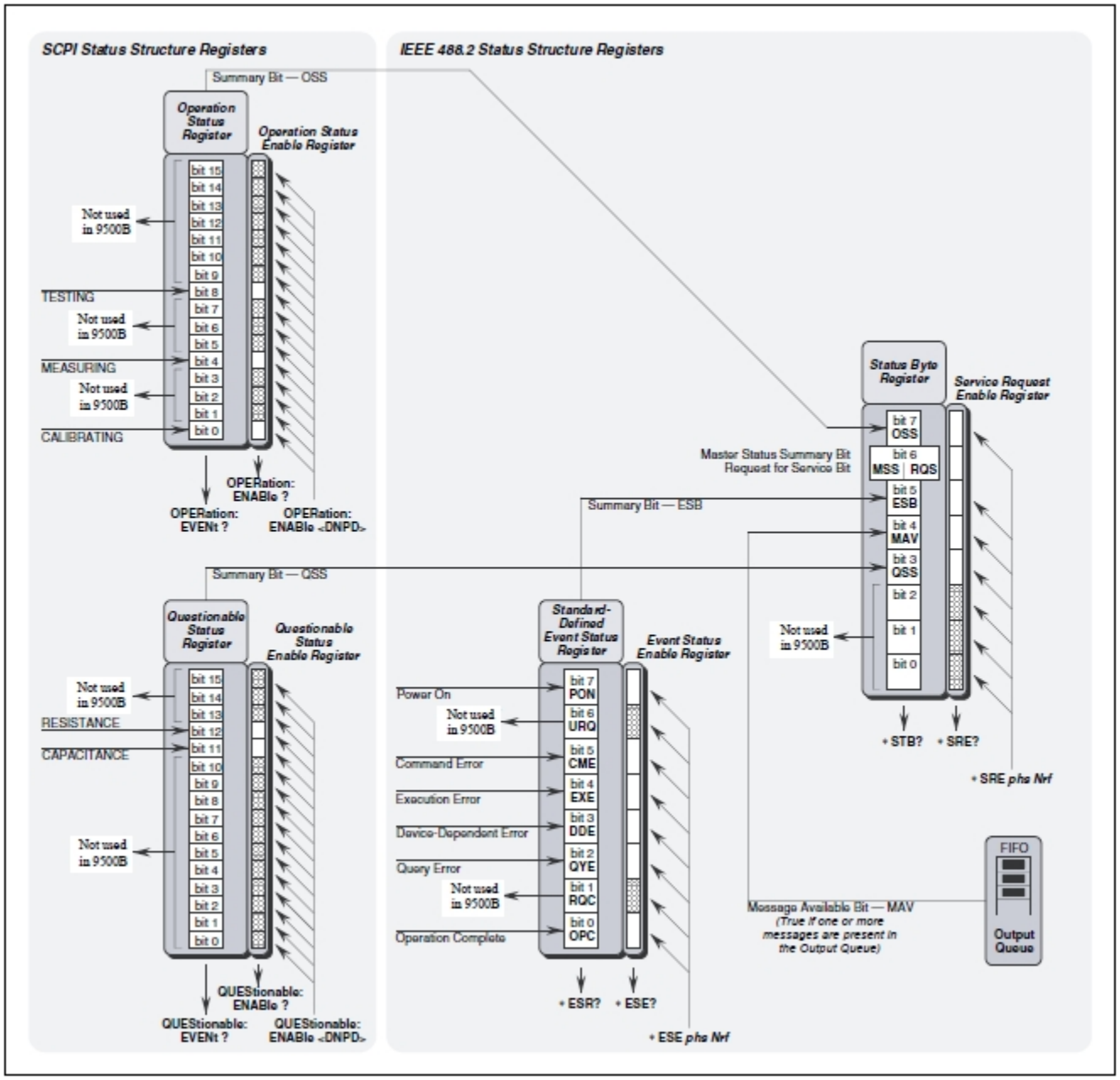


Figure 4. 9500B Status Reporting Structure

Two main categories of information are provided: 'Status Summary' information, and 'Event Register' conditions.

Status Summary Information and SRQ

The Status Byte consists of four 'summary' bits which notify events in the 8-bit latched IEEE-488.2-defined 'Event Status Register' (ESB), the two 16-bit latched SCPI-defined registers (OSS & 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 (Note that in Figure 4 no arrow points at bit 6 of the Service Request Enable Register—bit 6 is always enabled).

A subsequent serial poll by the Application Program will discover that the 9500B 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.

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, described in detail in *9500B Status Reporting - IEEE-488.2 Basics*.

OSS and QSS are features of the SCPI structure, described in *9500B Status Reporting — SCPI Elements*.

Access via the Application Program

Referring to Figure 3, take as an example the main Event Status register:

Enabling the Events

The main Standard-Defined Event Status Register' has a second 'Event Status Enable Register'. A program command (*ESE phs Nrf) can be used to set the state of the bits in the Enable register. This enables or disables the events which will set the main register's summary bit true.

Reading the Enable Register

A 'query' command (*ESE?) permits the application program to read the state of the Enable register, and hence find out which events are enabled to be reported.

Reading the Main Register

Another 'query' command (*ESR?) reads the state of the main Standard-Defined register, to discover which event has occurred (i.e. has caused the summary bit to be set true). Reading this register clears all its bits.

Reporting the Event

If an event is to be reported via the SRQ, its corresponding enable bit will have been set true, (using the number Nrf). Each bit in the Standard-Defined register remains in false condition unless its assigned event occurs, when its condition changes to true and remains true until cleared by *ESR? or *CLS. This causes the register's summary bit in the Status Byte also to be set true. If this bit is enabled, then the Status Byte bit 6 (MSS/RQS) will be set true, and the 9500B will set the IEEE-488 bus SRQ line true.

SCPI Status Registers

The two SCPI Status registers operate in the same way, using the appropriate program commands to set the enable registers, and query commands to discover the condition of the registers.

Subsequent Action

Thus the application programmer can enable any assigned event to cause an SRQ, or not. The controller can be programmed to read the Status Byte, using a serial poll to read the Status Byte register and the true summary bit (ESB, OSS, QSS or MAV). The application program then investigates the appropriate event structure until the causal event is discovered. The detail for each register is expanded in the following paragraphs, and in the command descriptions.

9500B Status Reporting - IEEE-488.2 Basics

IEEE 488.2 Model

This develops the IEEE 488.1 model into an extended structure with more definite rules. These rules invoke the use of standard 'Common' messages and provide for device-dependent messages. A feature of the structure is the use of 'Event' registers, each with its own enabling register as shown in Figure 4.

9500B Model Structure

The IEEE 488.2 Standard provides for an extensive hierarchical structure with the Status Byte at the apex, defining its bits 4, 5 and 6 and their use as summaries of a Standard-defined event structure, which must be included if the device is to claim conformance with the Standard. The 9500B employs these bits as defined in the Standard.

Bits 0, 1, 2 and 3 and 7 are available to the device designer; only bits 3 and 7 are used in the 9500B, and these are as defined by the SCPI standard.

It must be recognized by the application programmer that whenever the application program reads the Status Byte, it can only receive summaries of types of events, and further query messages will be needed to probe the details relating to the events themselves. For example: a further byte is used to expand on the summary at bit 5 of the Status Byte.

Status Byte Register

In this structure the Status Byte is held in the 'Status Byte Register'; the bits being allocated as follows:

Bits**:** 0 (DIO1), 1 (DIO2) and 2 (DIO3) are not used in the 9500B status byte. They are always false.

Bit 3: (DIO4) SCPI-defined Questionable Status Summary Bit (QSS)

Bit 3 summarizes the state of the 'Questionable Status data', held in the 'Questionable Status register' (QSR), whose bits represent SCPI-defined and device-dependent conditions in the 9500B. The QSS bit is true when the data in the QSR contains one or more enabled bits which are true; or false when all the enabled bits in the byte are false. The QSR and its data are defined by the SCPI Standard; they are described in 9500B Status Reporting — SCPI Elements.

Bit 4: (DIO5) IEEE 488.2-defined Message Available Bit (MAV)

The MAV bit helps to synchronize information exchange with the controller. It is true when a message is placed in the Output Queue; or false when the Output Queue is empty.

The common command *CLS can clear the Output Queue, and the MAV bit 4 of the Status Byte Register; providing it is sent immediately following a 'Program Message Terminator'.

Bit 5: (DIO6) IEEE 488.2-defined Standard Event Summary Bit (ESB)

Summarizes the state of the 'Event Status byte', held in the 'Event Status register' (ESR), whose bits represent IEEE 488.2-defined conditions in the device. The ESB bit is true when the byte in the ESR contains one or more enabled bits which are true; or false when all the enabled bits in the byte are false.

Bit 6: (DIO7) is the Master Status Summary Message (MSS bit), and is set true if one of the bits 0 to 5 or bit 7 is true (bits 0, 1 and 2 are always false in the 9500B).

Bit 7: (DIO4) SCPI-defined Operation Status Summary Bit (QSS)

Summarizes the state of the 'Operation Status data', held in the 'Operation Status register' (OSR), whose bits represent processes in progress in the 9500B. The OSS bit is true when the data in the OSR contains one or more enabled bits which are true; or false when all the enabled bits in the byte are false. The OSR is described in *9500B Status Reporting — SCPI Elements*.

Reading the Status Byte Register *STB?

The common query: *STB? reads the binary number in the Status Byte register. The response is in the form of a decimal number which is the sum of the binary weighted values in the enabled bits of the register. In the 9500B, the binary-weighted values of bits 0, 1 and 2 are always zero.

Service Request Enable Register

The SRE register is a means for the application program to select, by enabling individual Status Byte summary bits, those types of events which are to cause the 9500B to originate an RQS. It contains a user-modifiable image of the Status Byte, whereby each true bit acts to enable its corresponding bit in the Status Byte.

Bit Selector: *SRE phs Nrf

The common program command: *SRE phs Nrf performs the selection, where Nrf is a decimal numeric, whose binary decode is the required bit-pattern in the enabling byte.

For example:

If an RQS is required only when a Standard-defined event occurs and when a message is available in the output queue, then Nrf should be set to 48. The binary decode is 00110000 so bit 4 or bit 5, when true, will generate an RQS; but with this decode, even if bit 3 is true, no RQS will result. The 9500B always sets false the Status Byte bits 0, 1 and 2, so they can never originate an RQS whether enabled or not.

Reading the Service Request Enable Register

The common query: *SRE? reads the binary number in the SRE register. The response is in the form of a decimal number which is the sum of the binary-weighted values in the register. The binary-weighted values of bits 0, 1 and 2 will always be zero.

IEEE 488.2-defined Event Status Register

The 'Event Status Register' holds the Event Status Byte, consisting of event bits, each of which directs attention to particular information. All bits are 'sticky'; for example. Once true, cannot return to false until the register is cleared. This occurs automatically when it is read by the query: *ESR?. The common command *CLS clears the Event Status Register and associated error queue, but not the Event Status Enable Register.

Note that because the bits are 'sticky', it is necessary to read the appropriate subordinate register of the status structure in order to clear its bits and allow a new event from the same source to be reported.

The 'Event Status Register' bits are named in mnemonic form as follows:

Bit 0 Operation Complete (OPC)

This bit is true only if *OPC has been programmed and all selected pending operations are complete. As the 9500B operates in serial mode, its usefulness is limited to registering the completion of long operations, such as self-test.

Bit 1 Request Control (RQC)

This bit is not used in the 9500B. It is always set false.

Bit 2 Query Error (QYE)

QYEtrue indicates that the application program is following an inappropriate message exchange protocol, resulting in the following situations:

- Interrupted Condition: When the 9500B has not finished outputting its Response Message to a Program Query, and is interrupted by a new Program Message.
- Unterminated Condition: When the application program attempts to read a Response Message from the 9500B without having first sent the complete Query Message (including the Program Message Terminator) to the instrument.
- Deadlocked Condition: When the input and output buffers are filled, with the parser and the execution control blocked.

Bit 3 Device Dependent Error (DDE)

DDE is set true when an internal operating fault is detected, and the appropriate error message is added to the Error Queue. See the 'Note about the Error Queue' below.

Note

The Error Queue is a sequential memory stack. Each reportable error has been given a listed number and explanatory message, which are entered into the error queue as the error occurs. The queue is read destructively as a First-In/First-Out stack, using the query command SYSTem ERRor? to obtain a code number and message.

Repeated use of the query SYSTem ERRor? will read successive Device-Dependent, Command and Execution errors until the queue is empty, when the 'Empty' message (0,"No error") will be returned.

It would be good practice to repeatedly read the Error Queue until the 'Empty' message is returned.

*The common command *CLS clears the queue.*

Bit 4 Execution Error (EXE)

An execution error is generated if the received command cannot be executed, owing to the device state or the command parameter being out of bounds. The appropriate error message is added to the Error Queue.

See the 'Note about the Error Queue' above.

Bit 5 Command Error (CME)

CME occurs when a received bus command does not satisfy the IEEE 488.2 generic syntax or the device command syntax programmed into the instrument interface's parser, and so is not recognized as a valid command. The appropriate error message is added to the Error Queue. See the 'Note about the Error Queue' on the previous page.

Bit 6 User Request (URQ)

This bit is not used. It is always set false.

Bit 7 9500B Power Supply On (PON)

This bit is set true only when the Line Power has just been switched on to the 9500B, the subsequent Power-up Selftest has been completed successfully, and the 9500B defaults into Manual mode at Power-on. (If the Power-on default is Procedure mode, remote operation is not available. If the selftest is unsuccessful, the 9500B will report the fact in Test mode, which also does not permit remote operation).

Whether or not an SRQ is generated by setting bit 7 true, depends on the previously-programmed 'Power On Status Clear' message *PSC phs Nrf:

- For an Nrf of 1, the Event Status Enable register would have been cleared at power on, so PON would not generate the ESB bit in the Status Byte register, and no SRQ would occur at power on.
- If Nrf was zero, and the Event Status Enabling register bit 7 true, and the Service Request Enabling register bit 5 true; a change from Power Off to Power On will generate an SRQ. This is only possible because the enabling register conditions are held in non-volatile memory, and restored at power on.

This facility is included to allow the application program to set up conditions so that a momentary Power Off followed by reversion to Power On (which could upset the 9500B programming) will be reported by SRQ. To achieve this, the Event Status register bit 7 must be permanently true (by *ESE phs Nrf, where Nrf ≥ 128); the Status Byte Enable register bit 5 must be set permanently true (by command *SRE phs Nrf, where Nrf lies in one of the ranges 32-63, 96-127, 160-191, or 224-255); Power On Status Clear must be disabled (by *PSC phs Nrf, where Nrf = 0); and the Event Status register must be read destructively immediately following the Power On SRQ (by the common query *ESR?).

Standard Event Status Enable Register

The ESE register is a means for the application program to select, from the positions of the bits in the standard-defined Event Status Byte, those events which when true will set the ESB bit true in the Status Byte. It contains a user-modifiable image of the standard Event Status Byte, whereby each true bit acts to enable its corresponding bit in the standard Event Status Byte.

Bit Selector: *ESE phs Nrf

The program command: *ESE phs Nrf performs the selection, where Nrf is a decimal numeric, which when decoded into binary, produces the required bit-pattern in the enabling byte.

For example:

If the ESB bit is required to be set true only when an execution or device-dependent error occurs, then Nrf should be set to 24. The binary decode is 00011000 so bit 3 or bit 4, when true, will set the ESB bit true; but when bits 0-2, or 5-7 are true, the ESB bit will remain false.

Reading the Standard Event Enable Register

The common query: *ESE? reads the binary number in the ESE register. The response is a decimal number which is the sum of the binary-weighted values in the register.

The Error Queue

As errors in the 9500B are detected, they are placed in a 'first in, first out' queue, called the 'Error Queue'. This queue conforms to the format described in the SCPI Command Reference (Volume 2) Chapter 19, although errors only are detected. Three kinds of errors are reported in the Error Queue, in the sequence that they are detected:

Command Errors, Execution Errors and Device-Specific errors

Reading the Error Queue

The queue is read destructively as described in the SCPI Command Reference, using the query command SYSTem ERRor? to obtain a code number and error message. The query SYSTem ERRor? can be used to read errors in the queue until it is empty, when the message '0, No Error' will be returned.

9500B Status Reporting — SCPI Elements

General

In addition to IEEE 488.2 status reporting the 9500B implements the Operation and Questionable Status registers with associated 'Condition', 'Event' and 'Enable' commands. The extra status deals with current operation of the instrument and the quality of operations.

The structure of these two registers is detailed in Figure 4, together with the nature of the reported events. Access to the registers is detailed in the STATus subsystem of section 9500B SCPI Language - Commands and Syntax of this manual.

SCPI Status Registers

The SCPI states are divided into two groups, reporting from the Operation or Questionable Status event register. Each Status register has its own 'Enable' register, which can be used as a mask to enable bits in the event register itself, in a similar way to that set by the *ESE command for the Standard Event status Register (ESR).

Each Status Register is associated with its own third 'Condition' register (not illustrated in Figure 4), in which the bits are not 'sticky', but are set and reset as the internal conditions change.

Each Enable Register can be commanded to set its mask to enable selected bits in the corresponding Event Register. All registers (Event, Enable and Condition) can be interrogated by appropriate 'Queries' to divulge their bits' states.

Reportable SCPI States

Operation Status Event Register

The following 'sticky' bits are set by their associated conditions:

bit 0 CALIBRATING: the instrument is performing a VCO characterize, a DAC characterize or a DC/Square characterize.

bit 4 MEASURING: the instrument is performing a measurement cycle for capacitance or resistance.

bit 8 TESTING: the instrument is running a self test.

Questionable Status Event Register

The following 'sticky' bits are set by their associated conditions:

bit 11 CAPACITANCE: The measurement of capacitance is questionable.

bit 12 RESISTANCE: The measurement of resistance is questionable.

9500B SCPI Language - Commands and Syntax

The command subsystems are placed in alphabetical order.

Introduction

This section lists and describes the set of SCPI-compatible remote commands used to operate the 9500B.

To provide familiar formatting for users who have previously used the SCPI reference documentation, the command descriptions are dealt with in a similar manner. In particular, each sub-system's documentation starts with a short description, followed by a table showing the complete set of commands in the sub-system; finally the effects of individual keywords and parameters are described. Some extra identification of style and syntax is detailed in SCPI Syntax and Styles, and Legend to clarify shorthand meanings.

SCPI Syntax and Styles

Where possible the syntax and styles used in this section follow those defined by the SCPI consortium. The commands on the following pages are broken into three columns; the KEYWORD, the PARAMETER FORM, and any NOTES. Notes are signified by an oblique stroke (/) followed by curly brackets {}.

The KEYWORD column provides the name of the command. The actual command consists of one or more keywords since SCPI commands are based on a hierarchical structure, also known as the tree system.

Square brackets ([ ]) are used to enclose a keyword that is optional when programming the command; that is, the 9500B will 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).

The PARAMETER FORM column indicates the number and order of parameter in a command and their legal value. Parameter types are distinguished by enclosing the type in angle brackets (< >). If parameter form is enclosed by square brackets ([ ]) these are then optional (care must be taken to ensure that optional parameters are consistent with the intention of the associated keywords). The vertical bar (|) can be read as "or" and is used to separate alternative parameter options.

Legend

<dnpd> = Decimal Numeric Program Data, used to identify 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 'literate' 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 literate characters which will be recognized by the internal 9500B 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}

The response from this query will be one of the parameters listed in association with the command.

CALibration Subsystem

This subsystem is used to calibrate the functions and hardware ranges of the 9500B. This will correct for any system errors due to drift or aging effects.

Before any calibration can take place, two security levels must be set. First, there is a switch on the 9500B itself that must be set to CAL ENABLE. Having done this, the calibration password command must be sent.

Once entered into Calibration mode, the commands present in the Table 3 are enabled.

Table 3. CALibration Subsystem Table

Keyword	Parameter Form
CALibration	
:SECure	
:PASSword	<spd>
:EXIT	[<spd>,<cpd>{PRD7|PRD14|PRD30|PRD60}]
:TARGet	<dnpd>,<dnpd>[,<dnpd>]
:TRIGger?	
:HEAD	
:EHFSine	<cpd>{LINearity|FLATness}
:VHFSine	<cpd>{LINearity|FLATness}
:HFSine	<cpd>{LINearity|FLATness}
:LFSine	
:E70	<cpd>{LINearity|GAIN|SPEed}
:E150	<cpd>{LINearity|GAIN|SPEed}
:E500	<cpd>{LINearity|GAIN|SPEed}
:MARKer	<cpd>{SINusoid}
:CAPacitance	
:RESistance	
:STORe?	<spd>,<cpd>{PRD7|PRD14|PRD30|PRD60}
:BASE	
:SFRequency	<dnpd>
:SPECial	
:DAC?	
:VCO?	
:DCSQ?	
:TMK?	
:LFSine?	
:FADJust	
:FADJust?	<dnpd>
:PWD?	

CAL:SEC:PASS <spd>

Purpose

This command is used to gain access to Calibration mode. The <spd> must be the correct 'Calibration' password registered in the 9500B software. The calibration password can be changed only in Configuration mode from the 9500B front panel (Refer to the *9500B Users Guide, Controls and Features*).

CAL:SEC:EXIT [<spd>,<cpd>{PRD7|PRD14|PRD30|PRD60}]

Purpose

This command is used to switch off Calibration mode, canceling any set CAL:TARG command and protecting the calibration by disabling the calibration commands. Parameters in the command permit a user optionally to date-stamp the calibration, record and set up an advance warning for the next-due calibration date. Certain Functions are not available in Calibration Mode, for which calibration is not required.

When finishing a calibration procedure, it is necessary to exit from Calibration mode in order to access these functions.

- The <spd> must be the due date of the next calibration for the 9500B. It must conform to the format decided by the SYStem FORmat <spd> command.
- The <cpd>, PRDXX gives the required number of days advance warning of the cal due date. (Refer to *9500B Calibration Manual, Verification and Adjustment*).

CAL:TARG <dnpd>,<dnpd>[,<dnpd>]

Purpose

For each calibration operation, the required calibration point (factor) must be targetted (Refer to the *9500B Calibration Manual, Special Calibration*). This command permits the user to define three parameters associated with the calibration point in the current operation:

- The first <dnpd> is an integer from 1 to 6, allocated to the calibration point at which calibration is intended. This will be one of those listed on the Calibration mode screen, in 'Target State', for the corresponding function and hardware range.
- The second <dnpd> is a value which will determine the required hardware range (amplitude) of the 9500B for that calibration point.
- The third, optional, <dnpd> is a value which will determine the required hardware range (frequency) of the 9500B for that calibration point.

Once a target has been set, the 9500B adjustment is restricted to values within the selected hardware voltage span and frequency band. In order to release this restriction, one of the following commands must be sent:

TRIG? , EXIT or a new TARG command

Any error which occurs will also release the restriction.

CAL:TRIG?

Purpose

After the parameters are set for calibration at a single calibration point, this command initiates the internal calibration process. This command applies to the TARGet settings.

Response

Operation is successful: returns a '0'. Operation fails for any reason: returns a '1' and an error message is put in the error queue.

CAL:SPEC:DAC?

Purpose

This command characterizes the instrument's main digital-to-analogue converter (DAC). The process takes several minutes to complete.

Response

Operation is successful: returns a '0'.

Operation fails for any reason: returns a '1' and an error message is put in the error queue.

CAL:SPEC:VCO?

Purpose

This command characterizes the instrument's Voltage-controlled Oscillator (VCO).

Response

Operation is successful: returns a '0'.

Operation fails for any reason: returns a '1' and an error message is put in the error queue.

CAL:SPEC:DCSQ?

Purpose

This command performs calculations to derive the Square function calibration constants from the DC calibration constants.

Response

Operation is successful: returns a '0'.

Operation fails for any reason: returns a '1' and an error message is put in the error queue.

CAL:SPEC:FADJust

Purpose

This command selects the adjustment facility to allow the frequency generation of the instrument to be calibrated.

CAL:SPEC:FADJust? <dnpd>

Purpose

This command supplies the <dnpd> value that is to be written to the frequency correction DAC.

Response

Operation is successful: returns a '0'.

Operation fails for any reason: returns a '1' and an error message is put in the error queue.

CAL:SPEC:TMK?

Purpose

This command characterizes the LF timing marker amplitude. The process takes several minutes.

Response

Operation is successful: returns a ‘0’.

Operation fails for any reason: returns a ‘1’ and an error message is saved in the error queue.

CAL:SPEC:LFS?

Purpose

This command adjusts to zero the DC offset for LF sine.

Response

Operation is successful: returns a ‘0’.

Operation fails for any reason: returns a ‘1’ and an error message is saved in the error queue.

CAL:SPEC:PWD?

Purpose

This command characterizes the width of the pulse.

Response

Operation is successful: returns a ‘0’.

Operation fails for any reason: returns a ‘1’ and an error message is saved in the error queue.

CAL:HEAD:EHFS <cpd>{LIN|FLAT}

Purpose

This command provides the setup conditions specified in step 1 of the calibration sequence, as detailed in section *Levelled Sine Function: HF Calibration* of this manual.

CAL:HEAD:VHFS <cpd>{LIN|FLAT}

Purpose

This command provides the setup conditions specified in step 1 of the calibration sequence, as detailed in section *Levelled Sine Function: HF Calibration* this manual.

CAL:HEAD:HFS <cpd>{LIN|FLAT}

Purpose

This command provides the setup conditions specified in step 1 of the calibration sequence, as detailed in section *Levelled Sine Function: HF Calibration* of this manual.

CAL:HEAD:LFS

Purpose

This command provides the setup conditions specified in step 1 of the calibration sequence, as detailed in section *Levelled Sine Function: LF Gain Calibration* of this manual.

CAL:HEAD:E70 <cpd>{LIN|GAIN|SPE}

Purpose

This command provides the setup conditions specified in step 4 of the calibration sequence, as detailed in section *Edge Function Calibration* this manual.

CAL:HEAD:E150 <cpd>{LIN|GAIN|SPE}

Purpose

This command provides the setup conditions specified in step 4 of the calibration sequence, as detailed in section *Edge Function Calibration* of this manual.

CAL:HEAD:E500 <cpd>{LIN|GAIN|SPE}

Purpose

This command provides the setup conditions specified in step 4 of the calibration sequence, as detailed in section *Edge Function Calibration* of this manual.

CAL:HEAD:MARK<cpd>{ SIN }

Purpose

This command provides the setup conditions specified in step 2 of the calibration sequence, as detailed in section *Calibrating the Timing Markers* of this manual.

CAL:HEAD:CAP

Purpose

This command provides the setup conditions specified in step 2 of the calibration sequence, as detailed in section *Load Capacitance Calibration* of this manual.

CAL:HEAD:RES

Purpose

This command provides the setup conditions specified in step 2 of the calibration sequence, as detailed in section *50 Ω/1 MΩ Ratio Calibration* of this manual.

CAL:HEAD:STOR? <spd>,<cpd>{PRD7|PRD14|PRD30|PRD60}

Purpose

This command provides the store for the calibration data as detailed in section *Exit from Head Calibration* of this manual.

Response

Operation is successful: returns a ‘0’

Operation fails for any reason: returns a ‘1’ and an error message is saved in the error queue.

OUTPut Subsystem

This subsystem is used to configure the output connections of the 9500B and switch the output on and off.

Table 4. OUTPut Subsystem

Keyword	Parameter Form
OUTPut	
[:STATe](?)	<cpd>{ON|OFF|1|0}

OUTP[:STAT](?) <cpd>{ON|OFF|1|0}

Purpose

This command turns the 9500B output on and off, and connects both the output signal and trigger signal to the selected output channels.

The head connection will only be validated when the output is turned on. An error will be generated at this point if the head is not connected to the selected 9500B channel.

If a head is removed when the output is on, then if SRQs are enabled, an 'ON' SRQ will be generated.

- ON or 1 will set the output on
- OFF or 0 will set the output off

Response to Query Version

The 9500B will return ON if output is on, or OFF if output is off.

ROUTe Subsystem

This subsystem is used to configure the output channels to be used for signal and trigger outputs.

Table 5. ROUTe Subsystem

Keyword	Parameter Form
ROUTe	
:FITTed(?)	<cpd>{CH1|CH2|CH3|CH4|CH5}
:SIGNal	
[:PATH](?)	<cpd>{CH1|CH2|CH3|CH4|CH5}
:IMPedance(?)	<dnpd>
:SKEW(?)	<cpd>{CH1|CH2|CH3|CH4|CH5},
	{ON|OFF|1|0}
:DUAL(?)	<cpd>{CH1|CH2|CH3|CH4|CH5},
	{CH1|CH2|CH3|CH4|CH5}
:MCHannel(?)	<cpd>{CH1|CH2|CH3|CH4|CH5},
:TRIGger	{ON|OFF| | }
[:PATH](?)	<cpd>{CH1|CH2|CH3|CH4|CH5|NONE}
	[,<cpd>{ACTive|CAble}]
:IMPedance(?)	<dnpd>
:RATio(?)	<dnpd>

ROUT:FITT? <cpd>{CH1|CH2|CH3|CH4|CH5}

Purpose

This query command returns the type, serial number, date last calibrated and calibration due date of the active head fitted to the <cpd> channel.

Response Format

The response will be an <Arbitrary ASCII Response Data> element, consisting of four comma-separated fields:

Field 1	Type (e.g. 9510|9530|CABL|NONE).
Field 2	Serial Number up to 13 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.

For example, for a channel with an active head fitted:

' 9510,12345,1997/02/28,1998/02/27 '

If there is no active head fitted to the <cpd> channel, the response will be:

' NONE,0,0000/0/00,0000/0/00 '

The 9500B can only determine that a cable has been fitted if this was informed via the ROUT:TRIG[:PATH](?) command (ROUT:SIGN:SKEW(?) <cpd>{CH1|CH2|CH3|CH4|CH5},{ON|OFF|1|0}).

ROUT:SIGN[:PATH](?)
<cpd>{CH1|CH2|CH3|CH4|CH5}

Purpose

This command is used to define which channel is associated with the signal output.

The <cpd> does not turn the output on, only selects the signal channel to be used. If the output is on and the channel is to be changed, then the output will be turned off, the new channel will be selected and the output will be turned back on again.

A settings conflict will be generated if a signal channel is selected that is already in use, and an error message will be generated.

Response to Query Version

The 9500B will return the name of the selected signal channel.

ROUT:SIGN:IMP(?) <dnpd>

Purpose

This command chooses between the 50 Ω or 1 MΩ scope impedance matching levels for the selected signal channel.

The value of <dnpd> is rounded to select the required impedance:

values ≤55 select 50 Ω; values >55 select 1 MΩ.

Response to Query Version

The 9500B will return 50 if 50 Ω is selected, or 1E6 if 1 MΩ is selected.

ROUT:SIGN:SKEW(?)
<cpd>{CH1|CH2|CH3|CH4|CH5},{ON|OFF|1|0}

Purpose

Use this command to choose a single channel, then use the {ON|OFF|1|0} element to turn the channel ON or Off. Repeat for each channel. Note that at least two channels must be selected for signals to be generated.

A settings conflict error will be reported if the SKEW function has not been selected.

Other ROUTe:SIGNal commands and ROUTe:TRIGger commands are not valid in Zero Skew function.

Response to Query Version

The 9500B will return all of the selected channels.

ROUT:SIGN:DUAL(?)
<cpd>{CH1|CH2|CH3|CH4|CH5},
<cpd>{CH1|CH2|CH3|CH4|CH5}

This command is for use within the Sine function to output the signal selection on two active heads at the same time. Note that two channels must be selected for signals to be generated. In the parameter list above, the first <cpd> selects the Master signal, the second <cpd> selects the Slave signal.

A settings conflict error will be reported if the 'SINusoid' function shape has not been selected.

This dual mode is cancelled on receipt of a ROUTe:SIGNal <cpd> command or on selection of another function.

Both signals must have the same expected impedance. It is not possible to set their impedances independently.

Response to Query Version

The 9500B will return the two selected channels, in the same order.

ROUT:TRIG[:PATH](?) <cpd>{CH1|CH2|CH3|CH4|CH5|NONE}[,<cpd>{ACT|CABL}]

Purpose

This command defines the channel associated with trigger output.

The ROUT:TRIG command also has the ability to select no trigger output at all, using the NONE parameter.

The <cpd> does not turn the output on, only selects the trigger channel to be used. If the output is on and the channel is to be changed, then the output will be turned off, the new channel will be selected and the output will be turned back on again.

A settings conflict error will be generated if a trigger channel is selected that is already in use, has a cable plugged in, or is not connected. An error message will be generated.

The optional <cpd> also determines which channels will use an active head to deliver the trigger signal, and not a plain cable (with no head inserted). If the ACTive|CABLe <cpd> is not present then the selected channel type will not change.

If an active head is inserted into a channel that has been designated a CABLe, then the output will be turned off and the CABLe selection will be overridden by the ACTive setting.

Response to Query Version

The 9500B will return the name of the selected trigger channel.

ROUT:TRIG:IMP(?) <dnpd>

Purpose

This command chooses between the 50 Ω or 1 MΩ scope impedance matching levels for the selected trigger channel.

The value of <dnpd> is rounded to select the required impedance:

values ≤55 select 50 Ω; values >55 select 1 MΩ.

Attempting to set the trigger channel impedance when the trigger has been set to 'CABLE' will cause a 'settings conflict' error.

Commands setting the trigger channel impedance, when the trigger has been set to 'NONE', will be ignored.

Response to Query Version

The 9500B will return 50 if 50 Ω is selected, or 1E6 if 1 MΩ is selected.

ROUT:TRIG:RAT(?) <dnpd>

Purpose

This command sets the trigger frequency as a ratio of the selected function.

There are three distinct values, divide by 1, divide by 10, divide by 100.

The <dnpd> will be rounded in the ranges:

0.9 < dnpd < 1.1	selects 1:1 ratio
9.0 < dnpd < 11.0	selects 1:10 ratio
90.0 < dnpd < 110.0	selects 1:100 ratio

Values outside these ranges will generate a settings “Data out of range” error.

Response to Query Version

The 9500B response returns the selected ratio as follows:

if 1:1 is selected	9500B returns 1
if 1:10 is selected	9500B returns 10
if 1:100 is selected	9500B returns 1E2

ROUT:SIGN:MCH(?)
<cpd>{CH1|CH2|CH3|CH4|CH5},{OFF|ON|0|1}

Purpose

This command provides the capability to select multiple channels for the simultaneous output of a DCV signal only. Any changes to the amplitude of this DCV signal will appear on all selected output channels.

Response to Query Version

The 9500B will return all of the selected channels.

SOURce Subsystem

This subsystem is used to select the sources of 9500B output.

Note about backward compatibility with programs written for the Model 9100 plus Option 250:

For users upgrading to Model 9500B who already have SCPI programs written for Model 9100, a number of 9100 commands have been included in the 9500B command set. These 'SCOPE' commands can be used to make the 9500B select functions and parameters corresponding to those of the 9100.

Where 'SCOPE' commands are available, the keywords and parameters are shown as an alternative to the basic 9500B commands.

SOURce SubsystemTable

Note to the [SOURce] Subsystem Table

Many optional keywords are included in the table; shown in square brackets, as required by the SCPI reference document. The structure of the command set is such that in all cases, these optional keywords can be omitted.

Notes about Types of Command Separators

The [SOURce] subsystem has a complex tree structure. To clarify descriptions, examples of branching are referred to the root, so that rather than using the valid short-cut; branching separator, it is shown as returning to the root by a; separator.

This does not mean that valid short-cut 'program message unit' separators cannot be used, but merely that we are defining the commands in full, to avoid confusion.

The following commands are for 9100 compatibility

(They are not included in the main SOURce table, but do appear in the command descriptions):

Table 6. SOURce Subsystem

Keyword	Parameter Form
[SOURce]	
:SCOpe	
[:SHAPe](?)	<cpd>{DC|SQUare|EDGE|MARKer|SINusoid}
:UUT_Z(?)	<dnpd>
:TRANsition(?)	<cpd>{RISing|FALLing}
[SOURce]	
:SPERiod[:CW|FIXed](?)	<dnpd>
[SOURce]	
:FUNCtion	
[:SHAPe](?)	<cpd>{DC|SQUare|EDGE|MARKer|SINusoid|
	OPULse|TELevision|LEAKage|
	RAMP|SKEW|EXTernal|PWIDth}
:PARameter	
:DC	
:GROund(?)	<cpd>{ON|OFF|1|0}
:MCHannel(?)	<cpd>{ON|OFF|1|0}
:SQUare	
:POLarity(?)	<cpd>{POSitive|NEGative|SYMMetrical}
:GROund(?)	<cpd>{ON|OFF|1|0}
:EDGe	
:TRANsition(?)	<cpd>{RISing|FALLing}
:SPEed(?)	<dnpd>
:MARKer	
:WAVEform(?)	<cpd>{SQUare|PULSe|TRIangle|LINE}
:HIGHlight(?)	<cpd>{ON|OFF|1|0}
:OPULse	
:AMPLitude(?)	<dnpd>
:ENERgy(?)	<dnpd>
:DURation?	
:EXECute	
:TRIGger(?)	<cpd>{SINGle|CONTinuous}
:RAMP	
:TIME(?)	<dnpd>
:TRIGger(?)	<cpd>{STARt|MIDDle}
:SKEW	
:ALIGnment(?)	<cpd>{DEFault|PRECi

Table 6. SOURce Subsystem (cont.)

Keyword	Parameter Form
:TELevision	
:LINE(?)	<dnpd>
:SYNC(?)	<cpd>{COMPosite|FRAMe}
:LEVel(?)	<cpd>{BLACk|GREY|WHITe}
:POLarity(?)	<cpd>{POSitive|NEGative}
:LEAKag	
:STATe(?)	<cpd>{OPEN|CLOSe}
:TRIGger(?)	<cpd>{SINGle|CONTinuous}
:EXTernal	
:VOLTage	
[:LEVel]	
[:IMMediate]	
[:AMPLitude](?)	<dnpd>
:CURRent	
[:LEVel]	
[:IMMediate]	
[:AMPLitude](?)	<dnpd>
:FREQuency	
[:CW|FIXed](?)	<dnpd>
:PERiod	
[:CW|FIXed](?)	<dnpd>
:WIDth	
[:CW|FIXed](?)	<dnpd>

[SOUR]:FUNC[:SHAP](?) <cpd>{DC|SQU|EDGE|MARK|SIN|OPUL|TEL|LEAK|RAMP|SKEW|EXT|PWID}

(9100 Option 250 compatible)

[SOUR]:SCOP[:SHAP](?) <cpd>{DC|SQU|EDGE|MARK|SIN}

Purpose

This defines the main signal required output. i.e. selects the source function of the 9500B.

<cpd>

The 'character program data' determines the waveshape of the output signal. It can be chosen from ten alternatives:

DC	Determines that subsequent selection of VOLT or CURR will have a DC component only.
SQUare	Determines that subsequent selection of VOLT or CURR will have a square waveshape.
EDGE	Selects the edge function. The waveshape is selected with a separate command.

MARKer	Selects the timing marker waveshape.
SINusoid	Selects the levelled sinusoidal waveshape.
OPULSe	Selects the energy pulse used to test the overload detection of scopes.
TELevision	Selects the TV waveform video test signals.
LEAKage	Selects the open and closed head conditions used to determine the UUT's leakage current.
RAMP	Selects the Ramp Function.
SKEW	Selects the Zero Skew Function.
PWIDth	Selects the Pulse Width Function.
EXTernal	Selects the Auxiliary Input signal.

The [SOURce]:SCOPe[:SHAPe] command is for backward compatibility with Option 250 in the 9100. Note that there are some amplitude/frequency selections that were available on the 9100, but are not covered on the 9500B.

The query form of this command returns the short-form version of the command. If none of the above are currently selected (i.e. instrument is in measurement mode) then the word 'NONE' will be returned.

[SOUR]:PAR:DC:GRO(?) <cpd>{ON|OFF|1|0}

Purpose

This command sets the output of the DCV signal to zero (0V) when selected 'ON' and will return the output to its previous value when selected 'OFF'. Changing function will turn off the ground selection.

With output 'ON', a settings conflict error will be reported if the DC function has not been selected.

<cpd>

The 'character program data' <cpd>ON or <cpd>1 sets the output voltage to ground 0V. Conversely, <cpd>OFF or <cpd>0 returns the output to its previous value.

Response to Query Version

The instrument will return ON (grounded) or OFF (not grounded) as programmed.

[SOUR]:PAR:DC:MCH(?) <cpd>ON|OFF|1|0}

Purpose

This command enables the input of the DC signal to multiple channels when the selection is 'ON' and disables the multichannels selected when the selection is OFF (see section ROUT:SIGN:MCH).

Response to Query Version

The instrument will return ON or OFF as programmed.

[SOUR]:PAR:SQU:POL(?) <cpd>{POS|NEG|SYMM}

Purpose

This command selects the polarity of the square wave: above, below, or symmetrical about zero volts.

A settings conflict error will be reported if the SQUare function has not been selected.

<cpd>

The 'character program data' <cpd>POS sets the output square wave in a positive direction, referred to ground. Similarly, <cpd>NEG sets the output square wave in a negative direction referred to ground, and <cpd>SYMM sets the output square wave symmetrically about ground.

Response to Query Version

The instrument will return POS, NEG or SYMM as programmed.

[SOUR]:PAR:SQU:GRO(?) <cpd>{ON|OFF|1|0}

Purpose

This command sets the square wave output of the signal to zero (0 V) when selected ‘ON’ and will return the output to its previous value when selected ‘OFF’. Changing function will turn off the ground selection.

With output 'ON', a settings conflict error will be reported if the SQUare function has not been selected.

<cpd>

The 'character program data' <cpd>ON or <cpd>1 sets the output voltage to 0 V. Conversely, <cpd>OFF or <cpd>0 returns the output to its previous value.

Response to Query Version

The instrument will return ON (grounded) or OFF (not grounded) as programmed.

[SOUR]:PAR:EDGE:TRAN(?) <cpd>{RISing|FALLing}
[SOUR]:SCOP:TRAN(?) <cpd>{RISing|FALLing}

Purpose

This command applies only to the Edge function. It selects the direction of the edge which follows the trigger.

A settings conflict error will be reported if the EDGE function has not been selected.

<cpd>

<cpd> RIS sets a positive-going edge, <cpd> FALL sets a negativegoing edge.

For details of local operation and parameter limitations, refer to the *9500B Users Guide, Edge Function*.

Response to Query Version

The instrument will return the present edge setting: RIS or FALL.

[SOUR]:PAR:EDGE:SPE(?) <dnpd>

Purpose

This command selects the speed (slew rate) of the Edge function.

A settings conflict error will be reported if the EDGE function has not been selected.

<dnpd>

The <dnpd> is rounded so that:

dnpd ≥ 600E-12	selects 100 ns edge (HV Edge).
200E-12 < dnpd < 600E-12	selects 500 ps edge.
dnpd ≤ 200E-12	selects 150 ps edge.

For details of local operation and parameter limitations, refer to *9500B Users Guide, Edge Function*.

Response to Query Version

The instrument will return the present edge speed setting.

[SOUR]:PAR:MARK:WAV(?) <cpd>{SQU|PULS|TRI|LINE}

Purpose

This command selects the waveshape of the timing marker function.

A settings conflict error will be reported if the MARKer function has not been selected.

Note that period/frequency restrictions are placed on the waveshape selection. An 'Settings Conflict' error will be reported when outside limits.

<cpd> 'character program data' selects waveforms as follows:

<cpd>SQU:	square/sine waveform
<cpd>PULS:	pulse waveform
<cpd>TRI:	narrow triangular waveform
<cpd>LINE:	square waveform at line frequency

For details of local operation and parameter limitations, refer earlier to the *9500B Users Guide, Time Marker Function*.

Response to Query Version

The instrument returns the <cpd> for the presently-selected waveform.

[SOUR]:PAR:MARK:HIGH(?) <cpd>{ON|OFF|1|0}

Purpose

This selects whether the current edge wave shape has every 10th peak 'highlighted', by increasing the peak's amplitude.

A settings conflict error will be reported if LINE marker waveshape is selected.

<cpd>

The 'character program data' <cpd>ON or <cpd>1 turns the highlighted waveform ON. Conversely, <cpd>OFF or <cpd>0 removes the highlight from the waveform.

For details of local operation and parameter limitations, refer to the *9500B Users Guide, Time Marker Function*.

Response to Query Version

The instrument will return ON (highlighted) or OFF (not highlighted) as programmed.

[SOUR]:PAR:OPUL:AMPL(?) <dnpd>
[SOUR]:PAR:OPUL:ENER(?) <dnpd>

Purpose

These commands are used together to set the parameters of the overload test. The combination of amplitude and energy set the power contained within the pulse that will be applied to the unit under test. The amplitude <dnpd> must be signed '-' for negative pulse direction. These commands do not apply the pulse, just select the parameters.

Pulse power and pulse duration are internally calculated from these two commands of amplitude and energy.

A settings conflict error will be reported if the OPULse function has not been selected.

<dnpd>

The Amplitude <dnpd> has units of Volts, and is restricted to:

$5 \leq dnpd \leq 20$ or $-20 \leq dnpd \leq -5$.

The Energy <dnpd> has units of Joules, and is restricted so that:

$1.6 \leq dnpd \leq 50$.

For details of local operation and parameter limitations, refer to the *9500B Users Guide, Overload Pulse Function*.

Response to Query Version

The instrument will return the <dnpd> for the present amplitude or energy.

[SOUR]:PAR:OPUL:EXEC

Purpose

This command will cause the 9500B to apply the overload pulse.

A settings conflict error will be reported if the OPULse function has not been selected or if Output is not already ON.

The EXECute command is not buffered in the 9500B. It will be ignored and discarded if a current EXECute command is not completed

[SOUR]:PAR:OPUL:POWer?
[SOUR]:PAR:OPUL:DURation?

Purpose

These two query commands can be used to find out the Power and Duration settings which have been selected by the Amplitude/Energy combination.

A value of 200E33 will be reported if the OPULse function has not been selected.

[SOUR]:PAR:OPUL:TRIG(?) <cpd>{SING|CONT}

Purpose

These command selects the type of UUT triggers associated with the overload function.

Triggers are only produced if the output is on.

A settings conflict error will be reported if the OPULse function has not been selected.

<cpd>

SINGle: Generates one trigger coincident with the start of the overload pulse.

CONTinuous: Selects a free running (100 Hz) trigger signal.

For details of local operation and parameter limitations, refer to the *9500B Users Guide, Overload Pulse Function*.

Response to Query Version

The instrument will return the <cpd> for the currently-selected trigger type.

[SOUR]:PAR:RAMP:TIME(?) <dnpd>

Purpose

This command selects the rise time of the ramp. Note that it does not set the frequency of the signal (this is three times the ramp time).

A settings conflict will be reported if the RAMP function has not been selected.

<dnpd>

1 ms to 1 s: is rounded to the nearest decade point.

For details of local operation and parameter limitations, refer to the *9500B Users Guide, Linear Ramp Function*.

Response to Query Version

The instrument will return the rounded <dnpd>.

[SOUR]:PAR:RAMP:TRIG(?) <cpd>{STARt|MIDDle}

Purpose

This command selects the type of triggers associated with the Ramp function.

Triggers are produced only when the Output is ON.

A settings conflict will be reported if the RAMP function has not been selected.

<cpd>

For details of local operation and parameter limitations, refer to the *9500B Users Guide, Linear Ramp Function*.

Response to Query Version

The instrument will return the <cpd> for the currently-selected trigger type.

[SOUR]:PAR:SKEW:ALIGnment(?) <cpd>{DEFault|PRECision}

Purpose

This command enables and disables the application of precision calibration to the Zero Skew output waveforms. Note that the Zero Skew offsets must have already been set up manually, as there is no command to perform this calibration via the remote interface.

A settings conflict will be reported if the Zero Skew function has not been selected.

<cpd>

DEFault: The inter-channel skew is set to default (±50 ps).

PRECision: The precision adjustments, already carried out and stored manually, are applied.

For details of local operation and parameter limitations, refer to the *9500B Users Guide, Zero Skew Function*.

Response to Query Version

The instrument will return the <cpd> for the currently-selected trigger type.

[SOUR]:PAR:TEL:LINE(?) <dnpd>

Purpose

This command selects the line frequency standard of the TV composite video function.

A settings conflict will be reported if the TELevision function has not been selected.

<dnpd>

<600: Is rounded to select 525 line.

≥600: Is rounded to select 625 line.

For details of local operation and parameter limitations, refer to the *9500B Users Guide, Composite Video Function*.

Response to Query Version

The instrument will return the rounded <dnpd> for the currentlyselected line frequency standard.

[SOUR]:PAR:TEL:SYNC(?) <cpd>{COMP|FRAM}

Purpose

This command selects the sync standard of the TV function (available on the trigger channel if one has been selected).

A settings conflict will be reported if the TELevision function has not been selected.

<cpd>

COMPosite: Selects the full composite sync standard.

FRAMe: Selects the frame sync standard.

For details of local operation and parameter limitations, refer to the *9500B Users Guide, Composite Video Function*.

Response to Query Version

The instrument will return the <cpd> for the currently-selected sync standard.

[SOUR]:PAR:TEL:LEV(?) <cpd>{BLAC|GREY|WHIT}

Purpose

This command selects one of the three amplitude levels of the TV waveform.

A settings conflict will be reported if the TELevision function has not been selected.

<cpd>

BLACk: Selects the black-level amplitude.

GREY: Selects a mid-level amplitude equivalent to a TV grey tone.

WHITe: Selects the white-level amplitude.

For details of local operation and parameter limitations, refer to the *9500B Users Guide, Composite Video Function*.

Response to Query Version

The instrument will return the <cpd> for the currently-selected amplitude level.

[SOUR]:PAR:TEL:POL(?) <cpd>{POS|NEG}

Purpose

This command inverts the polarity of the TV waveform.

A settings conflict will be reported if the TELevision function has not been selected.

<cpd>

The 'character program data' <cpd>POS sets the output square wave in a positive direction, referred to ground. Similarly, <cpd>NEG sets the output square wave in a negative direction referred to ground.

For details of local operation and parameter limitations, refer to the *9500B Users Guide, Composite Video Function*.

Response to Query Version

The instrument will return the <cpd> for the currently-selected polarity.

[SOUR]:PAR:LEAK:STAT(?) <cpd>{OPEN | CLOS}

Purpose

This command selects the leakage function. The <cpd> parameters are used to determine which of the leakage currents are measured.

A settings conflict will be reported if the LEAKage function has not been selected.

<cpd>

OPEN: Selects open-circuit output.

CLOSe: Selects short-circuit output.

For details of local operation and parameter limitations, refer to the *9500B Users Guide, Input Leakage Function*.

Response to Query Version

The instrument will return the <cpd> for the currently-selected open/short circuit state.

[SOUR]:PAR:LEAK:TRIG(?) <cpd>{SING|CONT}

Purpose

This command selects the type of triggers associated with the leakage function.

Triggers are only produced if the output is on.

A settings conflict will be reported if the LEAKage function has not been selected.

<cpd>

SINGle: Generates one trigger coincident with each change of state of the open or close.

CONTinuous: Selects a free running (100 Hz) trigger signal.

For details of local operation and parameter limitations, refer to the *9500B Users Guide, Input Leakage Function*.

Response to Query Version

The instrument will return the <cpd> for the currently-selected trigger type.

[SOUR]:PAR:EXT

Purpose

This command selects the AUX INPUT signal for routing to any of the five channels. The required channel is selected using the ROUTe subsystem.

Refer to the *9500B Users Guide, Aux Input Function*.

[SOUR]:SCOPe:UUT_Z(?) <dnpd>

Purpose

This command is for backwards compatibility with the 9100+250 and selects the impedance matching for the signal and trigger channels.

<dnpd>

≤55: Is rounded to select 50 Ω

>55: Is rounded to select 1 MΩ

Response to Query Version

The instrument will return the rounded <dnpd> for the currentlyselected UUT input impedance.

[SOUR]:VOLT[:LEVE][:IMM][:AMPL](?) <dnpd>

Purpose

This command selects either DC or AC Voltage hardware, dependent upon the DC or SQU|EDGE|MARK|SIN|OPUL|TEL|LEAK|EXT parameter included in the most-recent FUNC command.

<dnpd>

The <dnpd> is a number which sets the required output voltage amplitude, expressed in units of DC or pk-pk AC Volts. It will automatically choose the 'best' hardware range for the defined voltage output. The 9500B will accept signed or unsigned positive values for DC Voltage. Only DC may be given a negative <dnpd>.

The voltage command will not cancel the ground mode, if it is active.

Response to Query Version

The instrument will return the present DC or AC voltage output value, dependent upon the DC or SQU|EDGE|MARK|SIN|OPUL|TEL|LEAK|EXT parameter implicit, or included, in the most-recent FUNC command. The returned number will be in standard scientific format (for example: -20 mV DC would be returned as -2.0E-2; positive numbers, however, are unsigned).

If the function is not selected, the query VOLT? will return the invalid number (2E35).

[SOUR]:CURR[:LEVE][:IMM][:AMPL](?) <dnpd>

Purpose

This command selects either DC or AC Current hardware, dependent upon the DC or SQU parameter included in the most-recent FUNC command.

<dnpd>

The <dnpd> is a number which sets the required output current amplitude, expressed in units of DC or pk-pk AC Amps. It will automatically choose the 'best' hardware range for the defined current output. The 9500B will accept signed or unsigned positive values for DC Current. Only DC may be given a negative <dnpd>.

A settings conflict will be reported if the DC or Square function has not been selected.

Response to Query Version

The instrument will return the present DC or AC current output value, dependent upon the DC or SQU parameter implicit, or included, in the most-recent FUNC command. The returned number will be in standard scientific format (for example: -200 mA DC would be returned as -2.0E-1; positive numbers, however, are unsigned).

If the function is not selected, the query CURR? will return the invalid number (2E35).

[SOUR]:FREQ[:CW|FIX](?) <dnpd>

Purpose

This command is used to set the frequency of the currently-selected waveform. The CW and FIXed optional parameters are included to stay with the SCPI definition of the frequency command. The command is valid only for AC waveshapes.

<dnpd>

The <dnpd> is a number which sets the required output frequency of the selected operation, expressed in units of Hertz. It will automatically choose the 'best' hardware range for the defined frequency of output.

Response to Query Version

The instrument will return the present output frequency value for the selected operation, dependent upon the parameter implicit, or included, in the most-recent FUNC command, and the most-recent VOLT or CURR command. The returned number will be in standard scientific format (20 kHz would be returned as 2.0E4).

[SOUR]:PER[:CW|FIX](?) <dnpd>
[SOUR]:SPER[:CW|FIX](?) <dnpd>

Note

The SPERiod command is used for backward compatibility with Option 250 in the 9100. In the 9100, the SPER command was available only in Edge and Timing Markers functions, but in the 9500B, the PER command is available in all applicable functions.

Purpose

This command is used to set the period of the currently-selected waveform. The CW and FIXed optional parameters are included to stay with the SCPI definition of the period command. The command is valid only for AC waveshapes.

<dnpd>

The <dnpd> is a number which sets the required output period of the selected operation, expressed in units of Seconds. It will automatically choose the 'best' hardware range for the defined period of output.

Response to Query Version

The instrument will return the present output period value for the selected operation, dependent upon the parameter implicit, or included, in the most-recent FUNC command, and the most-recent VOLT or CURR command. The returned number will be in standard scientific format (50 μ s would be returned as 5.0E-5).

SOUR:WIDT[: CW | FIX] (?)<dnpd>

Purpose

This command is used to set the width of the pulse waveform. The amplitude of the pulse is fixed but the frequency can be modified with the SOURce:FREQuency command. The CW and FIXed optional parmeters are included to provide continuity with other similar commands. The command is only valid for the PWIDth function.

<dnpd>

The <dnpd>is a number which sets the required pulse width, expressed in units of Seconds.

Response to Query Version

The instrument will return the present width value for the pulse. The returned number will be in standard scientific format. (50 μ s would be returned as 5.0E-5).

CONFigure Subsystem

This subsystem is used to select the input resistance or input capacitance measurement mode.

Note

There are only two parameters that a 9500B can measure: the UUT input capacitance and the UUT input resistance. These are simple measurements with the user having no control over read rate, resolution, trigger timing, etc.

Note that the Group Execute Trigger (GET) is not available on the 9500B. (The instrument is configured with 'DT0' interface capability: 'no device trigger capability'.)

CONFigure[:RESistance|CAPacitance]

Purpose

This command is used to select the UUT input resistance or capacitance measurement function as appropriate. Exit from the measurement function via the SOURce:FUNCtion:SHAPe commands.

Any command that is received that cannot be executed (e.g.:VOLT.:FREQ etc.,) will generate a 'settings conflict' error.

CONFigure[?

Response to Query

The instrument will return either 'RES' or 'CAP' if the measurement function is selected, or 'NONE' if not selected.

READ?

Purpose

This query-only command is used to return the most-recent measurement for either the UUT input resistance or capacitance function as appropriate.

Response to Query

This command will return the last measurement taken for either the resistance or capacitance function (as appropriate).

Resistance

In the case of successfully measuring the resistance value of the UUT, this command will return a number within the approximate range of 10 to 150 or 50E3 to 20E6 depending on the setting of the 9500B channel impedance.

Capacitance

In the case of successfully measuring the capacitance value of the UUT, this command will return a number within the approximate range of 1.0E-12 to 120.0E-12.

Value Cannot be Resolved

If the resistance or capacitance is selected, but the measurement is unable to resolve a value (i.e. no scope connected) then the value 2E35 will be returned.

Neither RESistance nor CAPacitance Selected

If neither RESistance nor CAPacitance is selected, this command will return 2E35.

Note

According to the SCPI spec, if a measurement is requested when it is not possible to perform the task (i.e. output off, function not selected, etc.) then the message -230, 'Data corrupt or stale' is put in the error buffer. NO READING IS RETURNED. This may hang the bus if the user application is poorly written because the controller will be expecting an answer to its query command. For user-friendliness a value of 2E35 is always returned.

STATus Subsystem

This subsystem is used to enable bits in the Operation and Questionable Event registers. The Operation and Questionable: Event, Enable and Condition registers can be interrogated to determine their state. For further information regarding the Status structure, refer to section, *Retrieval of Device Status Information*.

STATus Subsystem Table

Table 7. STATus Subsystem

Keyword	Parameter Form
STATus	
:OPERation	
[:EVENt]?	
:ENABle(?)	<dnpd>
:CONDition?	
:QUEStionable	
[:EVENt]?	
:ENABle(?)	<dnpd>
:CONDition?	
:PRESet	

STAT:OPER[:EVEN]?

Purpose

STAT:OPER? returns the contents of the Operation Event register, clearing the register.

Response

A <dnpd> in the form of an Nr1 number is returned. The value of the number, when converted to base 2 (binary), identifies the Operation Event register bits to determine their current status.

For example (refer to Figure 4).

If the 9500B had just performed a selftest, the 'TESTING' bit 8 of the register would be set, and if no other Operation Event bits were enabled, the number 256 would be returned. Bit 8 (indeed, all bits in the register) would be reset by this query.

STAT:OPER:ENAB(?) <dnpd>

Purpose

STAT:OPER:ENAB <dnpd> sets the mask which enables those Operation Event register bits which are required to be summarized at bit 7 of the IEEE 488.2 Status Byte register.

<dnpd>

This is a decimal integer whose binary equivalent represents the bits required to be enabled.

For example (refer to Figure 4 and 9500B Status Reporting — SCPI Elements):

The command: STAT:OPER:ENAB 272 would be required to enable only the 'TESTING' and 'MEASURING' bits 8 and 4 of the Operation Event register.

Response to the Query Version

A <dnpd> in the form of an Nr1 number is returned. The value of the number, when converted to base 2 (binary), identifies the bits set in the Operation Enable mask.

For example (refer to Figure 4 and 9500B Status Reporting — SCPI Elements):

If only the 'MEASURING' and 'CALIBRATING' bits 4 and 0 of the register are enabled, the number 17 would be returned.

STAT:OPER:COND?

Purpose

STAT:OPER:COND? returns the contents of the Operation Condition register (not shown in Figure 4), which is not cleared by the command.

Note

This register contains transient states, in that its bits are not 'sticky', but are set and reset by the referred operations. The response to the query therefore represents an instantaneous 'Snapshot' of the register state, at the time that the query was accepted.

Response

A <dnpd> in the form of an Nr1 number is returned. The value of the number, when converted to base 2 (binary), identifies the Operation Condition register bits to determine their current status.

For example (refer to Figure 4):

If the 9500B was in the process of performing a selftest, only the 'TESTING' bit 8 of the register would be temporarily set, and the number 256 would be returned.

STAT:QUES[:EVEN]?

Purpose

STAT:QUES? returns the contents of the Questionable Event register, clearing the register.

Response

A <dnpd> in the form of an Nr1 number is returned. The value of the number, when converted to base 2 (binary), identifies the Questionable Event register bits to determine their current status.

For example (refer to Figure 4 and 9500B Status Reporting — SCPI Elements):

If an error had been initiated by a doubtful measurement during resistance operations, the 'sticky' 'RESISTANCE' bit 12 of the register would be set, and if no other Questionable Event bits were enabled, the number 4096 would be returned. Bit 12 (indeed, all bits in the register) would be reset by this query.

STAT:QUES:ENAB(?) <dnpd>

Purpose

STAT:QUES:ENAB <dnpd> sets the mask which enables those Questionable Event register bits which are required to be summarized at bit 3 of the IEEE 488.2 Status Byte register.

<dnpd>

This is a decimal integer whose binary equivalent represents the bits required to be enabled.

For example (refer to Figure 4 and 9500B Status Reporting — SCPI Elements):

The command: STAT:QUES:ENAB 6144 would be required to enable only the 'RESISTANCE' and 'CAPACITANCE' bits 12 and 11 of the Questionable Event register.

Response to the Query Version

A <dnpd> in the form of an Nr1 number is returned. The value of the number, when converted to base 2 (binary), identifies the bits set in the Questionable Enable mask.

For example (refer to Figure 4 and 9500B Status Reporting — SCPI Elements):

If the 'CAPACITANCE' bit 11 of the register is the only enabled bit, the number 2048 would be returned.

STAT:QUES:COND?

Purpose

STAT:QUES:COND? returns the contents of the Questionable Condition register (not shown in Figure 4), which is not cleared by the command.

Note

This register contains transient states, in that its bits are not 'sticky', but are set and reset by the referred conditions. The response to the query therefore represents an instantaneous 'Snapshot' of the register state, at the time that the query was accepted.

Response

A <dnpd> in the form of an Nr1 number is returned. The value of the number, when converted to base 2 (binary), identifies the Questionable Condition register bits to determine their current status.

For example (refer to Figure 4):

If a doubtful measurement was generating an error during Capacitance operations, and the temporary 'CAPACITANCE' bit 11 of the Condition register was set; and if no other Questionable Condition bits were set, the number 2048 would be returned.

STAT:PRES

SCPI-Mandated Command

The intention behind mandating the STAT:PRES command is to enable all bits in the SCPI-defined 'Device-dependent' and 'Transition' registers in order to provide a "device-independent structure for determining the gross status of a device".

Purpose in the 9500B

In the 9500B, the functions of the 'Transition' registers are not required, so no access is given. The PRES command therefore affects only the two device-dependent enabling registers:

1. The Operation Event Enable register
2. The Questionable Event Enable register.

Refer to Figure 4. Sending STAT:PRES will set true all bits in both Enable registers. This will enable all bits in the two Event registers, so that all reportable device-dependent events, reported in the two registers, will be capable of generating an SRQ; providing only that bits 3 and 7 in the IEEE-488.2 Status Byte Register are also enabled.

The use of STAT:PRES in the 9500B allows the status-reporting structure to be set to a known state, not only for the intention of the SCPI mandate, but also to provide a known starting point for application programmers.

SYSTem Subsystem

This subsystem collects the functions that are not related to 9500B performance.

SYSTem Subsystem Table

Table 8. SYSTem Subsystem

Keyword	Parameter Form
SYSTem	
:ERRor?	
:DATE(?)	<spd>
:TIME(?)	<spd>
:SVOLtage(?)	<dnpd>
:VERSion?	
:FORMat?	

SYST:ERR?

The Error Queue

As errors in the 9500B are detected, they are placed in a 'first in, first out' queue, called the 'Error Queue'. This queue conforms to the format described in the SCPI Command Reference (Volume 2), although errors only are detected. Three kinds of errors are reported in the Error Queue, in the sequence that they are detected:

Command Errors, Execution Errors and Device-Dependent errors

Queue Overflow

Any time the Error Queue overflows, the earliest errors remain in the queue, and the most-recent error is discarded. The latest error in the queue is replaced by the error: -350,"Queue overflow".

Purpose of SYST:ERR? — Reading the Error Queue

This query is used to return any error which has reached the head of the Error Queue, and delete the error from the queue. The Error Queue is first in/first out, so the returned string will represent the earliest error in the queue.

The queue is read destructively as described in the SCPI Command Reference to obtain a code number and error message. The query can be used successively to read errors in the queue until it is empty, when the message 0,"No error" will be returned.

Response

The response is in the form of 'String Program Data', and consists of two elements: a code number and error message.

The list of possible responses is given in the *9500B Calibration Manual, Routine Maintenance and Test*.

SYST:DATE(?) <spd>

The date format can only be changed locally; using the Date Format menu, which is accessed via the Configuration menus.

Note

A password is required for access to change the date format. Refer to the 9500B Users Guide, Configuration Mode, 'MORE' Configuration and 'DATE TIME'.

Purpose

This command is not used to change the date format. It only changes the present date, as recognized by the 9500B, within the current date format, as defined locally.

<spd>

This string defines the present date. The numbers represent day, month and year, but not necessarily in that order. The locally-defined date format governs the sequence in which these three numbers are recognized, and their order within the string must reflect the locally defined sequence.

Possible Formats

The string must conform to the scheme: dd, mm, yyyy where the chosen sequence agrees with that set locally in 'DATE TIME'.

dd/mm/yyyy or mm/dd/yyyy or yyyy/mm/dd

Response to Query Version SYST:DATE?

The Query will return the presently-programmed date, as three slash separated two-digit numbers, in the date format that they are currently set.

SYST:TIME(?) <spd>

Purpose

This command changes the present time as recorded by the 9500B software. Any new time will be updated from a non-volatile real-time internal 24-hour clock.

<spd>

This string defines the present time, consisting of two 2-digit numbers, separated by a hyphen. The numbers represent hour and minute, in that order. Their order within the string must reflect the fixed sequence.

The string must conform to the scheme: X-Y, where X and Y are 2-digit numbers.

The combination of the 2-digit numbers must have the following meaning, within the context of a 24-hour clock:

Hour-Minute

Response to Query Version SYST:TIME?

The Query will return the updated time at the moment the query was accepted, as two hyphen-separated 2-digit numbers, in the fixed time format.

SYST:SVOL (?) <dnpd>

Purpose

This command sets the voltage value of the threshold of operation for the High Voltage Warning as employed in DC Voltage and AC Voltage functions. The 9500B need not be currently set in either of these functions to program the voltage.

<dnpd>

The 'decimal numeric program data' is a number which sets the required voltage safety warning threshold, expressed in units of DC or Pk-Pk AC Volts. It should be unsigned. The parameter <dnpd> must have a value in the range 10.00 V to 110.00 V inclusive.

Response to Query Version: SYST:SVOL?

The instrument will return the present DC or AC voltage safety warning threshold value. The returned number will be in standard scientific unsigned format (for example: 90 V would be returned as 9.0E1).

SYST:VERS?

Purpose

This query returns a numeric value corresponding to the SCPI version number for which the 9500B complies.

Response

SYST:VERS? returns an <Nr2> formatted numeric value corresponding to the SCPI version number for which the 9500B complies. At the time of writing, this will be 1994.0.

SYST:FORM?

Purpose

This query returns the present date format, as programmed locally.

Response

SYST:FORM? returns one of three sets of three characters: **DMY, MDY or YMD (Day/Month/Year,Month/Day/Year or Year/Month/Day** respectively). Formatting is carried out from a screen in 'Configuration' mode (Refer to the *9500B Users Guide, Configuration Mode*, 'DATE TIME').

REFerence Subsystem

This subsystem is used to configure the input and output reference frequencies.

REFerence SubsystemTable

Table 9. REFerence Subsystem

Keyword	Parameter Form
REFerence	
OUTPut	
:FREQuency(?)	<dnpd>
INPut	
:SOURce(?)	<cpd>{INTernal|EXTernal}
:FREQuency(?)	
:LOCK?	

REF:OUTP:FREQ(?) <dnpd>

Purpose

This command enables and disables the reference frequency output from the 9500B.

The <dnpd> are used:

<0.9 MHz Reference output will be disabled.

<9.0 MHz Reference output will be set to 1 MHz.

>=9.0 MHz Reference output will be set to 10 MHz.

Response to Query Version

The 9500B will return 0.000000E+00, 1.000000E+06, 1.000000E+07

REF:INP:SOURce(?)
<cpd>{INTernal|EXTernal}

Purpose

This command determines whether the frequency reference for the 9500B is from the internal source or from the external source.

<cpd>

INTernal: The 9500B will use its internal frequency reference.

EXTernal: The 9500B will use the frequency reference supplied on the external BNC connector.

Note that in external mode, if the 9500B has not locked to the external frequency, then the output of the 9500B cannot be turned on.

Response to Query Version

The instrument will return the <cpd> for the currently selected frequency source.

REF:INP:FREQ(?) <dnpd>

Purpose

This command enables and disables the reference frequency input for the 9500B. The <dnpd> is used to select the frequency of the external reference. The <dnpd> must be in the range 1.0E6 and 20.0E6. The 9500B will round the <dnpd> to the nearest MHz and uses this as the frequency selection. For example a <dnpd> of 9.1000E6 would be rounded to 9.0E6 and thus the frequency selected would be 9 MHz.

Response to Query Version

The 9500B will return the set frequency in scientific format.

REF:INP:LOCK?

Purpose

This query only command will respond with a <cpd>:

OFF 9500B is unlocked to the external input frequency.

ON 9500B is locked to the external input frequency. Note that when the internal frequency is selected, this command will always return ON.

IEEE 488.2 Device Documentation Requirements

IEEE 488.2 requires that certain information be supplied to the user about how the device has implemented the standard. The Device Documentation Requirements are detailed in the Standard document IEEE Std 488.2-1992. In this manual, the required information is already contained within the descriptions of the system, and this section provides cross references to those descriptions in which it is presented.

1. The list of IEEE 488.1 Interface Functions subsets implemented is given as Table 1. The list is also printed close to the IEEE 488 connector on the rear of the instrument.
2. The instrument address is set manually, and the instrument firmware refuses to set any address outside the range 0-30. It responds instead with a Device Dependent Error, displayed on the front panel screen:

   "Bus address must be within the range Ø - 3Ø".
3. The (manual only) method of setting the address is described, including the point in time when the 9500B recognizes a user-initiated address change.
4. Appendix D describes the active and nonactive settings at power-on.
5. Message Exchange Options:
   a. The Input Buffer is a first in - first out queue, which has a maximum capacity of 128 bytes (characters). Each character generates an interrupt to the instrument processor which places it in the Input Buffer for examination by the Parser. The characters are removed from the buffer and translated with appropriate levels of syntax checking. If the rate of programming is too fast for the Parser or Execution Control, the buffer will progressively fill up. When the buffer is full, the handshake is held.
   b. No query returns more than one <RESPONSE MESSAGE UNIT>.
   c. All queries generate a response when parsed.
   d. No query generates a response when read.
6. The following functional elements are used in constructing the device-specific commands:
   - Command Program Header
   - Query Program Header
   - Character Program Data
   - Decimal Numeric Program Data
   - String Program Data (PASS, EXIT, DATE, TIME)
   - Arbitrary Block Program Data (*PUD)
   - Arbitrary ASCII Response Data (to ROUTe:FITTed?)

   No Compound Command Program Headers are used within the SCPI format.
7. *PUD blocks are limited to 63 bytes.

8. Expression Program Data elements are not used.
9. The syntax for each command is described in the general list of commands in section *9500B SCPI Language - Commands and Syntax*, and *IEEE 488.2 Common Commands and Queries Implemented in the Model 9500B*. This list includes all queries, for which the response syntax is also described.
10. All device-to-device message transfer traffic follows the rules for <RESPONSE MESSAGE> elements.
11. The only command which elicits a Block Data response is the query ∗PUD?.

    Its response consists of #, 2, two digits and a data area of 63 bytes; 67 bytes in all.
12. A separate list of every implemented Common Command and Query is given in the alphabetical index in *Common IEEE 488.2 Commands and Queries*.

    They are also described in *IEEE 488.2 Common Commands and Queries Implemented in the Model 9500B*.
13. ∗CAL? is not implemented.
14. ∗DDT is not implemented.
15. Macro commands are not implemented.
16. ∗IDN? is described in *IEEE 488.2 Common Commands and Queries Implemented in the Model 9500B*.
17.
18. Neither ∗RDT nor ∗RDT? are implemented.
19. The states affected by ∗RST are described for each command in the list of commands and queries in *IEEE 488.2 Common Commands and Queries Implemented in the Model 9500B*.

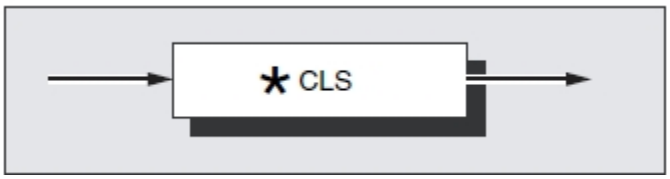
    Query Command ∗LRN? is not implemented; neither are Commands ∗RCL and ∗SAV.
20. ∗TST? invokes the Operational Selftest . The response to ∗TST? is described in *IEEE 488.2 Common Commands and Queries Implemented in the Model 9500B*, with a list of possible errors detailed in the *9500B Calibration Manual, Routine Maintenance and Test*.
21. The additional status data structures used in the instrument’s status reporting are fully described in *Retrieval of Device Status Information*.

    Operating instructions for the status reporting facilities are given in *IEEE 488.2 Common Commands and Queries Implemented in the Model 9500B*.
22. All commands are sequential - overlapped commands are not used.
23. As all commands are sequential, there are no pending parallel operations. The functional criterion which is met, therefore, is merely that the associated operation has been completed.
24. No representations are used for 'Infinity' and 'Not-a-Number'.

IEEE 488.2 Common Commands and Queries Implemented in the Model 9500B

Clear Status

This command conforms to the IEEE 488.2 standard requirements.



erw138

∗CLS

Clears all the event registers and queues except the output queue. The output queue and MAV bit will be cleared if ∗CLS immediately follows a 'Program Message Terminator'; refer to the IEEE 488.2 standard document.

Execution Errors:

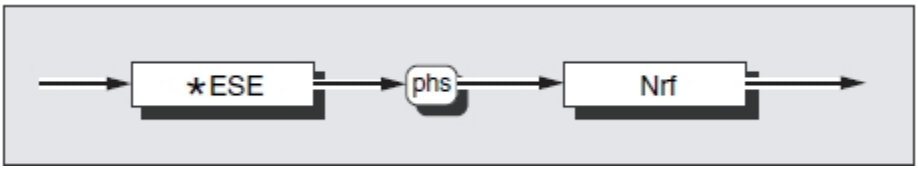
None

Power On and Reset Conditions

Not applicable

Event Status Enable

This event status data structure conforms to the IEEE 488.2 standard requirements for this structure.



erw139

∗ESE enables the standard defined event bits which will generate a summary message in the status byte. Refer to *Retrieval of Device Status Information*.

Nrf is a Decimal Numeric Data Element representing an integer decimal value equivalent to the Hex value required to enable the appropriate bits in this 8-bit register. The detailed definition can be found in section *IEEE 488.2-defined Event Status Register*. Note that numbers will be rounded to an integer.

Execution Errors:

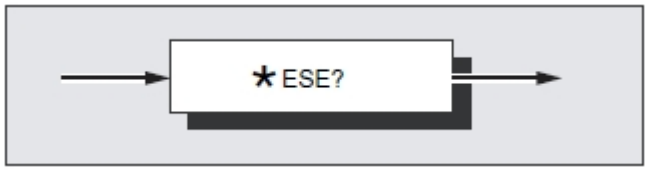
None.

Power On and Reset Conditions

Not applicable.

Recall Event Status Enable

This event status data structure conforms to the IEEE 488.2 standard requirements for this structure.



erw140

∗ESE?

Recalls the enable mask for the standard defined events. Refer to *Retrieval of Device Status Information*.

Response Decode:

The value returned, when converted to base 2 (binary), identifies the enabled bits which will generate a summary message in the service request byte, for this data structure.

Execution Errors:

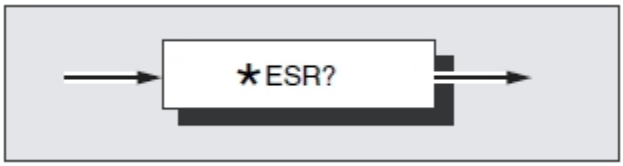
None

Power On and Reset Conditions

The Power On condition depends on the condition stored by the common ∗PSC command - if 0 then it is not cleared; if 1 then the register is cleared. Reset has no effect.

Read Event Status Register

This event status data structure conforms to the IEEE 488.2 standard requirements for this structure.



erw141

∗ESR?

Recalls the standard defined events. Refer to *Retrieval of Device Status Information*.

Response Decode:

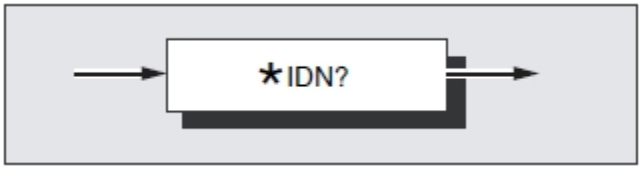
The value returned, when converted to base 2 (binary), identifies the bits as defined in the IEEE 488.2 standard.

Execution Errors:

None

I/D (Instrument Identification)

This command conforms to the IEEE 488.2 standard requirements.



erw142

∗IDN?

Will recall the instrument's manufacturer, model number, serial number and firmware level.

Response Format:

Character position

1 2 3 4 5 6

F l u k e ,

7 8 9 10 11 12

9 5 0 0 B ,

13 14 15 16 17 18 19 20 21 22 23 24 25

x x x x x x x x x x x x ,

26 27 28 29

x . x x

Where:

The data contained in the response consists of four commaseparated fields, the last two of which are instrument-dependent. The data element type is defined in the IEEE 488.2 standard specification.

A single query sent as a terminated program message will elicit a single response terminated by:

nl = newline with EOI

If multiple queries are sent as a string of program message units (separated by semi-colons with the string followed by a permitted terminator), then the responses will be returned as a similar string whose sequence corresponds to the sequence of the program queries. The final response in the string will be followed by the terminator:

nl = newline with EOI

Response Decode:

The data contained in the four fields is organized as follows:

- First field – manufacturer
- Second field – model
- Third field - serial number
- Fourth field - firmware level (will possibly vary from one instrument to another).

Execution Errors:

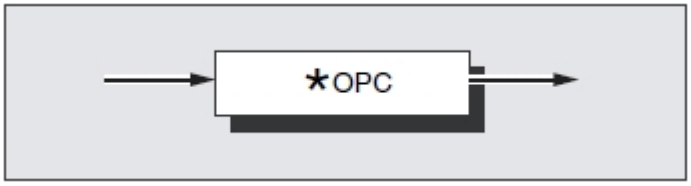
None

Power On and Reset Conditions

Not applicable

Operation Complete

This command conforms to the IEEE 488.2 standard requirements.



erw143

∗OPC

Is a synchronization command which will generate an operation complete message in the standard Event Status Register when all pending operations are complete.

Execution Errors:

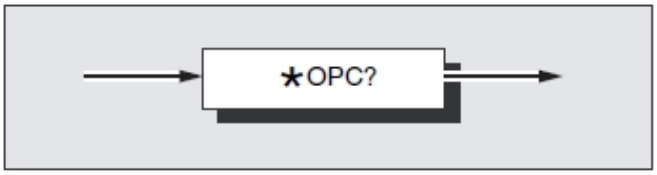
None

Power On and Reset Conditions

Not applicable

Operation Complete?

This query conforms to the IEEE 488.2 standard requirements.



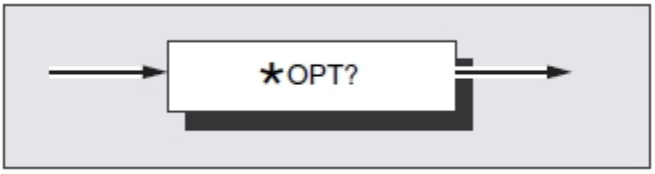
erw144

Response Decode:

The value returned is always 1, which is placed in the output queue when all pending operations are complete.

Recall the 9500B Instrument Hardware Fitment

This command conforms to the IEEE 488.2 standard requirements.



erw145

∗OPT?

Will recall the instrument's hardware fitment.

Response Format:

Character position:

1	2	3	4	5	6	7	8	9	10	11	12
Ch1	,	Ch2	,	Ch3	,	Ch4	,	Ch5	,	x1	,

13	14	15	16	17	18	19	20	21	22
s	s	s	s	s	s	s	,	LN	nl

Where:

The data in the response consists of comma-separated characters, either 1 or Ø.

nl = newline with EOI

The data element type is Nr1 as defined in the IEEE 488.2 standard specification.

Response Decode:

The character positions represent the following hardware fitment:

Ch1-Ch5: Active Head Fitment to Specified Channel where:

ChX = Ø: No Active Head Fitted

ChX = 1: Active Head Fitted

x1: Option 100: High Stability Crystal Reference where:

x1 = 1: Indicates that option 100 is fitted

x1 = 0: Indicates that option 100 is not fitted

s: Base Frequency Field

LN = 1: Indicates that enhanced multichannel DC is fitted

LN = 0: Indicates that enhanced multichannel DC is not fitted

Execution Errors:

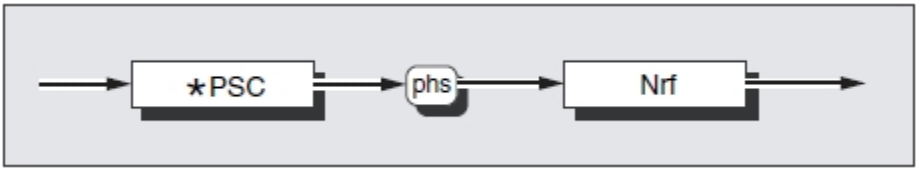
None.

Power On and Reset Conditions

Not applicable.

Power On Status Clear

This common command conforms to the IEEE 488.2 standard requirements.



erw146

∗PSC

Sets the flag controlling the clearing of defined registers at Power On.

Nrf is a decimal numeric value which, when rounded to an integer value of zero, sets the power on clear flag false. This allows the instrument to assert SRQ at power on, providing that the PON bit in the ESR is enabled at the time of power-down, by the corresponding bit in its Enable register (ESE).

When the value rounds to an integer value other than zero it sets the power on clear flag true, which clears the standard event status enable and service request enable registers so that the instrument will not assert an SRQ on power up.

Examples:

∗PSC 0 or ∗PSC 0.173 sets the instrument to assert an SRQ at Power On.

∗PSC 1 or ∗PSC 0.773 sets the instrument to not assert an SRQ on Power On.

Execution Errors:

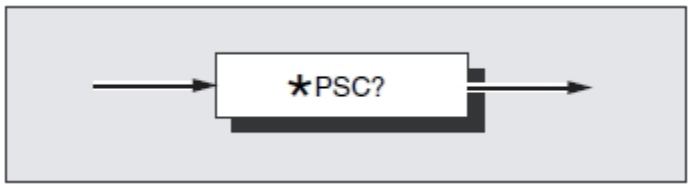
None

Power On and Reset Conditions

Not applicable

Recall Power On Status Clear Flag

This common query conforms to the IEEE 488.2 standard requirements. The existing flag condition will have been determined by the ∗PSC command.



erw147

∗PSC?

Will recall the Power On Status condition.

Response Format:

A single ASCII character is returned.

A single query sent as a terminated program message will elicit a single response terminated by:

nl = newline with EOI

If multiple queries are sent as a string of program message units (separated by semi-colons with the string followed by a permitted terminator), then the responses will be sent as a similar string whose sequence corresponds to the sequence of the program queries. The final response in the string will be followed by the terminator:

nl = newline with EOI

Response Decode:

The value returned identifies the state of the saved flag:

Zero indicates false. The instrument is not programmed to clear the Standard Event Status Enable Register and Service Request Enable Register at Power On, so the instrument will generate a 'Power On' SRQ, providing that the PON bit in the ESR is enabled at the time of power-down, by the corresponding bit in its Enable register (ESE).

One indicates true. The instrument is programmed to clear the Standard Event Status Enable Register and Service Request Enable Register at Power On, so the instrument cannot generate any SRQ at Power On.

Execution Errors:

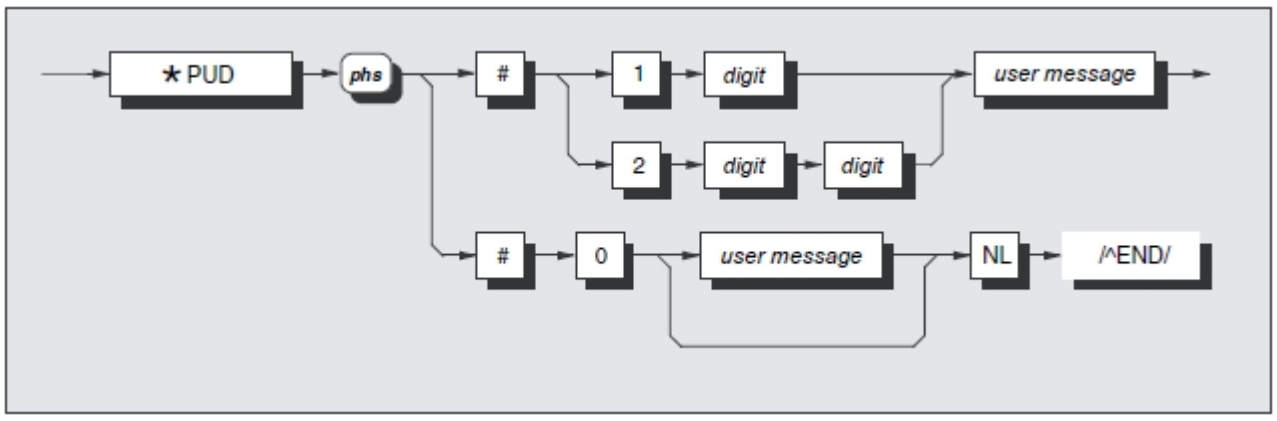
None

Power On and Reset Conditions

No Change. This data is saved in non-volatile memory at Power Off, for use at Power On.

Protected User Data — Entry of User Data

This command conforms to the IEEE 488.2 standard requirements.



where:

phs =	Program Header Separator
digit =	One of the ASCII-coded numerals
user message =	Any message up to 63 bytes maximum

Note

The slash-delimited /^END/ box is not outlined. This is to draw attention to the fact that it is not a data element, but represents the EOI line being set true with the last byte 'NL' to terminate the program message.

Refer to the Standard document IEEE Std 488.2-1992, Sub-section 7.7.6, page 78.

∗PUD

Allows a user to enter up to 63 bytes of data into a protected area to identify or characterize the instrument. The two representations above are allowed depending on the message length and the number of 'digits' required to identify this. The instrument must be in calibration mode for this command to execute.

The data can be recalled using the ∗PUD? query.

Execution Errors

∗PUD is executable only when the rear panel calibration switch is in the enabled position and calibration has been enabled. Otherwise an Execution Error is returned.

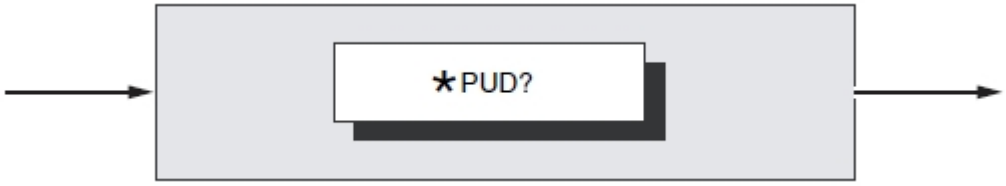
Command Errors

A Command Error is returned if the user message exceeds 63 bytes, or if the data does not conform to the standard format.

Power On and Reset Conditions

Data area remains unchanged.

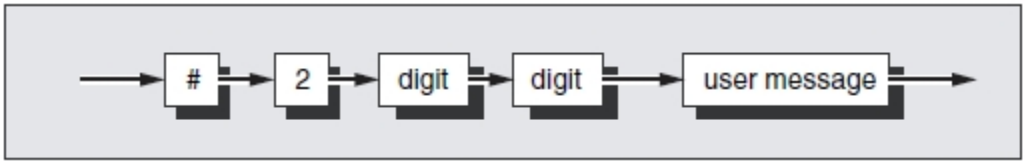
Protected User Data — Recall of User Data



erw149

This common command conforms to the IEEE 488.2 standard requirements. ∗PUD? recalls previously entered user data. Refer to program command ∗PUD.

Response Syntax:



erw150

where:

digit =	One of the ASCII-coded numerals previously determined from the length of the user message string
user message =	The saved user message

Response Decode:

The previously-saved message is recalled. If no message is available, the value of the two digits is 00. The data area contains up to 63 bytes of data.

A single query sent as a terminated program message will elicit a single response terminated by:

nl = newline with EOI

If multiple queries are sent as a string of program message units (separated by semi-colons with the string followed by a permitted terminator), then the responses will be sent as a similar string whose sequence corresponds to the sequence of the program queries. The final response in the string will be followed by the terminator:

nl = newline with EOI

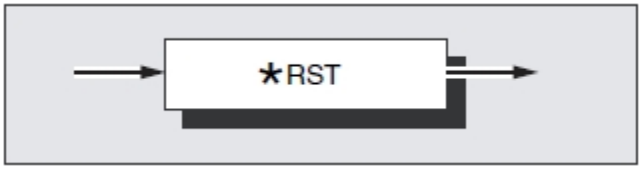
Execution Errors:

None

Power On and Reset Conditions

Data area remains unchanged.

Reset



erw151

∗RST

Will reset the instrument to a defined condition, stated for each applicable command with the command's description, and listed in *Model 9500B — Device Settings after ∗RST and Power On*.

The reset condition is not dependent on past-use history of the instrument except as noted below:

∗RST does not affect the following:

- The selected address of the instrument
- Calibration data that affect specifications
- SRQ mask conditions
- The state of the IEEE 488.1 interface

Execution Errors:

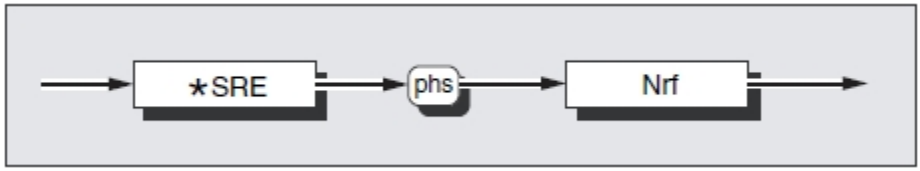
None.

Power On and Reset Conditions

Not applicable.

Service Request Enable

This Status Byte data structure conforms to the IEEE 488.2 standard requirements for this structure.



erw152

∗SRE enables the standard and user-defined summary bits in the service request byte, which will generate a service request. Refer to *Retrieval of Device Status Information*.

Nrf is a Decimal Numeric Data Element representing an integer decimal value equivalent to the Hex value required to enable the appropriate bits in this 8-bit register. The detail definition is contained in the IEEE 488.2 document.

Note that numbers will be rounded to an integer.

Execution Errors:

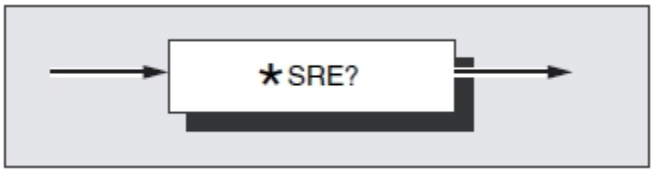
None.

Power On and Reset Conditions

Not applicable.

Recall Service Request Enable

This Status Byte data structure conforms to the IEEE 488.2 standard requirements for this structure.



erw153

∗SRE?

Recalls the enable mask for the standard defined events. Refer to *Retrieval of Device Status Information*.

Response Decode:

The value returned, when converted to base 2 (binary), identifies the enabled bits which will generate a service request. The detail is contained in the IEEE 488.2 standard document.

Execution Errors:

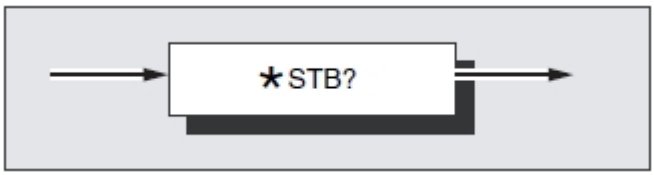
None.

Power On and Reset Conditions

The Power On condition depends on the condition stored by the common ∗PSC command - if 0 then it is not cleared; if 1 then the register is cleared. Reset has no effect.

Read Service Request Register

This Status Byte data structure conforms to the IEEE 488.2 standard requirements for this structure.



erw154

∗STB?

Recalls the service request register for summary bits. Refer to *Retrieval of Device Status Information*.

Response Decode:

The value returned, when converted to base 2 (binary), identifies the summary bits for the current status of the data structures involved. For the detail definition see the IEEE 488.2 standard document. There is no method of clearing this byte directly. Its condition relies on the clearing of the overlying status data structure.

Execution Errors:

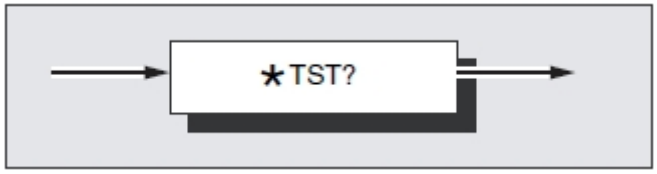
None.

Power On and Reset Conditions

Not applicable.

Test Operations — Full Selftest

This query conforms to the IEEE 488.2 standard requirements.



erw155

∗TST?

Executes a Full selftest. A response is generated after the test is completed.

Note

Operational selftest is valid only at temperatures: 23 °C±10 °C.

Response Decode:

The value returned identifies pass or failure of the operational selftest:

ZERO indicates operational selftest complete with no errors detected.

Non-zero indicates operational selftest has failed. The number itself represents the number of test failures.

The failure codes can be found only by re-running the self test manually. Refer to the *9500B Calibration Manual, Routine Maintenance and Test*.

Execution Errors:

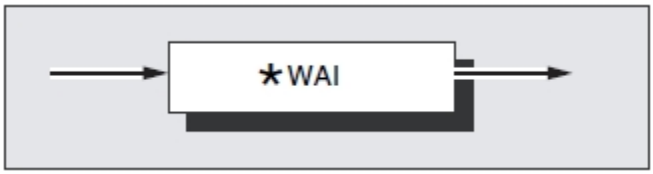
Operational selftest is not permitted when calibration is successfully enabled.

Power On and Reset Conditions

Not applicable.

Wait

This command conforms to the IEEE 488.2 standard requirements.



erw156

∗WAI

Prevents the instrument from executing any further commands or queries until the No Pending Operations Flag is set true. This is a mandatory command for IEEE-488.2 but has little relevance to this instrument as there are no parallel processes requiring Pending Operation Flags.

Execution Errors:

None.

Power On and Reset Conditions

Not applicable.

Model 9500B — Device Settings after ∗RST and Power On

∗RST

Will reset 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:

- ∗RST does not affect the following:
- The selected address of the instrument
- 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

The 'Enable Macro Command' (∗EMC) is not used.

The 'Define Device Trigger Command' (∗DDT) is not used.

Parallel Poll is not implemented in the 9500B.

∗RST enforces the following states:

- The 9500B reverts to Manual/Procedure mode
- The 9500B is returned to 'Operation Complete Command
- Idle State' (OCIS)
- The 9500B is returned to 'Operation Complete Query Idle State' (OQIS)
- Settings Related to Common IEEE 488.2 Commands are as detailed in *Model 9500B — Device Settings after ∗RST and Power On, General*
- Settings related to SCPI Commands are as detailed in *Model 9500B — Device Settings after ∗RST and Power On, ∗RST Settings Related to Common IEEE 488.2 Commands*

General

Active Mode: The 9500 can power-up in either 'Manual' or 'Procedure' mode, but Manual Mode or Calibration mode must be selected for Remote Operation.

The required mode is selected by pressing Mode key on front panel and choosing from the Mode Menu (Calibration mode requires a password).

Device I/D (Serial Number):Factory serial number preserved

Protected User:Data Previous entry preserved

Status Reporting Conditions:

Status Byte Register	Depends on state of ∗PSC
Status Byte Enable Register	Depends on state of ∗PSC
Event Status Register	Depends on state of ∗PSC
Event Status Enable Register	Depends on state of ∗PSC
Operation Status Event Register	Depends on state of ∗PSC
Operation Status Enable Register	Depends on state of ∗PSC
Questionable Status Event Register	Depends on state of ∗PSC
Questionable Status Enable Register	Depends on state of ∗PSC
Error Queue	Empty until first error is detected

*RST Settings Related to Common IEEE 488.2 Commands

Program Coding	Condition
*CLS	Not applicable
*ESE Nrf	Not applicable
*ESE?	Previous state preserved
*ESR?	Previous state preserved
*IDN?	No Change
*OPC	OPIC state forced
*OPC?	OPIQ state forced
*OPT?	Not applicable
*PSC 0/1	Not applicable
*PSC?	No change
*PUD	Data area remains unchanged
*PUD?	Data area remains unchanged
*SRE Nrf	Not applicable
*SRE?	Previous state preserved
*STB?	Previous state preserved
*TST?	Not applicable
*WAI	Not applicable

Power-On Settings Related to Common IEEE 488.2 Commands

Program Coding	Condition
*CLS	Not applicable
*ESE Nrf	Not applicable
*ESE?	Response depends on state of *PSC
*ESR?	Response depends on state of *PSC
*IDN?	Not applicable
*OPC	Not applicable
*OPC?	Not applicable
*OPT?	Not applicable
*PSC 0/1	Not applicable
*PSC?	No change. This data is saved at power off for use at power on
*PUD	Data area remains unchanged
*PUD?	Data area remains unchanged

Program Coding	Condition
∗RST	Not applicable
∗SRE Nrf	Not applicable
∗SRE?	Response depends on state of ∗PSC
∗STB?	Response depends on state of ∗PSC
∗TST?	Not applicable
∗WAI	Not applicable

∗RST and Power On Settings Related to SCPI Commands

Keyword	Condition
CALibration	Disabled
OUTPut	
[:STATe]	OFF
[SOURce]	
:FUNCtion	
[:SHAPe](?)	SQUare
:SCOPe	
[:SHAPe](?)	SQUare
:PARameter	
:SQUare	
:POLarity(?)	POS
:GROund(?)	OFF
:SKEW	Inactive
:ALIGnment(?)	DEFault
[SOURce]	
:VOLTage	
[:LEVEl]	20 mV
:FREQuency	
[:CW|FIXed](?)	1 kHz

All other settings remain unchanged.

Model 9500B — Emulation of Tektronix SG5030 and CG5010/5011

Purpose

The purpose of bus emulation is to minimize reprogramming work in adapting the 9500B into situations where the user already has existing [SG5030/CG5010] systems or applications. Where the 9500B matches (or exceeds) the functional capability of the emulated instrument, then the command(s) are emulated.

Basic Assumptions

The 9500B has two IEEE interfaces fitted. The emulation is ‘bus only’. There is no attempt to emulate any manual mode operations. Once emulation mode is selected (via a configuration screen which allows individual bus addressing) the only manual operation available is to return to normal (9500B) mode. Because the emulation is intended for bus only, local operation in Manual mode is limited to 9500B operation. There is no ability to mix emulation and SCPI commands.

Each emulated instrument has an internal ‘virtual state’. When a command is received for one of the instruments, its ‘virtual state’ will become the active state. In other words, the 9500B only exists as one instrument at a time.

The emulated instrument accepts parameter requests within the range of the 9500B, not the emulated instrument. For instance, a 9500B/400 variant will clearly not be able to generate 560 MHz as for a SG5030.

The application programmer may need to modify the application software in some way to deal with areas where emulation is not supported.

Command Compatibility

- The exact response format of the emulated instruments cannot be guaranteed.
- The low level command language is not emulated.
- The 9500B without Option 5 (5 full channels) has one signal channel and one trigger channel, matching the one signal and one trigger channel on the emulated instruments. With Option 5 fitted to the 9500B, ‘signal’ will use CH 1 and ‘trigger’ will use CH5.
- The terms NR1, NR2, NR3 and NRf appear within the following text and tables. These represent particular forms of 'Decimal Numeric Program Data' as described in the IEEE-488.2 Standard Specification. Briefly, they conform to the following criteria:

  NR1: A number expressed as an integer only (no decimal point). '375' is in the form of NR1.

  NR2: A number expressed as a 'mantissa', (i.e. can include a decimal point). '375.263' is in the form of NR2.

  NR3: A number expressed as a 'mantissa' plus an 'exponent', separated by a white space (i.e. can include a decimal point, and also can include an exponent in the form of the ASCII character 'E' or 'e', followed by a power of 10). '375.263 E-3' is in the form of NR3.

NRf: This is a flexible form which accepts any of the three above forms. The spirit adopted in IEEE-488.2 is that a specific command which is transmitted over the bus should be consistent in its conformance to one of the three forms. On the other hand, a device which receives commands should be able to accept any of the three forms. This leads to the user-friendly concept of 'Precise Talker' and 'Forgiving Listener'.

Emulation Mode and Bus Address Selection

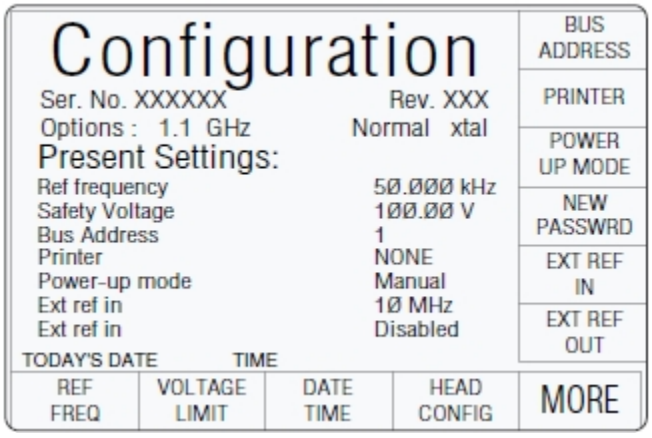
General

- Emulation mode and the appropriate bus address for CG5010/5011 or SG5030 are selected on a screen in Configuration mode.
- This section introduces the actions necessary to perform these selections.

Configuration Mode

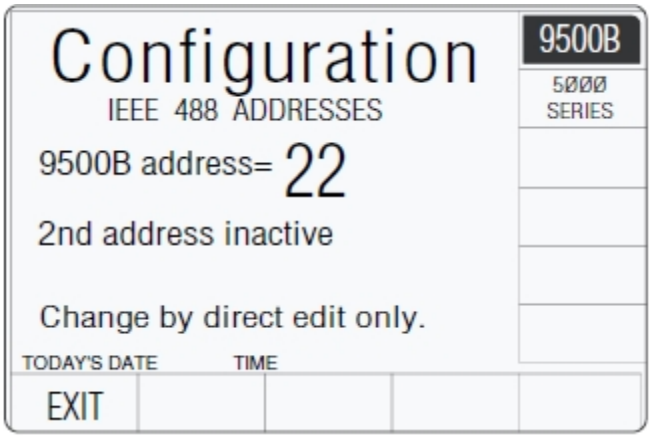
Before attempting to select Configuration mode, please refer to the *9500B Users Guide, Modes of Operation*, for information regarding Mode selection from the front panel. This section also deals with the use of a password to open the screens which permit the Config. mode parameters to be changed.

To activate 5000-series calibrator emulation, it is necessary first to press the 'MORE' soft key, then use the Config. Mode password to access the 'BUS ADDRESS' facility. Then the following screen will be displayed:



erw157

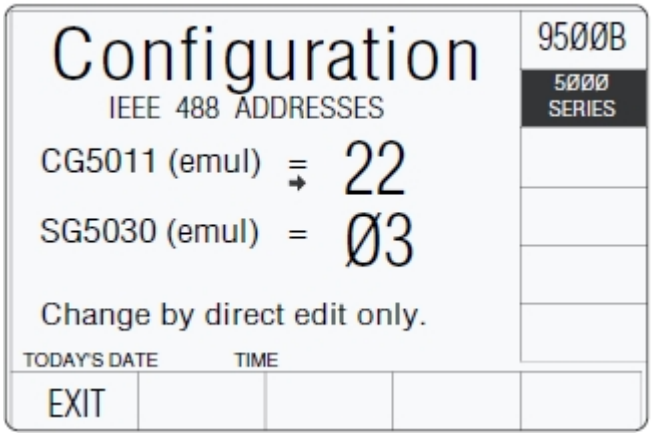
Pressing the BUS ADDRESS soft key presents the following screen:



erw158

Emulation Mode

On the IEEE 488 ADDRESSES screen, press the 5ØØØ SERIES soft key.



erw159

Note that the 9500B contains two IEEE-488 interfaces, each ofwhich will respond to a separate address. 9500B and CG5011 occupy one IEEE bus address and can be modified either on the 9500B screen or the 5000 series screen. SG5030 occupies the other bus address, which can be modified only on the 5000 series screen. The 5ØØØ SERIES selection also switches the interface to accept the emulation commands only.

The small arrow under the '=' sign indicates which address will be changed when direct editing is used. The arrow is toggled between the two addresses using the ⇥ (Tab) key.

The two emulation addresses cannot have the same number. Any attempt to write a duplicate address will result in an error message.

After setting the addresses, use EXIT to return to the Config mode 'Present settings' screen.

Points of Interest

- Addressing range is the standard 0 → 30
- The message terminator can be either LF+EOI or just EOI
- The IEEE-488 Interface Function Capability is the same as for the 9500B (SH1AH1T6L4SR1RL1PP0DC1DT0C0)

SG5030 Levelled Sine Generator

Command Equivalence

Table 10 lists the SG5030 commands (as outlined in the manual). The '9500B Emulation' column indicates whether the 9500B emulates the SG5030 command.

'X' Indicates that the 9500B does not have an equivalent mapping. In this case the 9500B will accept the command and take no further action.

'+' Indicates that the 9500B does not have an equivalent mapping, but the command is dealt with. For example, queries that report a ‘standard’ answer are mapped.

'√' Indicates that the command is mapped.

Status and Error Reporting.

The Status Byte coding is the same as the SG5030, but the error numbers returned are those of the 9500B.

Refer to the *9500B Calibration Manual*.

Table 10. SG5030 Command Emulation by 9500B

SG5030 Command	SG5030 Command Description	9500B Emulation	9500B Response
ABStouch	Causes front-panel buttons or controls to be remotely activated.	X	
AMPlitude <NR3>[:dBm]	Sets the amplitude of the output signal in Volts (pk-pk) or dBm.	√	
Amplitude?	Queries the present amplitude setting.	√	AMPLITUDE <NR3>:[DBM]
CAL?	Queries the present DAC settings stored in NVRAM.	+	CAL 0,0,0,0,0,0,0,0,0,0,0

Table 10. SG5030 Command Emulation by 9500B (cont.)

SG5030 Command	SG5030 Command Description	9500B Emulation	9500B Response
ERRor? EVEnt?	Queries information about the event reported in the most-recent serial poll. Note that these two commands are equivalent.	√	ERROR <9500B error number> EVENT <9500B error number>
EXTtb?	Queries the present state of the external time base.	√	EXTTB ACTIVE|INACTIVE
FREQuency <NR3>	Sets the frequency of the output signal.	√	
FREQuency?	Queries the present frequency setting.	√	FREQUENCY <NR3>.
HELp?	Returns a list of all the command headers which the instrument accepts.	+	As SG5030.
ID?	Returns the instrument identification:	+	ID TEK/SG5030,V0.0,FX.XX
INIt	Clears the present settings and initialises the SG5030 to: 'Output off, 1 V, 10 MHz, Refreq off, RQS on, Userreq off'.	√	
LEVeled?	Returns the levelled signal status of the output.	+	LEVELED YES|NO
OUTput ON|OFF	Turns the signal on or off at the output head.	√	
OUTput?	Returns the present status of the output signal	√	OUTPUT ON|OFF
RECall <NR3>	This command recalls the instrument settings from the non-volatile RAM store.	X	
REFreq ON|OFF	Turns the reference 50kHz on or off.	√	
REFreq?	Queries the reference setting.	√	REFREQ ON|OFF
RQS ON|OFF	Enables or disables the ability of the instrument to generate Service Requests.	√	
RQS?	Queries whether the SRQ is enabled or disabled.	√	RQS ON|OFF

Table 10. SG5030 Command Emulation by 9500B (cont.)

SG5030 Command	SG5030 Command Description	9500B Emulation	9500B Response
SET?	Returns the present condition of various settings.	+	As SG5030.
STOre <num>	Store front panel settings.	X	
TESt	Performs instrument selftest. Failure is reported via the SRQ system.	X	
USEreq ON|OFF	Enables or disables the ability to generate an SRQ by pressing the ID button on the front panel.	X	
USEreq?	Returns the present status of the instrument ID SRQ.	+	USEREQ OFF

CG5010/5011 Programmable Calibrator

Command Equivalence

Table 11 lists the CG5010 commands (as outlined in the manual). The '9500B Emulation' column indicates whether the 9500B emulates the CG5010 command.

'X' Indicates that the 9500B does not have an equivalent mapping. In this case the 9500B will accept the command and take no further action.

'+' Indicates that the 9500B does not have an equivalent mapping, but the command is dealt with. For example, queries that report a 'standard' answer are mapped.

'√' Indicates that the command is mapped.

Table 11. CG5010/5011 Command Emulation by 9500B

CG5010/5011 Command	CG5010/5011 Command Description	9500B Emulation	9500B Response
A/D <NR3>A	Sets mode to Current and sets units per division.	√	
CALDATE <mm>-<dd>-<yy>	Sets the calibration date.	√	
CALDATE?	Returns calibration date information	√	<mm>-<dd>-<yy>
CHOP ON|OFF	For amplitude modes only. OFF sets output signal level to the DC value ot the amplitude set. ON restores normal amplitude frequency output.	X	

Table 11. CG5010/5011 Command Emulation by 9500B (cont.)

CG5010/5011 Command	CG5010/5011 Command Description	9500B Emulation	9500B Response
COMP CG|DUT|AUTO	CG = Comparator head to CG5010 output, DUT = Comparator head to DUT AUTO = Chop between CG5010 output and DUT	X	
CS ON|OFF	Sets or clears Slewed Edge — used only in CG5010 calibration.	X	
CSET?	Returns <message unit> for changed settings information to the controller.	+	CSET NONE
DEC	Subtracts 0.1 from present percent error readout for HIGH or FAST indications, or adds 0.1 for LOW or SLOW indications.	+	
DLY ON|OFF	Sets delayed trigger for FAST EDGE mode.	X	
DSP	Enable or disable variable display for EDGE or FAST EDGE modes.	X	
DSPL?	Returns <message unit> for present units/division and percent error information.	√	PCT -0.5;U/D 1.0E+0 If VARIABLE is not on, then PCT has the value of 0.0.
DT ON|OFF	Changes status of DT0/DT1 mode of bus — allows use of GET.	X	
EDGE <NR1>	Sets number of edges generated for one slewing cycle.	X	
ERR?	Returns a code for the error condition.	√	ERR <9500B error number>
FREQ DC|<NR3>	DC = Sets chop frequency to DC; <NR3> = Sets chop frequency from 10Hz to 1MHz.	√	
FXD	Removes the VARIABLE (deviation) value from the output value.	√	
HOLD <NR1>	For SLEWED EDGE mode.	X	
ID?	Returns identity of instrument.	+	ID TEK/SG5011,V0.0,FX.XX

Table 11. CG5010/5011 Command Emulation by 9500B (cont.)

CG5010/5011 Command	CG5010/5011 Command Description	9500B Emulation	9500B Response
INC	Adds 0.1 from present DUT error readout for HIGH or FAST indications, or subtracts 0.1 for LOW or SLOW indications.	√	
INIT	Clears the present settings and initialises to defaults: Volts, 1 V/D, 1 kHz, 1 division, output off, trigger norm, off.	√	
LDZ 50|HI	50 = Selects 50 Ω termination; HI = Selects high impedance termination.	√	
LOOP ON|OFF	Selects or deselects current loop,	X	
LSHF	Decrements the shift counter by 1.	X	
MAG X1|X10	Sets time/division magnifier to X1 or X10 for Markers.	√	
MASK 1|2|3	Masks errors so that SRQ is not sent.	X	
MODE V|VOLTAGE MODE CUR|CURRENT MODE EDGE MODE FE|FASTEDGE MODE MKRS|MARKERS MODE SLWD|SLEWED	Selects VOLTS Selects CURRENT mode Selects EDGE Selects FAST EDGE Selects TIMING MARKERS Selects SLEWED EDGE	√ √ √ √ √ X	
MULT <NRF>	Sets Number of Divisions multiplier in range 1-10.	√	
NEG	Sets negative EDGE and VOLTAGE polarity.	√	
NM ON|OFF	Sets Narrow Markers mode.	X	
OPC ON|OFF	Controls generation of SRQ for operation complete when CONTINUE. X is pressed.	X	
OUT ON|OFF	Sets main output ON or OFF.	√	
PCT <NR2>	Sets DUT percent error readout.	√	
PCT?	Returns <message unit> present DUT percentage error information.	√	PCT 2.0; (if PCT selected), or PCT 0.0; if not.
POS	Sets positive EDGE polarity. POS is accepted in AC Volts with no error (NEG gives a 22 error number).	√	

Table 11. CG5010/5011 Command Emulation by 9500B (cont.)

CG5010/5011 Command	CG5010/5011 Command Description	9500B Emulation	9500B Response
READ?	Returns <message unit> units/division and DUT percentage error after operator pressed the X CONTINUE key.	X	
REM ON|OFF	Controls generation of SRQ when ID button is pressed.	X	
RPT?	Repeats the most-recent message sent.	√	
RQS ON|OFF	Turns on or off the SRQ generations.	√	
RSHF	Increments the shift counter by 1.	X	
SET?	Returns settings of instrument in settings-dependent format:	+	As CG5011
S/D <NR3>S	Sets Markers mode, if not already selected, and then sets the seconds per division value.	√	
SHIFT <NR1>	Sets shift counter argument.	X	
SRQ?	Returns the reason for SRQ.	X	
TEST	Activates the instrument power-on selftest routine (takes about 5 secs).	X	
TRIG ON|OFF|NORM|X.1|X.01	ON = Turns TRIGGER OUTPUT on.	√	
	OFF = Turns TRIGGER OUTPUT off. OFF = Turns TRIGGER OUTPUT off.	√	
	NORM = Sets trigger rate to the same as the output signal rate (Power-on default).	√	
	X.1 = Sets trigger rate to 1/10 of the output signal rate.	√	
	X.01 = Sets trigger rate to 1/100 of the output signal rate.	√	
TSET?	Returns the ASCII word 'NULL' message.	X	
U/D <NR3>	Sets the desired units per division.	√	
U/D?	Returns the present <NR3> units per division.	√	U/D <NR3>

Table 11. CG5010/5011 Command Emulation by 9500B (cont.)

CG5010/5011 Command	CG5010/5011 Command Description	9500B Emulation	9500B Response
UMSK <NR1>	Unmasks an error that was masked, opposite to the MASK command.	X	
VAR	Sets instrument to display DUT percent error readout.	√	
VERS?	Returns a version ID code.	+	VERS 0000FFFF
V/D <NR3>V	Sets the instrument to voltage and desired number of units/division.	√	
ZSHF	Resets the shift counter to zero.	X	