KEITHLEY

Model 7001 Switch System
Quick Reference Guide

A GREATER MEASURE OF CONFIDENCE

Model 7001 Switch System
Quick Reference Guide

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Safety Precautions

The following safety precautions should be observed before using this product and any associated instrumentation. Although some instruments and accessories would normally be used with non-hazardous voltages, there are situations where hazardous conditions may be present.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read the operating information carefully before using the product.

The types of product users are:

Responsible body is the individual or group responsible for the use and maintenance of equipment, for ensuring that the equipment is operated within its specifications and operating limits, and for ensuring that operators are adequately trained.

Operators use the product for its intended function. They must be trained in electrical safety procedures and proper use of the instrument. They must be protected from electric shock and contact with hazardous live circuits.

Maintenance personnel perform routine procedures on the product to keep it operating, for example, setting the line voltage or replacing consumable materials. Maintenance procedures are described in the manual. The procedures explicitly state if the operator may perform them. Otherwise, they should be performed only by service personnel.

Service personnel are trained to work on live circuits, and perform safe installations and repairs of products. Only properly trained service personnel may perform installation and service procedures.

Keithley products are designed for use with electrical signals that are rated Installation Category I and Installation Category II, as described in the International Electrotechnical Commission (IEC) Standard IEC 60664. Most measurement, control, and data I/O signals are Installation Category I and must not be directly connected to mains voltage or to voltage sources with high transient over-voltages. Installation Category II connections require protection for high transient

over-voltages often associated with local AC mains connections. The user should assume all measurement, control, and data I/O connections are for connection to Category I sources unless otherwise marked or described in the Manual.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak, or 60VDC are present. **A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.**

Users of this product must be protected from electric shock at all times. The responsible body must ensure that users are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product users in these circumstances must be trained to protect themselves from the risk of electric shock. If the circuit is capable of operating at or above 1000 volts, **no conductive part of the circuit may be exposed.**

Do not connect switching cards directly to unlimited power circuits. They are intended to be used with impedance limited sources. NEVER connect switching cards directly to AC mains. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the card.

Before operating an instrument, make sure the line cord is connected to a properly grounded power receptacle. Inspect the connecting cables, test leads, and jumpers for possible wear, cracks, or breaks before each use.

When installing equipment where access to the main power cord is restricted, such as rack mounting, a separate main input power disconnect device must be provided, in close proximity to the equipment and within easy reach of the operator.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting cables or jumpers, installing or removing

switching cards, or making internal changes, such as installing or removing jumpers.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.

The instrument and accessories must be used in accordance with its specifications and operating instructions or the safety of the equipment may be impaired.

Do not exceed the maximum signal levels of the instruments and accessories, as defined in the specifications and operating information, and as shown on the instrument or test fixture panels, or switching card.

When fuses are used in a product, replace with same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT as safety earth ground connections.

If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.

If a screw is present, connect it to safety earth ground using the wire recommended in the user documentation.

The symbol on an instrument indicates that the user should refer to the operating instructions located in the manual.

The symbol on an instrument shows that it can source or measure 1000 volts or more, including the combined effect of normal and common mode voltages. Use standard safety precautions to avoid personal contact with these voltages.

The **WARNING** heading in a manual explains dangers that might result in personal injury or death. Always read the as-

sociated information very carefully before performing the indicated procedure.

The **CAUTION** heading in a manual explains hazards that could damage the instrument. Such damage may invalidate the warranty.

Instrumentation and accessories shall not be connected to humans.

Before performing any maintenance, disconnect the line cord and all test cables.

To maintain protection from electric shock and fire, replacement components in mains circuits, including the power transformer, test leads, and input jacks, must be purchased from Keithley Instruments. Standard fuses, with applicable national safety approvals, may be used if the rating and type are the same. Other components that are not safety related may be purchased from other suppliers as long as they are equivalent to the original component. (Note that selected parts should be purchased only through Keithley Instruments to maintain accuracy and functionality of the product.) If you are unsure about the applicability of a replacement component, call a Keithley Instruments office for information.

To clean an instrument, use a damp cloth or mild, water based cleaner. Clean the exterior of the instrument only. Do not apply cleaner directly to the instrument or allow liquids to enter or spill on the instrument. Products that consist of a circuit board with no case or chassis (e.g., data acquisition board for installation into a computer) should never require cleaning if handled according to instructions. If the board becomes contaminated and operation is affected, the board should be returned to the factory for proper cleaning/servicing.

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Introduction

This quick reference guide includes summary information on front panel and IEEE-488 operation for the Model 7001 Switch System. For detailed information, consult the Model 7001 Instruction Manual.

Operation Summary

Channel List and Scan List

A Channel List specifies the channels to be closed or opened, and a Scan List specifies the channels to be scanned. Each channel in the list is made up of either a two integer CHANNEL number (for non-matrix type cards) or a three integer CHANNEL number (for matrix type cards). Examples:

1!2 = Slot 1, Channel 2
2!4 = Slot 2, Channel 4
1!2!3 = Slot 1, Row 2, Column 3
2!3!6 = Slot 2, Row 3, Column 6

Front panel operation

A Channel List is created with the SELECT CHANNELS prompt displayed, and a Scan List is created with the SCAN CHANNELS prompt displayed. The SCAN LIST key toggles the display between the Channel List and the Scan List.

Channels are entered into a Channel List and Scan List using the keypad. The following examples demonstrate proper format.

SELECT CHANNELS 1!1, 1!5-1!10, 2!1!1, M1,
SCAN CHANNELS 1!10-1!1, 2!1!3, M1,

Each entry is separated by a comma (,) which is inserted by pressing the right cursor key (▶) or the ENTER key. Notice that a comma is also used to terminate the list. A channel range is specified by separating the range limits

with a hyphen (-). The M1 entry represents a channel pattern that is stored in memory (see STORE and RECALL).

Edit keys — A list can also be modified by using the edit keys; DELETE and INSERT. A channel entry can be deleted by placing the cursor on the desired entry and pressing DELETE. To insert an entry, press INSERT (INSERTING ENTRY displayed), place the cursor at the appropriate location, and key in the new entry. Make sure to insert a comma after keying in the channel entry. When finished, press INSERT again to cancel the insert function.

IEEE-488 bus operation

Over the bus, the Channel List is included with the commands that are used to close or open channels. See Closing and Opening Channels. The Scan List is created using the :SCAN command. The following example demonstrates proper format:

:SCAN (@ 1!10:1!1, 2!1!3, M1)

Note that range limits are separated by a colon (:), and the last channel entry in the list is not terminated with a comma.

Closing and Opening Channels

Front panel operation

Channels specified in the Channel List are closed by pressing the CLOSE key. Channels specified in the Channel List are opened by pressing the OPEN key.

Note that the OPEN ALL key will open all channels, including those not specified in the Channel List.

IEEE-488 bus operation

Over the bus, the :CLOSe and :OPEN commands are used to control channels. Note that the Channel List is included with the following examples:

```
:CLOSe (@ 1!1, 1!5:1!10, 2!1!1, M1)
:OPEN (@ 1!1, 1!5:1!10, 2!1!1, M1)
```

Note that a colon (:) is used to separate range limits, and a comma is not used to terminate the list. The following command is analogous to the front panel OPEN ALL key and will simply open all channels:

```
:OPEN ALL
```

Scanning Channels

Channels are scanned in the order that they are presented in the Scan List.

Front panel operation

To perform a scan, first program the controlling aspects of the scan (see Table 2), and then press STEP to take the Model 7001 out of the idle state (ARM indicator on).

Regardless of how the scan is configured, the STEP key is always active allowing you to manually step through the scan.

The scan can be terminated at any time by pressing the OPEN ALL key. All closed channels will open and the Model 7001 will return to the idle state (ARM indicator off).

IEEE-488 operation

Over the bus, a scan is configured using the :TRIGger subsystem commands.

Send the following command to take the Model 7001 out of the idle state and begin a scan:

:INITiate

The scan can be terminated by sending the following command:

:ABORt

All closed channels will open and the Model 7001 will return to the idle state.

Store and Recall

Up to 100 channel patterns can be stored in memory. A channel pattern is simply a displayed pattern of open and closed channels.

Front panel operation

1. Close the desired channels.
2. Press STORE and enter the desired memory location (1 to 100).
3. Press ENTER.

To recall a channel pattern from memory:

1. Press RECALL and enter the memory location of the stored channel pattern.
2. Press ENTER. The channel status display will immediately update to reflect the recalled channel pattern.

Another way to recall a channel pattern is to include a memory location (e.g. M36) in a Channel List and/or Scan List. In a Channel List, when CLOSE is pressed, the closed channels in the specified channel pattern will close, and when OPEN is pressed, the channels will open. In a Scan List, when the memory location is scanned, the channel status display will update to reflect the specified channel pattern. The closed channels in the channel pattern will remain closed unless a different channel pattern is scanned.

IEEE-488 bus operation

Over the IEEE-488 bus, the :SAVe and :RECall commands are used to save (store) and recall channel patterns. The following examples demonstrate proper format:

:MEMory:SAVe M36
:MEMory:RECall M36

As in front panel operation, a memory location can be included in the Channel List and/or Scan List.

Menu Structures

The desired menu is displayed by pressing the appropriate key; MENU, SCAN CONFIGURATION or CARD CONFIGURATION. Once in a menu structure, place the cursor (◀ and ▶ keys) on the desired selection and press ENTER. Use the keypad to enter parameters. Use the EXIT key to back out of the menu structure and disable the menu.

Table 1: MAIN MENU structure

Menu item	**Description**
SAVESETUP	Setup Menu:
SAVE	Save setup at a memory location (up to 10).
RESTORE	Return 7001 to setup stored at a memory location.
PWRON	Power-on Menu:
FACTORY DEFAULT	Power-on to factory default setup conditions.
USER SETUP	Power-on to setup stored at a memory location.
RESET	Return 7001 to original power on setup.
GPIB	GPIB Setup Menu:
ADDRESS	Check/change IEEE-488 address.
STATUS	Display IEEE-488 status byte.
DIGITAL-I/O	Digital I/O Menu:
OUTPUT-STATUS	Check/change states of digital output channels.
OUTPUT-POLARITY	Check/change polarity of digital output port.
INPUT-STATUS	Read digital input channel.

Table 1: MAIN MENU structure (Cont.)

Menu item	Description
TEST BUILT-IN TESTS AUTO MANUAL DISPLAY TESTS KEYS PATTERNS	Self-Test Menu: Test Digital Board: Run all tests automatically Select tests to run Test Display Board: Verify operation of front panel keys Verify operation of display
LANGUAGE ENGLISH GERMAN FRENCH	Choose Language: Display messages in English. Display messages in German. Display messages in French.
GENERAL SERIAL # STATUS-MESSAGES	General Menu: Displays serial number, SCPI version, and software revision. Enables/disables status message mode.

Table 2: CONFIGURE SCAN menu structure

Menu item	Description
CHAN-CONTROL CHANNEL-SPACING TIMER EXTERNAL GPIB MANUAL TRIGLINK	Configure Channel Layer: Select channel spacing: Use a timer to select each channel in the scan. Use an external trigger to select each channel. Use a bus trigger to select each channel. Use STEP key to select each channel. Use a Trigger Link trigger to select each channel.

Table 2: CONFIGURE SCAN menu structure (Cont.)

Menu item	Description
ASYNCHRONOUS	Use separate lines for In/Out triggers.
SEMI-SYNCHRONOUS	Use same line for In/Out triggers.
IMMEDIATE	Use to scan channels immediately.
HOLD	Use to hold up the scan in the channel layer.
NUMBER-OF-CHANS	Define number of channels to scan:
USE-SCANLIST-LENGTH	Count = number of channel entries in scan list.
CHAN-COUNT	User defined count:
INFINITE	Repeat channel scanning indefinitely.
ENTER-CHAN-COUNT	Count = user defined value (1 to 9999)
CONTROL	Select trigger control mode:
SOURCE	Enable the Source Bypass.
ACCEPTOR	Disable the Source Bypass.
SCAN-CONTROL	Configure Scan Layer:
SCAN-SPACING	Select scan spacing:
TIMER	Use the timer to control scan spacing.
EXTERNAL	Use external triggers to control scan spacing.
GPIB	Use bus triggers to control scan spacing.
MANUAL	Use STEP key to control scan spacing.
TRIGLINK	Use Trigger Link triggers to control scan spacing.
IMMEDIATE	Use to pass operation immediately into the channel layer.
HOLD	Use to hold up the scan in the scan layer.
NUMBER-OF-SCANS	Define number of scans to be performed:
INFINITE	Repeat scan indefinitely.
ENTER-SCAN-COUNT	Count = user defined value (1 to 9999).

Table 2: CONFIGURE SCAN menu structure (Cont.)

Menu item	Description
CONTROL	Select trigger control mode:
SOURCE	Enable Source Bypass.
ACCEPTOR	Disable Source Bypass.
ARM-CONTROL	Configure Arm Layer:
ARM SPACING	Select arm spacing control:
MANUAL	Use STEP key to arm scanner.
IMMEDIATE	Use to arm scanner immediately.
GPIB	Use a bus trigger to arm scanner.
EXTERNAL	Use an external trigger to arm scanner.
TRIGLINK	Use a Trigger Link trigger to arm scanner.
HOLD	Use to hold up the scan in the arm layer.
ARM-COUNT	Define number of times to arm scanner:
INFINITE	Continuously re-arm scanner.
ENTER-ARM-COUNT	User defined count value (1 to 9999).
TRIGGER-CONTROL	Select trigger control mode:
SOURCE	Enable Source Bypass.
ACCEPTOR	Disable Source Bypass.
CHAN-RESTRICTIONS	Define channel restrictions:
SINGLE-CHAN	Enable/disable Single Channel Mode.
RESTRICTED-CHANNELS	Specify channels that cannot be closed.

Table 3: CARD CONFIG MENU structure

Menu item	Description
TYPE SLOT-1 SLOT-2	Set Card Type: Assign model number to card in slot 1. Assign model number to card in slot 2.
#-OF-POLES SLOT-1 SLOT-2	Select # Of Poles: Select pole mode for card in slot 1. Select pole mode for card in slot 2.
CARD-PAIR	Enable or disable Card Pair.
DELAY SLOT-1 SLOT-2	Set Delay For: Set delay for card in slot 1. Set delay for card in slot 2.
READ-I/O-CARD	Identify I/O Cards.

Default Conditions

Table 4: Factory default and RESET

Item	Factory default	RESET
Channel status	All open	All open
Channel list	Cleared	No change
Scan list	Cleared	No change
GPIB address	7	No change
Digital I/O output level	High	High
Language	English	No change
Status messages	Off	Off
# of poles	2-pole (both slots)	No change
Card pair	Off	Off
Delay	0 sec	0 sec
Channel spacing	Manual (STEP key)	Manual (STEP key)
Number of channels	Scan list length	Scan list length
Channel trigger control	Source	Source
Scan spacing	Immediate	Immediate
Number of scans	Infinite	Infinite
Scan trigger control	Acceptor	Acceptor
Arm spacing	Immediate	Immediate
Arm count	1	1
Arm trigger control	Acceptor	Acceptor
Single channel	Off	Off
Restricted channels	None	No change

Note: “No change” indicates that RESET does not affect the currently set condition.

Table 5: *RST and :SYSTem:PRESet

Command name	*RST value	:SYSTem:PRESet value
:INITiate		
:CONTinuous	OFF	OFF
:ARM		
:SEQuence[1]		
:LAYer[1]		
:COUNt	1	1
:SOURce	IMMediate	IMMediate
:TCONfigure		
:DIRection	ACCeptor	ACCeptor
:ASYNchronous		
:ILINe	1	1
:OLINe	2	2
:LAYer2		
:COUNt	1	INFinite
:DELay	0	0
:SOURce	IMMediate	IMMediate
:TIMer	0.001	0.001
:TCONfigure		
:DIRection	ACCeptor	ACCeptor
:ASYNchronous		
:ILINe	1	1
:OLINe	2	2
:TRIGger		
:SEQuence1		
:COUNt	1	Scan list length
:AUTO	OFF	ON
:DELay	0	0
:SOURce	IMMediate	MANual
:TIMer	0.001	0.001
:TCONfigure		
:PROTocol	ASYNchronous	ASYNchronous
:DIRection	ACCeptor	SOURce
:ASYNchronous		
:ILINe	1	1
:OLINe	2	2
:SSYNchronous		
:LINE	1	1

Table 5: *RST and :SYSTem:PRESet (Cont.)

Command name	***RST value**	**:SYSTem:PRESet value**
[:ROUTe]		
:CONFigure		
:SLOT[1]		
:STIMe	0	0
:SLOT2		
:STIMe	0	0
:CPAir	OFF	OFF
:SCHannel	OFF	OFF
:DISPlay		
:SMESsage	OFF	OFF

Error and Status Messages

Table 6: Error and status messages

Code number	Description
+522	“Slot 2 identification error” (EE)
+521	“Slot1 identification error” (EE)
+510	“Saved state error” (EE)
+173	“Waiting in arm layer 2” (SE)
+172	“Waiting in arm layer 1” (SE)
+171	“Waiting in trigger Layer” (SE)
+161	“Program running” (SE)
+101	“Operation Complete” (SE)
0	“No error” (SE)
-100	“Command Error” (EE)
-101	“Invalid Character” (EE)
-102	“Syntax Error” (EE)
-103	“Invalid Separator” (EE)
-104	“Data Type Error” (EE)
-105	“GET not allowed” (EE)
-108	“Parameter not allowed” (EE)
-109	“Missing Parameter” (EE)
-110	“Command Header Error” (EE)
-111	“Command Header Separator Error” (EE)
-112	“Program mnemonic too long” (EE)
-113	“Undefined header” (EE)
-114	“Header suffix out of range” (EE)
-120	“Numeric data error” (EE)
-121	“Invalid character in number” (EE)
-123	“Exponent too large” (EE)
-124	“Too many digits in number” (EE)
-128	“Numeric data not allowed” (EE)

EE = Error event
SE = Status event

Table 6: Error and status messages (Cont.)

Code number	Description
-140	“Character data error” (EE)
-141	“Invalid character data” (EE)
-144	“Character data too long” (EE)
-148	“Character data not allowed” (EE)
-150	“String data error” (EE)
-151	“Invalid string data” (EE)
-154	“String too long”
-158	“String data not allowed” (EE)
-160	“Block data error” (EE)
-161	“Invalid block data” (EE)
-168	“Block data not allowed” (EE)
-170	“Expression error” (EE)
-171	“Invalid expression” (EE)
-178	“Expression data not allowed” (EE)
-200	“Execution error” (EE)
-201	“Invalid while in local” (EE)
-202	“Settings lost due to rtl” (EE)
-210	“Trigger error” (EE)
-211	“Trigger ignored” (EE)
-212	“Arm ignored” (EE)
-213	“Init ignored” (EE)
-214	“Trigger deadlock” (EE)
-215	“Arm deadlock” (EE)
-220	“Parameter Error” (EE)
-221	“Settings conflict” (EE)
-222	“Parameter data out of range” (EE)
-223	“Too much data” (EE)
-224	“Illegal parameter value” (EE)
-241	“Hardware missing” (EE)
-260	“Expression Error” (EE)
-330	“Self Test failed” (EE)

EE = Error event

SE = Status event

Table 6: Error and status messages (Cont.)

Code number	Description
-350	“Queue overflow” (EE)
-410	“Query interrupted” (EE)
-420	“Query unterminated” (EE)
-430	“Query deadlocked” (EE)
-440	“Query unterminated after indefinite response” (EE)

EE = Error event
SE = Status event

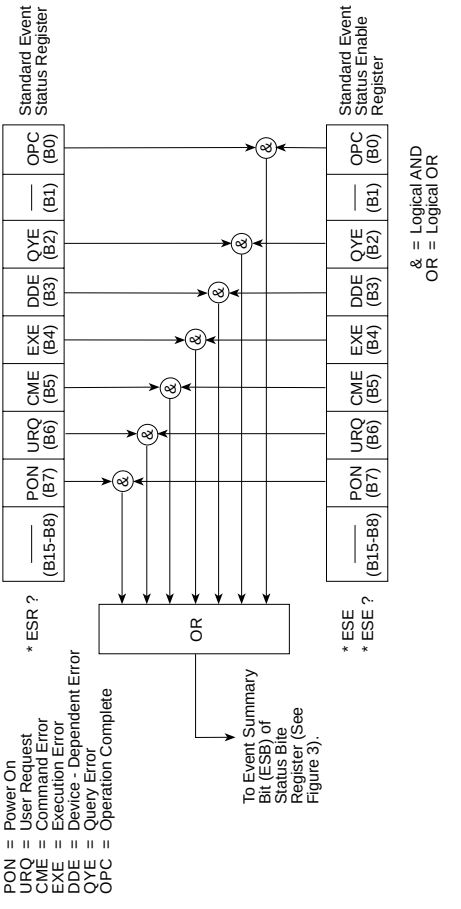

Figure 1: Standard event status

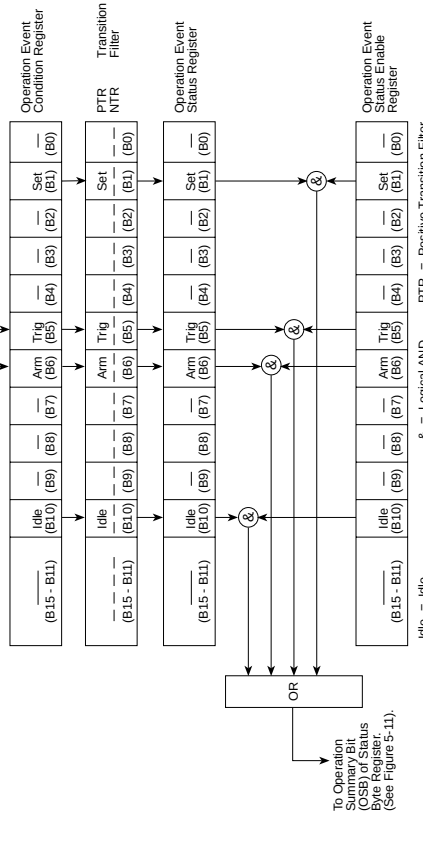

Figure 2: Operation event status

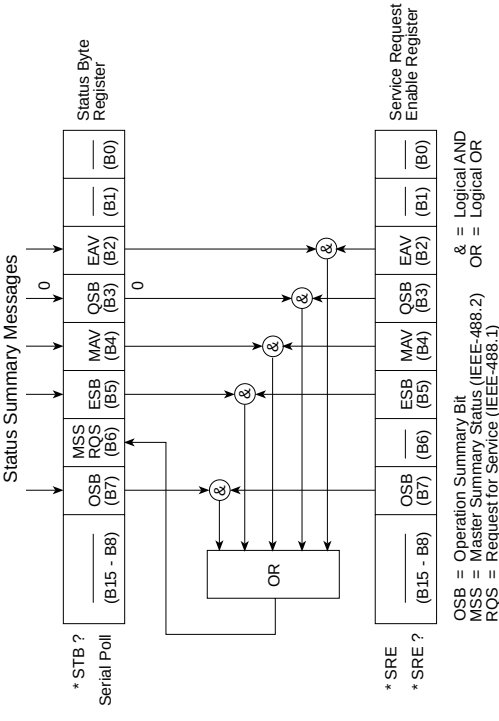

Figure 3: Status byte and service request (SRQ)

IEEE-488.2 Common Commands and Queries

Table 7: IEEE-488.2 common commands and queries

Mnemonic	Name	Description
*CLS	Clear status	Clears all event registers, and Error Queue.
*ESE <n>	Event status enable command	Read Standard Event Status.
*ESE?	Event status enable query	Read Standard Event Status Register.
*ESR?	Event status register query	Read Standard Event Status Register.
*IDN?	Identification query	Read ID information.
*OPC	Operation complete command	Sets OPC bit in the Standard Event Status Register after all pending commands have been executed.
*OPC?	Operation complete query	Places an ASCII “1” into the output queue when all pending commands have been completed.
*OPT?	Option identification query	Read model number for each slot.
*RCL <n>	Recall command	Returns the 7001 to the setup stored in the designated memory location (0 to 9).
*RST	Reset command	Returns the 7001 to the *RST default conditions.

Table 7: IEEE-488.2 common commands and queries (Cont.)

Mnemonic	Name	Description
*SAV <n>	Save command	Saves the current setup to the designated memory location (0 to 9).
*SRE <n>	Service request enable command	Programs Service Request Enable Register.
*SRE?	Service request enable query	Read Service Request Enable Register.
*STB?	Read status byte query	Read Status Byte Register.
*TRG	Trigger command	Issues a bus trigger.
*TST?	Self-test query	Performs a checksum test on ROM.
*WAI	Wait-to-continue command	Wait until all previous commands are executed.

SCPI Command Subsystems

Table 8: DISPlay command summary

Command	Description
:DISPlay	
[:WINDow[1]]	Path to locate message to top portion of display
:TEXT	Path to control user text messages:
:DATA <a>	Define ASCII message “a” (up to 20 characters).
:STATe <b>	Enable (1 or ON) or disable (0 or OFF) message.
:STATe?	Read state.
:WINDow2	Path to locate message to bottom portion of display:
:TEXT	Path to control user text messages:
:DATA <a>	Define ASCII message “a” (up to 32 characters).
:STATe <b>	Enable (1 or ON) or disable (0 or OFF) message.
:STATe?	Read state.
:SMESsage <b>	Enable (1 or ON) or disable (0 or OFF) status messages.
:SMESsage?	Read state of status message display.

Table 9: OUTPut command summary

Command	Description
:OUTPut	
:TTLn	Path and command to specify output line “n” (1-4):
:LSENse AHIGh|ALOW	Set polarity; active high (AHIG) or active low (ALOW).
:LSENse?	Read polarity.

Table 10: ROUTe command summary

Command	Description
[:ROUTe]	
:CLOSe <list> :STATe?	Close specified channels: Read closed channels.
:CLOSe? <list>	Read state of specified channels (1=closed, 0=open).
:OPEN <list>|ALL	Open specified (or all) channels.
:OPEN? <list>	Read state of specified channels (1=open, 0=closed).
:SCAN <list> :POINts?	Specify scan list: Read number of channels in scan list.
:SCAN?	Read scan list.
:FCHannels <list>	Specifies channels that cannot be closed (forbidden).
:FCHannels?	Read forbidden channels.
:CONFigure: :SCHannel <b> :SCHannel? :CPAir <b> :CPAir? :SLOT1 :CTYPE <type> :CTYPE? :POLE <n> :POLE? :STIMe <num> :STIMe?	Configuration command path: Enable (1 or ON) or disable (0 or OFF) Single Channel. Read Single Channel mode. Enable (1 or ON) or disable (0 or OFF) Channel Pairing. Read Channel Pairing. Path to configure CARD 1: Specify card type. Read card type. Select pole mode (1, 2 or 4). Read pole mode. Set relay settling time (0 to 99999.999 sec). Read relay settling time.

Table 10: ROUTe command summary (Cont.)

Command	Description
[:ROUTe]	
:CONFigure:	
:SLOT2	Path to configure CARD 2:
:CTYPE <type>	Specify card type.
:CTYPE?	Read card type.
:POLE <n>	Select pole mode (1, 2 or 4).
:POLE?	Read pole mode.
:STIMe <num>	Set relay settling time (0 to 99999.999 sec).
:STIMe?	Read relay settling time.
:MEMory	Path to program memory:
:SAVE M<num>	Saves channel pattern in memory (1-100).
:RECall M<num>	Recalls channel pattern from memory (1-100).

Table 11: SENSe command summary

Command	Description
:SENSe[1]	
:TTL1	Command path for input port.
:DATA?	Read digital input port.

Table 12: SOURce command summary

Command	Description
:SOURce	Command path to program digital output port bits:
:TTL1	Path to program Bit 1:
[:LEVel] <b>	Set (1 or ON) or reset (0 or off).
[:LEVel]?	Read Bit 1.
:TTL2	Path to program Bit 2:
[:LEVel] <b>	Set (1 or ON) or reset (0 or off).
[:LEVel]?	Read Bit 2.
:TTL3	Path to program Bit 3:
[:LEVel] <b>	Set (1 or ON) or reset (0 or off).
[:LEVel]?	Read Bit 3.
:TTL4	Path to program Bit 4:
[:LEVel] <b>	Set (1 or ON) or reset (0 or off).
[:LEVel]?	Read Bit 4.

Table 13: STATus command summary

Command	Description
:STATus	
:OPERation	Path to control operation event registers:
[:EVENt]?	Read status register.
:CONDition?	Read condition register.
:PTRansition <n>	Program positive transition register (0 to 1122).
:PTRansition?	Read positive transition register.
:NTRansition <n>	Program negative transition register (0 to 1122).
:NTRansition?	Read negative transition register.
:ENABle <n>	Program enable register (0 to 1122).
:ENABle?	Read enable register.
:ARM	Path to control arm event registers:

Table 13: STATus command summary (Cont.)

Command	Description
:STATus	
:OPERation	
:ARM	
[:EVENt]?	Read status register.
:CONDition?	Read condition register.
:PTRansition <n>	Program positive transition register (0 or 2).
:PTRansition?	Read positive transition register.
:NTRansition <n>	Program negative transition register (0 or 2).
:NTRansition?	Read negative transition register.
:ENABle <n>	Program enable register (0 or 2).
:ENABle?	Read enable register.
:SEQuence	Path to control the sequence event registers:
[:EVENt]?	Read status register.
:CONDition?	Read condition register.
:PTRansition <n>	Program positive transition register (0 to 6).
:PTRansition?	Read positive transition register.
:NTRansition <n>	Program negative transition register (0 to 6).
:NTRansition?	Read negative transition register.
:ENABle <n>	Program enable register (0 to 6).
:ENABle?	Read enable register.
:TRIGger	Path to control trigger event registers:
[:EVENt]?	Read status register.
:CONDition?	Read condition register.
:PTRansition <n>	Program positive transition register (0 or 2).
:PTRansition?	Read positive transition register.

Table 13: STATus command summary (Cont.)

Command	Description
:STATus	
:OPERation	
:ARM	
:TRIGger	
:NTRansition <n>	Program negative transition register (0 or 2).
:NTRansition?	Read negative transition register.
:ENABle <n>	Program enable register (0 or 2).
:ENABle?	Read enable register.
:PRESet	Return status registers to default states.
:QUEue	Path to access error queue:
[:NEXT]?	Read most recent error message.
:ENABle <list>	Specify error and status messages for queue.

Table 14: SYSTem command summary

Command	Description
:SYSTem	
:ERRor?	Read Error/Status Queue.
:POSetup RST|PRESet|SAV0|SAV1|SAV2|SAV3|SAV4|SAV5|SAV6|SAV7|SAV8|SAV9	Select Power-on setup.
:POSetup?	Read power-on setup.
:PRESet	Return instrument to default conditions.

Table 14: SYSTem command summary

Command	Description
:VERSion?	Read revision level of the SCPI Standard.

Table 15: Trigger command summary

Command	Description
:INITiate [:IMMediate]	Initiate one trigger (scan) cycle.
:CONTinuous <b>	Enable (1 or ON) or disable (0 or OFF) continuous initiation.
:ABORt	Reset trigger system and go to idle state.

Table 15: Trigger command summary (Cont.)

Command	Description
:ARM[:SEQuence[1]]	Subsystem command path to configure scan:
[:LAYer[1]]	Path to program Arm Layer 1 (arm layer) of scan:
:IMMediate	Loop around control source.
:COUNt <n>| INFinite	Program number of arms (1 to 9999, or INFinite).
:COUNt?	Read arm count.
:SOURce HOLD| IMMediate| MANual|BUS| TLINk|EXTernal	Select Arm Layer 1 control source.
:SOURce?	Read source.
:SIGNal	Loop around control source.
:TCONfigure	Path to configure Triggers.
:DIRection SOURce | ACCeptor	Enable (SOUR) or disable (ACC) Bypass.
:DIRection?	Read direction.
:ASYNchronous	Path to configure asynchronous Trigger Link:
:ILINe <n>	Select input line (1 to 6).
:ILINe?	Read input line.
:OLINe <n>	Select output line (1 to 6).
:OLINe?	Read output line.

Table 15: Trigger command summary (Cont.)

Command	Description
:ARM[:SEQuence[1]]	
:LAYer2	Path to program Arm Layer 2 (scan layer) of scan:
:IMMediate	Loop around control source.
:COUNt <n>| INFinite	Program number of scans (1 to 9999, or INFinite).
:COUNt?	Read scan count.
:DELay <num>	Program delay (0 to 99999.999 sec)
:DELay?	Read delay.
:SOURce HOLD| IMMediate| MANual|BUS| TLINk|EXTernal |TIMer	Select Arm Layer 2 control source.
:SOURce?	Read source.
:SIGNal	Bypass scan control source one time only.
:TIMer <num>	Set timer interval (0 to 99999.999 sec).
:TIMer?	Read timer interval.
:TCONfigure	Path to configure Triggers:
:DIRection SOURce| ACCeptor	Enable (SOUR) or disable (ACC) Bypass.
:DIRection?	Read direction.
:ASYNchronous	Path to configure asynchronous mode:
:ILINe <n>	Select input line (1 to 6).
:ILINe?	Read input line.
:OLINe <n>	Select output line (1 to 6).
:OLINe?	Read output line.

Table 15: Trigger command summary (Cont.)

Command	Description
:TRIGger	Path to program Trigger Layer (channel layer) of scan:
:IMMediate	Scan channels immediately. (Loop around control source.)
:COUNt <n>| INFinite	Program number of channels (1 to 9999, or INFinite).
:AUTO ON|OFF	Enable (on) to use scan-list-length.
:COUNt?	Read channel count.
:DELay <num>	Program delay (0 to 99999.999 sec)
:DELay?	Read delay period.
:SOURce HOLD| IMMediate| MANual|BUS| TLINk|EXTernal| TIMer	Select Trigger Layer Control Source.
:SOURce?	Read source.
:SIGNal	Bypass channel control source one time only.
:TIMer <num>	Set timer interval (0 to 99999.999 sec).
:TIMer?	Read timer interval.
:TCONfigure	Path to configure Triggers:
:PROTocol ASYNchronous| SSYNchronous	Select protocol (asynchronous or semi-synchronous Trigger Link.)
:PROTocol?	Read protocol.
:DIRection SOURce| ACCeptor	Enable (SOUR) or disable (ACC) Bypass.
:DIRection?	Read direction.
:ASYNchronous	Path to configure asynchronous Trigger Link mode:
:ILINe <n>	Select input line (1 to 6).
:ILINe?	Read input line.

Table 15: Trigger command summary (Cont.)

Command	Description
:TRIGger	
:TCONFigure	
:ASYNchronous	
:OLINe <n>	Select output line (1 to 6).
:OLINe?	Read output line.
:SSYNchronous	Path to configure semi-synchronous Trigger Link mode:
:LINE <n>	Select trigger line (1 to 6).
:LINE?	Read trigger line.

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