



SX Series Optical Switches

User Manual

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COMPLIANCE

FDA-CDRH Compliance

Under the US Food and Drug Administration (FDA) Center for Devices and Radiological Health (CDRH), the unit complies with the Code of Federal Regulations (CFR), Title 21, Subchapter J, which pertains to laser safety and labeling. See the link below for more information.

- <http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcr/CFRSearch.cfm?CFRPartFrom=1000&CFRPartTo=1050>

CSA / IEC Compliance

The unit complies with certain standards of the Canadian Standards Association (CSA) and the International Electrotechnical Commission (IEC).

The unit falls in the Installation Category (Overvoltage Category) II under IEC 664. IEC 664 relates to impulse voltage levels and insulation coordination. The particular category is defined as: local level, appliances, portable equipment, etc, with smaller transient overvoltages than Installation Category (Overvoltage Category) III.

The unit falls in the Pollution Degree 2 category under IEC 1010-1 and CAN/CSA-C22.2 No. 1010.1. The IEC standard on Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use relates to insulation coordination. The CSA standard is on Safety Requirements for Electrical Equipment for Measurement Control, and Laboratory Use, Part I: General Requirements. The Pollution Degree 2 category is defined as follows: “Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.”

CE Compliance

Electronic test equipment is subject to the EMC Directive in the European Union. The EN61326 standard prescribes both emission and immunity requirements for laboratory, measurement, and control equipment. This unit has undergone extensive testing according to the European Union Directive and Standards.



FCC Certification

15.19(a)(3) All devices

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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GENERAL INFORMATION

SX Series Optical Switch Overview

This User Manual for the SX Series Optical Switches contains complete operating instructions. The SX switches can be ordered as a single-mode or multimode model.

The SX Series Optical Switches offer low insertion loss, and very high stability and repeatability needed to meet the stringent test, measurement, and manufacturing system requirements.



Figure 1: SX4 Benchtop Optical Switch



Figure 2: SX8 Rackmount Optical Switch

In addition to manual front panel operation, SX Optical Switches may be operated via the RS-232 serial interface, USB by using the USB-DB9 adapter cable and IEEE



488 GPIB parallel interface using remote control commands. Please refer to the “REMOTE CONTROL COMMANDS” section on page 27 for more information.

Key Features

- Low IL (0.7 dB)
- Up to 360 outputs
- Up to 4 inputs
- Multiple possible configurations
- RS-232 serial and IEEE 488 GPIB parallel interface

Applications

- High-volume production testing
- Multiple device testing
- R&D applications
- System compliance testing

Accessories

- AC power cord
- User Manual
- Test Report

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SAFETY INFORMATION



To avoid situations that could result in serious injuries or death, always observe the following precautions.

The safety instructions must be observed whenever the unit is operated, serviced, or repaired. Failure to comply with any of these instructions or with any precaution or warning contained in the User Manual is in direct violation of the standards of design, manufacturing, and intended use of the unit. JGR Optics assumes no liability for the customer’s failure to comply with any of these safety requirements.

Safety Symbols

The following symbols and messages can be marked on the unit (see Table 1 below). Observe all safety instructions that are associated with a symbol.

Table 1: Safety Symbols


	<p>Frame or chassis terminal for electrical grounding within the unit.</p>
	<p>Protective conductor terminal for electrical grounding to the earth.</p>
<p>WARNING</p>	<p>Procedure can result in serious injury or loss of life if not carried out in proper compliance with all safety instructions. Ensure that all conditions necessary for safe handling and operation are met before proceeding.</p>
<p>CAUTION</p>	<p>Procedure can result in serious damage to or destruction of the unit if not carried out in compliance with all instructions for proper use. Ensure that all conditions necessary for safe handling and operation are met before proceeding.</p>

Classification

SX Series Optical Switches consist of an exposed metal chassis that is connected directly to earth via a power cord and, therefore, is classified as a Class 1 instrument.

Safety Instructions

Electrical Shock Hazards:

	<p>Warning</p> <ul style="list-style-type: none">• Use only the type of power cord supplied with the unit. If you need to replace a lost or damaged cord, make sure to replace with a power cord of the same type.• Connect the power cord only to a power outlet equipped with a protective earth contact. Never connect to an extension cord or any receptacle that is not equipped with this feature.• If using a voltage-reducing autotransformer to power the unit, ensure that the common terminal connects to the earthed pole of the power source.• Do not interrupt the protective earth grounding. Such action can lead to a potential shock hazard that can result in serious personal injury. Do not operate the unit if an interruption to the protective grounding is suspected.• Use only the type of fuse specified by JGR Optics as appropriate for this unit. Do not use “repaired” fuses, and avoid any situations that can short-circuit the fuse.• Do not operate the unit when its cover or panels have been removed.
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Fuse Replacement


SX Optical Switches are protected with a fuse which is located at the back of the unit near the power inlet. The fuse type used is 5 x 20 mm, 1 A/250 V (slow blow/time delay). To avoid electrical fire or damaging the unit, only replace the fuse with one of the same size and rating.

There are no user-serviceable parts inside the SX switches. Opening of the unit by anybody other than an authorized JGR Optics technician may damage the meter and will void the warranty.


Disconnecting from Line Power

Some of the circuits are powered whenever the unit is connected to the AC power source (line power). To ensure that all circuits are powered off, disconnect the power cord from either the power inlet on the unit’s rear panel or from the AC line-power source (receptacle). The power cord must always be accessible from one of these points. If the unit is installed in a cabinet, the operator must be able to disconnect the unit from the line power by the system’s line-power switch.


Environmental Hazards

	<p>Warning</p> <ul style="list-style-type: none"> • To prevent potential fire or shock hazard, do not expose the unit to any source of excessive moisture. • Do not use the unit outdoor. • Operating the unit in the presence of flammable gases or fumes is extremely hazardous.
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Laser Hazards

	<p>Warning</p> <ul style="list-style-type: none"> • Never look into the end of an optical cable connected to an optical output device that is operating. Laser radiation is invisible, and direct exposure can severely injure the human eye.
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Other Hazards

	<p>Warning</p> <ul style="list-style-type: none"> • If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Repairs are to be carried out only by a JGR Optics authorized technician. In addition to voiding the warranty, opening the unit (even when unplugged) can expose the user to potential shock hazards. • Some of the unit’s capacitors can be charged even when the unit is not connected to the power source. • Do not perform any operating or maintenance procedure that is not described in the User Manual.
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GETTING STARTED

**Caution**

To avoid injury or death, always observe the precautions listed in “SAFETY INFORMATION” section on page 5.

This manual contains complete operating instructions for safe and effective operation of the SX Series Optical Switches. It is recommended that users of the SX switches familiarize themselves with contents of this manual before using the instrument.

The inspection report and a description of any customer-requested information may be found in the calibration document envelope included with the instrument.

Initial Inspection

**Warning**

To avoid electrical shock, do not initialize or operate the unit if it bears any sign of damage. Ensure that the unit and any devices or cords connected to it are properly grounded.

- Inspect the package and contents for signs of damage.
- Ensure all contents are included:
 - SX Series Optical Switch
 - 1 AC power cord
 - User Manual
 - Test Report
- Read the User Manual thoroughly, and become familiar with all safety symbols and instructions to ensure that the unit is operated and maintained safely.

- ☑ Ensure the unit is operational:
 - Connect the unit to a power source using the power cord provided
 - Set the power switch to ON to initialize the SX optical switch, and observe the power-up sequence:
 - **Model number and** firmware version of the switch are displayed
 - The message “Initializing” should follow momentarily
 - Set the power switch to OFF and disconnect the switch.
- ☑ Keep the packaging.
- ☑ Immediately notify JGR Optics and, if necessary, the carrier if the content of the shipment is incomplete, if the unit or any of its components are damaged or defective, or if the unit does not pass the initial inspection.

Operational Requirements

In order for the unit to meet the warranted specifications, the operating environment must meet the following conditions for altitude, temperature, humidity, and voltage.

Table 2: Environmental Requirements

<i>Parameter</i>	<i>Specification</i>
Altitude	Up to 2000 m
Temperature	Range of 0 to 40 °C
Humidity	Up to 95% humidity (0 to 40 °C)
Voltage	Main supply voltage fluctuations must not

Product Overview

SX4 Front Panel and Key Description

The front of the SX4 switch is shown in Figure 5 and described in Table 5 respectively. The switch front panel will vary with model ordered.

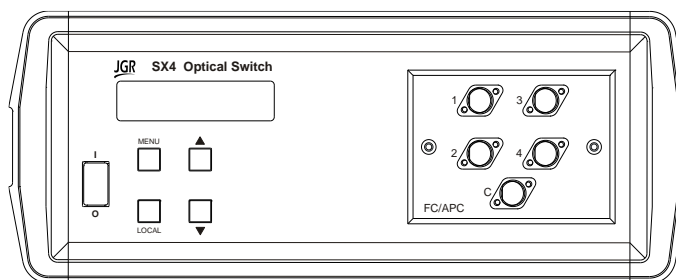


Figure 3: Front of the Switch

Table 3: Operating Keys and Status LEDs

Key/LED	Description
I/O	Power ON / OFF switch.
MENU	Used to turn the Menu mode on and off. When deeper menu levels are selected, press the MENU key to step back one level at a time.
LOCAL	Returns the meter back to Local (front panel operation) mode when operating remotely (with GPIB or RS-232).
▲ ▼	Selects the output channel and adjusts the LCD display values.

SX4 Rear Panel

The SX4 rear-panel features shown in Figure 4 and are described in Table 4.

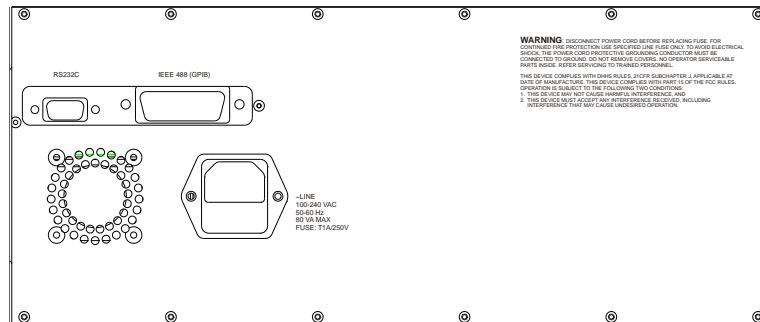


Figure 4: Rear of Optical Switch

Table 4: Rear Panel Components

Component	Function
RS-232C	RS-232C serial interface port
IEEE 488 (GPIB)	GPIB (IEEE 488.1) interface port
~LINE	Power Input (also contains the user-replaceable fuse)

SX8 Front Panel and Key Description

The SX8 switch front panel will vary depending on model ordered. Two front panel key pad configurations are shown in Figure 5 and Figure 6 and described in Table 5.

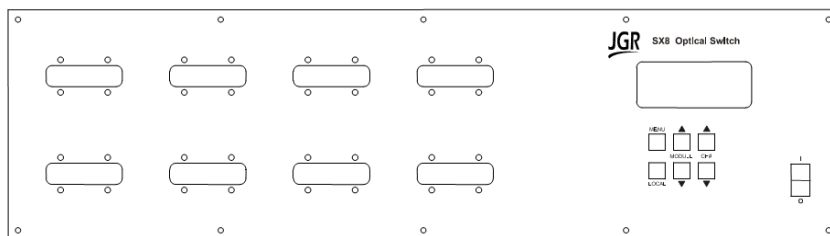


Figure 5: Front Panel of Switch Without Softkeys

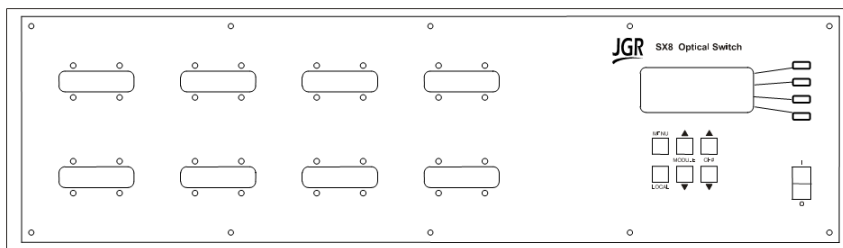


Figure 6: Front Panel of Switch With Softkeys

Table 5: Operating Keys and Status LEDs

Key/LED	Description
I/O	Power ON / OFF switch.
MENU	Used to turn the Menu mode on and off. On models <u>without</u> the SOFT KEYS, press the MENU key to go to the next menu option. On models <u>with</u> the SOFT KEYS, when deeper menu levels are selected, press the MENU key to step back one level at a time.
LOCAL	Returns the switch back to Local (front panel operation) mode when operating remotely (with GPIB or RS-232). On models <u>without</u> the SOFT KEYS, when in MENU mode, press the LOCAL key to go to the previous menu option.
MODULE ▲ ▼	Selects the optical switch module.

Key/LED	Description
CHANNEL ▲ ▼	Selects the output channel. Adjusts the values in MENU mode.
SOFT KEYS	When present, used to select the menu options.

SX8 Rear Panel

SX8 Rear-panel features are described in Table 6.

Table 6: Rear Panel Components

<i>Component</i>	<i>Function</i>
RS-232C	RS-232C serial interface port
IEEE 488 (GPIB)	GPIB (IEEE 488.1) interface port
~LINE	Power Input (also contains the user-replaceable fuse)

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OPERATION

Powering Up the Switch

To power up the switch:

1. Connect the meter to an AC power source using the power cord provided. If the meter has been running, ensure that the meter is powered off and restarted.
2. Set the power switch to I (ON), and wait for the “Initialization” process to finish.
3. Allow 30 minutes warm-up time in order to obtain a stable performance.

User Menu Operation

Accessing the SX4 User Menu

To access the SX4 User Menu:

1. Press the “MENU” button to enter the User Menu mode. The key lamp will light.
2. User Menu Options are shown in Table 7.

Table 7: User Menu Options

<i>Options</i>	<i>Note</i>
BAUD RATE:____ Default:9600	Choose a Rate from 300-38400
GPIB ADDR:____ Default:21	Select a GPIB address from 01-30
Save? Quit?	Once changes are made the switch returns to standard switching mode

Messages and Symbols

The messages and symbols displayed by the SX4 Optical Switch are shown in Table 11.

Table 8: SX4 Meter Display Messages and Symbols

<i>Display</i>	<i>Description</i>
SX4 VER: Y.YY	Displayed momentarily during the power-up sequence and indicates the model number and the software version (Y.YY).
INITIALIZING	Displayed momentarily during the power-up sequence as the initial internal programs are set.

Accessing the SX8 User Menu

To access the User Menu:

1. Press the “MENU” button to enter the User Menu mode.
2. User Menu Options are shown in Table 9 and Table 10
3. For models without the SOFT KEYS: Use the MENU button and the LCL button to navigate through the menu options.
4. For models with the SOFT KEYS: Use the MENU button and the SOFT KEYS to navigate through the menu options
5. Use UP/DOWN keys to select options or change values.

Table 9: User Menu Options (Models without SOFT KEYS)

Options	Note
BAUD RATE: _____ Default:9600	Choose a Baud Rate from 1200 to 57600.
GPIB ADDR: __ Default:21	Select a GPIB address from 01 to 30.
JDS Compatible? Y/N Default: N	Select between JGR (N) and JDS(Y) modes.
Emulate JDS SB/SC or JDS SX?	If JDS compatible is set to Yes(Y), select between JDS SB/SC and SX modes.



Options	Note
Save? Quit?	Once changes are made the switch returns to standard switching mode.

Table 10: User Menu Options (Models with SOFT KEYS)

Options	Note
REMOTE MENU	
JGR SX8 COMMANDS/ Emulate JDS SB/SC or SX	Choose between JGR, JDS SB/SC or JDS SX modes.
RS232 Baud: _____ Default:9600	Choose a Baud Rate from 1200 to 57600.
GPIB Address: __ Default:21	Select a GPIB address from 01 to 30.
OPTION MENU*	
No Driver1/LCL Key->Driver1	Assign Driver1 function to LOCAL key.
RECALL RLY PTN: _____*	Select a relay pattern index to recall.
STORE RELAY PATERN*	
RLY PTN Index: _____	Select a relay pattern index from 1 to 8.
RLY Pattern: _____	Select a relay pattern represented in binary-coded integer from 0 to255.
STORE	Assign the relay pattern to the corresponding relay pattern index.
BACK	Go back to the previous menu level.
SAVE? QUIT?	Once changes are made the switch returns to standard switching mode.

* These options are displayed on models with a relay driver present.

Messages and Symbols

The messages and symbols displayed by the SX8 Optical Switch are shown in Table 11.

Table 11: SX8 Meter Display Messages and Symbols

Display	Description
SX8 VER: Y.YY	Displayed momentarily during the power-up sequence and indicates the model number and the software version (Y.YY).
INITIALIZING	Displayed momentarily during the power-up sequence as the initial internal programs are set.
M1:2 M2:1 M3:12 ...	M1~M16 are optical switch module numbers, flashing mark front of 'M' indicates the selected module, numbers after ':' are channel numbers.

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PROGRAMMING GUIDE

Setting up for RS-232, USB or GPIB communication

The SX Series Optical Switches may be remotely controlled via GPIB (IEEE-488) and RS-232 interface. The GPIB interface of the switch conforms to the ANSI/IEEE standards 488.1-1987 and 488.2-1987. The RS232C interface conforms to ANSI/IEEE standard 488.2-1987 where applicable.

The common command set conforms to ANSI/IEEE 488.2 standard syntax. All other commands conform to the Standard Commands for Programmable Instruments (SCPI) command language, version 1999.0.

Accessing the “User Menu” mode

In order to establish communication between the computer and the meter, the RS-232 bus or the GPIB bus must be configured properly. The different options for the communication are contained in the User Menu. Refer to the “USER MENU OPERATION” section on page 13 for further details.

JDSU Compatibility

Refer to JDSU SB/SC/SX switch user manual programming guide section when JDSU SB/SC/SX switch emulation mode is chosen.

Programming over GPIB

The SX Series supports the IEEE-488.1(1978) interface standard. It also supports the mandated common commands of IEEE-488.2(1987) standard. Before attempting to communicate with a SX switch via the GPIB interface, the device address must be set. The address is set by accessing the User Menu function from the front panel.

Programming Over RS-232

In order to establish a serial communication between the computer and the SX8, the computer’s COM port must be configured as described in Table 9.

To connect the SX switch to the computer, a standard 9 pins straight RS-232 cable is required. Only three pins, Txd, Rxd and GND are needed.



Programming Over USB

It is also possible to remote control the SX Series switches via USB by using a USB to DB9 adapter cable. The same RS-232 commands are used for USB communication.

Table 12: Serial Communication Settings

Transmission Rate	Selectable in the "User Menu". Available options are 300, 1200, 2400, 9600, 19200 and 38400 Baud
Data bit	8
Parity	N
Stop bits	1
Flow Control	None

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MAINTENANCE AND TROUBLESHOOTING

Maintenance

Cleaning the Unit

1. Unplug the unit from the line power.
2. Clean the enclosure with a damp cloth.
3. Do not plug the unit back until it is completely dry.

Cleaning the Connector Ends

1. Clean all connector ends with a lint-free tissue and alcohol before every mating. See the “CLEANING CONNECTORS” section on page 21.
2. Loosen the retaining screws of the connector panel, and remove the panel carefully to access the internal connectors (**Error! Reference source not found.**).
3. Remove the connector from the mating sleeve in the panel.
4. Clean the connector end faces and mating sleeve in accordance with the “CLEANING CONNECTORS” Section on page 21.
5. Reinstall the connector onto the panel.
6. Reinstall the connector panel. To avoid damaging the input and output port fibers, make one or two large loops in the fibers when reinstalling the panel.

Cleaning Connectors

**Warning**

Connecting damaged or dirty fibers to the unit can damage the front-panel connectors of the unit.



	Never force an optical connector. Some connectors have a ceramic ferrule that can easily be broken.
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Optical cable ends need to be cleaned before using them with the unit. The following items are required for cleaning the connector:

- Filtered compressed air or dusting gas
- Lint-free swab and lint-free towels
- Optical grade isopropyl alcohol or optical grade 200° ethanol (**do not use rubbing alcohol, which contains 30% water**)

To clean the connectors:

1. Blow the sleeve with filtered compressed air.
2. Apply optical grade isopropyl alcohol or optical grade ethanol to a small area of a lint-free towel and rub the end of the ferrule over the wet area.
3. Wipe the ferrule on a dry area of the lint-free towel.
4. Using the dusting gas or compressed air, blow the end of the ferrule.
5. Apply the alcohol or ethanol to a lint-free pipe cleaner or swab and wipe off the remaining parts of the connector.
6. With the other end of the pipe cleaner or swab, dry the areas cleaned.
7. Using the dusting gas or compressed air, blow the areas cleaned.

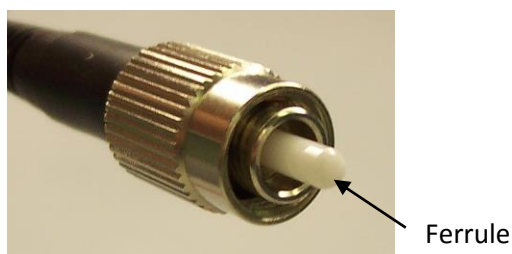


Figure 7: Connector (Connector Type May Vary)

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STORAGE AND SHIPPING

Damage can occur from improper handling during storage or shipping. Make sure to maintain the unit within the specified temperature range during storage or shipping. Please follow the recommendations below to minimize the possibility of damage:

If possible, pack the unit in its original packing material when shipping;

Avoid high humidity or large temperature fluctuations that could generate condensation within the unit.

Avoid unnecessary shocks and vibrations.

Returning Instruments to JGR Optics

As indicated above, please ship the returned material in the original shipping box and packing material. If these are not available, follow the guidelines below:

1. Contact JGR Optics to obtain a RMA number;
2. Cover the front panel with foam to prevent damage;
3. Wrap the unit in anti-static packaging. Use anti-static connector covers;
4. Pack the unit in a strong enough shipping box considering the unit's weight;
5. Use enough shock-absorbing material (10 to 15 cm) to cushion the unit and prevent it from moving inside the box. Pink poly anti-static foam is recommended;
6. Seal the shipping box securely;
7. Clearly mark FRAGILE on at least 3 of the 4 sides of the box;
8. Always provide the model and serial number of the unit and, if necessary, the RMA number on any accompanying documentation. If possible, indicate the RMA number on the box itself to facilitate identification.

Contact Information

JGR Optics Inc.
 160 Michael Cowpland Drive
 Ottawa, Ontario, Canada
 K2M 1P6

Phone: 613-599-1000
 Fax: 613-599-1099
 sales@jgroptics.com
 www.jgroptics.com



SPECIFICATIONS

Specifications are provided here as a reference only and may be changed without notice. Please refer to JGR Optics’s website for the most recent specifications.

SX4 Specifications

OPTICAL / ELECTRICAL SPECIFICATIONS		
Parameter	Specification	
	Single-mode	Multimode
Wavelength Range (nm)	1250 - 1670	840 - 1350
Insertion Loss (dB) ¹	0.7	
Backreflection (dB) ¹	≤ - 60	≤ - 40
PDL (dB)	0.05	N/A
Repeatability (random switching) (dB)	± 0.03	
Repeatability (sequential) (dB)	± 0.005	
Crosstalk (maximum) (dB)	- 80	
Maximum Input Power (mW)	300	
Switching Time (ms)	300	
Input Voltage	100 - 240 V AC, 50 - 60 Hz	
Power Consumption (VA)	60 maximum	
Control	Front Panel / GPIB / RS232 / USB ²	
Switch Life	10 ⁸ cycles	

¹ Excluding connectors.

² USB interface via-USB-DB9 adapter.

MECHANICAL / ENVIRONMENTAL SPECIFICATIONS		
Parameter	Specification	
	Single-mode	Multimode
Unit Dimensions W x H x D (cm)	25 x 12 x 27	
Shipping Box Dimensions W x H x D (cm)	37 x 25 x 38	
Unit Weight (kg)	3	
Total Shipment Weight (kg)	4	
Operating Temperature (°C)	0 to 55	
Storage Temperature (°C)	- 40 to 70	
Humidity (Non-condensing) (°C)	Maximum 95% RH from 0 to 40	

SX8 Specifications

OPTICAL / ELECTRICAL SPECIFICATIONS		
Parameter	Specification	
	Single-mode	Multimode
Wavelength Range (nm)	1250 - 1670	840 - 1350
Insertion Loss (dB) ¹	0.7	
Backreflection (dB) ¹	≤ - 60	≤ - 40
PDL (dB)	0.05	N/A
Repeatability (random switching) (dB)	± 0.03	
Repeatability (sequential) (dB)	± 0.005	
Crosstalk (maximum) (dB)	- 80	
Maximum Input Power (mW)	300	
Switching Time (ms)	300	
Input Voltage	100 - 240 V AC, 50 - 60 Hz	
Power Consumption (VA)	150 maximum	
Control	Front Panel / GPIB / RS232 / USB ²	
Switch Life	10 ⁸ cycles	

¹ Excluding connectors.

² USB interface via-USB-DB9 adapter.

MECHANICAL / ENVIRONMENTAL SPECIFICATIONS		
Parameter	Specification	
	Single-mode	Multimode
Unit Dimensions W x H x D (cm)	48 x 13.5 x 37.5 / 48 x 27 x 37.5	
Shipping Box Dimensions W x H x D (cm)	53 x 32 x 57 / 53 x 55 x 55	
Unit Weight (kg)	14 (depending on configuration)	
Total Shipment Weight (kg)	15 (depending on configuration)	
Operating Temperature (°C)	0 to 55	
Storage Temperature (°C)	- 40 to 70	
Humidity (Non-condensing) (°C)	Maximum 95% RH from 0 to 40	

B

REMOTE COMMANDS

CONTROL

Command Syntax and Style

Program Message Formats

A program message consists of a command header, followed by its required parameters. The parameters must be separated from the command header by a space, for example, ***ESE 10**. Multiple parameters must be separated by a comma (,).

Each program message can contain one or more message units. The message units in a program message must be separated by a semicolon (;), for example, ***CLS;*ESE 10**.

Terminating a Program Message

The command terminator should be a linefeed <LF> plus EOI for GPIB, and a carriage return <CR> plus a linefeed <LF> for RS-232. No command processing occurs until a command terminator is received.

Command Header Variations

Each command header in the command tree has a long form and a short form. Both forms are acceptable and each form gives an identical response.

Examples:

:ROUTE:CLOSE 5

:ROUT:CLOS 5

:STATUS:OPERATION:ENABLE 255

:STAT:OPER:ENAB 255

The query form of a command must end with a question mark (?). A command can be entered in either uppercase characters or lowercase characters.

Specifying the Command Path

In order to use a command in the command tree, the meter must know the full path to the command. If the command is the first command in the program message, the command header must contain the full path to the command. Subsequent commands in the same program message are automatically referenced in the same path as the previous command, unless a colon (:) precedes the command's command header, in which case the full path to the command must be included in the command header.

[:ROUTE]

:CLOSE <channel list>

The following program messages are valid:

ROUTE:CLOSE 5;CLOSE?

ROUTE:CLOSE 5;:ROUTE:CLOSE?

STAT:OPER:ENAB 5;ENAB?

The following program messages are **NOT** valid:

ROUTE:CLOSE 5;ROUTE:CLOSE?

(no colon before second command)

STAT:OPER:ENAB 5;OPER?

(DET command at different level than NEXT)

Default Commands

Default commands are commands that do not need to be explicitly included in the command path. If a default command for a path exists, it is enclosed by square brackets ([]) in the command tree. If a default command is implied in the first command of a program message, the command path for subsequent commands is determined as if the default command had been explicitly included in the first command header.

[:ROUTE]

:CLOSE <channel list>

The following program messages are valid:



ROUTE:CLOSE 5

CLOSE 10

Implemented Status Structures

There are three distinct status data structures implemented in the SX8 switch:

- IEEE 488.2 defined standard registers (standard status structure)
- SCPI defined operation registers (operation status structure)
- SCPI defined questionable registers (questionable status structure)

The 488.2 standard status structure consists of four registers:

- status byte register
- service request enable register
- standard event status register
- standard event status enable register

The operation and questionable status structures are identical except for the use of their individual bits. These status structures are each composed of five registers:

- condition register
- positive transition register (PTRansition)
- negative transition register (NTRansition)
- event register
- event enable register

The bits in the operation status structure reflect a specific condition within the switch. The SX8 switch only uses bit 1 of the condition register. Bit 1, the “Settle” bit, is set when the SX8 switch is in the process of switching channels.

The bits in the questionable registers give an indication of the quality of the output of the SX8 switch. None of the bits in the questionable register are currently used by the switch.

All three status structures are connected by the status byte register. Refer to IEEE488.2 and SCPI1999 documents for the details.

Note that the standard event status register and the event register are both “sticky” (i.e. once their bits are set to 1 they remain set until they are cleared by appropriate commands). The status byte register and the condition register are both dynamic and get updated when the state of the instrument or the underlying status structures change.



Status Byte Register

The status byte register contains the summary bits for each of the structures implemented in the switch, the master summary bit (MSB) and the request for service bit (RQS).

Status Register							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
operation summary (OSB)	request for service or master summary	event summary (ESB)	message available (MAV)	questionable summary (QSB)	settle bit (STL)	not used	not used
Read with		By serial polling *STB?					
Written to with		Cannot be written to					
Cleared by		*CLS common command					

- Bit 0 is not used.
- Bit 1 is not used.
- Bit 2 (settle bit) is cleared when the device is in the process of switching channels. This bit is set to 1 once the device is settled.
- Bit 3 (questionable summary) is the summary bit for questionable status structure. It is set if any bit in the questionable event status register is set while the corresponding bit in the questionable event enable register is set.
- Bit 4 (message available) is set to 1 when a response message is available in the output queue.
- Bit 5 (event summary bit) is the summary bit for the standard event status structure. The ESB summary message bit is set if any bit in the standard event status register is set while its corresponding value in the standard event status enable register is set.
- Bit 6, as the service request bit, is set to 1 if a service request has been generated.

Bit 6, as the master summary bit, is set when there is at least one reason for the switch to request service from the controller. That is, the master summary bit is

set if any summary bit in the status byte register is set and if the corresponding bit in the service request enable register is also set.

- Bit 7 (operation summary bit) is the summary bit for the operation status register. It is set if any bit in the operation event register is set while the corresponding bit in the operation event enable register is set.

Service Request Enable Register

The service request enable register determines which summary bits in the status byte register can generate service requests. If a summary bit in the status register is set to 1 and the corresponding bit in the service request enable register is set to 1, a service request is generated by the switch. A new service request is not generated for this condition unless the bit in the status register or the bit in the service request enable register is cleared and the condition reoccurs.

Service Request Enable Register	
Read with	*SRE? common query (the value of bit 6 is always 0)
Written to with	*SRE common command (the value of bit 6 is always zero, regardless of the value sent with the command)
Cleared by	*SRE common command with a parameter value of 0 Power-on

Standard Event Status Register

Standard Event Status Register							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
power on (PON)	user request (URQ)	command error (CME)	execution error (EXE)	device dependent error (DDE)	query error (QYE)	request control (RQC)	operation complete (OPC)
Read with		*ESR? common query					
Written to with		Cannot be written to					

Cleared by	<p>*ESR? common query</p> <p>*CLS common command</p> <p>Power-on</p>
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- Bit 0 (operation complete) is set in response to the ***OPC** common command. This bit is set when all operations are complete.
- Bit 1 (request control) is always set to 0.
- Bit 2 (query error) is set when a query error occurs, for example, an attempt is made to read the output queue when the output queue is empty or when the data in the output queue is lost.
- Bit 3 (device dependent error) is set by the switch to indicate that an error has occurred that is not a command error, an execution error, or a query error.
- Bit 4 (execution error) is set when an execution error is detected by the switch, for example, if a command parameter is out of the range of the switch or a valid program message cannot be executed due to some condition in the switch.
- Bit 5 (command error) is set when a command error is detected by the switch, for example, if a syntax error is detected in a program message, an incorrect command header is received, or if an IEEE GET message is received in the middle of a program message.
- Bit 6 (user request) is always set to 0.
- Bit 7 (power on) is set when an off-to-on transition occurs in the power supply of the switch.

Standard Event Status Enable Register

The contents of the standard event status enable register determine which events in the standard event status register are reflected in the event summary bit (ESB) of the status byte register.

Standard Event Status Enable Register	
Read with	*ESE? common query
Written to with	*ESE common command
Cleared by	<p>Power-on</p> <p>*ESE common command with a parameter 0</p>

Operation and Questionable Condition Registers

Each bit in these condition registers reflects a specific condition or state within the switch. A bit is set when the switch enters the state associated with that bit and remains set while the device is in that state.

Operation Condition Register	
Read with	STATus:OPERation:CONDition? query
Written to with	Cannot be written to
Cleared by	Power-on

Questionable Condition Register	
Read with	STATus:QUEStionable:CONDition? query
Written to with	Cannot be written to
Cleared by	Power-on

Operation and Questionable Event Registers

Event registers reflect changes in the conditions of the switch. Each bit in the operation event register and the questionable event register is associated with a bit in the corresponding condition register. Depending on the values of the positive transition register and the negative transition register, a bit in the event register can be set when the associated bit in the condition register changes from 0 to 1, from 1 to 0, or both. If both the positive transition and negative transition bits are set to 0, the event register bit is not set on either transition.

Operation Event Register	
Read with	STATus:OPERation:EVENT? query
Written to with	Cannot be written to
Cleared by	*CLS common command

Questionable Event Register	
Read with	STATus:QUESTionable:EVENT? query
Written to with	Cannot be written to
Cleared by	Power-on * CLS common command

Operation and Questionable Event Enable Registers

The event enable registers determine which event bits in the associated event register causes the summary message bit in the status byte register to be set. If any event bit in the event register is set while its associated bit in the event enable register is also set, the summary message bit is set to true.

Operation Event Enable Register	
Read with	STATus:OPERation:ENABLE? query
Written to with	STATus:OPERation:ENABLE command
Cleared by	Power-on

Questionable Event Enable Register	
Read with	STATus:QUESTionable:ENABLE? query
Written to with	STATus:QUESTionable:ENABLE command
Cleared by	Power-on

Operation and Condition Positive Transition Register

If a bit in the positive transition register is set, then a positive transition (a transition from 0 to 1) in the associated bit in the condition register sets the associated bit in the event register.

Operation Positive Transition Register	
Read with	STATUS:OPERation:PTRansition? query
Written to with	STATUS:OPERation:PTRansition command
Cleared by	Power-on

Condition Positive Transition Register	
Read with	STATUS:QUEStionable:PTRansition? query
Written to with	STATUS:QUEStionable:PTRansition command
Cleared by	Power-on

Operation and Condition Negative Transition Register

If a bit in the negative transition register is set, then a negative transition (a transition from 1 to 0) in the associated bit in the condition register causes the associated bit in the event register to be set.

Operation Negative Transition Register	
Read with	STATUS:OPERation:NTRansition? query
Written to with	STATUS:OPERation:NTRansition command
Cleared by	Power-on

Questionable Negative Transition Register	
Read with	STATUS:QUEStionable:NTRansition? query
Written to with	STATUS:QUEStionable:NTRansition command
Cleared by	Power-on

Queues

Input Queue

The input queue in the switch is a first-in-first-out (FIFO) queue and is 256 characters in length. Data bytes received from the controller are placed in the input queue in the order received. When a full message unit is received, it is transferred to the parser.

If the input queue becomes full while the GPIB is being used, the data acknowledge signal (DAQ) is not sent to the GPIB controller until a character is transferred from the input buffer to the parser. This ensures that no bytes in the program message are lost. However, the RS232C interface has no DAQ signal and cannot be signaled when the input queue becomes full. Therefore, characters sent to the SX8 switch are lost.

If a new program message is received before the response to a query in a previous message is read, the output queue is cleared, MAV is set to false, and the query error bit is set. This error is also referred to as an unterminated error.

Output Queue

Responses to query messages are placed in the output queue. This queue is 256 characters in length. When a response is placed in the output queue, the MAV bit in the status register is set. The MAV bit is cleared when the response is sent.

Response messages are always terminated with the sequence <LF> and, if the response is being sent through the GPIB, the EOI signal is set to true when the last character in a response is sent.

If an attempt is made to read the output queue when it is empty and the current program message does not contain a query, a query error bit is set.

Error Queue

The error queue is where errors are placed and it can contain up to 10 error messages. Because it is a FIFO queue, the error returned when the error queue is read is always the first error that occurred.

If more than 10 errors are put in the error queue, an overflow error occurs and the last error in the queue is overwritten with error number -350 (Queue Overflow). Each error in the queue consists of an error number and a brief error message.

Description of Error Numbers

0	No error
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No error has occurred.

-100 Command error

A command error was detected, but the parser cannot be more specific.

-130 Suffix error

An error was detected in the suffix sent with the command, but the parser cannot be more specific.

-220 Parameter error

An error was detected in a parameter, but the control block cannot be more specific.

-240 Hardware error

A hardware error was detected, but the control block cannot be more specific.

-330 Self-Test error

The device failed a self-test.

-350 Queue overflow

The error queue has overflowed, and an error has occurred that cannot be recorded.

-400 Query error

A query error was detected, but the parser cannot be more specific.

IEEE 488.2 Common Commands and the SCPI Command Tree

IEEE 488.2 Common Commands

Command	Parameter	Response	Minimum	Maximum
*CLS	N/A	N/A	N/A	N/A
*ESE	Integer	N/A	0	255
*ESE?	N/A	Integer	0	255
*ESR?	N/A	Integer	0	255
*IDN?	N/A	String	N/A	N/A
*OPC	N/A	N/A	N/A	N/A
*OPC?	N/A	Integer	1	1



*RST	N/A	N/A	N/A	N/A
*SRE	Integer	N/A	0	255
*SRE?	N/A	Integer	0	255
*STB?	N/A	Integer	0	255
*TST?	N/A	Integer	0	1
*WAI	N/A	N/A	N/A	N/A

SCPI Command Tree

All commands other than the IEEE 488.2 common commands are listed in the following table.

Command Status	Parameters	Response	Minimum	Maximum
:STATus				
:OPERation				
[:EVENT]?		Integer		
:CONDition?		Integer		
:ENABle	Integer		0	32,768
:ENABle?		Integer		
:NTRansition	Integer		0	32,768
NTRansition?		Integer		
:PTRansition	Integer		0	32,768
PTRansition?		Integer		
:QUEStionable				
[:EVENT]?		Integer		
:CONDition?		Integer		
:ENABle	Integer		0	32,768
:ENABle?		Integer		
:NTRansition	Integer		0	32,768
NTRansition?		Integer		
:PTRansition	Integer		0	32,768
PTRansition?		Integer		
:PRESet				
:SYSTem				
:ERRor?		Integer , String		
:VERSion?		String		

:[ROUTE]				
:MODule	Integer			
:MODule?		Integer		
:CLOSe[m]	Integer MIN MAX			
:CLOSe[m]?	MIN MAX	Integer		

Description of Individual Commands

IEEE-488.2 Common Commands

Clear Status Command

Syntax	*CLS
Function	<p>Clears the following queues and registers:</p> <ul style="list-style-type: none"> • Error queue • Standard event status register • Status byte register • Operation event register • Questionable event register <p>If *CLS is sent immediately after a message terminating sequence, both the output queue and the MAV bit in the status byte register are cleared.</p>
Example	*CLS

Standard Event Status Enable Register Command

Syntax	*ESE<space><numeric value> where $0 \leq \text{<numeric value>} \leq 255$
Function	Sets the bits in the standard event status enable register. The numeric value is converted to a binary number. The bits of the register are set to match the bit values of the binary number.
Example	*ESE 97 sets the standard event status enable register bits to 01100001.

Standard Event Status Enable Register Query

Syntax	*ESE?
Function	Returns the contents of the standard event status enable register as an integer that, when converted to a binary number, represents the bit values of the register.
Example	*ESE? returns 97 if the standard event status enable register is set to 01100001.

Standard Event Status Register Query

Syntax	*ESR?
Function	Returns the contents of the standard event status register as an integer that, when converted to a binary number, represents the bit values of the register. The standard event status register is cleared after *ESR? command.
Example	*ESR? returns 195 if the standard event status register is set to 11000011.

Identification Query

Syntax	*IDN?
Function	The *IDN query returns a string value which identifies the manufacturer, instrument type and firmware version.
Example	*IDN? Returns "JGR Optics Inc., SX8, XXXXX, YYY" Where: <XXXXX> = device serial number <YYY> = firmware revision number

Operation Complete Command

Syntax	*OPC
Function	Causes the switch to set the OPC bit in the standard event status register when all pending operations have been completed.

Example	*OPC
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Operation Complete Query

Syntax	*OPC?
Function	Places a “1” in the output queue of the switch when all pending operations have been completed. Because the “1” is not always placed in the output queue immediately, the status byte register should be polled and the MAV bit checked to determine if there is a message available in the output queue.
Example	*OPC?

Reset Command

Syntax	*RST
Function	Switch position is set to the first configured channel. Relay driver pattern is set to 0.
Example	*RST

Service Request Enable Command

Syntax	*SRE<space><numeric value> where $0 \leq \text{<numeric value>} \leq 63$ and $128 \leq \text{<numeric value>} \leq 191$
Function	Sets the bits in the service request enable register. The numeric value is converted to a binary number. The bits of the register are set to match the bit values of the binary number.
Example	*SRE 154 sets the service request enable register bits to 10011010.

Service Request Enable Query

Syntax	*SRE?
Function	Returns the contents of the service request enable register as an integer that, when converted to a binary number, represents the bit values of the register.

Example	*SRE? returns 154 if the service request enable register is set to 10011010.
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Read Status Byte Query

Syntax	*STB?
Function	Returns the contents of the status byte register as an integer that, when converted to a binary number, represents the bit values of the register. The bit value for bit 6 of the register is the MSS bit value, not the RQS bit value.
Example	*STB? returns 170 if the status byte register is set to 10101010.

Self-Test Query

Syntax	*TST?
Function	Initiates a self-test of the switch and returns 0 if the switch passes the self-test or 1 if it fails.
Example	*TST?

*WAI Command

Syntax	*WAI
Function	Prevents the switch from executing any further commands or queries until all previously pending operations have been completed. There are no consequences to this command because all commands are executed sequentially; therefore, any subsequent commands are completed by the time this command is parsed.
Example	*WAI

Status Commands

:STATus:OPERation:CONDition?

Syntax	:STATus:OPERation:CONDition?
Function	Returns the contents of the operation condition register as an integer that, when converted to a binary number, represents the bit values of the register. The switch only uses bit 1 of the operation condition register. Bit 1, the Settle bit, is set when the switch is in the process of switching.
Example	:STAT:OPER:COND?

:STATus:OPERation:ENABle

Syntax	STATus:OPERation:ENABle<space><NRf>
Function	Sets the bits in the operation enable register. The NRf value is converted to a binary number. The bits of the register are set to match the bit values of the binary number.
Example	:STATUS:OPERATION:ENABLE 33 sets bit 0 and bit 5 of the operation enable register to 1.

:STATus:OPERation:ENABle?

Syntax	:STATus:OPERation:ENABle?
Function	Returns the contents of the operation event enable register as an integer that, when converted to a binary number, represents the bit values of the register.
Example	:STAT:OPER:ENAB 23;ENAB? returns 23.

:STATus:OPERation[:EVENT]?

Syntax	:STATus:OPERation[:EVENT]?
Function	Returns the contents of the operation event register as an integer that, when converted to a binary number, represents the bit values of the register.
Example	:STAT:OPER:EVENT?

:STATus:OPERation:NTRansition

Syntax	:STATus:OPERation:NTRansition<space><NRf>
Function	Sets the bits of the operation negative transition register. The NRf value is converted to a binary number. The bits of the register are set to match the bits of the binary number.
Example	:STAT:OPER:NTR 256 sets the bits of the operation negative transition register to 0000000011111111.

:STATus:OPERation:NTRansition?

Syntax	:STATus:OPERation:NTRansition?
Function	Returns the contents of the operation negative transition register as an integer that, when converted to a binary number, represents the bit values of the register.
Example	STAT:OPER:NTR 12;NTR? returns 12.

:STATus:OPERation:PTRansition

Syntax	:STATus:OPERation:PTRansition<space><NRf>
Function	Sets the bits of the operation positive transition register. The NRf value is converted to a binary number. The bits of the register are set to match the bits of the binary number.
Example	STAT:OPER:PTR 255 sets the bits of the operation positive transition register to 0000000011111110.

:STATus:OPERation:PTRansition?

Syntax	:STATus:OPERation:PTRansition?
Function	Returns the contents of the operation positive transition register as an integer that, when converted to a binary number, represents the bit values of the register.
Example	STAT:OPER:PTR 12;PTR? returns 12.

:STATus:QUEStionable:CONDition?

Syntax	:STATus:QUEStionable:CONDition?
Function	Returns the contents of the questionable condition register as an integer that, when converted to a binary number, represents the bit values of the register. The switch only uses bit 1 of the register. Bit 1, the Settle bit, is set when the switching mechanism is in the process of switching.
Example	:STAT:QUES:COND?

:STATus:QUESTionable:ENABLE

Syntax	:STATus:QUESTionable:ENABLE<space><NRf>
Function	Sets the bits in the questionable enable register. The NRf value is converted to a binary number. The bits of the register are set to match the bit values of the binary number.
Example	:STATUS:QUESTIONABLE:ENABLE 33 sets bit 0 and bit 5 of the questionable enable register to 1.

:STATus:QUESTionable:ENABLE?

Syntax	:STATus:QUESTionable:ENABLE?
Function	Returns the contents of the questionable event enable register as an integer that, when converted to a binary number, represents the bit values of the register.
Example	:STAT:QUES:ENAB 23;ENAB? returns 23.

:STATus:QUESTionable[:EVENT]?

Syntax	:STATus:QUESTionable[:EVENT]?
Function	Returns the contents of the questionable event register as an integer that, when converted to a binary number, represents the bit values of the register.
Example	:STAT:QUES:EVENT?

:STATus:QUESTionable:NTRansition

Syntax	:STATus:QUESTionable:NTRansition<space><NRf>
Function	Sets the bits of the questionable negative transition register. The NRf value is converted to a binary number. The bits of the register are set to match the bits of the binary number.
Example	:STAT:QUES:NTR 256 sets the bits of the questionable negative transition register to 0000000011111111.

:STATus:QUEStionable:NTRansition?

Syntax	:STATus:QUEStionable:NTRansition?
Function	Returns the contents of the questionable negative transition register as an integer that, when converted to a binary number, represents the bit values of the register.
Example	:STAT:QUES:NTR 12;NTR? returns 12.

:STATus:QUEStionable:PTRansition

Syntax	:STATus:QUEStionable:PTRansition<space><Nrf>
Function	Sets the bits of the questionable positive transition register. The Nrf value is converted to a binary number. The bits of the questionable positive transition register are set to match the bits of the binary number.
Example	:STAT:QUES:PTR 255 sets the bits of the questionable positive transition register to 0000000011111110.

:STATus:QUEStionable:PTRansition?

Syntax	:STATus:QUEStionable:PTRansition?
Function	Returns the contents of the questionable positive transition register as an integer that, when converted to a binary number, represents the bit values of the register.
Example	:STAT:QUES:PTR 12;PTR? returns 12.

:STATus:PRESet

Syntax	:STATus:PRESet
Function	Presets all the enable and transition registers in the questionable and operation structures to the following settings.

	<ul style="list-style-type: none"> All bits in the ENABLE registers are set to 1 except the most significant bit (MSB). All bits in the positive transition registers are set to 1 except the MSB. All bits in the negative transition registers are set to 0.
Example	:STAT:PRES

:SYSTem:ERRor?

Syntax	:SYSTem:ERRor?
Function	Returns the error number and an error message from the error queue. See the Error Queue section, for a list of error numbers and their associated messages.
Example	: SYST:ERR? returns: 0, "No error".

:SYSTem:VERSion?

Syntax	:SYSTem:VERSion?
Function	Returns the formatted numeric value the of the SCPI version number.
Example	: SYST:VERS? returns: 1999.0.

:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess

Syntax	:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess<space><numeric_value>
Function	Sets the GPIB address. The factory-set GPIB address is 21. When the address is changed, the interface immediately responds to the new address.
Example	: SYST:COMM:GPIB:ADDR 7

:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess?

Syntax	:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess?
Function	Returns the GPIB address.



Example	:SYST:COMM:GPIB:ADDR? returns 7.
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User Commands

[ROUte]:MODule

Syntax	:[ROUte]:MODule<space>[module_number]
Function	Switches the SX8 to the specified module. If the parameter was not provided, the SX8 switches to the next module.
Example	MOD 8 sets the current module to 8.

[ROUte]:MODule?

Syntax	:[ROUte]:MODule?
Function	Returns the current module number.
Example	MOD? returns 8.

[ROUte]:CLOSe[m]

Syntax	:[ROUte]:CLOSe[m]<space>[channel_number MAX MIN]
Function	Switches to a specified channel on module 'm' ('m' becomes the new current module number). If the suffix 'm' is omitted, switches to a specified channel on the current module. The following parameters are accepted by the command: <ul style="list-style-type: none"> • no parameter: switches to the next channel • channel_number: switches to the specified by the parameter channel number • MAX: switches to the maximum configured channel number • MIN: switches to the first configured channel number
Example	CLOSE 10 switches current module to channel 10. CLOS switches to channel 11 (from channel 10). ROUT:CLOSe2 5 switches to channel 5 on module 2. CLOSE2 MAX switches to the maximum configured channel on module 2.

[ROUTe]:CLOSE[m]?

Syntax	: [ROUTe]:CLOSE[m]?<space>[MAX MIN]
Function	<p>Returns the current channel number on module 'm' ('m' becomes the new current module number). If m is omitted, returns the current channel number on the current module. The following parameters are accepted by the command:</p> <ul style="list-style-type: none"> • no parameter: returns the current channel number • MAX: returns the maximum configured channel number • MIN: returns the first channel number
Example	<p>CLOSE? returns 10.</p> <p>CLOSE2? returns 5. (on module 2).</p> <p>:ROUT:CLOSE2? MAX returns the maximum configured channels on module 2.</p>

LCL

Syntax	:LCL
Function	Returns the control status to local front panel control. This function is identical to pressing the "LOCAL" key on the front panel when the instrument is in the remote control mode.
Example	LCL