SCG SERIES
FIBEROPTIC SWITCH

User's Manual

JDS Uniphase

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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 100 VA.

Fuse Type

The fuse type used by the unit is (5x20) mm, T1A/250 V (slow).

Laser Application

Warning

The unit is rated as a system for use with laser equipment. The laser class of any unit connected to the SCG unit applies to the SCG unit. Follow appropriate laser safety procedures for that class.

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:

- When 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.
- Do not operate the unit if an interruption to the protective grounding is suspected. In this case, ensure that the unit remains inoperative.
- Willfully interrupting the protective earth connection is prohibited.
- 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.
- 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.
- Do not operate the unit when its covers or panels have been removed.

	• 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.

(table continued)

Symbol	Description
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

FCC Compliance

The Federal Communications Commission (FCC) of the United States of America requires that equipment operating in that country does not cause interference to communications. The unit has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of Title 47 of the Code of Federal Regulations for Radio Frequency Devices. Operation is subject to the following two conditions, which the FCC requires to be labeled on the unit:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

FCC rules require that the following note and subsequent information be included in this manual:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

These limits are designed to provide reasonable protection against harmful interference in a commercial installation. The unit generates, uses, and radiates radio frequency energy and, if not installed and used in accordance with instructions, can cause harmful interference to radio communications.

Any user modification made to the unit voids the user's authority to operate the unit under the FCC rules.

If this unit is used in a residential setting, resulting interference must be corrected by the user.

For more information, see Title 47 of the Code of Federal Regulations at http://www.access.gpo.gov/nara/cfr/cfr-table-search.html.

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.”

UL[1] Compliance

The unit complies with Underwriters Laboratories (UL) standard 1950, the Standard for Safety Information Technology Equipment.

[1] UL is a registered trademark of Underwriters Laboratories Inc.

General Information and Specifications

General Information

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

The SCG Series Fiberoptic Switch is a programmable switch (Figure 1) that aligns multiple inputs with multiple outputs. Performance, configuration, and flexibility are suitable for a wide range of applications, including fiberoptic component testing systems, remote fiber test systems in telecommunications, and research and development.

Figure 1: SCG Switch

The SCG switch connects a selected input to a selected output channel. The terminations are precisely aligned using a processor-controlled stepper motor. Collimating lenses terminate the fiberoptic attachments, minimizing the insertion loss of the switch and improving the repeatability and stability of its parameters.

The SCG switch is equipped with an IEEE[2] 488.1 parallel interface and an RS232C serial interface for remote control operation. The switch is operated manually using the front-panel controls.

The SCG switch is available in multiple-common (SCG-D, SCG-E, and SCG-F) configurations. The multiple-common units support many grouped fiberoptic input channels.

[2] IEEE is a registered trademark of the Institute of Electrical and Electronics Engineers. Inc.

Multiple-Common (SCG-D) Switch Configuration

The multiple-common (SCG-D) switch configuration provides simultaneous connection of a bank of inputs to outputs (Figure 2). Input 1 can be connected to 1-1 or any 1-M/N output. In this configuration, channel connections are stepped by groups. The number of states is equal to the number of output channels divided by the number of input channels.

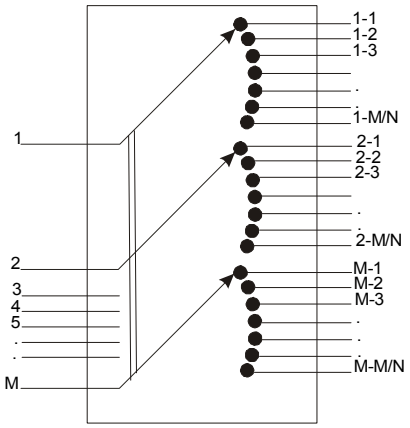

Figure 2: Multiple-Common Configuration for MxN Channels

Single-Step Multiple-Common (SCG-E) Switch Configuration

The non-blocking single-step multiple-common (SCG-E) configuration allows any input to be connected to any output. At the same time, adjacent inputs align with adjacent outputs (Figure 3). This configuration allows for single-step movement of any input channel to any output channel.

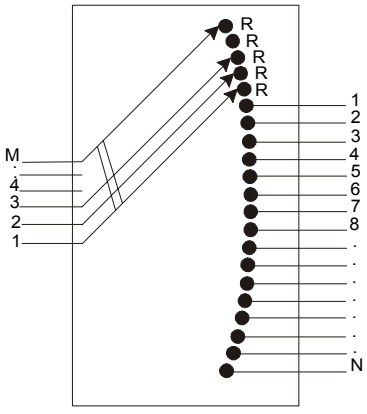

Figure 3: Single-Step Multiple-Common Configuration for MxN Channels

Multiple-Common Blocking (SCG-F) Switch Configuration

In the multiple-common blocking (SCG-F) configuration, any input can be aligned to any output, and the inputs not used are blocked (Figure 4).

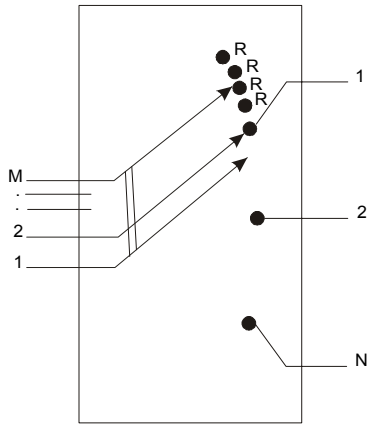

Figure 4: Multiple-Common Blocking Configuration for MxN Channels

Key Features

- Up to 180 channels
- Typical insertion loss of 0.3 dB
- Typical repeatability of 0.005 dB
- Typical return loss greater than 65 dB
- Local and remote control using IEEE 488 and RS232C interfaces
- Single-height, rack-mounted unit

Applications

- Fiberoptic component testing
- Transmitter and receiver measurement
- Research and development

Standard Accessories

- AC power cord
- User's manual

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 and Table 4).

Table 2: Optical Specifications

Parameter	Typical		Maximum	
	SCG-D	SCG-E SCG-F	SCG-D	SCG-E SCG-F
Insertion loss single-mode[1] multimode[1]	 0.5 dB 0.5 dB	 0.7 dB 0.7 dB	 1.0 dB 1.0 dB	 1.5 dB 1.5 dB
Return loss single-mode[2] standard/analog multimode[2] standard/analog	 65 dB 25 dB	 65 dB 25 dB	 60 dB 20 dB	 60 dB 20 dB
Polarization dependent loss (single-mode)	0.02 dB	0.03 dB	0.05 dB	0.07 dB
Insertion loss stability[3]	±0.03 dB		±0.05 dB	
Repeatability[4] sequential switching random switching	 ±0.005 dB ±0.02 dB		 ±0.01 dB ±0.04 dB	
Crosstalk (single-mode)	-90 dB		-80 dB	
Input power (continuous wave)	300 mW		N/A	
Channel options front or rear panel connectors front or rear panel pigtail	 60 (maximum) 90 (maximum)			
Switching time one channel each additional channel	 420 ms (typical) +20 ms (typical)			

[1] Insertion loss does not include connectors. Include 0.2 dB (typical), 0.5 dB (maximum) for each connector.

[2] Excluding connectors.

[3] Drift of any channel relative to one assigned reference channel at ±3 °C deviation of ambient temperature over a seven-day period.

[4] Optimum repeatability after one hour warm-up.

Table 3: Operating Specifications

Parameter	Description
Local control	• Step-up, step-down channel selection • Control of eight relay drivers • IEEE 488.1 address selection • Return-to-local function • Language selection
Remote control	• GPIB interface: IEEE 488.1 1987 capability SH1, AH1, T6, L4, SR1, PP0, DC1, C0, E1 • RS232C interface: setting 8 bits, 9600 baud, 1 stop bit, no parity
Command set	Revised command set
Drivers	Eight open collector outputs, sink current 100 mA maximum per output (driver): • Drivers 1, 2, 3, 4, +5 V and GND (ground) are accessible from back panel connector • Drivers 5, 6, 7, and 8 are internal
Warm-up time[1]	1 hour at 25 °C ambient temperature

[1] Applicable for optimum repeatability performance.

Table 4: Other Specifications

Electrical	
Input voltage	100 to 240 V AC, 50 to 60 Hz
Power consumption	100 VA maximum
Physical	
Dimensions (W x H x D) single-height with rack mount	48 x 13.25 x 38 cm
Weight	9 kg
Environmental	
Operating temperature	0 to 55 °C
Storage temperature	-40 to 70 °C
Humidity (non-condensing)	Maximum 95% RH from 0 to 55 °C

Getting Started

The SCG Series Fiberoptic Switch consists of the rack-mounted switch unit and a power cord.

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. Ensure that the power switch is set to **O** (off).

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

6. Set the power switch to **I** (on). All key lamps and status LEDs light. The unit designation and the firmware version are displayed. If no malfunction is detected during power-up, all lamps and LEDs turn off and the display reads the switch number and channel connection status. If a malfunction is detected during the power-up sequence, an error message is displayed.

7. Set the power switch to **O** (off) and disconnect the AC power cord from the power supply and from the SCG switch.

8. 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 0 to 55 °C.

Humidity

The unit can be operated in environments with up to 95% humidity (0 to 55 °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 in) of clearance at the rear and at least 25 mm (1 in) 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, packaging guidelines are as follows:

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

2. Wrap the unit in anti-static packaging. Use anti-static connector covers, if applicable.

3. Pack the unit in a reliable shipping container.

4. 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.

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. Ship the unit only to the address given at the beginning of this document.

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 (for example, Tech Spray Envi-Ro-Tech Duster 1671 gas, available from http://www.techspray.com/1671.htm)
- Lint-free pipe cleaners (for example, from 3M[3]) or lint-free swab
- Lint-free towels (for example, 10 x 10 cm or 4 x 4 in HydroSorb III wipers, available from http://www.focenter.com/acctech/hydrosobr_wipers.htm)
- Optical grade isopropyl alcohol or optical grade 200° ethanol (do not use rubbing alcohol, which contains 30% water)

[3] 3M is a trademark of 3M.

To clean the connectors:

1. Blow the sleeve with filtered compressed air (Figure 5).

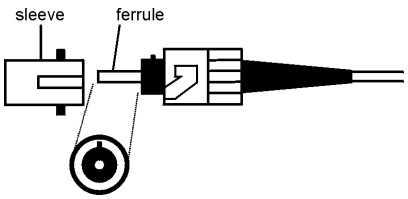

Figure 5: Connector Cleaning (connector type can vary)

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

	**Caution** In sensitive applications, to avoid shock and vibration, do not mount the switch in non-rigid racks or on top of raised floors or tables. Avoid use with high-impact doors that lack impact-reducing bumpers upon closing.

To install the switch:

1. Place the SCG switch in its intended operating location. The rack-mounting flanges fully support the weight of the switch. Avoid blocking the ventilation holes at the back and at the bottom of the instrument.

2. Route the fiber cables in such a way as to avoid creating bends that have a radius of less than 1.5 cm; do not lay cables across sharp corners or tie bundles of cables together tightly. Do not pull on the fibers that exit through the rear-panel strain relief. Excessive force can damage the optics.

3. Reattach the AC power cord and reinitialize the switch.

Front Panel

The front of the unit is shown in Figure 6. A close-up of the key panel is shown in Figure 7.

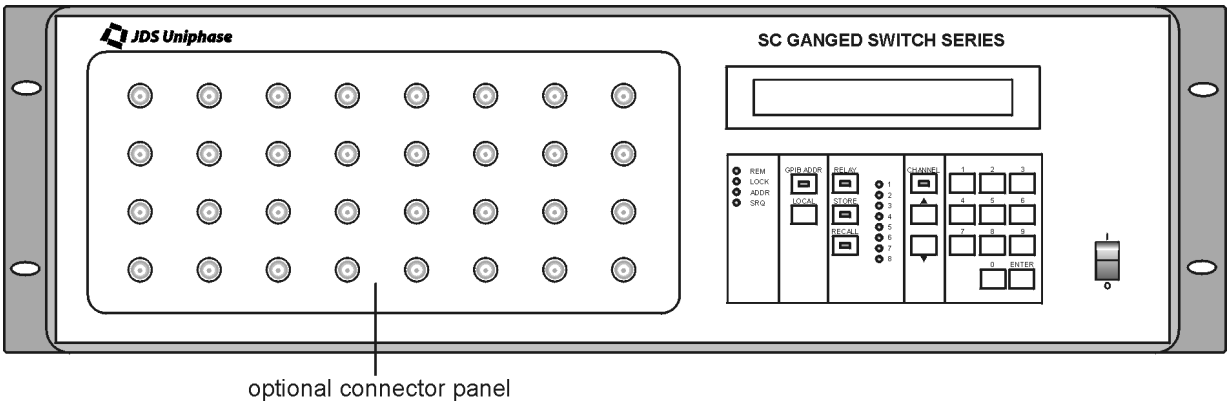

Figure 6: Front of Switch

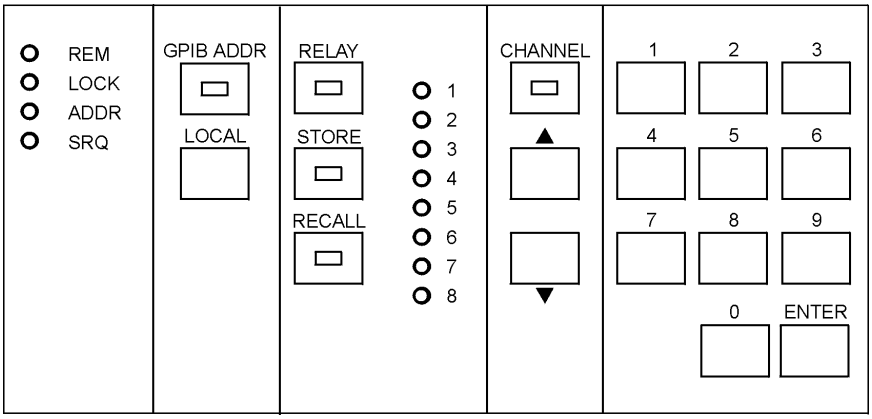

Figure 7: Operating Keys and Status LEDs

Operating Keys

The operating keys are described in Table 5.

Table 5: Operating Keys

Key	Description
I / **O**	Power on (**I**) and off (**O**) switch
GPIB ADDR	Sets the switch to GPIB Address (IEEE 488.1) mode
LOCAL	Returns the switch to Local mode from Remote mode, unless the switch is in Local Lockout mode
RELAY	Sets the switch to Relay (driver control) mode
STORE	Stores relay driver patterns in non-volatile memory
RECALL	Recalls a stored driver pattern
CHANNEL	Sets the switch to Channel Control mode
▲	Channel increment key
▼	Channel decrement key
☐ (0 to 9)	Numeric entry key pad
ENTER	Terminates an entry, such as the channel number or GPIB address

Status LEDs

The status LEDs are described in Table 6.

Table 6: Status LEDs

LED	Description
REM	Indicates that the GPIB or RS232 interface is in Remote mode. All front-panel keys except Local are locked out.
LOCK	Indicates that the switch is in Local Lockout mode. This mode prevents the Local key from returning the switch to Local mode.
ADDR	Indicates that the GPIB interface is in talk or listen state
SRQ	Indicates that the interrupt logic of the switch has generated a service request interrupt on the GPIB interface
○ (1 to 8)	Indicates the on/off state of the relay drivers (driver is on when LED is lit and off when LED is dark)

Rear Panel

The back of the unit is shown in Figure 8.

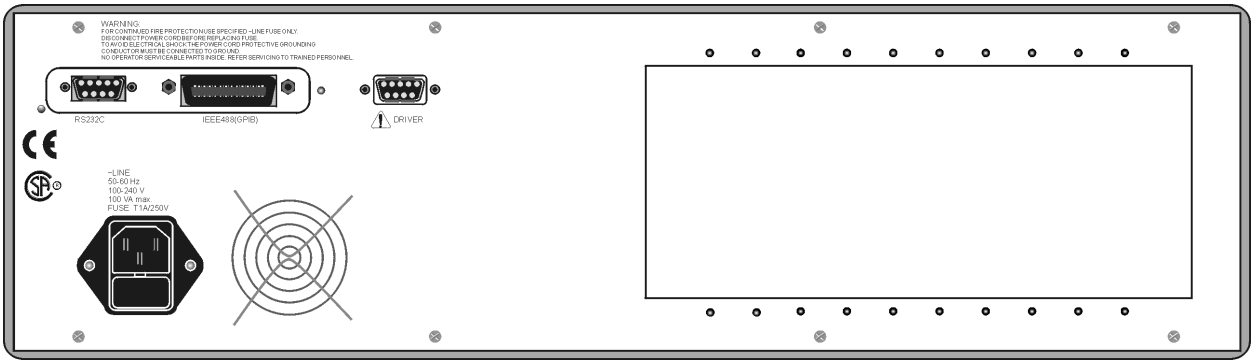

Figure 8: Back of Switch

Making External Switch Module Connections

External Switch Module without TTL Input Controls

The setup for a switch without transistor-to-transistor logic (TTL) is shown in Figure 9.

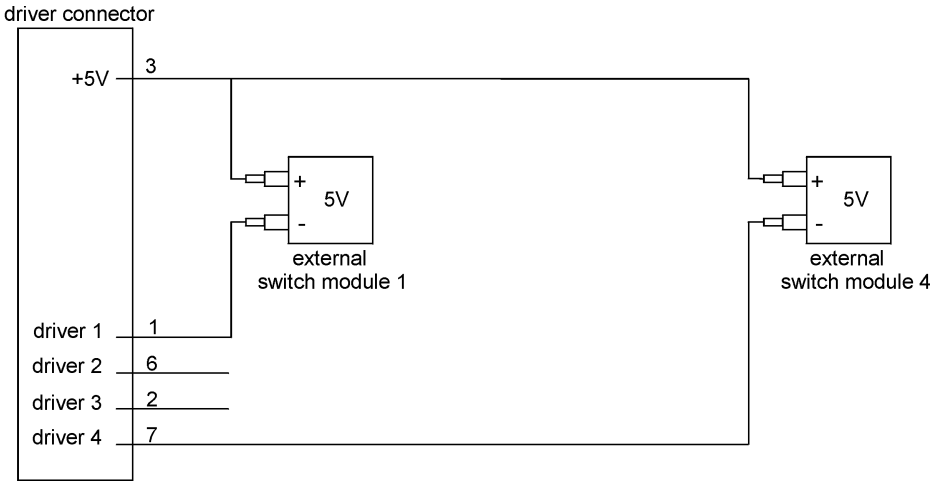

Figure 9: Switch Setup without TTL

External Switch Module with TTL Input Controls

The setup for a switch with TTL is shown in Figure 10.

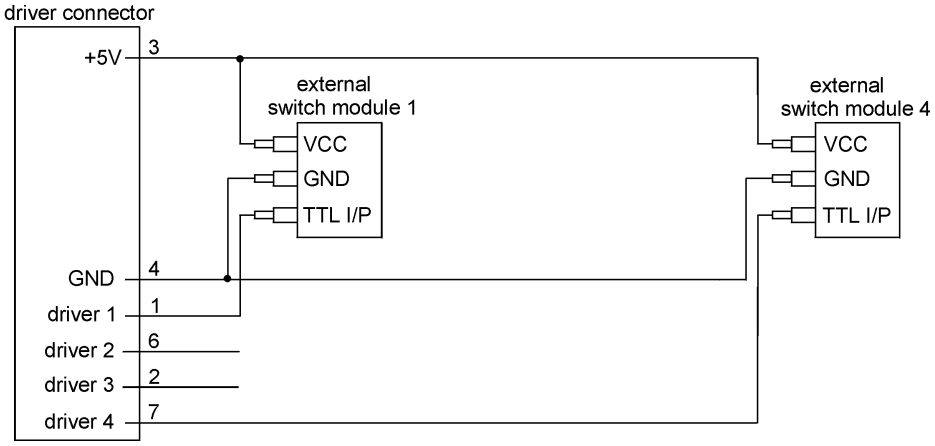

Figure 10: Switch Setup with TTL

Sample Driver Application

A sample driver application, which is the electrical equivalent of the driver, is shown in Figure 11.

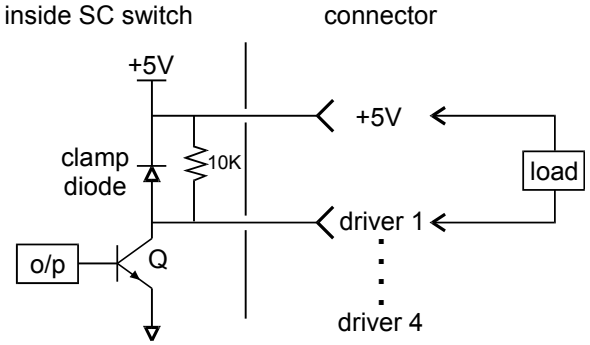

Figure 11: Sample Driver Application (electrical equivalent of driver)

Caution

Do not exceed 100 mA per driver.

Powering Up the Unit

To power up the unit:

1. Connect the unit to the AC power source, with the AC power cord provided.

2. Set the power switch to **I** (on). All key lamps and status LEDs light during the power-up sequence. The LCD displays the unit designation (SCG) and the firmware version (Figure 12).

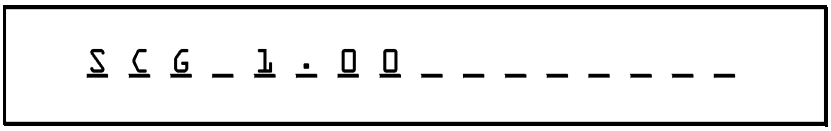

Figure 12: LCD Display for Power On, without Expansion Hardware

The switch number and channel connection status are shown in a generic format on the LCD, referred to as the default unit display (Figure 13).

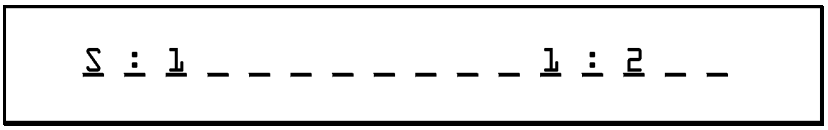

Figure 13: Default LCD Display

The field “S : 1” indicates the switch number, field “1” indicates the current input channel number, and field “2” indicates the current output channel number.

Instructions to set the SCG unit for remote control by GPIB or RS232 interface are in the **Programming Guide** section.

Selecting Input Channels and Output Channels

When the default unit display is active (Figure 13), the Channel key is lit on the front panel of the unit.

To select a channel using the Channel key:

1. Press and release the Channel key to activate the input channel field. An active field is indicated on the LCD by the characters within that field blinking continuously.

2. Press and release the Channel key a second time to activate the output channel field.

3. Press and release the Channel key again to deactivate all fields.

Fields that have only one possible parameter (for example, a unit with a single input channel) cannot be selected. When there is only one parameter selection, the field is skipped when the Channel key is pressed and the next valid field is activated. When any field is active, the field can be modified by using the numeric key pad or the ▲ or ▼ keys.

To modify a field by using the numeric key pad:

1. Press and release the Channel key until the desired field is activated.

2. Enter a number (one to three digits) using the numeric keypad.

3. Press the Enter key.

Numeric entry is automatically accepted if the maximum number of digits is entered; the Enter key does not need to be pressed. For example, if the SCG chassis contains less than 10 input channels, only a single digit can be entered in the input field.

To modify a field by using the ▲ or ▼ keys:

1. Press and release the Channel key until the desired field is activated.

2. Press the ▲ key or ▼ key to change the field sequentially.

Output channel 0 is an open circuit, such as when the selected switch is in an unconnected state. This condition is shown on the LCD as “OFF”.

Saving and Recalling Switch or Relay Driver States

The SCG unit has 10 non-volatile memory locations available for storing and recalling SCG unit data. If expansion hardware is not installed in the SCG unit chassis, the current state of the eight direct-drive relay lines is stored.

To store and recall the current state:

1. Select a switch or place the direct-drive relay lines in the desired pattern.

2. Press the Store key.

3. Enter a number (0 to 9) using the key pad to assign the stored switch state.

4. To recall the switch state, press the Recall key, followed by the assigned number.

Displaying Switch Details or Controlling Direct Drivers

The Relay key places the unit in driver control mode. In driver control mode, the SCG unit has four drivers (1, 2, 3, and 4) for driving the external switch modules and four drivers (5, 6, 7, and 8) for driving internal switch modules. The LCD indicates that relay control is active (Figure 14).

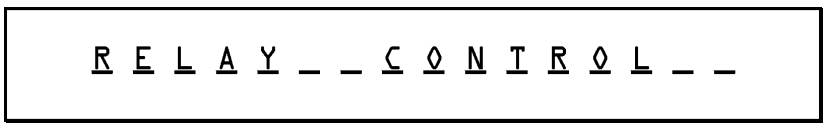

Figure 14: Relay Control Display without Expansion Hardware

To activate or deactivate direct-driver lines:

1. Press the Relay key. The Relay Control message is displayed.

2. Toggle the desired direct-driver line on or off by pressing and releasing the corresponding key on the numeric keypad.

The status LED of the corresponding driver is lit when the driver line is active.

Changing or Verifying the GPIB Address

To change or check the GPIB address:

1. Press the GPIB ADDR key. The current GPIB address, appended with an asterisk, is displayed.

2. Scroll to the required address using the ▲ key or ▼ key, or enter the address using the numeric keypad. Valid GPIB addresses are numbers in the range 1 to 30.

3. Press the Enter key to activate the new address or to leave the GPIB address unchanged, then press a mode key (for example, Relay or Channel). The address entry is confirmed by the appearance of an asterisk.

Calibrating the Unit

No calibration is required.

Maintaining the Unit

Clean the connector ends with a lint-free tissue and alcohol before every mating, as outlined in the **Cleaning Connectors** section.

Clean the internal connectors and the panel-mounted connector bulkheads periodically or when high losses are suspected. Access the internal connectors by removing the connector panel at the front of the unit.

To remove the connector panel:

1. Loosen the retaining screws of the connector panel.

2. Pull the panel out carefully, extending it no more than 10 cm (4 in) from the body of the unit.

3. Remove the connectors from the connector bulkheads.

4. Clean the connector ends and the bulkhead mating sleeves with a lint-free tissue and alcohol.

5. Reinstall the connectors into the bulkheads.

6. Reinstall the connector panel, guiding the fiber back to ensure that it does not bend sharply.

Caution

Do not extend the connector panel more than 10 cm (4 in) from the body of the SCG unit.

Programming Guide

The following programming instructions for the SCG unit are intended for users who are familiar with the GPIB interface and how to send or receive messages over the bus. A detailed description of the GPIB interface is contained in *ANSI/IEEE Std. 488.1-1987 IEEE Standard Digital Interface for Programmable Instrumentation*, published by the Institute of Electrical and Electronics Engineers (IEEE).

The SCG unit is equipped with a GPIB parallel interface and an RS232C serial interface. The unit accepts the same device-dependent commands (commands that control the instrument) over either interface.

GPIB Pin Assignment

Figure 15 shows the GPIB pin assignment.

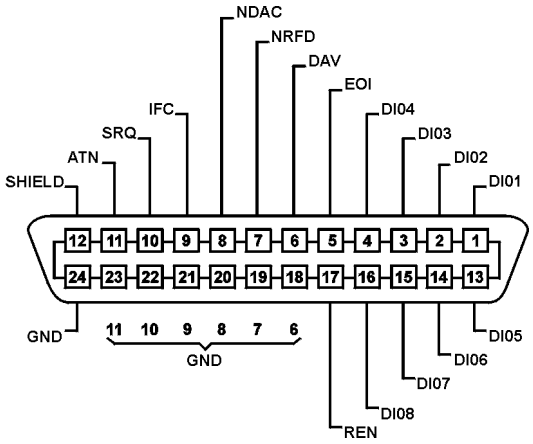

Figure 15: GPIB Pin Assignment

Caution

Tighten the connector lock screws by hand. Do not use a screwdriver.

The GPIB interface functions are outlined in Table 7.

Table 7: GPIB Interface 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

Setting the GPIB Address

To set the GPIB address:

1. Press the GPIB ADDR key. The current GPIB address, appended with an asterisk, is displayed. (The factory-set GPIB address is 7.)

2. Scroll to the required address using the ▲ or ▼ key, or enter the address using the numeric keypad.

3. Press the Enter key to activate the new address. To leave the GPIB address unchanged, press a mode key (GPIB ADDR, Relay, or Channel).

RS232C Pin Assignment

Figure 16 shows the RS232 pin assignment, which is not applicable if expansion hardware is installed.

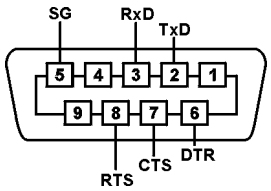

Figure 16: RS232 Pin Assignment

The RS232C interface specifications are outlined in Table 8.

Table 8: RS232C Interface Functions

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	7	in
Data terminal ready	DTR	6	out
Signal ground	SG	5	

The data protocol is permanently set to 9600 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.

Figure 17 shows the RS232 pin assignment of the drivers.

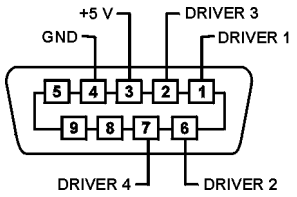

Figure 17: RS232 Driver Pin Assignment

Caution

Do not exceed 100 mA per driver.

Operation and Query Commands

Most operation and query commands control instrument functions and are interface independent.

Command Parser Rules

- A command consists of a mnemonic (for example, a switch) and, if required, a data parameter. The mnemonic and the data parameter must be separated by at least one space.

- Parameters can be entered in various formats; for example, 10 and 10.0 are recognized as the same value.

- Commands can be sent in uppercase or lowercase characters.

- A command is transmitted in a message, which can contain more than one command. For example, **SWITCH 1 1 3;SWNUM? <CR> <LF>** contains two commands.

- All GPIB messages must end with the terminating sequence <CR> <LF>.

- All RS232C commands must be terminated with a single <CR> character.

- The input buffer of the SCG unit can hold 100 characters. If the buffer is full, the unit holds the handshaking line on the GPIB interface until space is available. Similarly, over the RS232C interface, the SCG unit sets the Clear To Send line low. Any characters received after the line goes low are ignored.

- Commands are executed as they are parsed; consequently, a command can be executed before the entire message in which it is contained is received.

- The SCG unit delays accepting new characters sent over the GPIB interface while the switch mechanism is moving, but no data are lost. The SCG unit is always ready to accept characters over the RS232C interface.

- A query command is used to extract status information from the SCG unit. For example, **SRE? <CR> <LF>** returns the contents of the status register (see the **Status Reporting and Service Request Control** section).

- Multiple-command messages can contain only one query command. A query must be the last command in the message, for example, **SWITCH 1 1 1; XDRS? <CR> <LF>**.

Operation Commands

RESET	**Reset**

Returns the SCG unit to the power-up state, for example, channel 0, relay drivers off. All motors and non-latching relay switches are returned to the reset position. The state of the latching switches is not modified.

SRE I	**Clear Status Byte**

Writes a decimal number to the SRQ mask register (see the **Status Reporting and Service Request Control** section). Setting a bit to 1 generates an SRQ interrupt when the corresponding bit in the status register changes from 0 to 1.

CSB	**Clear Status Byte**

Resets the status register.

CLR	**Clear Device**

Clears the SRQ mask register.

SWITCH I J K	**Set Optical Connection**

Sets the optical connection of the selected switch.

- I = switch number
- J = input channel number
- K = output channel number

CLOSE I	**Modify Stepper Motor Optical Setting**

Connects input channel 1 to the output channel specified by I on the first motor.

- I = output channel number to be connected to input channel 1

GPIB I	**Set the GPIB Address (RS232 Interface Only)**

Modifies the GPIB address.

- I = GPIB address (0 to 30)

Query Commands

SWITCH ? A	**Query Optical Connection**

Returns the connection status of the switch specified by A: current input, current output.

- A = switch number

CLOSE?	**Optical Switch Path**

Returns the current output channel number connected to input channel 1 of the first motor (if any). CLOSE? MAX returns the maximum output channel of the first motor.

SWNUM?	**Number of Switches**

Returns integer equal to total number of switches within the unit.

CONFIG?	**Query Switch Configuration**

Returns a data stream containing a number of packets equal to the number of switches within the unit, with each packet separated by a semicolon (;) delimiter. Each data packet contains:

- One integer representation of the switch number
- Two characters representing the switch designation
- One integer describing the output channel currently connected to input channel one
- One integer defining the board or motor address of the switch
- Two integers defining the numbers of the first and last relay lines used by this switch (if motor, these are 0)
- One integer defining the number of input channels
- One integer defining the number of output channels

LRN?	**Learn**

Returns a string containing the commands that, if sent, reset the currently selected switch to its current state, for example, **SWITCH I J K;SRE L**, where I represents the switch number, J represents the input channel number, K represents the output channel number, and L represents the value of the service request enable register.

STB?	**Status Register**

Returns a three-digit integer and automatically clears the status register if the SRQ bit is set.

SRE?	**SRQ Mask**

Returns the contents of the SRQ mask register.

CNB?	**Condition Register**

Returns the contents of the condition register.

TST?	**Self-test**

Executes a verification operation on all installed stepper motor type switches. An error code that can be queried with **ERR?** or **LERR?** is placed in an error queue. The query **TST?** also sets bit 7 in the status register.

- 0 = self-test passed
- 1 = self-test failed

ERR?	**Error Number**

Returns the last error number that occurred. Returns 0 if the error queue is empty.

LERR?	**Last Number Error**

Returns a three-digit error number from the error queue. The queue can contain as many as five error numbers. The first error read is the last error that occurred. **LERR?** returns 0 if the error queue is empty. This command removes the error number from the error queue, once it is read.

- -350 = queue overflow
- -330 = self-test failed
- 301 = command error
- 303 = invalid command
- 200 = parameter error
- 0 = no error

IDN?	**Identifier**

Returns a string that identifies the manufacturer, the SCG unit model number, and the firmware level, for example, **JDS Uniphase, SCG unit, v1.20**.

XDR I J	**Direct Drive Line Control**

Sets the specified direct-drive relay line ON or OFF.

- I = driver number (1 to 8)
- J = state (1 = ON, 0 = OFF)

XDRS I	**Direct Drive Line Group Control**

Sets all eight direct-drive relay lines ON or OFF according to the binary conversion of I. The binary weight of the drivers is as follows:

- Driver 1 = 1
- Driver 2 = 2
- Driver 3 = 4
- Driver 4 = 8
- Driver 5 = 16
- Driver 6 = 32
- Driver 7 = 64
- Driver 8 = 128
- I = sum of the weights of the drivers to be activated; when I = 255, all driver lines are active

XDR? I	**Direct Drive Line Query**

Returns the current state of the specified direct-drive relay line (1 = ON, 0 = OFF).

- I = driver number (1 to 8)

XDRS?	**Direct Drive Line Group Query**

Returns the current state of all specified direct-drive relay lines (1 = ON, 0 = OFF).

Status Reporting and Service Request Control

The SCG unit maintains three eight-bit registers that are used for status reporting and for enabling the GPIB service request interrupt:

- Condition register
- Status register
- SRQ mask register

Condition Register

The condition register monitors the current state of the switch mechanism. Bit 2, the settled condition bit, is 1 when the switch mechanism is stopped at the desired channel and 0 when the switch is moving to a new output channel. The **CNB?** query command returns the value of the condition register. When the settled bit is true, the **CNB?** query returns 4.

Condition Register							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	0	0	0	0	Settled	0	0

Status Register

The status register records errors and other events that have occurred in the SCG unit. When an event occurs, the status logic of the SCG unit sets the corresponding bit to 1. This register can be read at any time because the bits stay set until the register is read at least once.

Status Register							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Self-Test Error	Service Request	Syntax Error	Message Available	0	Settled	0	Parameter Error

- Bit 7 (Self-Test Error) is set if a calibration error is detected after power-up or after the self-test query (**TST?**) is executed. At all other times, the bit is 0.
- Bit 6 (Service Request) is set when the interrupt request logic of the SCG unit detects a reason to generate a service request interrupt on the GPIB interface.
- Bit 5 (Syntax Error) is set when the parser detects a syntax error in a command mnemonic.
- Bit 4 (Message Available) is set when a message is available in the output buffer.

- Bit 2 (Settled) is set when bit 2 in the condition register changes from 0 to 1.
- Bit 0 (Parameter Error) is set when a parameter value is out of the range of the SCG unit.

The status register can be read with the status register query (**STB?**) or by serial polling the GPIB interface. During power-up, the status register contains 0 and can only be read by serial polling. After initial power-up, only the settled bit (bit 2) is set to 1. The clear status byte command (**CSB**) and the clear device command (**CLR**) clear the status register. **STB?** also clears the status register, but only if the service request bit (bit 6) is set to 1.

SRQ Mask Register

The SRQ mask register unmasks specific events in the status register that generate service request interrupts on the GPIB interface. The SRQ mask command (**SRE**) writes to the SRQ mask register. When a bit in the SRQ mask register is set to 1, the interrupt logic of the switch monitors the corresponding event bit in the status register; an SRQ is generated and bit 6 in the status register is set when the corresponding bit changes from 0 to 1.

The SRQ mask register can unmask more than one event at a time. The first unmasked event to change from 0 to 1 causes an interrupt. To acknowledge this interrupt, the GPIB interface can be serial polled or the status register can be read with **STB?**. The first time the SCG unit is serial polled after an SRQ is generated, bit 6 is on. Subsequent serial polling returns a value with bit 6 off. Similarly, **STB?** returns the status register with the SRQ bit set, but the logic of the SCG unit automatically clears the register. As a result, subsequent **STB?** queries return 0.

The SRQ mask register is cleared by powering up the SCG unit, by the clear device command (**CLR**), or by the universal device clear command (**DC1**).

SRQ Mask Register							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Self-Test Error	n/a	Syntax Error	Message Available	n/a	Settled	n/a	Parameter Error

GPIB Programming Examples

This section provides programming examples for controlling the SCG unit over the GPIB interface. The examples are written in MS-DOS Qbasic and run on a personal computer equipped with a National Instruments[4] GPIB interface board, with National Instruments Universal Language Interface drivers loaded. The commands that control the GPIB are very similar to Hewlett Packard[5] HP Basic commands. Most other controller board manufacturers provide basic output and input statements for communicating messages to a GPIB instrument.

The GPIB commands provided in this section do not always show the terminating sequence <CR><LF>; however, it is implied.

[4] National Instruments is a trademark of National Instruments.
[5] Hewlett Packard is a registered trademark of Hewlett-Packard Co.

Before using any of these examples, ensure that the GPIB address is set to 7, the interface command set is SC, the ULI.EXE driver is loaded, and the switch is connected to the computer using a GPIB cable.

Sending Commands

This example sets the SCG unit to channel 6 and turns on all the external relay drivers.

```
' set up the interface card and drivers
OPEN "GPIB0" FOR OUTPUT AS #1
OPEN "GPIB0" FOR INPUT AS #2
PRINT #1, "ABORT"
' set terminating character to CR LF sequence
PRINT #1, "GPIBEOS OUT CR LF"
PRINT #1, "GPIBEOS IN CR LF"
' sample commands "SWITCH 1 1 1; STB?"
PRINT #1, "OUTPUT 07;SWITCH 1 1 1;STB?"
PRINT #1, "ENTER 07"
' sample queries
PRINT #1, "OUTPUT 07;SWNUM?"
PRINT #1, "ENTER 07"
INPUT #2, a
PRINT "switch ",a
PRINT #1, "OUTPUT 07;ERR?"
PRINT #1, "ENTER 07"
INPUT #2, a
PRINT "error number= ",a
END
```

Serial Polling the Status Register

This example changes the channel setting and reads the status register continuously until the output is settled.

```
PRINT #1, "OUTPUT 07;csb"              ' clearing the status byte clears the settling bit
PRINT #1, "OUTPUT 07;SWITCH 1 1 1"     ' change channel
sr = 0                                 ' initialize sr variable to enter the while loop
WHILE ((sr AND 4 ) =0)                 ' loop until settled bit is true
  PRINT #1, "SPOLL 07"                 ' serial poll SCG
  INPUT #2, sr
WEND
PRINT sr                               ' print final value of sr
END
```

Generating a Service Request Interrupt

This example tests the service request interrupt function. It unmasks the settled bit in the SRQ mask register and selects a channel. An interrupt is generated when the SCG unit reaches the channel.

```
ON PEN GOSUB SPOLL                  ' enable SRQ interrupt
PEN ON
PRINT #1, "OUTPUT 07;CSB;SRE 4"     ' clear status register and unmask
                                    ' settled bit in SRQ mask register
PRINT #1 "OUTPUT 07;SWITCH 1 1 1"   ' change channel
' More code executed while switch channel set
'
'
WHILE (INKEY$ = "")                 ' endless loop to simulate bigger program
WEND                                ' ends when any key is pressed
PEN OFF
END

SPOLL:
  PRINT #1, "SPOLL 07"              ' serial poll SCG
  INPUT #2, sr                      ' read status register
  PRINT sr                          ' verify SRQ bit is set
  PRINT #1, "SPOLL 07"              ' serial poll again to verify SRQ bit is now cleared
  INPUT #2, sr                      ' read status register
  PRINT sr
RETURN
```

Learn Query (LRN?)

This example demonstrates the use of the learn query.

```
DIM LEARN$[100]
PRINT #1, "OUTPUT 07;LRN?"          ' send the learn query command
PRINT #1, "ENTER 07"
LINE INPUT #2, LEARN$
' The above variables can be saved in a data file before quitting the program and
' later read back to restore the SCG unit to a same state.
' Like this...
PRINT#1, "OUTPUT 07;"LEARN$
' SCG settings are now restored
END
```

RS232C Programming Examples

This section provides programming examples for controlling the SCG unit over the RS232C interface. The samples are written in MS-DOS Qbasic and run on a personal computer equipped with a serial port. COM port 2 of the computer is designated as the serial port and is connected to the SCG unit.

The RS232C commands that appear in this section do not always show the terminating character <CR>; however, it is implied.

The RS232C interface cannot receive an SRQ interrupt.

Sending Commands

This example shows how to send a command.

```
OPEN "COM2:9600,N,8,1" FOR RANDOM AS #3
A = 10
PRINT#3, "SWITCH 1 1 1 ";A
END
```

Querying Status

This example queries and displays the current channel setting.

```
PRINT#3, "SWITCH?"
INPUT#3, A
PRINT A
END
```

Reading the Status Register

The serial polling function is not supported on any RS232C interface, but **STB?** can be used to query the status register because the query command performs the same function as serial polling.

The following example changes the channel setting and reads the status register continuously until the output is settled.

```
OPEN "COM2:9600,N,8,1" FOR RANDOM AS #3
PRINT#3, "CSB"                          ' clear status register
PRINT#3, "SWITCH 1 1 2"
DO                                      ' loop until motor settles
        PRINT#3, "STB?"
        INPUT#3, SR1
LOOP UNTIL (SR1 AND 4)
PRINT SR1
END
```