SG SERIES
FIBEROPTIC MATRIX SWITCH

User's Manual

JDS Uniphase

Contents

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13 GENERAL TERMS:

13.1 The validity, interpretation and performance of this Agreement shall be governed by and construed under the applicable laws of the State of New York and the United States of America, as if performed wholly within the state and without giving effect to the principles of conflict of laws. The parties specifically disclaim the application of the United Nations Convention on Contracts for the International Sale of Goods. JDSU and Customer hereby irrevocably and unconditionally submit to the courts of the State of New York and all courts competent to hear appeal therefrom.

13.2 JDSU shall not be liable for any delay or failure in performance whatsoever due to acts of God, earthquakes, shortage of supplies, transportation difficulties, labor disputes, riots, war, fire, explosion, epidemics, or other occurrences beyond JDSU's reasonable control or due to unforeseen circumstances.

13.3 Waiver by JDSU of any provision herein must be in writing and shall not be deemed to be a waiver of such provision in the future or of any other provision.

13.4 Customer shall hold confidential and shall not use, disclose or permit others to use any confidential information identified as such in writing or orally by JDSU or information which Customer knows or ought to reasonably know is confidential, proprietary or trade secret information of JDSU, including, without limitation, trade secrets embodied in Products.

13.5 Neither this Agreement nor any rights under this Agreement, other than monies due or to become due, shall be assigned or otherwise transferred by Customer (by operation of law or otherwise) without the prior written consent of JDSU. This Agreement shall bind and inure to the benefit of the successors and permitted assigns of the parties.

13.6 In the event that any of the terms of this Agreement, apart from payment, become or are declared to be illegal by any court of competent jurisdiction, such terms shall be null and void and shall be deemed deleted from this Agreement, but only to the extent that such term is illegal, it being the intent and agreement of the parties that the Agreement shall be deemed amended by modifying such term to the extent necessary to make it legal while preserving its intent or, if that is not possible, by substituting therefor another term that is legal and achieves the same objective. All remaining terms of this Agreement shall remain in full force and effect.

13.7 Neither party has the right or authority to, and shall not, assume or create any obligation of any nature whatsoever on behalf of the other party or bind the other party in any respect whatsoever.

13.8 JDSU neither assumes nor authorizes any third party, person or entity to assume or accept any liability or obligation, or to make any commitment for JDSU with regard to JDSU services or the Products.

13.9 This Agreement constitutes the entire agreement between the parties hereto concerning the subject matter of this Agreement, apart from existing non-disclosure agreements, and there are no understandings, agreements, representations, conditions, warranties, or other terms, express or implied, which are not specified herein. This Agreement may only be modified by a written document executed by authorized representatives of JDSU and Customer.

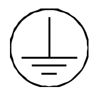
Safety Information, Instructions, and Symbols

Safety Information

Classification

The unit 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. Class 1 refers to equipment relying on ground protection as a means of shock protection.

The following symbol is used to indicate a protective conductor terminal in the unit.



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.

Line Power Requirements

The unit can operate from any single-phase AC power source that supplies between 100 and 240 V at a frequency range of 50 to 60 Hz. The maximum power consumption is 500 VA.

Fuse Type

The fuse type used by the 3U unit is (5x20) mm, FA2.0A / 250 V (fast). The fuse type used by the 7U and 14U units is (5x20) mm, T2.5A / 250 V (slow).

Safety Instructions

The following 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. JDS Uniphase assumes no liability for the customer's failure to comply with any of these safety requirements.

Before Initializing and Operating the Unit

☑ Inspect the unit for any signs of damage, and read the user's manual thoroughly.

☑ Install the unit as specified in the **Getting Started** section.

☑ Ensure that the unit and any devices or cords connected to it are properly grounded.

Operating the Unit

Warning

To avoid the risk of injury or death, always observe the following precautions before initializing the unit:

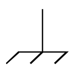
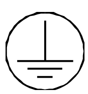
- If using a voltage-reducing autotransformer to power the unit, ensure that the common terminal connects to the earthed pole of the power source.
- Use only the type of power cord supplied with the unit.
- Connect the power cord only to a power outlet equipped with a protective earth contact. Never connect to an extension cord that is not equipped with this feature.
- Do not interrupt the protective earth grounding. Any such action can lead to a potential shock hazard that can result in serious personal injury. If an interruption to the protective grounding is suspected, ensure that the unit remains inoperative.
- 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. For more information, see the user's manual of the laser source in use.
- Turning off the power to the device does not always block the externally supplied radiation to the connector at the output of the unit.
- Do not use the unit outdoors.
- To prevent potential fire or shock hazard, do not expose the unit to any source of excessive moisture.
- Do not operate the unit when its covers or panels have been removed.
- Use only the type of fuse specified by the manufacturer as appropriate for this unit. Do not use repaired fuses, and avoid any situations that can short-circuit the fuse.

	• Unless absolutely necessary, do not attempt to adjust or perform any maintenance or repair procedure when the unit is opened and connected to a power source. • Repairs are to be carried out only by a qualified professional. • Do not attempt any adjustment, maintenance, or repair procedure to the unit's internal mechanism if immediate first aid is not accessible. • Disconnect the power cord from the unit before adding or removing any components. • Operating the unit in the presence of flammable gases or fumes is extremely hazardous. • Do not perform any operating or maintenance procedure that is not described in the user's manual. • Some of the unit's capacitors can be charged even when the unit is not connected to the power source.

Safety Symbols

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

Table 1: Safety Symbols

Symbol	Description
	Laser safety. See the user’s manual for instructions on handling and operating the unit safely.
	See the user’s manual for instructions on handling and operating the unit safely.
	Electrostatic discharge (ESD). See the user’s manual for instructions on handling and operating the unit safely.
	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.

Compliance

CE Compliance

The unit has been designed and tested to comply with directive 73/23/EEC and its subsequent amendments by the European Community (EC or CE). The directive relates to electrical equipment designed for use within certain voltage limits. It ensures that electrical equipment is constructed with good engineering practice in safety matters.

The unit has been designed and tested to comply with directive 89/336/EEC and its subsequent amendments. The directive relates to electromagnetic compatibility. It demands that electromagnetic disturbance does not exceed a prescribed level; that the equipment be immune to a prescribed level of ambient level of interference; that the equipment be protected against electrostatic discharges; and that the equipment be immune to all electrical shock wave disturbances. As of 1997, measures have been added to test for fire hazard, electric shock hazard, and also external exposure to other forms of energy.

The requirements specified by directive 89/336/EEC are as follows. CE compliance requires that the manufacturer or its authorized representative established within the Community affix the EC conformity mark to the apparatus or else to the packaging, instructions for use, or guarantee certificate. The EC conformity mark shall consist of the letters CE as specified and the figures of the year in which the mark was affixed. This mark should, where appropriate, be accompanied by the distinctive letters used by the notified body issuing the EC type-examination certificate. Where the apparatus is the subject of other Directives providing for the EC conformity mark, the affixing of the EC mark shall also indicate conformity with the relevant requirements of those other Directives.

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.”

General Information and Specifications

General Information

This user's manual for the SG Series Fiberoptic Matrix Switch contains complete operating instructions.

The SG switch is fully defined in its product requirement specification (document ENG-SP-0198). Where specifications quoted in this document differ from the requirement specification, the requirement specification takes precedence.

The SG switch is a compact, rack-mountable instrument, based on the proven opto-mechanical switching technology of JDS Uniphase. The M-ports to N-ports non-blocking configuration, is derived by connecting a bank of 1xM switches to a bank of 1xN switches (Figure 1). This configuration allows any M port to be connected to any N port. A port may not be connected to more than one other port at a time. A general schematic is shown in Figure 2.

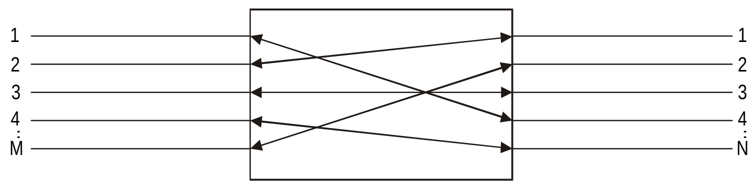


Figure 1: Block Diagram

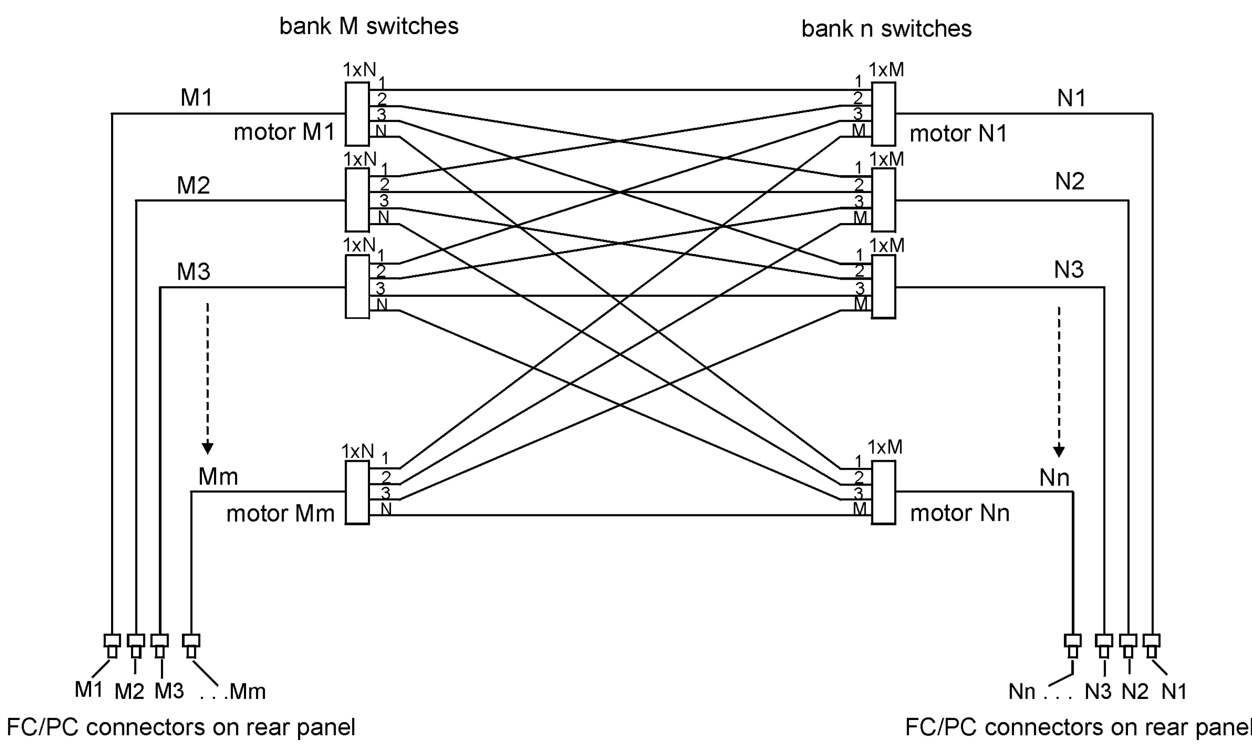


Figure 2: General Schematic of an SG MxN Switch

A control unit provides remote GPIB IEEE 488 and RS232C interfaces. The controller interprets CLOSE M to N port commands and sets the positions of the 1xM and 1xN switches accordingly. LabVIEW[1] drivers are supplied to facilitate remote control. For information on using the LabVIEW drivers, see the SG *LabVIEW Instrument Driver User's Manual* (document SD000335).

The SG switch is available in over 100 combinations of 4Mx4N switches (Figure 3). Matrix switches requiring 16 switches or less can be accommodated in a 3U unit. Requirements of 32 switches or less can be accommodated in a 7U 19 inch (48.26 cm) rack. Larger configurations of up to 64 switches are accommodated in a 14U 19 inch (48.26 cm) rack.

[1] LabVIEW is a registered trademark of National Instruments Corporation.

m Max = 48

N Max = 48

48x4	48x8	48x12	48x16								
44x4	44x8	44x12	44x16	44x20							
40x4	40x8	40x12	40x16	40x20	40x24						
36x4	36x8	36x12	36x16	36x20	36x24	36x28					
32x4	32x8	32x12	32x16	32x20	32x24	32x28	32x32				
28x4	28x8	28x12	28x16	28x20	28x24	28x28	28x32	28x36			
24x4	24x8	24x12	24x16	24x20	24x24	24x28	24x32	24x36	24x40		
20x4	20x8	20x12	20x16	20x20	20x24	20x28	20x32	20x36	20x40	20x44	
16x4	16x8	16x12	16x16	16x20	16x24	16x28	16x32	16x36	16x40	16x44	16x48
12x4	12x8	12x12	12x16	12x20	12x24	12x28	12x32	12x36	12x40	12x44	12x48
8x4	8x8	8x12	8x16	8x20	8x24	8x28	8x32	8x36	8x40	8x44	8x48
4x4	4x8	4x12	4x16	4x20	4x24	4x28	4x32	4x36	4x40	4x44	4x48
3U chassis			7U chassis				14U chassis				

Figure 3: Configurations

Non-standard configurations requiring other than 4M or 4N switches, configurations requiring more than 64 switches, and other customized features are available.

Key Features

- Non-blocking
- Low insertion loss
- Broad wavelength operation
- High reliability
- Local and remote control via IEEE 488 and RS232C interfaces

Applications

- Reconfiguration and restoration of broadband fiber telecommunication networks
- Data communications and multimedia networks
- Research and development

Standard Accessories

- AC power cord
- SG LabVIEW application software
- User's Manual

Optional Accessories

- Dual redundant hot swappable power supply
- Installation kit that includes a 19 inch (48.26 cm) rack slide set
- Rack extenders for a 24 inch (60.96 cm) rack

Specifications

The following optical specifications describe the warranted characteristics of the unit (Table 2). Supplementary specifications describe the typical non-warranted performance of the unit (Table 3).

Table 2: Optical Specifications

Parameter	Typical	Maximum
Insertion loss[1] single-mode multimode	 1.2 dB 1.2 dB	 1.8 dB 1.8 dB
Return loss[2] single-mode multimode	 60 dB 25 dB	 55 dB (minimum) 20 dB (minimum)
Polarization dependent loss single-mode	 0.03 dB	 0.07 dB
Insertion loss stability	±0.1 dB	±0.2 dB
Insertion loss change on power off	0.5 dB	1.0 dB
Repeatability[3]	±0.04 dB	±0.05 dB
Crosstalk	-90 dB	-80 dB
Optical input power	300 mW continuous	
Lifetime	at least 10 million cycles	

(table continued)

Parameter	Typical	Maximum
Switching time single-channel increment average connection (approximate)	 120 ms 225 ms	
Control	Local[4] or remote via IEEE 488.1, IEEE 488.2, and RS232C interfaces	

[1] Insertion loss does not include connectors. Additional 0.2 dB typical, 0.5 dB maximum per connector.
[2] Return loss specifications based on 1 m pigtail length.
[3] Optimum repeatability after one hour warm up.
[4] The local control feature is only available on the 3U model.

Table 3: Other Specifications

Electrical	
Input voltage	100 to 240 V AC, 50 to 60 Hz
Power consumption	500 VA maximum
Physical	
Dimensions (W x H x D)	48 x 13.5 x 42 cm 3U 48 x 31 x 61 cm 7U 19 in (48.26 cm) rackmount 48 x 62 x 61 cm 14U 19 in (48.26 cm) rackmount
Weight	12 kg for 3U switch 45 kg for 7U switch 75 kg for 14U switch
Environmental	
Operating temperature	5 to 40 °C
Storage temperature	-40 to 70 °C
Humidity	maximum 80% RH from 5 to 40 °C non-condensing
Altitude	2000 m maximum

Getting Started

The SG Series Fiberoptic Matrix Switch consists of the SG switch unit, the power cord, and SG LabVIEW software.

Before Initializing and Operating the Unit

☑ Inspect the unit for any signs of damage.

☑ 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.

Initial Inspection

	Warning To avoid electrical shock, do not initialize or operate the unit if it bears any sign of damage to any portion of its exterior surface, such as the outer cover or panels.

Check that the unit and contents are complete:

1. Wear an anti-static wrist strap and work in an electrostatic discharge (ESD) controlled area.

2. Inspect the shipping container for any indication of excessive shock to the contents, and inspect the contents to ensure that the shipment is complete.

3. Inspect the unit for structural damage that can have occurred during shipping.

4. Connect the unit to a power source, using the AC power cord provided.

5. Set the power switch on the rear panel to **I** (on). The power lamp on the front panel lights and the ventilation fan turns on.

6. Set the power switch to **O** (off), and disconnect the AC power cord from the AC power source and from the SG switch.

7. Keep the packaging.

Immediately inform JDS Uniphase 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.

Operating Environment

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

Temperature

The unit can be operated in the temperature range of 5 to 40 °C.

Humidity

The unit can be operated in environments with up to 80% humidity (5 to 40 °C). Do not expose it to any environmental conditions or changes to environmental conditions that can cause condensation to form inside the unit.

Ventilation

The unit contains a built-in cooling fan. Do not install it in any location where the ventilation is blocked. For optimum performance, the unit must be operated from a location that provides at least 75 mm (3 inches) of clearance at the rear and at least 25 mm (1 inch) of clearance at the bottom. Blocking the air circulation around the unit can cause the unit to overheat, compromising its reliability.

Warning

- Do not use the unit outdoors.
- To prevent potential fire or shock hazard, do not expose the unit to any source of excessive moisture.

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.

Claims and Repackaging

Immediately inform JDS Uniphase and, if necessary, the carrier, if

- The contents of the shipment are incomplete
- The unit or any of its components are damaged or defective
- The unit does not pass the initial inspection

In the event of carrier responsibility, JDS Uniphase will allow for the repair or replacement of the unit while a claim against the carrier is being processed.

Returning Shipments to JDS Uniphase

JDS Uniphase only accepts returns for which an approved Return Material Authorization (RMA) has been issued by JDS Uniphase sales personnel. This number must be obtained prior to shipping any material to JDS Uniphase. The owner's name and address, the model number and full serial number of the unit, the RMA number, and an itemized statement of claimed defects must be included with the return material.

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

1. Wear an anti-static wrist strap and work in an ESD controlled area.

2. Cover the front panel, if applicable, with a strip of cardboard.

3. Wrap the unit in anti-static packaging. Use anti-static connector covers, as applicable.

4. Pack the unit in a reliable shipping container.

5. Use enough shock-absorbing material (10 to 15 cm or 4 to 6 in on all sides) to cushion the unit and prevent it from moving inside the container. Pink poly anti-static foam is the best material.

6. Seal the shipping container securely.

7. Clearly mark FRAGILE on its surface.

8. Always provide the model and serial number of the unit and, if necessary, the RMA number on any accompanying documentation.

9. Please contact the RMA department, using the contact information at the beginning of this document, to provide an RMA number and a shipping address.

Cleaning Connectors

Caution

- 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:

- filtered compressed air or dusting gas
- lint-free pipe cleaners or 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 (Figure 4).

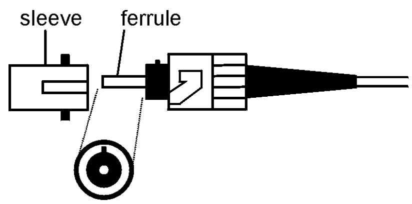


Figure 4: Connector Cleaning (connector type can vary)

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. 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.

Installing the Switch

To install the switch:

1. With the switch off and unplugged, mount it into a standard EIA 19 in (48.26 cm) rack frame. Keep the SG switch level while lifting and attaching it to the rack-mount. Do not block the ventilation holes at the back and at the top of the instrument. Do not pull on the fibers exiting through the rear panel strain relief. Excessive force can damage the optics.

2. Route the fiber cables to avoid creating bends with a radius of less than 1.5 cm, meaning do not lay cables across sharp corners. Do not tie bundles of cables together tightly.

3. Reattach the AC power cord, and reinitialize the switch by turning on the power switch.

Controlling the Switch Remotely – GPIB Operation

To set up the switch for remote control by GPIB operation:

1. Connect the SG switch GPIB (IEEE 488) port of the SG switch to a controlling computer.

2. At the GPIB controlling computer, set the message terminating character to line feed (<LF>), for example, ASCII character code 10.

3. Send a sample command to the SG switch; for example, use an OUTPUT statement (or equivalent) to send the command **CLOSE (@1!1)** to address 7, the factory-set address of the SG switch.

4. Send a sample query command, for example, **CLOSE:STATE?**, then use an INPUT statement to receive the message (@1!1) from GPIB address 7.

Front Panel

The front panel and keypad of the 3U SG switch is shown in the figure below.

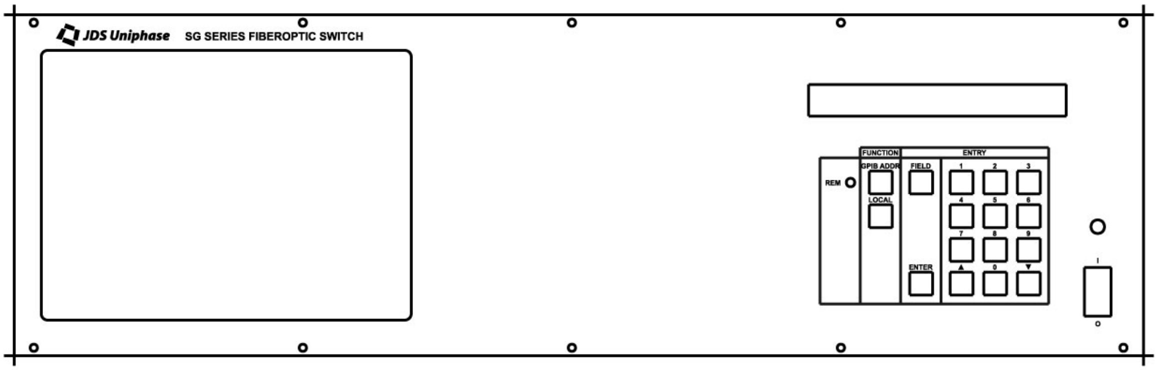


Figure 5: Front Panel of 3USG with keypad

Status LEDs and Operating Keys (3U model ONLY)

The descriptions of the keypad and LEDs are indicated in Table 4 and Table 5.

Table 4: Status LEDs

LED	INDICATION
I/O	Indicates the power ON/OFF status of the SG switch
REM	Indicates the SG switch is in Remote mode, controlled either through GPIB or RS232 interfaces. All front-panel keys except Local become non-functional

Table 5: Operating Keys

KEY	FUNCTION
GPIB ADDR	Sets the SG switch to GPIB address mode and allows change to the GPIB address
LOCAL	Returns the SG switch to Local mode from Remote mode and enables the key functions
FIELD	Sets the SG switch to Control mode. Subsequently selects numeric input fields of IN or OUT channel position
UP (▲)	Increases the IN Channel position or GPIB address
DOWN (▼)	Decreases the IN Channel position or GPIB address
Numeric (0 to 9)	Allows numeric selection
ENTER	Terminates an entry, for example, channel number or GPIB address

The front of the switch for the 14U model is shown in Figure 6. The panel height can differ depending on the configuration.

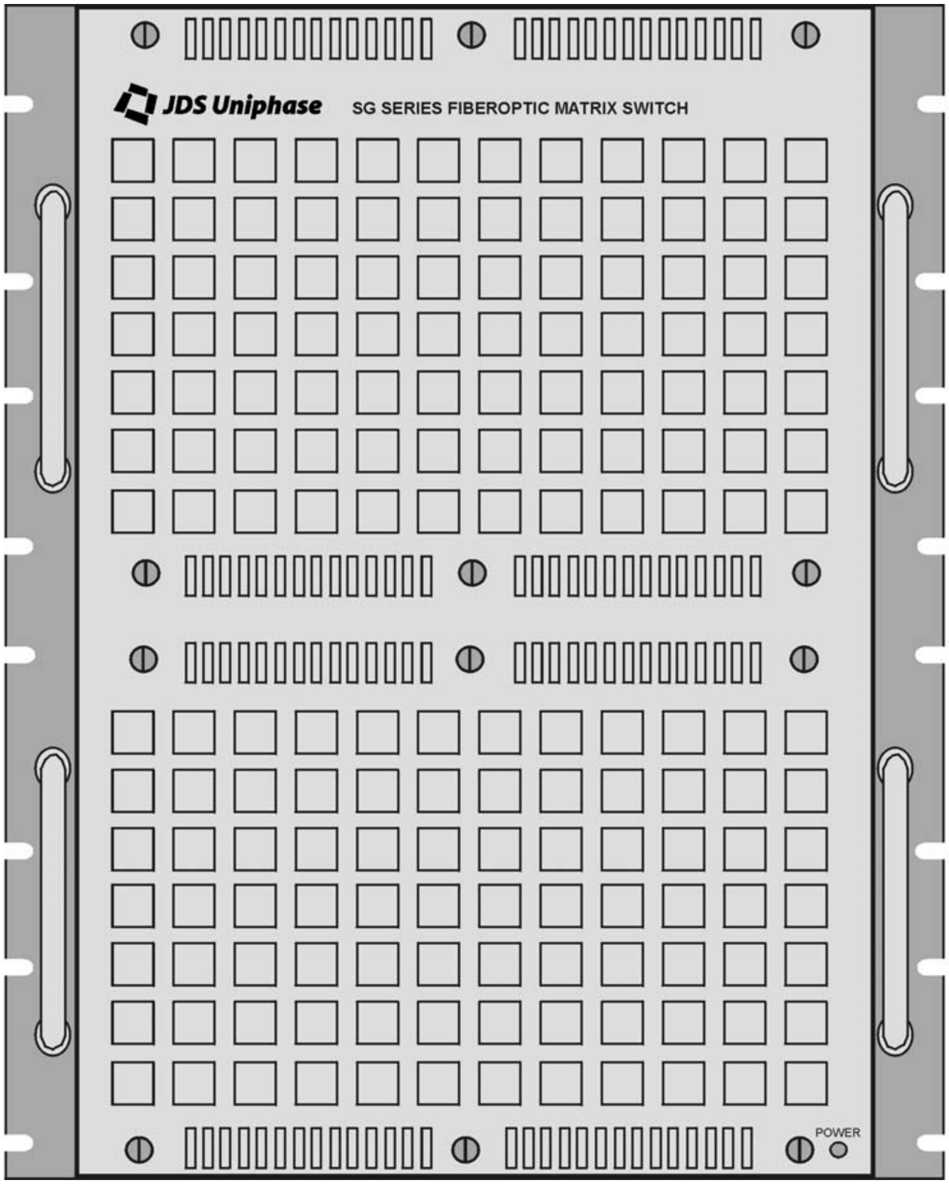
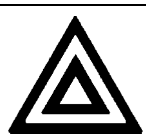


Figure 6: Front of SG Switch (14U height shown)



Warning

The front panel of the SG switch must be removed by trained personnel only.

Rear Panel

The back of the switch for a 14U model is shown in Figure 7. The panel height can differ depending on the configuration.

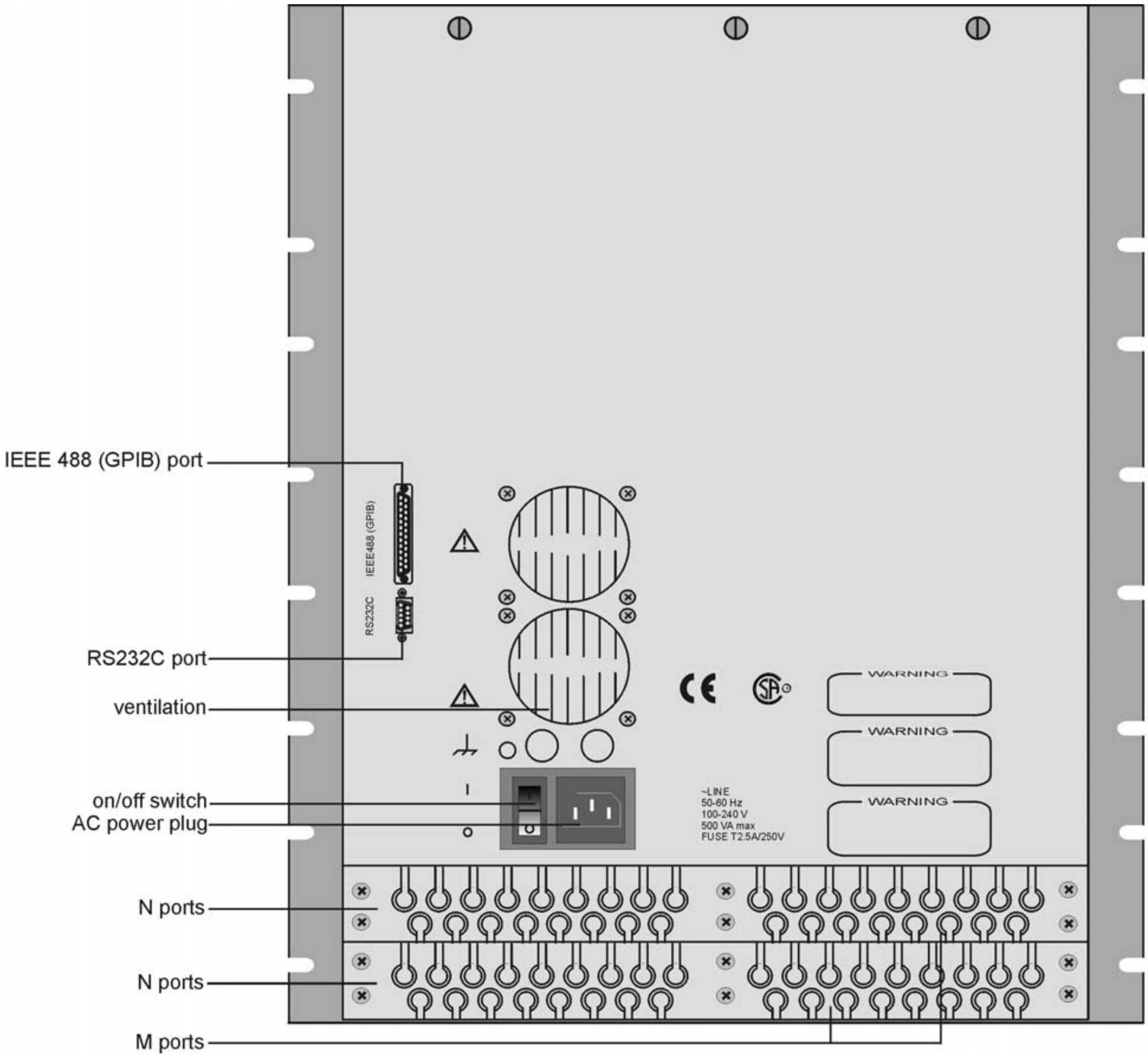


Figure 7: Back of Switch (14U height shown)

Controlling and Monitoring the Switch

For information on using the LabVIEW drivers, see the SG *LabVIEW Instrument Driver User's Manual* (document SD000335).

Calibrating the Switch

The unit is factory calibrated.

Maintaining the Switch

Clean all connector ends with a lint-free tissue and alcohol before every mating to increase the life of the connectors, minimize insertion loss, and reduce backreflection. See the **Cleaning Connectors** section.

Warning

- For continued fire protection, use the specified fuse only.
- Disconnect the power cord from the SG switch and from the power supply before replacing the fuse.
- To avoid electrical shock, the power cord protective grounding conductor must be connected to ground.
- The switch contains no user-serviceable parts. For service information, contact JDS Uniphase or your local representative.

SCPI Conformance Information

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 1995.0.

SCPI 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 terminating sequence <LF> or an end of identity (EOI) message sent with a character signals the switch that the end of the program message has been received. When an EOI message is received with any character other than the terminating sequence <LF>, <LF> is put in the input queue immediately after the character. This applies only to characters sent through the GPIB interface because the RS232C interface does not have an EOI signal.

The terminating sequence <LF> does not always appear in the sample program messages provided in this section; however, it is implied.

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 (@1!4)
:ROUT:CLOS (@1!4)
: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>
        :STAT?
    :OPEN     <channel list>
        :ALL
```

The following program messages are valid.

```
ROUTE:OPEN (@1!4);CLOSE (@5!5)
ROUTE:OPEN (@1!4);:ROUTE:CLOSE (@5!5)
ROUTE:CLOSE:STATE?
```

The following program messages are not valid.

```
ROUTE:OPEN (@1!4);ROUTE:CLOSE (@5!5)     (no colon before second command)
ROUTE:CLOSE (@1!4);STATE?                (STATE? command at different level than CLOSE)
ROUTE:OPEN:ALL;CLOSE (@1!4)              (CLOSE command at different level than ALL)
```

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>
        :STAT?
    :OPEN     <channel list>
        :ALL
```

The following program messages are valid.

```
ROUTE:CLOSE (@3!4)
CLOSE (@3!4)
```

The following program message is not valid.

```
CLOSE (@3!4):STATE?     (the STATE? command is not at the same level as CLOSE)
```

Parameter Types

The acceptable parameter types for each command or query are listed in the command table (see the **IEEE 488.2 Common Commands** section). A definition of each parameter type is provided here.

- **Numeric Value**—Any value between 9.9E37 and -9.9E37. The value can be sent as an integer (154), a decimal (15.2), or an exponential number (4.5E6). The character data forms MIN (minimum), MAX (maximum), and DEF (default) are also acceptable.

- **NRf**—Any value between 9.9E37 and -9.9E37. The value can be sent as an integer (154), a decimal (15.2), or an exponential number (4.5E6). The character data forms MIN, MAX, and DEF are not acceptable.

- **Boolean**—0, 1, ON, OFF. Any other numeric value sent is rounded to the nearest integer. If the resulting integer is anything but 0, it is interpreted as 1.

- **Character**—A character string that contains no more than 12 characters. Each character in the string must be either an uppercase or a lowercase letter, a digit (0 to 9), or an underscore (_).

- **String**—Any character string. The characters in the string can be any ASCII character, and the string can be of any length unless otherwise specified in the command table. In order for the switch to recognize a single (‘) or double quotation mark (“) as part of the string and not as the end of the string, two sequential single quotation marks or two sequential double quotation marks are used to represent a single quotation mark or a double quotation mark, respectively.

- **Non-Decimal Numeric**—Any binary, octal, or hex value, where the non-decimal numeric values (xxxx) are preceded by the type (T), for example, #Txxxx. T is defined as follows:

  – octal = # followed by q or Q
  – hex = # followed by h or H
  – binary = # followed by b or B

  The value (xxxx) following the type must be less than the decimal value 2^{32} and must conform to the following rules for each type:

  – octal values can only contain the numeric characters 0 to 7
  – hex values can only contain the numeric characters 0 to 9 and the letters A to F (both lowercase and uppercase are accepted)
  – binary values can only contain the numeric characters 1 and 0

  For example:

  – #Q12347 is a valid octal number
  – #ha57b2 is a valid hex number
  – #B010111 is a valid binary number

Overview of Implemented Status Structures

There are three distinct status data structures implemented in the SG 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 SG switch only uses bit 1 of the operation registers. Bit 1, the SETTling bit, is set when the SG 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 SG 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. The following diagrams illustrate the relationship between the registers.

Operational and questionable status data structures are shown in Figure 8. Registers are shown in Figure 9.

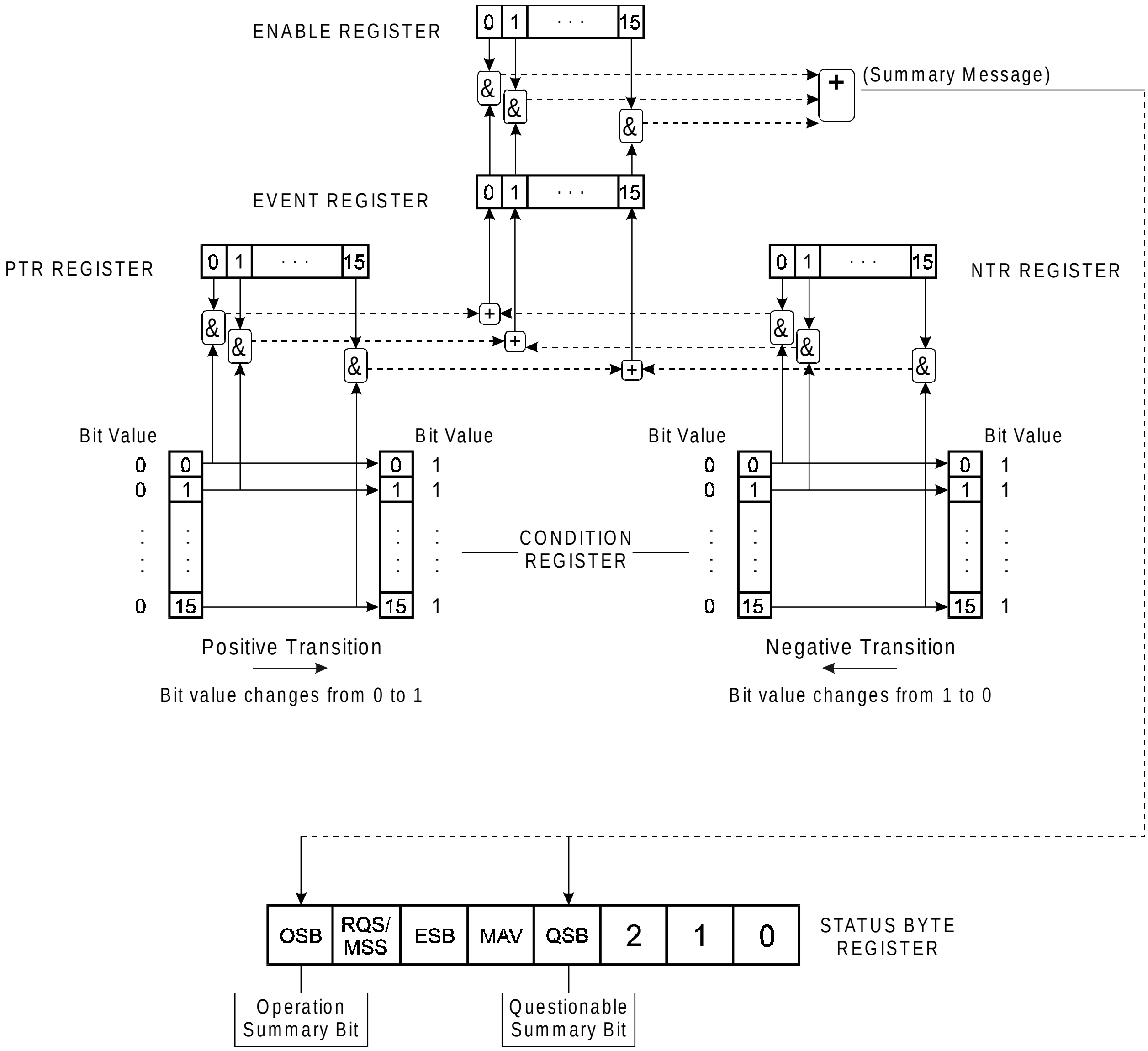


Figure 8: Data Structures

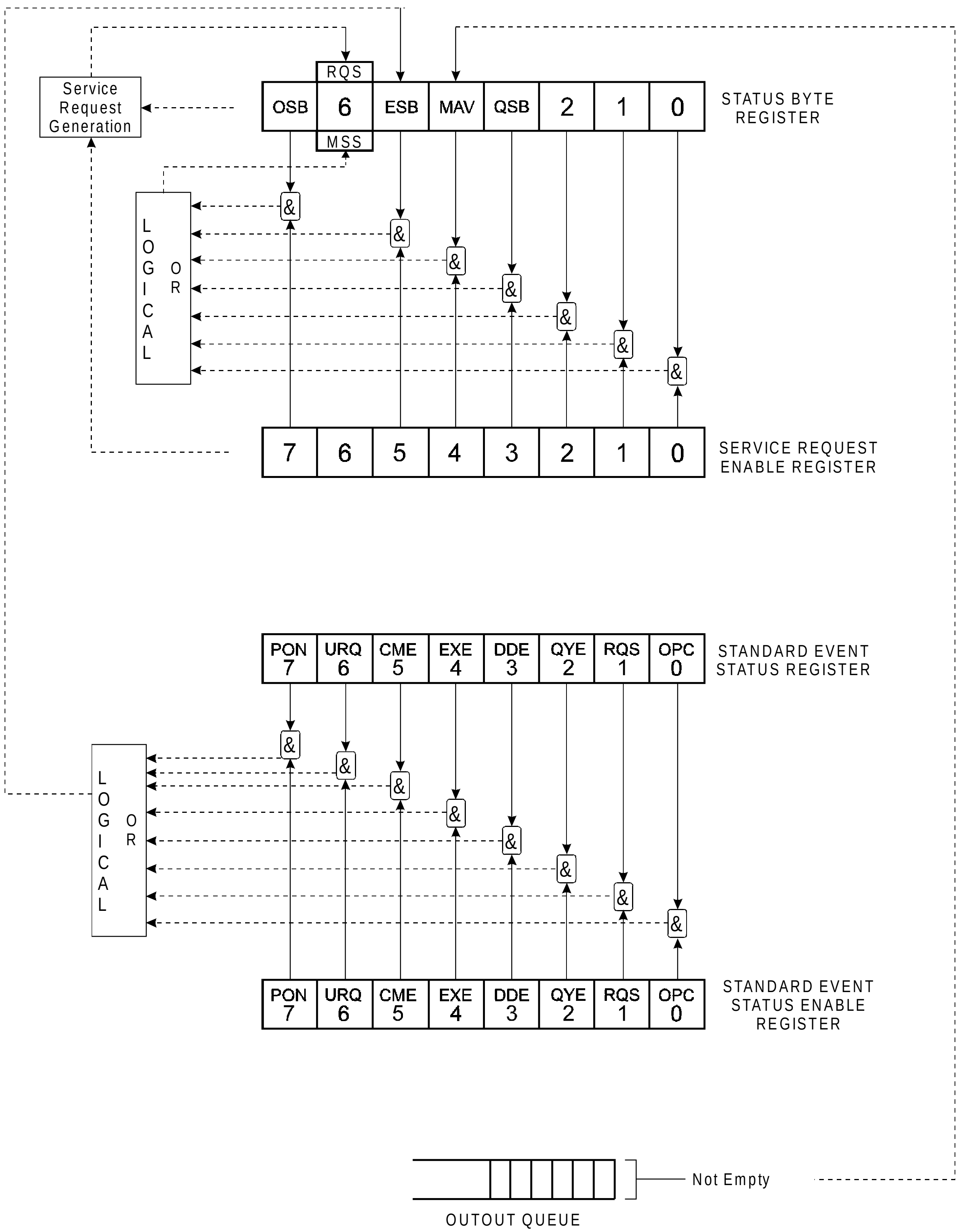


Figure 9: Registers

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 0	**Bit 1**	**Bit 2**	**Bit 3**	**Bit 4**	**Bit 5**	**Bit 6**	**Bit 7**
not used	not used	not used	questionable summary (QSB)	message available (MAV)	event summary (ESB)	request for service *or* master summary	operation summary (OSB)
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 is not used.
- 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 0	**Bit 1**	**Bit 2**	**Bit 3**	**Bit 4**	**Bit 5**	**Bit 6**	**Bit 7**
operation complete (OPC)	request control (RQC)	query error (QYE)	device dependent error (DDE)	execution error (EXE)	command error (CME)	user request (URQ)	power on (PON)
Read with		***ESR?** common query					
Written to with		Cannot be written to					
Cleared by		***ESR?** common query ***CLS** 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	***ESE?** common query
Written to with	***ESE** common command
Cleared by	Power-on ***ESE** common command with a parameter value of 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	**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 200 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 SG 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 100 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 is 100 bytes long. Because it is a FIFO queue, the error returned when the error queue is read is always the first error that occurred. An error is only put into the queue once.

If more than three 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.

-102	**Syntax Error**

The command or data could not be recognized.

-103	**Invalid Separator**

The parser was expecting a separator and did not find one.

-104	**Data Type Error**

A parameter was not the right type; for example, a string was expected but a non-decimal number was received.

-108	**Parameter Not Allowed**

More parameters were received than the command or query requires.

-109	**Missing Parameter**

Fewer parameters were received than the command or query requires.

-110	**Command Header Error**

An error was detected in the command header, but the parser cannot be more specific.

-111	**Header Separator Error**

A character that was not a valid header separator was encountered.

-112	**Program Mnemonic Too Long**

The command header contained too many characters.

-113	**Undefined Header**

The command header has the correct syntax but is not defined for the switch.

-114	**Header Suffix Out of Range**

The suffix is incorrect.

-120	**Numeric Data Error**

An error was detected in a numeric data element, but the parser cannot be more specific.

-121	**Invalid Character In Number**

An invalid character was found in a character-type parameter.

-123	**Exponent Too Large**

The exponent in a decimal numeric value was greater than 32,000.

-124	**Too Many Digits**

The mantissa in a decimal numeric value had more than 255 digits.

-128	**Numeric Data Not Allowed**

A valid numeric parameter was received, but the required parameter type is not numeric.

-130	**Suffix Error**

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

-134	**Suffix Too Long**

The suffix sent with the command was more than 12 characters long.

-140	**Character Data Error**

An error was detected in a character type parameter, but the parser cannot be more specific.

-141	**Invalid Character Data**

An invalid character was detected in a character-type parameter.

-144	**Character Data Too Long**

A character-type parameter contained more than 12 characters.

-200	**Execution Error**

An execution error has occurred, but the control block cannot be more specific.

-220	**Parameter Error**

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

-221	**Settings Conflict**

A valid parameter was received, but it cannot be used due to the current state of the switch.

-222	**Data Out of Range**

A valid parameter type was received, but it is out of range for the switch.

-223	**Too Much Data**

A block-, expression-, or string-data type was too long for the SG switch to process.

-224	**Illegal Parameter Value**

A valid parameter type was received, but it did not match any of the permitted values.

-240	**Hardware Error**

A command could not be executed due to a hardware error, but the control block cannot be more specific.

-300	**Device-Specific Error**

A device-specific error occurred, but more specific information is unavailable.

-310	**System Error**

An instrument system error has occurred.

-313	**Save/Recall Memory Lost**

The non-volatile data saved by the ***SAV** command has been lost.

-330	**Self-Test Failed**

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.

-410	**Query Interrupted**

An interrupted error occurred; for example, an attempt was made to read the output queue before a query had been received.

-420	**Query Unterminated**

An unterminated error occurred; for example, a new program message was sent before the response to a previous query was read.

-430	**Query Deadlocked**

The device is deadlocked. Both the input buffer and output queue are full, and the switch is unable to continue.

??	**Undefined Error Number**

An undefined error occurred.

IEEE 488.2 Common Commands

The commands are outlined in Table 6.

Table 6: IEEE Commands

Command	Parameter	Response	Minimum	Maximum
*CLS	N/A	N/A	N/A	N/A
*ESE	NRf	N/A	0	255
*ESE?	N/A	NRf	0	255
*ESR?	N/A	NRf	0	255
*IDN?	N/A	String	N/A	N/A
*OPC	N/A	N/A	N/A	N/A
*OPC?	N/A	NRf	1	1
*OPT?	N/A	String	N/A	N/A
*RCL	NRf	N/A	0	9
*RST	N/A	N/A	N/A	N/A
*SAV	NRf	N/A	1	9
*SRE	NRf	N/A	0	255
*SRE?	N/A	NRf	0	255
*STB?	N/A	NRf	0	255
*TST?	N/A	NRf	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 Table 7. The following abbreviations are used in the Command Status column on the computer screen:

- SC (SCPI Confirmed command)
- SA (SCPI Approved command)
- N (command is neither SCPI confirmed or approved)

Table 7: SCPI Commands

Command Status	Parameters	Response	Minimum	Maximum
:STATus				
:OPERation				
[:EVENt]?		NRf		
:CONDition?		NRf		
:ENABle	NRf		0	32,768
:ENABle?		NRf		
:NTRansition	NRf		0	32,768
NTRansition?		NRf		
:PTRansition	NRf		0	32,768
PTRansition?		NRf		
:QUEStionable				
[:EVENt]?		NRf		
:CONDition?		NRf		
:ENABle	NRf		0	32,768
:ENABle?		NRf		
:NTRansition	NRf		0	32,768
NTRansition?		NRf		
:PTRansition	NRf		0	32,768
PTRansition?		NRf		
:PRESet				
:SYSTem				
:ERRor?		NRf , String		
:VERSion?		String		
:[ROUTe]				
:CLOSe	<channel list>			
:STATe?		<channel list>		
:CLOSe?	<channel list>	NRf		
:OPEN	<channel list>			
:ALL				
:DIMension?		NRf, NRf		

Description of Individual Commands

Common Commands

Clear Status Command

Syntax	***CLS**
Function	Clears the following queues and registers: • Error queue • Standard event status register • Status byte register • Operation event register • Questionable event register 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. ***CLS** also cancels the functions of ***OPC** and ***OPC?**.
Example	***CLS**

Standard Event Status Enable Register Command

Syntax	***ESE<space><numeric value>** where 0 ≤ <numeric value> ≤ 255
Function	Sets the bits in the standard event status enable register. The numeric value is rounded to the nearest integer and converted to a binary number. The bits of the register are set to match the bit values of the binary number.
Example	***ESE 216** sets the standard event status enable register bits to 11011000.

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 216 if the standard event status enable register is set to 11011000.

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.
Example	***ESR?** returns 195 if the standard event status register is set to 11000011.

Identification Query

Syntax	***IDN?**
Function	Returns a string that identifies the manufacturer, the switch model number, the serial number (or 0 if unavailable), and the firmware level.
Example	***IDN?** returns JDS UNIPHASE, SG, 0, Y.YY

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**

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?**

Option Identification Query

Syntax	***OPT?**
Function	Reports on options installed or included with the switch.
Example	***OPT?** returns ??? in all cases.

Reset Command

Syntax	***RST**
Function	Restores the switch to the following setting. • ROUTE:OPEN:ALL (set all optical paths to open state)
Example	***RST**

Service Request Enable Command

Syntax	***SRE<space><numeric value>** where 0 ≤ <numeric value> ≤ 63 and 128 ≤ <numberic value> ≤ 191
Function	Sets the bits in the service request enable register. The numeric value is rounded to the nearest integer and converted to a binary number. The bits of the register are set to match the bit values of the binary number.
Example	***SRE 152** sets the service request enable register bits to 10011000.

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 152 if the service request enable register is set to 10011000.

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. During self-testing, established optical paths are interrupted for approximately 10 seconds while the position of the switching mechanism is verified.
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 SETTling 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 rounded to the nearest integer and 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 rounded to the closest integer and 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:OPERreration: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 rounded to the closest integer and 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 SETTling 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 rounded to the nearest integer and 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 rounded to the closest integer and 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 rounded to the closest integer and 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. • 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: 1995.0

: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 7. 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<numeric_value>**
Function	Returns the GPIB address.
Example	**:SYST:COMM:GPIB:ADDR?** returns 7

User Commands

[ROUTe]:CLOSe

Syntax	**: [ROUTe]:CLOSe<space><channel_list>**
Function	Establishes the optical paths from M channels to N channels (see figure). The paths are specified in the <channel_list>; for example, (@ m!n) where m and n are channel numbers. The list may contain more than one path if each path is separated by a comma; for example, : (@m1!n1, m2!n2,...) An M channel cannot connect to more than one N channel at a time. It is possible to specify connections in the channel list that are physically impossible to close at the same time.
Example	**:ROUT:CLOS (@ 5!8)** connects channel 5 to channel 8. (Do not forget the space between CLOS and the bracket.) **:CLOS (@ 2!3, 5!8)** connects channel 2 to channel 3 and channel 5 to channel 8. (Do not forget the space between CLOS and the bracket.)
Incorrect use	**:CLOS (@2!3,2!10)** connects channel 2 to channel 10; the connection between channel 2 and channel 3 is broken.

Optical Paths

The optical paths are shown in Figure 10.

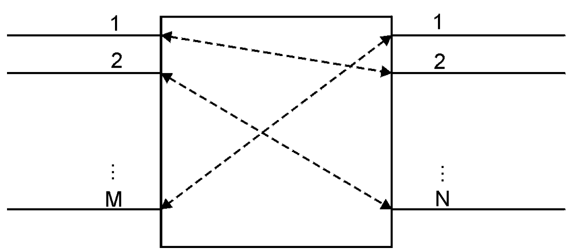


Figure 10: Optical Paths

:[ROUTe]:CLOSe?

Syntax	**[ROUTe]:CLOSe?<space><channel_list>**
Function	Returns the state of all the channels specified in the <channel_list>. The query returns 1 for each channel that is closed; 0 for each channel that is open. The number of channels that can be reported by one query is limited by the length of the output buffer.
Example	**:CLOSE (@1!2);OPEN (@2!5);CLOSE? (@1!2,2!5)** returns 1, 0. (Do not forget the space between CLOS and the bracket.)
Response	k1, k2, k3, . . . km . . . kM where km is 1 for channel closed, 0 for channel open. M, the number of responses, is the number of channels specified in the

	<channel_list>.

:[ROUTe]:CLOSe:STATe?

Syntax	**[ROUTe]:CLOSe:STATe?**
Function	Returns the current closed channels, for example, if channels 1 to 3, 4 to 5, and 10 to 7 are closed, the channel list is (@1!3,4!5,10!7).
Example	**:OPEN:ALL;:CLOS (@1!2,7!3);:CLOS:STATE?** returns (@1!2.7!3). (Do not forget the space between CLOS and the bracket.)
Response	<channel_list>

:[ROUTe]:OPEN

Syntax	**[ROUTe]:OPEN<whitespace><channel_list>**
Function	Opens specified channels. The <channel_list> contains the channels to be opened. If, for example, (@3!4) is sent, the ports M3 and N4 are switched to open channels.
Example	**:OPEN (@1!2)**

:[ROUTe]:OPEN:ALL

Syntax	**[ROUTe]:OPEN:ALL**
Function	Open all channels; therefore, all ports M and N switch to open channels.
Example	**:OPEN:ALL**

:[ROUTe]:DIMension?

Syntax	**: [ROUTe]:DIMension?**
Function	Returns the numbers of input (m) and output (n) ports provided in the switch and a configuration parameter.
Example	**"ROUT:DIM?"** returns m,n,0/1.
Response	16,16,1—The configuration parameter 0 or 1 does not present any information to the user.

Programming Example

```
' This program tests the serial port of a SCPI command instrument.
' The terminating character is a line feed character which cannot be set
' in the OPEN COM statement. The program is written in Qbasic.
' The instrument is connected to the computer port COM1.


CLS

' open COM1 serial port
OPEN "COM1:1200,N,8,1" FOR RANDOM AS #1

' empty the input buffer at start of program
WHILE EOF(1) = 0
 ch$ = INPUT$(1, 1)
 PRINT "buffer not empty: "; ch$
WEND

lf$ = CHR$(10) ' set the line feed character constant

' send a command. If a query then call getstring subroutine
' Note: the PRINT #1 statement must end with lf$ and ";" because the Qbasic OPEN
' statement does not have this option.

PRINT #1, ":close (@1!2,2!3,3!4,4!5,5!6,6!7);:close:state?"; lf$;
GOSUB getstring
PRINT rx$
END

getstring:
' This routine will read characters from the serial port
' and put them into rx$ and stop when a line feed terminating character is
' read. The Qbasic INPUT and LINE INPUT statements will not terminate with
' the linefeed character because the OPEN "COM statement will not allow
' this setting.
rx$ = "" 'initialize the input string
DO
 ch$ = INPUT$(1, 1)                  ' get one character from serial port
 IF ch$ <> "" AND ch$ <> lf$ THEN    ' check for valid character
   rx$ = rx$ + ch$                   ' add to string
 END IF
LOOP UNTIL ch$ = lf$                 ' loop until line feed character received
RETURN
```

GPIB Interface Functions

GPIB functions are outlined in Table 8.

Table 8: GPIB Functions

Mnemonic	Function
SH1	Source handshake, complete capability
AH1	Acceptor handshake, complete capability
T6	Basic talker, serial poll, not addressed if MLA
L4	Basic listener, not addressed if MTA
SR1	Service request capability
RL1	Remote/local, complete capability
PP0	Parallel poll, no capability
DC1	Device clear, complete capability
DT0	Device trigger, no capability
C0	Controller, no capability
E1	Electrical interface, open collector drivers

RS232C Interface Specifications

RS232 specifications are outlined in Table 9.

Table 9: RS232 Specifications

Name	Symbol	Pin Number	Signal Direction
Transmitted data	TxD	2	out
Received data	RxD	3	in
Request to send	RTS	8	out
Clear to send	CTS	8	in
Data terminal ready	DTR	6	out
Signal ground	SG	5	

The data protocol is permanently set to 1200 baud ASCII character code, with eight bits per character, one stop bit, and no parity bit. The serial port of the controlling computer must be configured with the same settings.

Use a straight-through cable to connect the SG switch to the serial port of a DTE (computer).