



# **SX8 Optical Switch**

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## **User Manual**

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# 1

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## GENERAL INFORMATION

This user's manual for the SX8 Series Optical Switch contains complete operating instructions. The SX8 Series Optical Switch can be ordered as a single-mode or multimode model. The inspection report and a description of any customer-requested information can be found in the Test Report document envelope.

The SX8 Series Optical Switches offer low insertion loss, and very high stability and repeatability needed to meet the stringent test, measurement, and manufacturing system requirements.

In addition to manual front panel operation, the SX8 switch may be operated over the RS-232 serial interface and IEEE 488 GPIB parallel interface. Please refer to the PROGRAMMING GUIDE section on page 15 for more information.

### **Key Features**

- Low IL (0.7 dB)
- Up to 360 outputs
- Up to 4 inputs
- Many configuration possibilities
- User friendly
- 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's manual
- Test Report

## Specifications

The following optical specifications describe the warranted characteristics of the unit. Supplementary specifications describe the typical non-warranted performance of the unit.

**Table 1: Optical/Electrical Specifications**

<i>Parameter</i>	<i>Specification</i>	
	Single-Mode	Multimode
Wavelength Range	1250 - 1670 nm	840 - 1350 nm
Fiber Type	9/125 $\mu\text{m}$	50/125 or 62.5/125 $\mu\text{m}$
Insertion Loss*	0.7 dB	
Backreflection	$\leq -60$ dB	$\leq -40$ dB
PDL	0.05 dB	-
Stability	$\pm 0.03$ dB	
Repeatability	0.005 dB	
Crosstalk (maximum)	-80 dB	
Maximum Input Power	300 mW	
Switching Time		
one channel	300 ms	
each additional channel	+12 ms	
Input Voltage	100 - 240 V AC, 50 - 60 Hz	
Power Consumption	150 VA maximum	
Control	Front Panel/GPIB/RS232	

\* excluding connectors

**Table 2: Other Specifications**

<i>Parameter</i>	<i>Specification</i>
Dimensions W x H x D (3U/6U)	48 x 13.5 x 37.5/48 x 27 x 37.5 cm
Weight	15 kg (depending on configuration)
Operating Temperature	0 to 55 °C
Storage Temperature	-40 to 70 °C
Humidity (Non-condensing)	Maximum 95% RH from 0 to 40 °C

## 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/cfcfr/CFRSe arch.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 is in 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 is 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.”

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## GETTING STARTED



### Caution

To avoid the risk of injury or death, always observe the precautions listed in the SAFETY on page 41.

This user's manual contains complete operating instructions for the safe and effective operation of the SX8 Optical Switch. It is recommended that users of the SX8 familiarize themselves with contents of this manual.

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:
  - SX8 Series Optical Switch
  - 1 AC power cord
  - User's manual
  - Test report
- ☒ Read the user's 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 the power source using the power cord provided.
  - Set the power switch to ON to initialize the SX8 switch, and observe the power-up sequence. The version number of the



firmware is displayed. The message “Initializing” is displayed momentarily.

- Set the power switch to OFF and disconnect the switch.

- ☒ Keep the packaging.
- ☒ Immediately inform JGR Optics and, if necessary, the carrier if the contents of the shipment are 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 3: Environmental Requirements**

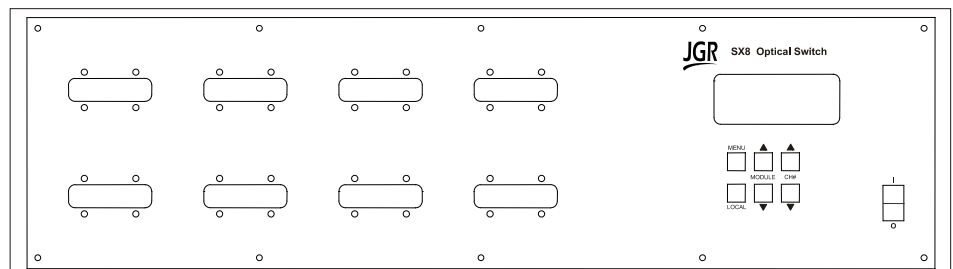
<i>Parameter</i>	<i>Specification</i>
Altitude	Up to 2000 m
Temperature	Range of 0 to 40 °C
Humidity	Up to 95% humidity (0 to 40 °C)
c	Main supply voltage fluctuations must not exceed $\pm 10\%$ of the nominal voltage

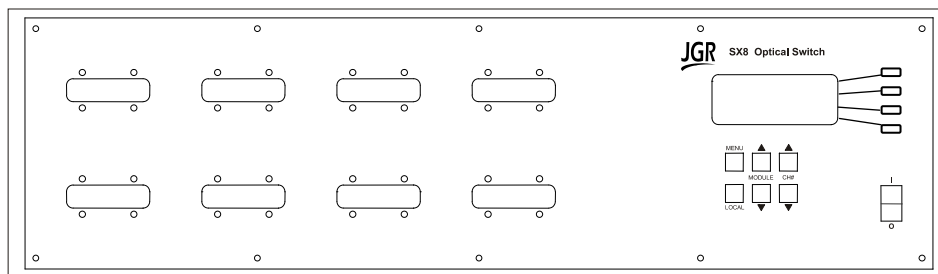
## Product Overview

### Front Panel and Key Description

The switch front panel will vary with model ordered. Two front panel key pad configurations are shown in Figure 1 and Figure 2. They are described in Table 4.

**Figure 1: Front of the Switch (Models without SOFT KEYS)**



**Figure 2: Front of the Switch (Models with SOFT KEYS)**

**Table 4: Operating Keys and Status LEDs**

<i>Key/LED</i>	<i>Description</i>
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 meter 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.
CHANNEL ▲ ▼	Selects the output channel and adjusts the values in MENU mode.
SOFT KEYS	When present, used to select the menu options.

## Rear Panel

The rear-panel features are described in Table 5.

**Table 5: 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 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 6 and Table 7
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 6: User Menu Options (Models without SOFT KEYS)**

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

**Table 7: User Menu Options (Models with SOFT KEYS)**

<b>Options</b>	<b>Note</b>
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 PATTERN*	
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/symbols displayed by the SX8 Optical Switch are shown in Table 8.

**Table 8: SX8 Meter Display Messages and Symbols**

<b><i>Display</i></b>	<b><i>Description</i></b>
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 or GPIB communication***

The SX8 Series Optical switch 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 switch, 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 section “User Menu Operation” on page 11 for further details.

### **JDSU Optical Switch 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 SX8 supports the IEEE-488.1(1987) interface standard. It also supports the mandated common commands of IEEE-488.2(1987) standard. Before attempting to communicate with the SX8 over 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.

**Table 9: Serial Communication Settings**

Baud Rate	Selectable in the "User Menu". Available options are 1200, 2400, 4800, 9600, 19200, 38400 and 57600 bps
Data bit	8
Parity	N
Stop bits	1
Flow Control	None

To connect the SX8 to the computer, a standard 9 pins straight RS-232 cable is required. Only three pins, Txd, Rxd and GND are needed.

## ***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 switch 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?
(OPER command at different level than ENAB)
```

### 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 <b>*STB?</b>					
Written to with		Cannot be written to					
Cleared by		<b>*CLS</b> 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	<b>*SRE?</b> common query (the value of bit 6 is always 0)
Written to with	<b>*SRE</b> common command (the value of bit 6 is always zero, regardless of the value sent with the command)
Cleared by	<b>*SRE</b> 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		<b>*ESR?</b> common query					
Written to with		Cannot be written to					
Cleared by		<b>*ESR?</b> common query <b>*CLS</b> common command Power-on					

- 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	<b>*ESE?</b> common query
Written to with	<b>*ESE</b> common command
Cleared by	Power-on <b>*ESE</b> common command with a parameter 0

### 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	<b>STATus:OPERation:CONDition?</b> query
Written to with	Cannot be written to
Cleared by	Power-on

Questionable Condition Register	
Read with	<b>STATus:QUESTionable:CONDition?</b> 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	<b>STATUS:OPERation:EVENT?</b> query
Written to with	Cannot be written to
Cleared by	<b>*CLS</b> common command

Questionable Event Register	
Read with	<b>STATUS:QUESTionable:EVENT?</b> query
Written to with	Cannot be written to
Cleared by	Power-on <b>*CLS</b> 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	<b>STATUS:OPERation:ENABLE?</b> query
Written to with	<b>STATUS:OPERation:ENABLE</b> command
Cleared by	Power-on

Questionable Event Enable Register	
Read with	<b>STATUS:QUESTionable:ENABLE?</b> query
Written to with	<b>STATUS:QUESTionable:ENABLE</b> 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	<b>STATUS:OPERation:PTRansition?</b> query
Written to with	<b>STATUS:OPERation:PTRansition</b> command
Cleared by	Power-on

Condition Positive Transition Register	
Read with	<b>STATUS:QUESTionable:PTRansition?</b> query
Written to with	<b>STATUS:QUESTionable:PTRansition</b> 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	<b>STATUS:OPERation:NTRansition?</b> query
Written to with	<b>STATUS:OPERation:NTRansition</b> command
Cleared by	Power-on

Questionable Negative Transition Register	
Read with	<b>STATUS:QUESTionable:NTRansition?</b> query
Written to with	<b>STATUS:QUESTionable:NTRansition</b> 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
---	----------

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

### Common Commands

#### Clear Status Command

Syntax	<b>*CLS</b>
Function	<p>Clears the following queues and registers:</p> <ul style="list-style-type: none"> <li>• Error queue</li> <li>• Standard event status register</li> <li>• Status byte register</li> <li>• Operation event register</li> <li>• Questionable event register</li> </ul> <p>If <b>*CLS</b> 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	<b>*CLS</b>

#### Standard Event Status Enable Register Command

Syntax	<b>*ESE&lt;space&gt;&lt;numeric value&gt;</b> 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	<b>*ESE 97</b> sets the standard event status enable register bits to 01100001.

#### Standard Event Status Enable Register Query

Syntax	<b>*ESE?</b>
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	<b>*ESE?</b> returns 97 if the standard event status enable register is set to 01100001.

### Standard Event Status Register Query

Syntax	<b>*ESR?</b>
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 <b>*ESR?</b> command.
Example	<b>*ESR?</b> returns 195 if the standard event status register is set to 11000011.

### Identification Query

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

### Operation Complete Command

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

### Operation Complete Query

Syntax	<b>*OPC?</b>
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	<b>*OPC?</b>

#### Reset Command

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

#### Service Request Enable Command

Syntax	<b>*SRE</b> <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	<b>*SRE 154</b> sets the service request enable register bits to 10011010.

#### Service Request Enable Query

Syntax	<b>*SRE?</b>
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	<b>*SRE?</b> returns 154 if the service request enable register is set to 10011010.

#### Read Status Byte Query

Syntax	<b>*STB?</b>
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	<b>*STB?</b> returns 170 if the status byte register is set to 10101010.

### Self-Test Query

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

### \*WAI Command

Syntax	<b>*WAI</b>
Function	<p>Prevents the switch from executing any further commands or queries until all previously pending operations have been completed.</p> <p>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.</p>
Example	<b>*WAI</b>

## Status Commands

:STATus:OPERation:CONDition?

Syntax	<b>:STATus:OPERation:CONDition?</b>
Function	<p>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.</p> <p>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.</p>
Example	<b>:STAT:OPER:COND?</b>

:STATus:OPERation:ENABle

Syntax	<b>:STATus:OPERation:ENABle</b> <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	<b>:STATUS:OPERATION:ENABLE 33</b> sets bit 0 and bit 5 of the operation enable register to 1.

:STATus:OPERation:ENABle?

Syntax	<b>:STATus:OPERation:ENABle?</b>
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	<b>:STAT:OPER:ENAB 23;ENAB?</b> returns 23.

:STATus:OPERation[:EVENT]?

Syntax	<b>:STATus:OPERation[:EVENT]?</b>
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	<b>:STAT:OPER:EVENT?</b>

:STATus:OPERation:NTRansition

Syntax	<b>:STATus:OPERation:NTRansition</b> <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	<b>:STAT:OPER:NTR 256</b> sets the bits of the operation negative transition register to 0000000011111111.



:STATus:OPERation:NTRansition?

Syntax	<b>:STATus:OPERation:NTRansition?</b>
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	<b>STAT:OPER:NTR 12;NTR?</b> returns 12.

:STATus:OPERation:PTRansition

Syntax	<b>:STATus:OPERation:PTRansition</b> <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	<b>STAT:OPER:PTR 255</b> sets the bits of the operation positive transition register to 0000000011111110.

:STATus:OPERation:PTRansition?

Syntax	<b>:STATus:OPERation:PTRansition?</b>
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	<b>STAT:OPER:PTR 12;PTR?</b> returns 12.

:STATus:QUEStionable:CONDition?

Syntax	<b>:STATus:QUEStionable:CONDition?</b>
Function	<p>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.</p> <p>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.</p>
Example	<b>:STAT:QUES:COND?</b>

:STATus:QUESTionable:ENABle

Syntax	<b>:STATus:QUESTionable:ENABle</b> <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	<b>:STATUS:QUESTIONABLE:ENABLE 33</b> sets bit 0 and bit 5 of the questionable enable register to 1.

:STATus:QUESTionable:ENABle?

Syntax	<b>:STATus:QUESTionable:ENABle?</b>
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	<b>:STAT:QUES:ENAB 23;ENAB?</b> returns 23.

:STATus:QUESTionable[:EVENT]?

Syntax	<b>:STATus:QUESTionable[:EVENT]?</b>
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	<b>:STAT:QUES:EVENT?</b>

:STATus:QUESTionable:NTRansition

Syntax	<b>:STATus:QUESTionable:NTRansition</b> <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	<b>:STAT:QUES:NTR 256</b> sets the bits of the questionable negative transition register to 0000000011111111.

:STATus:QUESTionable:NTRansition?

Syntax	<b>:STATus:QUESTionable:NTRansition?</b>
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	<b>:STAT:QUES:NTR 12;NTR?</b> returns 12.

:STATus:QUESTionable:PTRansition

Syntax	<b>:STATus:QUESTionable:PTRansition</b> <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	<b>:STAT:QUES:PTR 255</b> sets the bits of the questionable positive transition register to 000000001111110.

:STATus:QUESTionable:PTRansition?

Syntax	<b>:STATus:QUESTionable:PTRansition?</b>
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	<b>:STAT:QUES:PTR 12;PTR?</b> returns 12.

:STATus:PRESet

Syntax	<b>:STATus:PRESet</b>
Function	<p>Presets all the enable and transition registers in the questionable and operation structures to the following settings.</p> <ul style="list-style-type: none"> <li>• All bits in the ENABLE registers are set to 1 except the most significant bit (MSB).</li> <li>• All bits in the positive transition registers are set to 1 except the MSB.</li> <li>• All bits in the negative transition registers are set to 0.</li> </ul>
Example	<b>:STAT:PRES</b>

**:SYSTem:ERRor?**

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

**:SYSTem:VERSion?**

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

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

Syntax	<b>:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess</b> <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	<b>:SYST:COMM:GPIB:ADDR 7</b>

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

Syntax	<b>:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess?</b>
Function	Returns the GPIB address.
Example	<b>:SYST:COMM:GPIB:ADDR?</b> returns 7.

## User Commands

[ROUTe]:MODule

Syntax	<b>: [ROUTe]:MODule&lt;space&gt;[module_number]</b>
Function	Switches the SX8 to the specified module. If the parameter was not provided, the SX8 switches to the next module.
Example	<b>MOD 8</b> sets the current module to 8.

[ROUTe]:MODule?

Syntax	<b>: [ROUTe]:MODule?</b>
Function	Returns the current module number.
Example	<b>MOD?</b> returns 8.

[ROUTe]:CLOSe[m]

Syntax	<b>: [ROUTe]:CLOSe[m]&lt;space&gt;[channel_number   MAX   MIN]</b>
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"> <li><b>no parameter:</b> switches to the next channel</li> <li><b>channel_number:</b> switches to the specified by the parameter channel number</li> <li><b>MAX:</b> switches to the maximum configured channel number</li> <li><b>MIN:</b> switches to the first configured channel number</li> </ul>
Example	<p><b>CLOSE 10</b> switches current module to channel 10.</p> <p><b>CLOS</b> switches to channel 11 (from channel 10).</p> <p><b>ROUT:CLOSe2 5</b> switches to channel 5 on module 2.</p> <p><b>CLOSE2 MAX</b> switches to the maximum configured channel on module 2.</p>

[ROUTe]:CLOSe[m]?

Syntax	<b>: [ROUTe]:CLOSe[m]?&lt;space&gt;[MAX MIN]</b>
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"> <li>• <b>no parameter:</b> returns the current channel number</li> <li>• <b>MAX:</b> returns the maximum configured channel number</li> <li>• <b>MIN:</b> returns the first channel number</li> </ul>
Example	<p><b>CLOSE?</b> returns 10.</p> <p><b>CLOSE2?</b> returns 5. (on module 2).</p> <p><b>:ROUT:CLOSe2? MAX</b> returns the maximum configured channels on module 2.</p>

LCL

Syntax	<b>:LCL</b>
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	<b>LCL</b>

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## MAINTENANCE AND TROUBLESHOOTING

### Maintenance

**Warning**

Devices with malfunctioning lasers must be returned to the manufacturer for repair.

### 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 in until it is completely dry.

### Cleaning the Connector Ends (for Bulkhead Versions only)

1. Clean all connector ends with a lint-free tissue and alcohol before every mating. See the Cleaning Connectors section.
2. Loosen the retaining screws of the connector panel, and remove the panel carefully to access the internal connectors.
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.
5. Reinstall the connectors 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 replacing the panel.

### Cleaning Connectors

**Warning**

Connecting damaged or dirty fibers to the unit can damage the connectors on the unit.

Never force an optical connector. Some connectors have a ceramic ferrule that can easily be broken.

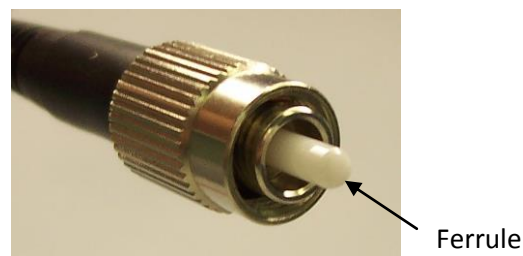
Optical cable ends need to be cleaned before using them with the unit. The following items are required for cleaning the connector:

- Filtered compressed air or dusting gas
- Lint-free swab
- 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 (do not use rubbing alcohol) to a small area of a lint-free towel and rub the end of the ferrule over the wet area.
3. Apply optical grade isopropyl alcohol or optical grade ethanol (do not use rubbing alcohol) to a small area of a lint-free towel and rub the end of the ferrule over the wet area.
4. Wipe the ferrule on a dry area of the lint-free towel.
5. Using the dusting gas or compressed air, blow the end of the ferrule.
6. Apply the alcohol or ethanol to a lint-free pipe cleaner or swab and wipe off the remaining parts of the connector.
7. With the other end of the pipe cleaner or swab, dry the areas cleaned.
8. Using the dusting gas or compressed air, blow the areas cleaned.

**Figure 3: Connector (Connector Type May Vary)**





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## SAFETY



To avoid the risk of injury 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's manual is in direct violation of the standards of design, manufacture, 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 10). Observe all safety instructions that are associated with a symbol.

**Table 10: Safety Symbols**


<b><i>Symbol</i></b>	<b><i>Description</i></b>
	Frame or chassis terminal for electrical grounding within the unit.
	Protective conductor terminal for electrical grounding to the earth.
WARNING	The 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.
CAUTION	The 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.

## Classification

The SX8 Optical Switch consists 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><b>Warning</b></p> <ul style="list-style-type: none"> <li>• Use only the type of power cord supplied with the unit.</li> <li>• 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.</li> <li>• If using a voltage-reducing autotransformer to power the unit, ensure that the common terminal connects to the earthed pole of the power source.</li> <li>• Do not interrupt the protective earth grounding. Any 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.</li> <li>• 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.</li> <li>• Do not operate the unit when its covers or panels have been removed.</li> </ul>
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### Fuse Replacement


The SX8 Series Optical Switch is protected with a fuse which is located at the back of the unit near the power inlet. The fuse type used by the unit is (5 x 20) mm, 1 A/250 V (slow). To avoid electrical fire or damaging the unit, only replace the fuse with a fuse of the same size and rating.

There are no user-serviceable parts inside. Opening the unit by personnel other than a qualified technician may damage the switch, 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 the unit is not connected to the line power, 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><b>Warning</b></p> <ul style="list-style-type: none"> <li>• To prevent potential fire or shock hazard, do not expose the unit to any source of excessive moisture.</li> <li>• Do not use the unit outdoors.</li> <li>• Operating the unit in the presence of flammable gases or fumes is extremely hazardous.</li> </ul>
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## Laser Hazards

	<p><b>Warning</b></p> <ul style="list-style-type: none"> <li>• 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.</li> </ul>
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## Other Hazards

	<p><b>Warning</b></p> <ul style="list-style-type: none"> <li>• 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 qualified technician. In addition to voiding the warranty, opening the unit (even when unplugged) can expose the user to potential shock hazards.</li> <li>• Some of the unit's capacitors can be charged even when the unit is not connected to the power source.</li> <li>• Do not perform any operating or maintenance procedure that is not described in the user's manual.</li> </ul>
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## STORING AND SHIPPING

To maintain optimum operating reliability, do not store the unit in locations where the temperature falls below -40 °C or rises above 70 °C. Avoid any environmental condition that can result in internal condensation. Ensure that these temperature and humidity requirements can also be met whenever the unit is shipped.

### ***Returning Shipments to JGR Optics***

Ship the return material in the original shipping container and packing material. If these are not available, packaging guidelines are as follows:

1. Cover the front panel with foam to prevent damage.
2. Wrap the unit in anti-static packaging. Use anti-static connector covers.
3. Pack the unit in a reliable shipping container.
4. Use enough shock-absorbing material (10 to 15 cm) to cushion the unit and prevent it from moving inside the container. Pink poly anti-static foam is the best material.
5. Seal the shipping container securely.
6. Clearly mark FRAGILE on its surface.
7. Always provide the model and serial number of the unit and, if necessary, the RMA number on any accompanying documentation.
8. In order to ship the unit, please contact JGR Optics.

### ***Contact Information***

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