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SAFETY AND WARRANTY INFORMATION

The Safety and Warranty Information section provides details about cautionary symbols used in the manual, safety markings used on the instrument, and information about the Warranty including Customer Service contact information.

Safety Information and the Manual

Throughout this manual, you will see the words *Caution* and *Warning* indicating potentially dangerous or hazardous situations which, if not avoided, could result in death, serious or minor injury, or damage to the product.

Caution indicates a potentially hazardous situation which can result in minor or moderate injury or damage to the product or equipment.

Warning indicates a potentially dangerous situation which can result in serious injury or death.

Visible and/or invisible laser radiation. Avoid eye or skin exposure to direct or scattered radiation.

General Safety Considerations

If any of the following conditions exist, or are suspected, do not use the instrument until safe operation can be verified by trained service personnel:

- Visible damage
- Severe transport stress
- Prolonged storage under adverse conditions
- Failure to perform intended measurements or functions

If necessary, return the instrument to ILX Lightwave, or the authorized local ILX Lightwave distributor, for service or repair to ensure that safety features are maintained (see the contact information on page xvi).

All instruments returned to ILX Lightwave are required to have a Return Authorization Number assigned by an official representative of ILX Lightwave Corporation. See Returning an Instrument on page xiv for more information.

Laser Safety for the FOS-79800F

WARNING

DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION.
AVOID DIRECT EXPOSURE TO THE BEAM.

GEFAR: SEHBAR UND/ODER UNSICHTBAR LASER STRAHLUNG.
MEIDE RICHTE AUFDECKUNG ANS STRAHL.

DANGER: VISIBLE ET/OU INVISIBLE LASER RADIATION.
EVITENT DIRECT EXPOSURE AU POUTRE.

PERICOLO: VISIBLE E/O INVISIBLE LASER RADIAZIONE.
EVITANO DIRETTA EXPOSURE AGLT TRAVE.

There are laser and electrical safety issues that must be considered during the operation of the FOS-79800F laser source modules. The FOS-79800F laser source modules must be used as intended in this manual. Any other use not specified in this manual may result in a hazard. The high brightness, invisible light output of laser diodes and other laser sources pose a definite eye hazard. Direct viewing of the laser output may produce retinal or corneal damage. Absorption of the laser light by the eye causes localized heating and denaturing of tissue proteins. The ANSI publication Z-136.1, “The Safe Use of Lasers”, lists Maximum Permissible Exposure (MPE) levels for direct, or intrabeam viewing of laser beams. From the MPE levels, a “hazard zone” may be computed for a particular laser and exposure time. For more information concerning lasers and laser diode safety, contact the Center for Devices and Radiological Health or ILX Lightwave.

SAFETY SYMBOLS

This section describes the safety symbols and classifications.

Technical specifications including electrical ratings and weight are included within the manual. See the Table of Contents to locate the specifications and other product information. The following classifications are standard across all ILX Lightwave products:

- Indoor use only
- Ordinary Protection: This product is NOT protected against the harmful ingress of moisture.
- Class I Equipment (grounded type)
- Mains supply voltage fluctuations are not to exceed +6% and -10% of the nominal supply voltage.
- Pollution Degree II
- Installation (overvoltage) Category II for transient overvoltages
- Maximum Relative Humidity: <80% RH, non-condensing
- Operating temperature range of 0 °C to 40 °C
- Storage and transportation temperature of –40 °C to 70 °C
- Maximum altitude: 3000 m (9843 ft.)
- This equipment is suitable for continuous operation.

Safety Marking Symbols

This section provides a description of the safety marking symbols that appear on the instrument. These symbols provide information about potentially dangerous situations which can result in death, injury, or damage to the instrument and other components.

 Caution, refer to manual	 Earth ground Terminal	 Alternating current	 Visible and/or invisible laser radiation
 Caution, risk of electric shock	 Protective Conductor Terminal	 Caution, hot surface	 Frame or chassis Terminal
 or (I) On: In position of a bistable push control. The slash (I) only denotes that mains are on.		 or (O) Off: Out position of a bistable push control. The circle (O) only denotes that mains are off.	

WARRANTY

ILX LIGHTWAVE CORPORATION warrants this instrument to be free from defects in material and workmanship for a period of one year from date of shipment. During the warranty period, ILX will repair or replace the unit, at our option, without charge.

Limitations

This warranty does not apply to fuses, lamps, defects caused by abuse, modifications, or to use of the product for which it was not intended**.**

This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability or fitness for any particular purpose. ILX Lightwave Corporation shall not be liable for any incidental, special, or consequential damages**.**

This document has been prepared for use by ILX Lightwave customers as a guide to the proper use and operation of its products, and no warranty or representation, either expressed or implied, is made with respect to the documentation or to the software described in this document with regard to their quality, performance, merchantability, or fitness for any particular purpose.

If a problem occurs, please contact ILX Lightwave Corporation with the instrument's serial number, and thoroughly describe the nature of the problem.

Returning an Instrument

If an instrument is to be shipped to ILX Lightwave for repair or service, be sure to:

1. Obtain a Return Authorization number (RA) from ILX Customer Service.
2. Attach a tag to the instrument identifying the owner and indicating the required service or repair. Include the instrument serial number from the rear panel of the instrument.
3. Attach the anti-static protective caps that were shipped with the instrument and place the instrument in a protective anti-static bag.
4. Place the instrument in the original packing container with at least 3 inches (7.5 cm) of compressible packaging material. **Shipping damage is not covered by this warranty.**
5. Secure the packing box with fiber reinforced strapping tape or metal bands.
6. Send the instrument, transportation pre-paid, to ILX Lightwave. Clearly write the return authorization number on the outside of the box and on the shipping paperwork. ILX Lightwave recommends you insure the shipment.

If the original shipping container is not available, place the instrument in a container with at least 3 inches (7.5 cm) of compressible packaging material on all sides.

Repairs are made and the instrument returned transportation pre-paid. Repairs are warranted for the remainder of the original warranty or for 90 days, whichever is greater.

Claims for Shipping Damage

When you receive the instrument, inspect it immediately for any damage or shortages on the packing list. If the instrument is damaged, file a claim with the carrier. The factory will supply you with a quotation for estimated costs of repair. You must negotiate and settle with the carrier for the amount of damage.

Copyright

Comments, Suggestions, and Problems

To ensure that you get the most out of your ILX Lightwave product, we ask that you direct any product operation or service related questions or comments to ILX Lightwave Customer Support. You may contact us in whatever way is most convenient:

Phone . . . . . (800) 459-9459 or (406) 586-1244

Fax . . . . . (406) 586-9405

On the web at: . . . . . ilx.custhelp.com

Or mail to:

ILX Lightwave Corporation
P. O. Box 6310
Bozeman, Montana, U.S.A 59771
www.ilxlightwave.com

When you contact us, please have the following information:

Model Number: _____

Serial Number: _____

End-user Name: _____

Company: _____

Phone: _____

Fax: _____

Description of what is connected to the ILX Lightwave instrument: _____

Description of the problem: _____

If ILX Lightwave determines that a return to the factory is necessary, you will be issued a Return Authorization (RA) number. Please mark this number on the outside of the shipping box.

You or your shipping service are responsible for any shipping damage when returning the instrument to ILX Lightwave; ILX recommends you insure the shipment. If the original shipping container is not available, place your instrument in a container with at least 3 inches (7.5 cm) of compressible packaging material on all sides.

We look forward to serving you even better in the future!

U.S. EXPORT CONTROL LAWS COMPLIANCE

Export and re-export of laser sources manufactured by ILX Lightwave Corporation may be subject to U.S. Export Administration Regulations, which are administered by the U.S Department of Commerce. In addition, shipments of certain components may be regulated by the U.S. State Department under the International Traffic in Arms Regulations (ITAR).

The applicable restrictions vary depending on the specific product involved and its destination. In some cases, United States law requires U.S. Government approval be obtained prior to resale, export or re-export of certain articles. When there is uncertainty about the requirements imposed by U.S. law, clarification should be obtained from ILX Lightwave or an appropriate U.S. Government agency.

CHAPTER 1

INTRODUCTION AND SPECIFICATIONS

This chapter is an introduction to the FOM-7900B Multi-Channel Fiber Optic Test System. The chapter contains first time setup information, important safety considerations, maintenance information, instrument specifications, and general FOM-7900B System information.

WARNING

If any of the following symptoms exist, or are even suspected, remove the FOM-7900B from service. Do not use the instrument until trained service personnel can verify safe operation.

- Visible damage
- Severe transport stress
- Prolonged storage under adverse conditions
- Failure to perform intended measurements of functions

If necessary, call ILX Lightwave Customer Service to ensure that all safety features are maintained and functioning correctly.

Product Overview

The FOM-7900B Fiber Optic System supports up to eight modules of stabilized DFB or Fabry-Perot laser sources, fiber optic switches or dual power meters. All are controlled from a single user interface.

The mainframe and modules can be controlled by a GPIB/IEEE-488.2 or RS-232 interface. Up to twenty-five FOM-7900B Systems can be linked to control up to 200 channels from one GPIB address.

Available Options

The following options are available with the FOM-7900B Fiber Optic System:

Table 1.1 Module Options

Description	Model Number
1 x 4 Fiber Optic Switch Module	FOS-79710
Precision Fiber Optic Source Module	FOS-79800F

Installation

Initial Inspection

After receiving the FOM-7900B Fiber Optic Test System, verify that the following items were shipped along with the instrument:

- FOM-7900B Fiber Optic Mainframe
- FOS-79800F Fiber Optic Source Modules, as appropriate
- FOS-79710 Fiber Optic Swich Module, as appropriate
- Power Cord Appropriate for the Local Service

Grounding Requirements

The FOM-7900B comes with a three-conductor AC power cable. The power cable must be inserted into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire connected to an electrical ground (safety ground). The FOM-7900B's AC input and supplied power cable meets IEC safety standards.

AC Power Requirements

The FOM-7900B Fiber Optic Test System may be operated from a single phase power source delivering nominal line voltages of 100-120 or 220-240 VAC (all values RMS), from 50 to 60 Hz. The internal power supplies are configured to the input voltage specified at the time of the order and will be marked on the rear panel of the unit. If the system must be reconfigured for input voltage, contact ILX Lightwave Customer Service for additional information.

WARNING

Before connecting the FOM-7900B mainframe to a power source, verify that the AC power source is within the voltage range printed on the instrument's rear panel.

Potentially lethal voltages exist within the FOM-7900B chassis. To avoid electric shock, do not perform any maintenance on the instrument. Qualified service personnel trained in ESD prevention are required. High voltages are present on and around the printed circuit boards.

There are no user-serviceable parts inside the instrument, excepting any external fuses in the AC power entry module. Contact ILX Customer Service for information about servicing the instrument.

Obtaining Repair Services

The instrument may at some point need to be returned to the factory for service whether or not it is under warranty. If the warranty has expired, there will be a nominal charge for repair and/or calibration. See the section entitled Returning an Instrument in the Preface for shipping and contact information.

Our goal is to make the best laser diode instrumentation available anywhere. To achieve this, we need your ideas and comments on ways we can improve our products. We invite you to contact us at any time with your suggestions.

FOM-7900B General Specifications

Table 1.2 FOM-7900B General Specifications

Power Input[1]:	100 – 120 VAC (50/60 Hz, 1.5 A)
	220 – 240 VAC (50/60 Hz, 0.8 A)
Rack Mounting:	19” (48.3 cm)
Weight:	28 lbs (12.7 kg)
Height:	5.5” (14.0 cm)
Width:	17.75” (45.1 cm)
Depth:	17.5” (44.5 cm)
Maximum Relative Humidity:	<80% RH, non-condensing
Operating Temperature Range[2]:	0°C – +40°C
Storage Temperature Range:	-40°C – +70°C
Maximum Altitude:	3000 m
Chassis Ground:	4 mm Banana Jack on Rear Panel

Suitable for continuous operation.

Ordinary Protection (Not protected against harmful ingress of moisture.)

Class 1 Equipment (Grounded Type).

Indoor Use Only.

[1] Permitted fluctuations in rated line voltage of +6% and -10%.

[2] Operating temperature range may vary for individual modules.

FOM-7900B System Specifications

Table 1.3 FOM-7900B System Specifications

Internal Modulation	
Waveform	Square Wave
Frequency	1 - 500 kHz
Duty Cycle	50% ± 1%
Modulation Depth	100%
Rise/Fall Time	<250 ns
Channel-to-Channel Synchronization[1]	<100 ns
Modulation In	
Level	TTL
Frequency	1 - 500 kHz
Duty Cycle[2]	50% ± 1%
Polarity	0 V = Laser OFF +5 V = Laser ON
Optical Delay[3]	<1 µs
Channel-to-Channel Synchronization[1]	<100 ns
Jitter[4]	<50 ns
Connector	BNC femals on rear panel
Modulation Out	
Level	TTL
Polarity of OUT	0 V = Laser OFF +5 V = Laser ON
Polarity of $\overline{\text{OUT}}$	0 V = Laser ON +5 V = Laser OFF
Gate Delay[5]	<60 ns per mainframe
Jitter[4]	<50 ns
Connector	BNC female on rear panel
Load Capability	Capabile of synchronously modulating up to 3 additional FOM-7900B mainframes

Table 1.3 FOM-7900B System Specifications (Continued)

External Trigger Input/Output

Level	TTL; Active Low
Pulsewidth	100 ns, minimum
Connector	BNC female on rear panel

Computer Interface - GPIB / IEEE-488.2

Hardware meets ANSI/IEEE Std. 488.1 - 1987

Hardware meets ANSI/IEEE Std. 488.2 - 1992

SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E1, E2

Fanout	Capable of driving up to 200 modules

Computer Interface - RS-232

Baud Rate	9600
Stop Bits	1
Parity	None
Data Bits	8
Flow Control	None
RS-232 A Connector	DB-9 male on rear panel
RS-232 B Connector	DB-9 female on rear panel

1 Channel-to-Channel Synchronization is defined as the maximum variation in optical delay between modules in the same mainframe.

2 Input modulation duty cycles other than 50% ± 1% will result in output power inaccuracies.

3 Optical Delay is defined as the time between the rising edge of the electrical input modulation signal and the rising edge of the electrical input.

4 Jitter is defined as the variation in optical delay for any given module.

5 Gate Delay is defined as the time between the input modulation signal and the output modulation signal.

6 From one GPIB address and using serial connections between successive mainframes (up to 25).

Note: The mains supply voltage is factory set and cannot be changed by the user. If a change is required, contact ILX Lightwave Customer Service.

Rear Panel

The following paragraphs describe the rear panel of the FOM-7900B Fiber Optic System. The FOM-7900B Mainframe Rear Panel is shown in Figure 1.1.

Figure 1.1 FOM-7900B Fiber Optic System Rear Panel

Power Entry Module and Fuse

The AC Power Entry Module and fuse are located on the right side of the FOM-7900B rear panel. The unit must be connected to a properly rated AC power source in order to operate. The AC line voltage is preset at the factory and is not adjustable in the field. Permitted fluctuations from rated line voltages are +6% and -10%.

Fuse Rating

Replace fuse only with the specified type and rating as listed on the back panel of the FOM-7900B. Instructions for replacing a fuse are found in the chapter describing maintenance.

LINE VOLTAGE	FUSE (5 X 20mm)
100-120V ~	T 2.0A, 250V
220-240V ~	T 1.6A, 250V

WARNING

FOR CONTINUED PROTECTION, REPLACE FUSE ONLY WITH SPECIFIED TYPE AND RATING.

ZUM FORTBESTEHENDEN SCHUTZ, ERSETZEN SIE DIE SICHERUNG NUR MIT DEM SPEZIFIZIERTEM TYP AND NENNWERT.

POUR ASSURER LA PROTECTION FUTURE, LE FUSIBLE DE REMPLACEMENT DOIT ETRE AUX MEMES SPECIFICATIONS.

PER UNA CORRETA PROTEZIONE, SOSTITUIRE IL FUSIBILE SOLO CON UNO DI IDENTICO TIPO E POTENZA.

GPIB Connector

The GPIB connector is located adjacent to the fan on the right hand side of the rear panel. It is compliant with ANSI/IEEE Standard 488.1-1987. Interface specifications are listed in Table 7.1 It is possible to link several FOM-7900B mainframes together and control them all from one GPIB address.

RS-232 Connectors

The FOM-7900B can be controlled remotely through a serial link between a computer COM port and the FOM-7900B. The commands described in Chapter 7 GPIB Remote Operation & Common Commands and Chapter 8 Command Reference can be sent via GPIB or RS-232. It is possible to link several FOM-7900B mainframes together and control them all from one RS-232 interface. Refer to Chapter 6 RS-232 Interface for details regarding RS-232 communications to the FOM-7900B.

Trigger Input / Output Connectors

The TRIGGER IN may be used to externally signal modules to execute a predetermined set of instructions. The input signal is active low, edge triggered, TTL, with a minimum pulse width of 100 ns. All modules will receive the trigger pulse but *not all* modules support the external trigger.

Some modules are capable of generating a trigger signal that is available at the rear panel TRIGGER OUT connector. The electrical specifications are the same at the trigger input. A trigger input signal is duplicated at the trigger output connector. Sending the *GET or TRIG GPIB commands also generates a signal at the TRIGGER OUT connector.

Modulation Input Connector (External Modulation)

It is possible to modulate the sources within the FOM-7900B using an external signal. This signal must be in the form of a TTL signal between 1 kHz and 500 kHz applied to the MODULATION IN connector on the rear panel. When the TTL signal is high (+5 volts), the source(s) will be turned on. When the TTL signal is low (0 volts), the source(s) will be turned off. The input signal is also available at the MODULATION OUT connectors on the rear panel.

To use this feature the FOM-7900B must be configured for external modulation by choosing EXTERNAL from the Mod Source menu. Refer to Chapter 2 FOM-7900B Mainframe Operation, for explanation of mainframe menu selections.

Modulation Output Connectors

The signal used to modulate the sources (internal or external) is available as differential outputs from the rear panel of the instrument. The non-inverted signal is high (+5 volts) when the sources are turned on and low (0 volts) when the sources are turned off. The inverted signal has the opposite polarity.

The Modulation Out signal can be used as an external signal to synchronously modulate other FOM-7900B mainframes or to trigger peripheral test equipment.

Module Installation

Use the following instructions when installing modules into the FOM-7900B mainframe:

Figure 1.2 FOS-7900B Multi-Channel Fiber Optic Test System

CAUTION

Do not insert or remove any module while the FOM-7900B is energized. This could damage the module and/or mainframe. Be sure the module is properly installed before applying power to the FOM-7900B.

CAUTION

The Fiber Optic Source Module and the Dual Power Meter are static sensitive devices. Installing or removing any module from the FOM-7900B System should take place in an ESD protected environment.

1. Make sure the power to the FOM-7900B mainframe is turned off.
2. Select any available mainframe channel and, if necessary, remove the blank plate that covers that channel. The plate is removed by loosening the screw at the bottom left corner.
3. Position the module upright and guide it into the bay using the mounting rails on top and bottom of the mainframe bay.
4. Press the module firmly into the bay. The module should “snap”securely into place.
5. Secure the module using the screw at the bottom left corner of the front panel.

Power-Up

Connect the FOM-7900B mainframe to an AC power source. Press the POWER switch to supply power to the device and start the six-second startup sequence.

WARNING

To avoid electrical shock hazard, connect the FOM-7900B System to a properly earth grounded, three prong receptacle only. Failure to observe this precaution can result in severe injury or death.

Warm-up and Environmental Considerations

To achieve rated stability, the mainframe, with modules installed, must warm up for a minimum of one hour with the power on. Some modules may require a longer warm-up time. The operating conditions are determined by the type of module installed, but must not exceed 0-40°C and < 80%, non condensing relative humidity.

WARNING

**DANGER: VISIBLE AND/OR INVISIBLE LASER RADIATION.
AVOID DIRECT EXPOSURE TO THE BEAM.**

**GEFAR: SEHBAR UND/ODER UNSICHTBAR LASER STRAHLUNG.
MEIDE RICHTE AUFDECKUNG ANS STRAHL.**

**DANGER: VISIBLE ET/OU INVISIBLE LASER RADIATION.
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**PERICOLO: VISIBLE E/O INVISIBLE LASER RADIAZIONE.
EVITANO DIRETTA EXPOSURE AGLT TRAVE.**

The high brightness, sometimes invisible light output of laser diodes and other laser sources poses a definite eye hazard. Direct viewing of the laser output can produce retinal or corneal damage. The ANSI publication Z-136.1, “The Safe Use of Lasers”, lists Maximum Permissible Exposure (MPE) levels for direct, or intrabeam viewing of laser beams. From the MPE levels, a “hazard zone” may be computed for a particular laser and exposure time. For more information concerning lasers and laser diode safety, contact the Center for Devices and Radiological Health or ILX Lightwave.

CHAPTER 2

FOM-7900B MAINFRAME OPERATION

This chapter describes the operation of the FOM-7900B mainframe through its front panel menus. Details specific to module operation and configuration will be described in following chapters.

Front Panel Controls

Two module types are available for use in the FOM-7900B mainframe: the FOS-79800F Fiber Optic Source module and the FOS-79710 Fiber Optic Switch. All are controlled using the mainframe keypad.

Details unique to individual modules are described in the corresponding module chapter.

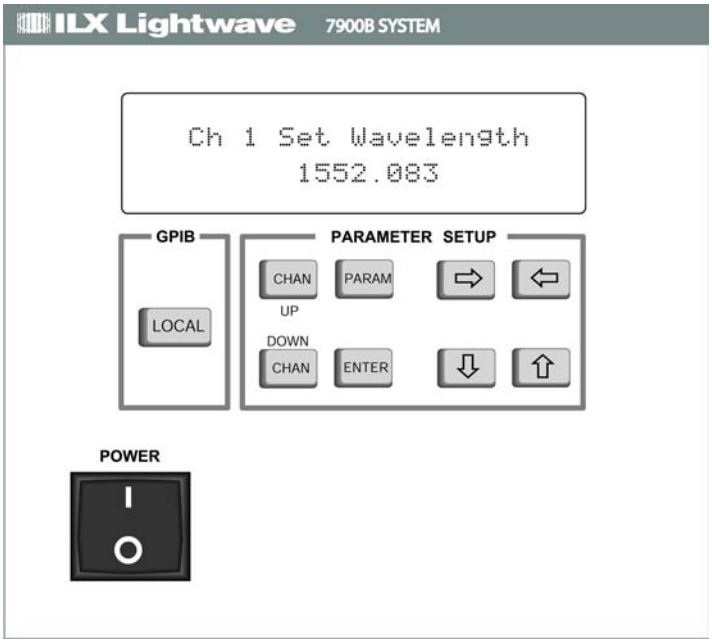


Figure 2.1 FOM-7900B Front Panel

Display

The selected module channel number is always shown in the upper left corner of the display. A description of the selected parameter is provided in the upper right corner of the display.

Local/Remote Control

When the FOM-7900B is addressed remotely by a host computer the display reads >>REMOTE<< and the front panel is disabled. Press the LOCAL key to return to local, front panel, control.

When the instrument is in local mode, pressing the LOCAL key causes the GPIB address to be displayed. The GPIB address can then be changed by pressing the UP and DOWN arrow keys to select the desired address. The new address is implemented when the ENTER key is pressed.

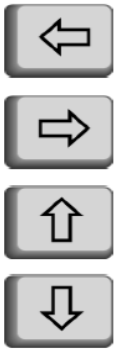
Channel Selection

Use the CHAN UP or CHAN DOWN keys to select one of the eight modules in the FOM-7900B Mainframe. When a module is selected, parameters for that module are displayed on the FOM-7900B front panel.

Parameter Selection

Repeatedly press the PARAM key to view the adjustable parameters for the selected module.

Parameter Adjustment



The LEFT and RIGHT arrow keys are used to place the cursor at a specific position in the adjustable parameter.

The UP and DOWN arrow keys are used to increase (decrease) the value of the displayed parameter highlighted by the cursor. Changes made to the parameter are not implemented until the ENTER key is pressed.

Parameter Entry

The ENTER key must be pressed after editing to apply changes to the displayed parameter. Editing sessions are automatically cancelled if the ENTER key is not pressed within 3 seconds of changing the parameter.

Sweeping Parameter Values

It is possible to rapidly adjust and implement changes to a parameter value by pressing either the UP or DOWN arrow key and the ENTER key simultaneously. This provides the capability to sweep over a range of parameter values.

Mainframe Parameter Menu

The FOM-7900B Fiber Optic System Mainframe menu is shown in Table 2.1. (Pressing the CHAN UP or CHAN DOWN key until “Ch All” is shown in the upper left corner of the display accesses the mainframe parameter menu.) A selection is made by repeatedly pressing the PARAM key until the desired parameter is displayed.

Table 2.1 FOM-7900B Parameter Menu

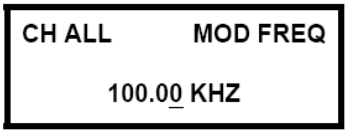
Mod Setup[1]
Mod Freq
Mod Source
User Mode[2]
Modulation
Coherence Ctl
Source Output
Setup Mode[1]
GPIB Address
Bank Address
User Mode[2]
ERROR[3]

[3]Pressing ENTER at this parameter passes control to the secondary menu.
[4]Pressing ENTER at this parameter menu passes control back to the main menu.
[5]Error messages are displayed only when an error condition exists within the mainframe.

Modulation Setup

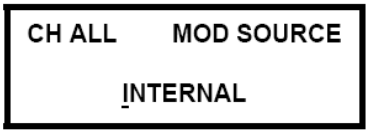
Press the ENTER key to proceed to the secondary menu structure specific to the setup of the internal/external modulation.

Modulation Frequency



Use this parameter to set the internal modulation frequency in kHz. The value on the bottom line indicates the present modulation frequency. Use the LEFT and RIGHT arrow keys to move the cursor and the UP and DOWN arrow keys to adjust the frequency. Then press the ENTER key to implement the change.

Modulation Source



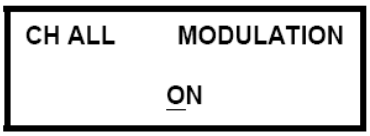
Use this parameter to set the modulation source as INTERNAL or EXTERNAL. The value on the bottom line indicates the present source of the modulation signal. Use the UP and DOWN arrow keys to select the source of the modulation signal. Then press the ENTER key to implement the change.

When the modulation source is **INTERNAL**, the signal generated by an internal function generator is sent down the FOM-7900B backplane and to the MODULATION OUT connectors on the rear panel. When the modulation source is **EXTERNAL**, the modulation signal provided at the MODULATION IN connector on the FOM-7900B rear panel is sent down the backplane and to the MODULATION OUT connectors. The modulation is then enabled and disabled in the modules using the **Modulation** command.

Return to Main Menu

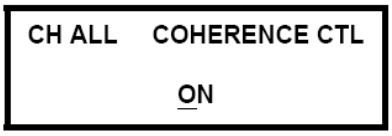
Press the ENTER key at this display to return to the main menu structure.

Modulation ON/OFF



Use this parameter to enable or disable the modulation in the modules. Use the UP or DOWN arrow keys to select **ON** or **OFF**. Then press the ENTER key to implement the change.

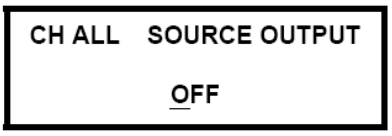
Coherence Control ON/OFF



In single mode fiber applications, light from narrow linewidth sources will remain coherent even after traveling long distances. This coherence can cause interference between reflective surfaces such as FC/PC interfaces downstream from the optical source. This interference is most noticeably seen as power instability. Enabling coherence control broadens the linewidth of the laser, thus decreasing the source's coherence length and minimizing the associated interference effects. The coherence control feature also minimizes the nonlinear effects seen in fiber optic systems due to Brillouin scattering.

Use this parameter to enable or disable coherence control in all source modules. Use the UP or DOWN arrow keys to select **ON** or **OFF**. Then press the ENTER key to implement the change.

Sources ON/OFF

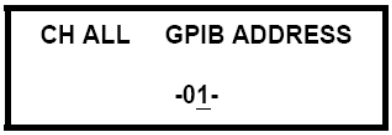


Use this parameter to turn all source module outputs on or off. Use the UP or DOWN arrow keys to select **ON** or **OFF**. Then press the ENTER key to implement the change. The green LEDs on the front of all source modules indicate the state of the sources. There is a three second safety startup when the outputs are turned on. During the startup period the front panel ON LEDs blink rapidly.

Setup Mode

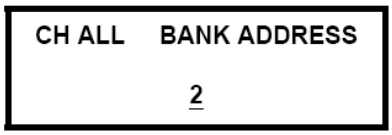
Press the ENTER key to proceed to GPIB remote setup.

Set GPIB Address



Use this parameter to adjust the GPIB Talk/Listen address. Use the LEFT and RIGHT arrow keys to move the cursor and the UP and DOWN arrow keys to adjust the GPIB address to a value from 1 through 31. Then press the ENTER key to implement the change.

Set Bank Address



It is possible to link several FOM-7900B Systems together to control up to 200 channels from one GPIB Address. Each FOM-7900B in the linked system must have a unique Bank Address.

Use this parameter to adjust the Bank Address. Use the LEFT and RIGHT arrow keys to move the cursor and the UP and DOWN arrow keys to adjust the Bank Address to a value from 0 through 24. Then press the ENTER key to implement the change.

Return to Main Menu

Press the ENTER key at this display to return to the main menu structure.

CHAPTER 3

FOS-79800F MODULE

This chapter describes the features of the FOS-79800F Fiber Optic Source Module. Performance specificiations, operational menu details and remote commands are included. Refer to Chapter 1 for installation instructions.

CAUTION: Do not insert or remove any module while the FOM-7900B is powered up. This could damage the module and/or mainframe. Be sure the module is properly installed before applying power to the FOM-7900B.

CAUTION: The Fiber Optic Source Module is a static sensitive device. Installing or removing any module from the FOM-7900B System should take place at an ESD protected workbench. The operator should be properly earth grounded.

The 79800F Source Modules with version 6.2 or higher firmware should be used in the FOM-7900B Mainframes running version 3.4 or higher firmware. Each module provides a stable laser source at a user specified maximum power and center wavelength.

Annual factory calibration is recommended for best performance of the FOS-79800F Source Modules.

FOS-79800F Specifications

A list of wavelength and power levels for source modules is shown in Table 3.1. Performance specifications for the series of FOS-79800F Precision Fiber Optic Source Modules are shown in Table 3.2. In keeping with our commitment to continuing improvement, ILX Lightwave Corporation reserves the right to change specifications without notice or liability for such changes.

Table 3.1 DFB Source Module Options

MODULE	CENTER WAVELENGTH	MAXIMUM POWER LEVEL
FOS-79800F/315C1	1527.98 – 1564.26 nm (C-band)	9 – 10 mW
FOS-79800F/315L1	1564.27 – 1610.00 nm (L-band)	9 – 10 mW
FOS-79800F/315C2	1527.98 – 1564.26 nm (C-band)	>10 up to 20 mW
FOS-79800F/315L2	1564.27 – 1610.00 nm (L-band)	>10 up to 20 mW
FOS-79800F/315S	1475.00 – 1527.97 nm (S-band)	9 – 20 mW
FOS-79800F/315EL	1601.01 – 1625.00 nm (Extended L-band)	9 – 20 mW
FOS-79800F/SERV	1310, 1480, 1510, 1625 ± 5 nm (Service Channels)	9 – 20 mW
FOS-79800F/CUST	Customer-supplied lasers; non-standard product	
FOS-79800F/000	Special product for non-standard wavelength	

Table 3.2 FOS-79800F Module Specifications

PARAMETER	SPECIFICATION
Output Power	
Level at Full Power[1]	Refer to Table 3-1
Stability[2]	
15 Minutes (spec)	<0.005 dB rms (<0.002 dB rms typical)
24 Hours	±0.03 dB
Attenuation	
Calibrated Range	Full power to 0 dBm
Accuracy[3]	±0.1 dB
Wavelength	
Available center λ	Refer to Table 3-1
Resolution	1 pm
Accuracy[4]	±25 pm
Stability	
15 Minutes	±3 pm
24 Hours	±5 pm
Tuning Range	±0.85 nm
Spectral Width	
Coherence Control OFF	<30 MHz
Coherence Control ON	1 GHz (typical)[5]
General	
Side Mode Suppression[6]	>40 dB (>45 dB typical)
Signal to Background[7]	>30 dB
Optical Isolation	>30 dB
RIN[8]	-145 dB/kHz
Modulation Frequency[9]	1 – 500 kHz
Optical Connector[10]	FC/APC
Operating Temperature	15°C – 35°C
SSE50 Option	
Signal/Spontaneous Emission (within ±100nm of center λ)	>50 dB

[1]User-specified maximum power level.

[2]After 1-hour warm-up (typical). Some modules may require longer warm-up time. For short-term stability, assume ambient temperature constant within ±0.1°C. For long-term stability, assume ambient temperature constant witin ±1.0°C. 79800F/SERV requires warm-up of up to six hours.

[3]Defined as: ΔP_{meas} - ΔP_{set} from maximum power to 5 dB down.

[4]Wavelength accuracy ±25 pm for 90 days following factory or user calibration; ±50 pm for 1 year.

[5]Other linewidths available.

[6]Measured at output connector, set to maximum power.

[7]±100 nm about center wavelength.

[8]Measured at output connector. Use angled connector patchcords to minimize noise.

[9]Modulation depth 100%, duty cycle 50%, rear panel TTL level input. Some rising edge ring above 100 kHz. See FOM-7900B System Mainframe specifications for more information.

[10]Other connector types available. Some specifications may be degraded. Also available: PANDA PM fiber aligned to slow axis.

Table 3.3 General FOS-79800F Module Specifications

Operating Temperature	15°C – 35°C
Storage Temperature	-40°C – 70°C
Relative Humidity	<80% RH, non-condensing
Module Dimensions (H x W x D)	12.8 x 3.5 x 29.0 cm (5” x 1.4” x 11.4”)
Weight	0.5 kg (1.1 lb)

SS-810 Source Shutter Option

The SS-810 source shutter is a thermally stabilized optical 1x1 switch which is used to block the light from the laser in the FOS-79800F Source Module. When the shutter is shut, light is blocked but the laser remains on. The shutter can be controlled through both the front panel and the GPIB interface.

Table 3.4 SS-810 Source Shutter Specifications

Power Stability, 24 hr (25°C ± 1°C)	< ±0.07 dB
Power Stability, 15 min (25.0°C ± 0.1°C)	<0.005 dB rms
Wavelength Stability, 24 hr (25°C ± 1°C)	< ±5 pm
Shutter ON/OFF Power Repeatibility	±0.05 dB
Lifetime	>10 M cycles
Transistion Time	
Off – On	30 ms
On – Off	10 ms

FOS-79800F Source Module Parameter Menu

For FOM-7900B system commands, refer to the Mainframe Parameter Menu, Table 2.1 in Chapter 2.

Table 3.5 FOS-79800F Parameter Menu

79800F Ver. 6.2

Output

Source Shutter (OPEN/SHUT)

Set Level (dBm)

Set Wavelength (nm)

Cal Mode[1]

Cal Level

Cal Wavelength

Default Cal

User Mode[2]

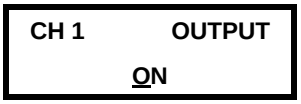
ERROR[3]

[1]Pressing ENTER at this parameter passes control to the secondary menu.
[2]Pressing ENTER at this parameter passes control back to the main menu.
[3]Error messages are displayed only when an error condition exists within the module.

Module Identification

This parameter displays the model number, module serial number and the firmware version. The parameter is not adjustable. The arrow keys and ENTER are disabled.

Output ON/OFF



Use this parameter to turn the laser output on or off. Use the UP or DOWN arrow keys to select ON or OFF. Then press the ENTER key to implement the change. The green LED on the front of the module indicates the presence of light. The green LED will only illuminate if the Output is ON and the Shutter is OPEN.

Source Shutter OPEN/SHUT

Use this parameter to open or shut the Source Shutter. Use the UP or DOWN arrow keys to select OPEN or SHUT. Then press the ENTER key to implement the change. The green LED on the front of the module indicates the presence of light. The green LED will only illuminate if the Output is ON and the Shutter is OPEN. This parameter is displayed only when the shutter option has been detected in the module.

Set Power Level

Use this parameter to set the output power in dBm. The number displayed on the bottom line indicates the present power level. Use the LEFT and RIGHT arrow keys to move the cursor and the UP and DOWN arrow keys to adjust the level. Then press the ENTER key to implement the change.

Set Wavelength

CH 1 SET WAVELENGTH
1552.456 NM

Use this parameter to set the wavelength in nanometers. The number displayed on the bottom line indicates the present wavelength setting. Use the LEFT and RIGHT arrow keys to move the cursor and the UP and DOWN arrow keys to adjust the wavelength. Allow time for wavelength to stabilize after resetting.

User Calibration

CH 1 CAL MODE
(PRESS ENTER)

Press the ENTER key to proceed to the secondary menu structure specific to the field calibration of the FOS-79800F Fiber Optic Source Module.

Calibrate Power Level

CH 1 CAL LEVEL
+1.55 DBM

The Cal Level feature can be used when the measured output power does not match the front panel setting or to compensate for losses induced by patch cords. Use the steps below to enter a Power User Calibration. This calibration generates a single point offset that is applied to all future power levels.

1. Connect an optical power meter to the end of a fiber optic patch cord. Program the power meter to the wavelength of the FOS-79800F PrecisionFiber Optic Source. Zero the power meter.
2. Set the FOS-79800F Precision Fiber Optic Source Module to a level near that of the test application. Turn the source on.
3. Proceed to the Cal Level display.
4. Give the system one hour to warm up and stabilize. Measure the output power with the power meter. Then use the LEFT and RIGHT arrow keys to move the cursor and the UP and DOWN arrow keys to enter the measured power from the power meter. Then press the ENTER key.

Calibrate Wavelength

CH 1 CAL WAVELENGTH
1554.001 NM

The Cal Wavelength feature can be used when the measured wavelength does not match the front panel setting. Use the steps below to enter a Wavelength User Calibration. The cal generates a single point offset that is applied to all future wavelength settings.

1. Connect a wavelength meter to the end of a fiber optic patch cord.
2. Set the FOS-79800F Fiber Optic Source Module to a wavelength
3. near that of the test application. Turn the source on.
4. Proceed to the Cal Wavelength display.
5. Give the "system" 1 hour to warm up and stabilize. Measure the wavelength with the wavelength meter. Then use the LEFT and RIGHT arrow keys to move the cursor and the UP and DOWN arrow keys to enter the measured wavelength from the meter. Then press the ENTER key.

Reset User Calibration

CH 1 DEFAULT CAL
(PRESS ENTER)

Press ENTER at this display to remove the effects of the User Calibration(s). The User Calibration is an offset that is applied to all power and wavelength settings. Resetting the calibration returns these offsets to 0.00dB and 0.000nm.

Return to Main Menu

CH 1 USER MODE
(PRESS ENTER)

Press the ENTER key to return to the main menu structure.

Error Display

CH 1 **ERROR**
501 – CASE TEMP ERROR

This parameter is displayed only when an error condition has been detected within the module. The parameter cannot be modified and the arrow keys and the ENTER key are disabled. Error messages are defined in Chapter 11 of this manual.

External Trigger

The FOS-79800F Fiber Optic Source Module does not support external triggering.

Error Indicator

When an error is detected within the FOS-79800F Module the red LED on the front of the module blinks. To view a description of the error press the PARAM key repeatedly until the ****ERROR**** screen is displayed. Error messages are displayed until the error causing condition is remedied.

Error messages are also described in Chapter 11, Error Messages.

On Indicator

When light is present at the output connector the green LED is on. This indicates that both the Laser is energized and the Source Shutter option is open. The default condition for the modules is laser not energized and shutter open. This configuration has been adopted to maintain consistency between modules with and without the source shutter option.

Modulation

It is possible to modulate the laser output of the FOS-79800F. Control of the modulation is provided in the **Ch All** menu structure. Refer to Chapter 2, FOM-7900B Mainframe Operation for more detail. Modulation applies to all source modules simultaneously.

Coherence Control

In single mode fiber applications, light from narrow linewidth sources will remain coherent even after travelling long distances. This coherence can cause interference between reflective surfaces such as FC/PC interfaces downstream from the optical source. This interference is most noticeably seen as power instability. The coherence control feature of the FOS-79800F broadens the linewidth of the laser, thus decreasing the coherence length and minimizing the associated interference effects. The coherence control feature also minimizes the

nonlinear effects seen in fiber optic systems due to Brillouin scattering. The Coherence Control is turned **ON** or **OFF** within the **Ch All** menu structure.

Table 3.6 FOS-79800F Remote Commands

COMMAND NAME	# PARAMETERS EXPECTED	DESCRIPTION
CAL:LEVEL	##.##	Sets the Power User Calibration.
CAL:RESET	##.##	Resets the User Calibration.
CAL:WAVE	####.###	Sets the Wavelength User Calibration.
ERRor?	NONE	Returns an error code. (See Chapter 11)
IDN?	NONE	Returns a string that identifies the module.
LEVEL	±##.##	Sets the output power level.
LEVEL?	NONE	Returns the output power level.
OUT	#	Turns the output on and off.
OUT?	NONE	Returns the ON/OFF status of the laser.
SHUTPRES?	NONE	Returns the presence of the shutter option.
SHUTTER	ON/OFF or 1/0	Open (ON) and closes (OFF) the shutter.
SHUTTER?	NONE	Returns the state of the shutter.
WAVE	####.###	Sets the wavelength.
WAVE?	NONE	Returns the wavelength setting.
WAVEMAX?	NONE	Returns the maximum wavelength setting.
WAVEMIN?	NONE	Returns the minimum wavelength setting.

CHAPTER 4

FOS-79710 MODULE

This chapter describes the features of the FOS-79710 1x4 Fiber Optic Switch Module. Performance specificiations, operational menu details and remote commands are included. Refer to Chapter 1 for installation instructions.

CAUTION

Do not insert or remove any module while the FOM-7900B is powered up. This could damage the module and/or mainframe. Be sure the module is properly installed before applying power to the mainframe.

WARNING

The Fiber Optic Switch Module is a static sensitive device. Installing or removing any module from the FOM-7900B System should take place in an ESD protected environment. The operator should be properly earth grounded.

The FOS-79710 Fiber Optic Switch Module must be used with the FOM-7900B Mainframe. It is designed to connect a single fiber optic signal to one of four possible channels. The modules are optically transparent to signal formats and bandwidths as well as being bi-directional in operation. Random, sequential or triggered switching modes enhance switch module functionality.

The optical and mechanical performance specifications for the FOS-79710 Fiber Optic Switch Module are shown in Table 4.1.

Table 4.1 FOS-79710 Module Specifications

Fiber Type	9 / 125 µm, SMF-28
Wavelength Range	1280 – 1650 nm
Connector Type	FC/APC
Insertion Loss[1]	1.2 dB typical, 1.7 dB maximum[2]
Crosstalk	< -80 dB
Polarization Dependent Loss[3]	< 0.05 dB
Repeatability[4]	< +0.03 dB
Switching Time[5]	16 ms/channel + 300 ms (maximum)
Maximum CW Input Power	+24 dBm
Return Loss	> 55 dB
Switch Life	> 10M cycles
Operating Temperature	+15°C – +35°C
Operating Humidity	< 80% RH, non-condensing
Storage Temperature	-20°C – +70°C
Dimensions (H x W x D)	12.8 x 3.5 x 29.0 cm (5 x 1.4 x 11.4 in)
Module Weight	0.8 kg (1.8 lb)

[1]Measured at 23°C ± 5°C.
[2]Maximum insertion loss, any module output port.
[3]Measured at 1550 nm.
[4]Sequential switching; 100 cycles measured at constant temperature after module warm-up.
[5]Excluding GPIB and mainframe processor latency.

When enabled, the FOS-79710 Fiber Optic Switch Module responds to an external trigger signal on the rear panel of the FOM-7900B Mainframe.

FOS-79710 Parameters

For FOM-7900B system commands, refer to the Mainframe Processor Menu in Chapter 2.

The FOS-79710 1 x 4 Fiber Optic Switch Module menu is shown in Table 4.2. A selection is made by repeatedly pressing the PARAM key until the desired parameter is displayed.

Table 4.2 FOS-79710 Parameter Menu

79710 Ver 2.0
Output Port
Triggered Mode[1]
Trigger Enable
Sequence 1 → 4
Step #1 Port
Step #2 Port
Step #3 Port
Step #4 Port
User Mode[2]
Timed Mode[1]
Timer Enable
Time Interval
Sequence 1 → 4
Step #1 Port
Step #2 Port
Step #3 Port
Step #4 Port
User Mode[2]
ERROR[3]

[1]Pressing ENTER at this parameter passes control to the secondary menu.
[2]Pressing ENTER at this parameter passes control back to the primary menu.
[3]Error messages are displayed only when an error condition exists in the module.

Module Identification

CH 1 79710 VER 2.0
1 X 4 FIBER SWITCH

This parameter displays the model number, firmware version number and a description of the module. The parameter is not adjustable. The arrow keys and ENTER key are disabled.

Select Switch Port

CH 1 OUTPUT PORT
2

This menu is used to determine which port (1-4 or None) is switched to the common port (top connector). The number displayed on the bottom line indicates the current port. Use the UP and DOWN arrow keys to select a new port, then press the ENTER key to activate the change. Selecting “None” places the switch into the optically off (blocked) position. For laser safety reasons, the FOS-79710 Switch Module always powers up in the “None” position.

In Trigger or Timer modes, the port number shown reflects the last manually selected port. This menu can be used to override the current output port in these modes. However, this action may have unintended consequences and is suggested that overriding the Trigger or Timer modes be avoided.

Select External Trigger

CH 1 TRIGGERED MODE
(PRESS ENTER)

Press the ENTER key to proceed to the secondary menu structure specific to the control of the external triggering features of the Switch Module.

Enable External Trigger

CH 1 TRIGGER ENABLE
ENABLE

Use this parameter to enable or disable the effects of the external trigger signal from the FOM-7900B rear panel. Use the UP or DOWN arrow keys to ENABLE or DISABLE the external trigger, then press ENTER to activate the change. For laser safety reasons, the FOS-79710 Switch Module always powers up with Trigger mode disabled.

When the external trigger is enabled, the module will automatically move the switch position to the next port in the sequence whenever a trigger signal is received at the FOM-7900B rear panel (or when the TRIG command is sent through GPIB). The Trigger and Timer Modes are mutually exclusive; if the Trigger Mode is ENABLEd, the Timer Mode will be DISABLEd.

Initialize Trigger Switch Sequence

CH 1 SEQUENCE 1 → 4
(PRESS ENTER)

Press the ENTER key to initialize the four-element trigger switch sequence to the following default sequence:

1 → 2 → 3 → 4 ↵

Customize Trigger Switch Sequence

CH 1 STEP #1 PORT
4

Use this and the next three menu items to customize the switch sequence for the external trigger mode. Use the UP or DOWN arrow keys to select the next port in the sequence and press ENTER to activate the change. Pressing ENTER does not change the current switch position but merely places the new port position into the chosen element of the sequence array. It is possible to select “None” to skip a switch position, or to shorten the executed sequence by repeating a port position.

For instance, to switch repeatedly between ports 1 and 3, choose the sequence:

1 → 3 → 1 → 3 ↵

Return to Main Menu

CH 1 USER MODE
(PRESS ENTER)

Press the ENTER key to return to the main menu structure.

Select Timed Mode

CH 1 TIMED MODE
(PRESS ENTER)

Press the ENTER key to proceed to the menu for controlling the Timed Mode interval switching feature.

Enable Interval Timer

CH 1 TIMER ENABLE
ENABLE

Use this parameter to enable or disable the automatic switching of the built-in timer. Use the UP or DOWN arrow keys to ENABLE or DISABLE the timer, then press ENTER to activate the change. For laser safety reasons, the FOS-79710 Switch Module always powers up with Timer mode disabled.

When the timer is enabled, the module will automatically move the switch position to the next port in the sequence at the rate determined by the timer interval. The Timer mode is convenient for conducting long-term tests in situations where remote control of the switch by a host computer is not possible. Note that the Timer and Trigger modes are mutually exclusive; if the Timer mode is ENABLEd, the Trigger mode will be DISABLEd.

Set Interval Time

CH 1 TIME INTERVAL
3.21 SEC

This parameter sets the internal timer interval in seconds. Use the LEFT and RIGHT arrow keys to move the cursor and the UP and DOWN arrow keys to adjust the interval time. Then press the ENTER key to activate the change.

The timer interval is can be set from 1.00 to 60.00 seconds. The resolution of the internal timer itself is 10 ms; however it should be kept in mind that the absolute resolution of the switch is 16 ms.

Initialize Timer Switch Sequence

CH 1 SEQUENCE 1 → 4
(PRESS ENTER)

Press the ENTER key to initialize the four-element timer switch sequence default:

1 → 2 → 3 → 4 ↵

Customize Timer Switch Sequence

CH 1	STEP #1 PORT
	3

Use this and the next three menu items to customize the switch sequence for the Timer mode. Use the UP or DOWN arrow keys to select the next port in the sequence and press ENTER to activate the change. Pressing ENTER here does not change the actual switch position but merely places the new port position into the chosen element of the sequence array. It is possible to select “None” to skip a switch position, or to shorten the executed sequence by repeating a port position.

For instance, to switch repeatedly between ports 2 and 4, choose the sequence:

2 → 4 → 2 → 4 ↵

Return to Main Menu

CH 1	USER MODE
(PRESS ENTER)	

Press the ENTER key to return to the main menu structure.

Error Display

CH 1	**ERROR**
504	INVALID SWITCH

This parameter is displayed only when an error condition has been detected within the module. The parameter cannot be modified and the arrow keys and ENTER key are disabled. Error messages are defined in Chapter 11.

External Trigger Specifications

When Trigger mode is enabled, the FOS-79710 Fiber Optic Switch Module responds to an external trigger signal on the rear panel of the FOM-7900B Mainframe. The same effect may be accomplished by sending the TRIG command using GPIB or RS-232 communication protocol. The TRIG command is particularly useful for switching several FOS-79710's simultaneously. The electrical specifications of the external trigger interface are shown in Table 4.3.

Table 4.3 FOS-79710 External Trigger Specifications

Level	TTL; Normally high (+5 volts)
Edge	Active Low (triggers on high-to-low transition)
Pulsewidth	100 ns, minimum
Latency	500 ms, absolute maximum (time between trigger edge & complete stability of optical signal)
Switching Frequency	2.0 Hz, maximum (triggers above this rate will produce maximum switching frequency)

For every trigger pulse or TRIG command sent to the FOM-7900B, the switch will move to the next port in the switch sequence array. Trigger pulses occurring at a frequency higher than the maximum will produce the maximum switch rate.

Table 4.4 FOS-79710 Remote Commands

NAME	PARAMETER	DESCRIPTION
ERR?	NONE	Returns any error codes generated (see Chapter 12).
IDN?	NONE	Returns a string that identifies the modue.
INTERVAL	##.##	Sets the timer interval, in seconds.
INTERVAL?	NONE	Returns the timer interval, in seconds.
PORT	#	Sets the port that is switched to the common port.
PORT?	NONE	Returns the currently-selected switch port.
SEQ:DEFAULT	NONE	Initializes the Trigger/Timer switch sequence.
SEQ:SWn	#	Sets the nth position in the switch sequence array.
SEQ:SWn?	NONE	Returns the nth position from the sequence array.
SEQ:TMR	ON / OFF	Enables or Disables the Interval Timer (1 or 0).
SEQ:TMR?	NONE	Returns the state of the Timer Mode (1 or 0).
SEQ:TRG	ON / OFF	Enables or Disables the External Trigger (1 or 0).
SEQ:TRG?	NONE	Returns the state of the Trigger Mode (1 or 0).

CHAPTER 5

RS-232 INTERFACE

This chapter provides information on using the RS-232 serial communication interface of the FOM-7900B. This interface may be used to either provide a communication link directly with the host computer or to link several 7900B mainframes together.

RS-232 Communications Protocol

To establish serial communications between a computer serial port and the FOM-7900B System, a serial cable is connected between an available COM port on the host computer and the RS-232 connector on the rear panel of the FOM-7900B. This cable must be wired *straight through* and have a male connector on the FOM-7900B side. The serial port on the computer is initialized to the parameters described in Table 5.1.

Table 5.1 RS-232 Parameter Values

Baud Rate	9600
Stop Bits	1
Parity	None
Data Bits	8
Flow Control	None

Linking Multiple FOM-7900B Systems

It is possible to link up to twenty-five FOM-7900B Systems to control up to 200 channels from one GPIB address or one RS-232 connection to a host computer.

If several FOM-7900B mainframes are being controlled from one GPIB address, a GPIB cable is connected to the first FOM-7900B and the GPIB address is set for that unit. Serial cables are used between subsequent FOM-7900B mainframes. The cable between the first and second mainframes must have male connectors (pins) on both ends and must have one twist between pins 2 and 3. Refer to Table 5.2. This cable is connected between the RS-232 A connectors on both units.

Additional FOM-7900B mainframes are linked using a cable that has a female connector on one end and a male connector on the other end. This cable should have ***no*** twists between pins 2 and 3 (in other words, it must be wired *straight through*). The female end of this cable is inserted into the RS-232 B connector of the upstream FOM-7900B and the male end into the RS-232 A connector of the downstream FOM-7900B. Refer to Table 5.2 for more details.

Table 5.2 RS-232 Connector Wiring

Connector 1	Connector 2
1	1
2	**3**
3	**2**
4	4
5	5
6	6
7	7
8	8
9	9

Note: A unique Bank Address must be assigned to each FOM-7900B in the chain. ***The unit connected to the GPIB interface must be assigned the bank address of 0.***

Note: Figure 5.1 shows the addressing scheme for all FOM-7900B modules.

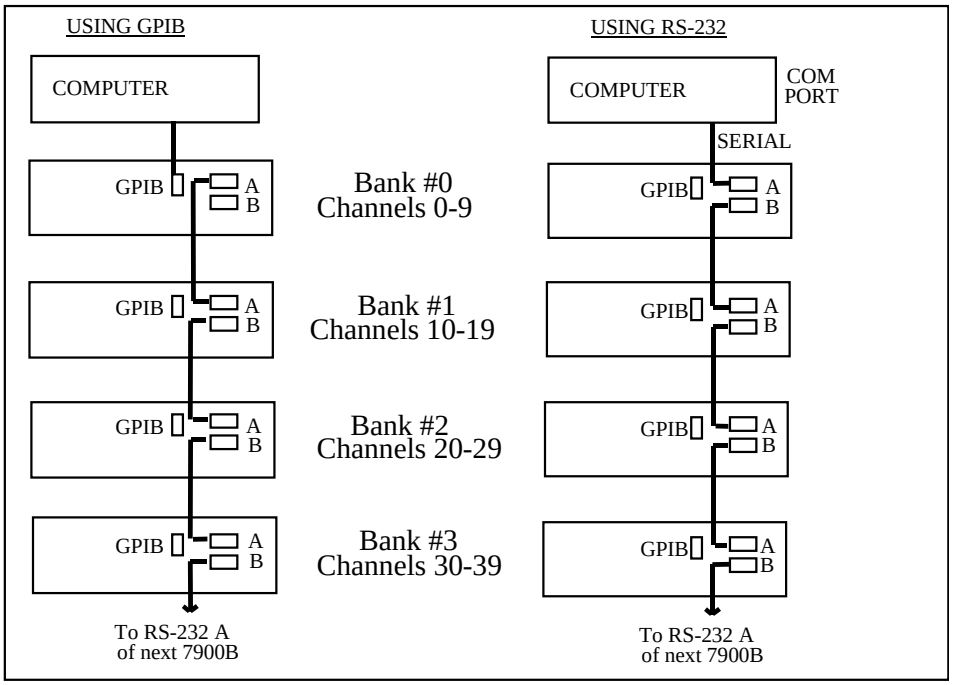


Figure 5.1 FOM-7900B Stacked System

Communication with Multiple FOM-7900B Systems

The following issues are important when communicating with a stacked FOM-7900B System.

All of the GPIB common commands listed in Chapter 7 and device specific commands listed in Chapter 8 respond normally with multiple FOM-7900B systems.

All GPIB commands and queries, including IEEE-488.2 common commands and queries, are sent to the FOM-7900B mainframe (or module) selected by the CHAN command. This includes the reset command *RST. Use the following formula to determine the channel number of a module in a multiple FOM-7900B system.

Channel # = (Bank Address x 10) + Slot Number

Note: A unique Bank Address must be assigned to each FOM-7900B in the chain. ***The unit connected to the GPIB interface must be assigned the bank address of 0.***

Note: Figure 5.1 shows the addressing scheme for all FOM-7900B modules.

Example: The fourth channel in the second mainframe would be Channel #14.

The sixth channel in the eleventh mainframe would be Channel #106.

All CHAN x0 commands (e.g. CHAN 0, 10, 20, ... 240) are directed to the appropriate mainframe. This is important for commands such as MOD ON/OFF, and FREQ.

CHAN x9 commands (e.g. CHAN 9, 19, 29, ... 249) are module specific and will apply to all modules in the mainframe. If CHAN x9 is selected then subsequent commands are forwarded to all the modules in the selected mainframe. The command sequence CHAN 49; LEVEL -3.00 is useful to set the power level for all eight sources in the fifth mainframe to -3.00 dBm

The following rules must be followed when sending commands and queries to a "stacked" FOM-7900B System (these rules apply to a system connected to the host computer with either a GPIB cable or an RS232 cable).

The CHANNEL command should always be sent as the only command on the command line, and it must be followed by an *OPC? (operation complete) query. No other command or query should appear on the command line.

Example: Incorrect command line:

```
CHANNEL 25 ; LEVEL 5.0 ; WAVE 1550.0; *OPC?
```

Correct command lines:

```
CHANNEL 25 ; *OPC?
```

```
LEVEL 5.0 ; WAVE 1550.0 ; *OPC?
```

Any command line sent should be terminated by a *OPC? query if it does not already contain a query.

Example: Incorrect command lines:

```
MOD ON
```

```
LEVEL 5.00
```

Correct command lines:

```
MOD ON; *OPC?
```

```
LEVEL 5.00; *OPC?
```

```
LEVEL 5.00; LEVEL?
```

Commands and/or queries to different banks must not be mixed on the same command line.

Example: Incorrect command lines:

```
CHAN 12; LEVEL 5; CHAN 13; LEVEL 5; WAVE 1550.0
CHAN 22; LEVEL?; WAVE?; CHAN 23; LEVEL?; WAVE?
```

There are three errors above:

1. Mixing commands to multiple channels on the same command line.
2. Sending a message that does not contain a query (the last line).
3. Not using the correct method of selecting a channel.

Correct command lines:

```
CHAN 12; *OPC?
LEVEL 5; *OPC?
CHAN 13; *OPC?
LEVEL 5; WAVE 1550.0; *OPC?
CHAN 22; *OPC?
LEVEL?; WAVE?
CHAN 23; *OPC?
LEVEL?; WAVE?
```

If a non-existant bank is addressed and sent a query, the response “Bank not found: *n*” will be returned in approximately 10 seconds, where *n* is the bank number (channel number divided by 10). This time-out period can be changed with the TIMEOUT command described in Chapter 8.

CHAPTER 6

GPIB REMOTE OPERATION & COMMON COMMANDS

This chapter provides information on using the FOM-7900B's GPIB remote interface. This interface is used to provide a communication link directly with the host computer so that automated testing and configuration can occur.

The GPIB/IEEE-488.2 interface is installed in the FOM-7900B system to allow fast and efficient remote operation. This interface complies with the IEEE-488.2/1987 standard to the extent shown below.

Table 6.1 IEEE-488 Interface Specifications

SH1	Source Handshake - complete compatibility
AH1	Acceptor Handshake - complete capability
T6	Talker Functions
L4	Listener Functions
SR1	Service Request - complete capability
RL1	Remote Local Function - complete capability
PP0	Remote Configuration Parallel Poll - NO CAPABILITY
DC0	Device Clear - NO CAPABILITY
DT1	Device Trigger - complete capability
C0	Controller Function - NO CAPABILITY
E1, E2	Tri-state bus drivers with automatic switch to open collector during Parallel Poll.

Other GPIB features include:

- A concise and straightforward command set
- Full serial poll capability, with SRQ
- Full local/remote capability including LOCAL LOCKOUT

This chapter is divided into three parts. The first part contains information for getting started using GPIB. It also contains the syntax for each 488.2 common command which is supported by the FOM-7900B. The second part contains information on status reporting. The third part contains information on remote interface messages which are generally transparent to the user.

7900 and GPIB Controller Synchronization

To ensure that the 7900 instrument is synchronized with the computer while under GPIB control, follow each command with a query. It is imperative that the response to the query is read by the computer. This effectively forces the computer to wait for the response to the query before transmitting the next command. Since every 7900 command is sequential, the instrument will not return a query response until the preceding command has been completed.

Preparation for GPIB Control

To use the FOM-7900B remotely, an IEEE-488 interface adapter is required in the host computer. These adapters and support software are available from several manufacturers and can be installed in most computers.

LOCAL Control

When the instrument is in REMOTE all front panel controls are disabled except the LOCAL key and the display indicates >>REMOTE<<. Press the LOCAL key to return the device to LOCAL control, re-enabling the front panel.

When the unit is in LOCAL mode, pressing the LOCAL key causes the GPIB address to be shown on the display for three seconds, e.g. -01-.

Remote Control

Whenever the instrument is addressed by a system controller the display indicates >>REMOTE<< and the front panel is disabled from manual control. Press the LOCAL key to return to manual control.

GPIB Address

The talk and listen addresses on the FOM-7900B are identical. When the unit is in LOCAL mode, pressing the LOCAL key causes the GPIB address to be displayed. Extended GPIB addressing is not implemented in the FOM-7900B. Use the following procedure to change the GPIB address.

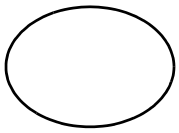
1. Press the CHAN UP or CHAN DOWN key until **Ch All** is displayed.
2. Press PARAM repeatedly until **Setup Mode** is displayed. Press the ENTER key.
3. Press PARAM repeatedly until **GPIB Address** is displayed. Use the UP and DOWN arrow keys to select the desired GPIB address then press the ENTER key. The allowable range is 1 through 31.

ANSI/IEEE-488.2 Definitions

The following sections contain the relevant definitions for syntax diagrams and syntax elements for the GPIB commands, as defined by the IEEE-488.2 standard.

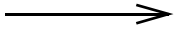
Syntax Diagrams

Syntax diagrams indicate the most complete form of GPIB command construction. The terminology shown here and in subsequent sections is used throughout this manual to define the command syntax. These syntax diagrams conform to the ANSI/IEEE-488.2-1987 standard and the terminology presented here reflects that standard.



The oval (or round) shape contains a terminal syntactic element. These represent a basic function such as a single ASCII character, which cannot be divided.

Rectangles represent non-terminal syntactic elements. These represent elements which are expandable to a diagram of terminal syntactic elements. However, they are presented as a unit for clarity or emphasis.



Lines and arrows indicate correct paths through the syntax diagram. A reverse line around an element indicates that the element may be repeated indefinitely. A forward arrow around an element indicates that the element is optional.

<white space>

White space is defined by the syntactic diagram shown in Figure 6.1, where <white space character> is defined as a single ASCII-encoded byte in the range 00-09, 0B-20 (0-9, 11-32 decimal). This range includes the ASCII control characters, carriage return, and the space, but excludes the new line character.

In most practical programming situations, the space character (space bar) would be used as white space. White space is generally used to separate syntactic elements and is processed without interpretation.

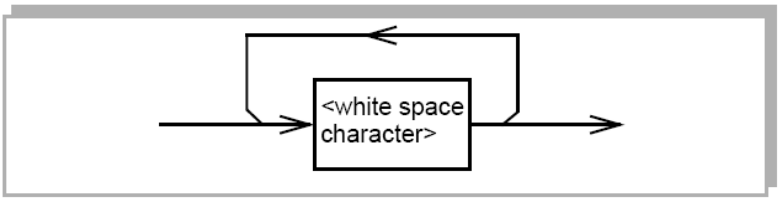


Figure 6.1 White Space Syntactic Diagram

<nrf value>

The symbol, <nrf value>, refers to the flexible numeric representation, as defined by the IEEE-488.2 standard. This means that numbers may be represented in one of three forms, integer, floating point, or engineering/scientific notation. All of the following are equal nrf values:

20, +20, 20.0, +20.0, 2.0E+1, +2.0E+1, 2.0e+1, +2.0e+1

<suffix unit>

The symbol, <suffix unit>, refers to the suffix program data that may follow an <nrf value>. If the suffix is not used, a default suffix is assumed. The device interprets any alpha characters following decimal data as a suffix without regard to upper/lower case. Suffixes are not utilized in the FOM-7900B System.

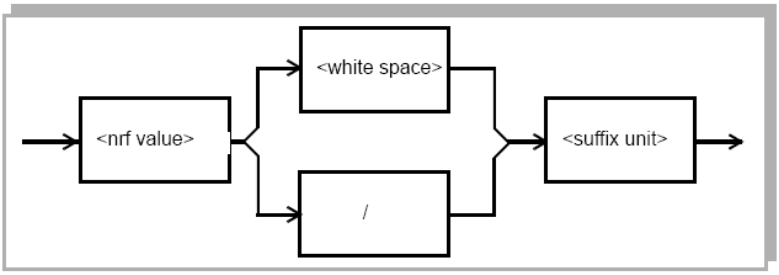


Figure 6.2 Suffix Syntactic Diagram

<PROGRAM MESSAGE TERMINATOR>

When a command is sent using the standard format, the host computer (or GPIB driver) usually puts a <NL><^END> (line feed-EOI) on the data bus following the command string. The IEEE-488.2 standard requires <NL><^END>, however, many GPIB drivers utilize <CR><NL><^END> or <NL>. The FOM-7900B accepts <LF><^END>, <CR><NL><^END>, <NL> or <^END> as an acceptable <PROGRAM MESSAGE TERMINATOR. The FOM-7900B always terminates its query responses with <CR><NL><^END> unless changed by the **TERM** command.

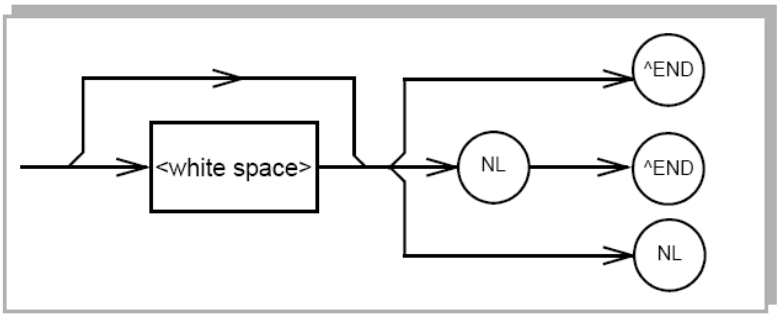


Figure 6.3 <PROGRAM MESSAGE TERMINATOR>

<PROGRAM MESSAGE UNIT SEPARATOR>

A <PROGRAM MESSAGE UNIT SEPARATOR> is used to separate sequential <PROGRAM MESSAGE UNIT> elements (commands) from one another within a <PROGRAM MESSAGE>. The syntax for a <PROGRAM MESSAGE UNIT SEPARATOR> is shown in Figure 6.4.

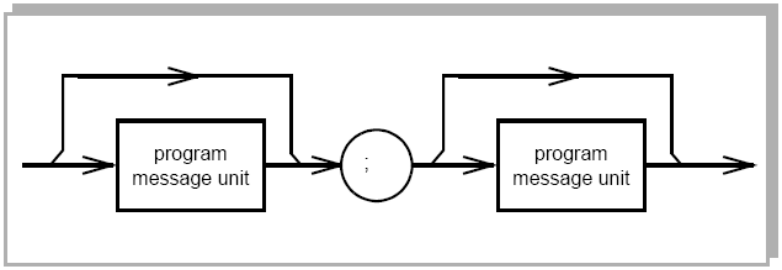


Figure 6.4 <PROGRAM MESSAGE UNIT SEPARATOR>

<PROGRAM HEADER SEPARATOR>

The <PROGRAM HEADER SEPARATOR> separates the <COMMAND PROGRAM HEADER> (GPIB command) from the <PROGRAM DATA> (first parameter after the command). A single white space must be used to separate the command from the first parameter.

<compound command program header>

Some of the FOM-7900B remote commands require a compound structure. This is done to distinguish between different commands of the same type. The compound command structure is similar to a directory path structure, as found in DOS. For example, commands which deal with FOM-7900B calibration have the path **CAL:**, as in the command to calibrate the display to a known output power:

CAL:LEVEL 0.5

A <compound command program header> is a compound command heading which may be followed by <program data> (parameters). A compound command or <compound command program header> is similar to a path for a file that starts with the root directory and lists the intermediate subdirectories. The syntax for a <compound command program header> is shown in Figure 6.5. The syntax diagram for a <compound query program header> is shown in Figure 6.6.

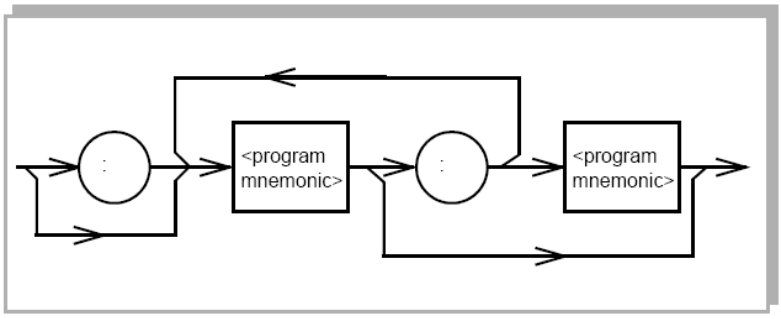


Figure 6.5 <compound command program header>

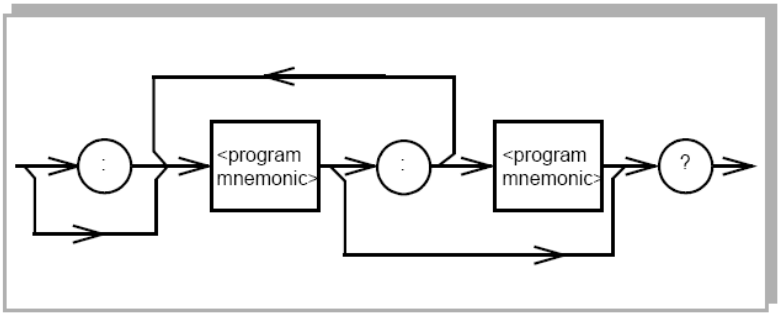


Figure 6.6 <compound query program header>

A <program mnemonic> is a command or command path identifier. For example, the <PROGRAM MESSAGE> “ENABLE:COND 256" consists of the command “COND” and the path identifier “ENABLE:”. All of the legal <compound command program headers> may be traced by starting from the root node of the command structure and moving down by levels to paths, and finally to the command.

A <PROGRAM MESSAGE TERMINATOR> causes the next command search to begin at the root node. A leading colon (:) on a <PROGRAM MESSAGE UNIT> causes the instrument to begin searching for the command at the root node. Otherwise (after a semicolon), the instrument first searches the most recently used node for the command. It continues to search the command tree until it finds a legal command path, by searching each previously used node up to the root. If no legal path is found, the instrument generates an error message.

<PROGRAM DATA> (Parameters)

<PROGRAM DATA> (parameters) may be entered after a command in a <PROGRAM MESSAGE UNIT>. The <COMMAND PROGRAM HEADER> (command) and first <PROGRAM DATA UNIT> (parameter) must be separated by a <PROGRAM HEADER SEPARATOR> (white space).

<ARBITRARY BLOCK PROGRAM DATA>

This element allows any 8-bit bytes (including extended ASCII) to be transmitted in a message. The syntax for an <ARBITRARY BLOCK PROGRAM DATA> element is shown in Figure 6.7.

The only FOM-7900B command that requires arbitrary block program data is the *PUD command.

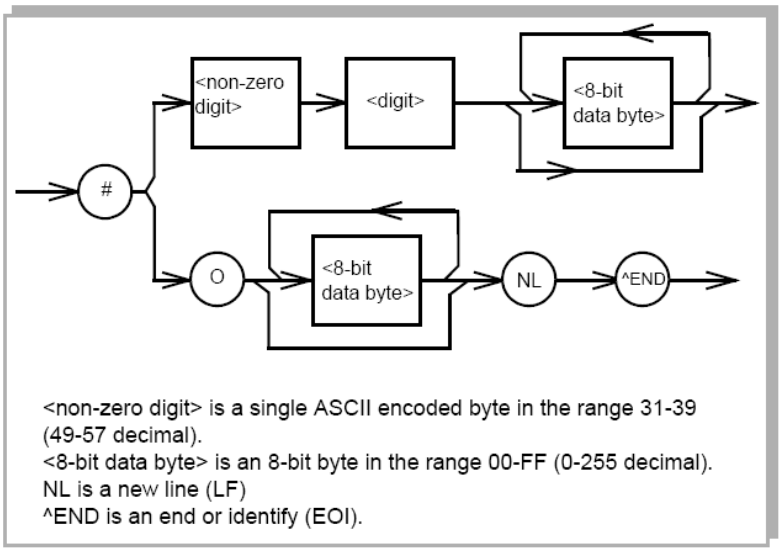


Figure 6.7 <ARBITRARY BLOCK PROGRAM DATA>

<PROGRAM DATA SEPARATORS>

When there is a list of <PROGRAM DATA UNITS> (parameters) following a <PROGRAM HEADER SEPARATOR> (white space), the <PROGRAM DATA UNITS> must be separated with a <PROGRAM UNIT SEPARATOR>. Figure 6.8 shows a syntax diagram for a <PROGRAM UNIT SEPARATOR>.

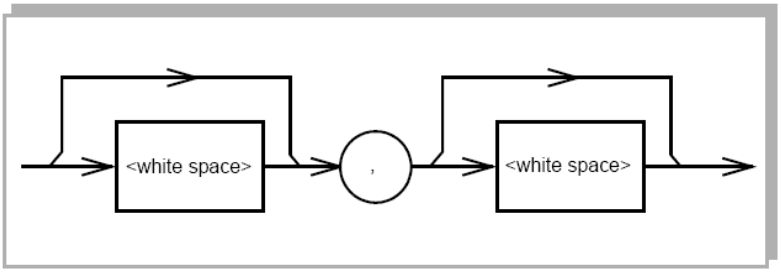


Figure 6.8 <PROGRAM DATA SEPARATOR>

Power-On Conditions

At power-on, the FOM-7900B complies with the ANSI/IEEE Std. 488.2-1987 requirements. It initializes the device parameters to be the same as when the power was last shut down. However, **the source outputs are always disabled at power-up**. The default conditions may be recalled by using the *RST command. Default conditions are shown below.

Default Parameters

There are no default values for omitted parameters. If a command is expecting a parameter and none is entered, an error is generated. If a reset is performed with the *RST command, the instrument is configured as shown in Table 6.2.

Table 6.2 FOM-7900B Default Configuration

GPIB	LOCAL indicator is off (unless *RST is sent via GPIB)
Channel	
Modulation	Ch 1
OFF	
Modulation Frequency	1 kHz
Source Output	OFF
Coherence Control	OFF

Getting Started With GPIB

This section is intended as a quick guide to the GPIB syntax and commands used by the FOM-7900B. The FOM-7900B module (device-dependent) commands are described in Chapter 8, Command Reference.

Overview of the FOM-7900B Syntax

Generally, a command or query is entered as shown in Table 6.1. The command/query must contain all of the letters which are shown in upper case in Figure 6.2 and Table 6.1. However, the command parser is not case sensitive so either upper or lower case may be used in any combination. The lower case letters shown with the commands are optional and may be used for software clarity. The commands **FREQ?** and **FREQuency?** are equal.

The syntax of the FOM-7900B commands follow the rules laid out in the IEEE-488.2 standard. Colons (:) indicate the start of a new command path. Semicolons (;) indicate a separation of commands within a string. A leading semicolon may be used to return the FOM-7900B command parser to the command path root.

Spaces may be placed anywhere in a command string (after the command header or query question mark), and must be used to separate the command (header) from the first parameter (or program data). For more information, refer to the IEEE-488.2 standard definition <white space>, on page 48. Examples of valid syntax for commands with the FOM-7900B are shown in Table 6.3.

Table 6.3 Examples of Valid Command Syntax

:ENAB:COND 256
:enable:event 256
***IDN?**

Examples of invalid syntax for commands are shown in Table 6.4. These command strings would produce an error.

Table 6.4 Examples of Invalid Command Syntax

INVALID SYNTAX	ERROR	VALID SYNTAX
ENAB COND 13	Missing colon between program headers.	**ENAB:COND 13**
CHAN 2 LEVEL?	Missing semicolon between commands.	**CHAN 2; LEVEL?**
ERR ?	Space not allowed before question mark.	**ERR?**
LVL?	Letters must be in correct order.	**LEVEL?**

Using Commands with Parameters

Some commands expect a parameter. For example, to adjust the internal modulation frequency to 100 kHz the command would be “FREQ 100.00". If a single parameter is expected, it should follow the command with one space between the command and the parameter.

Substitute Parameter Names

For clarity in programming, the (Boolean) values of one and zero may also be represented by the appropriate substitute parameter names, as shown in Table 6.5.

The ON parameter name could be used in place of the 1. The commands **OUT 1**, **OUT ON** and **OUT TRUE** are equal.

Table 6.5 Substitute Parameter Names

Substitute Name	Value
ON	1
OFF	0
TRUE	1
FALSE	0

Queries

A query has no space between the mnemonic and the question mark, as in:

OUT?

Terminators

The FOM-7900B uses a terminator of <NL><^END> (new line, EOI). In almost all cases, these terminators are automatically inserted by the system controller or GPIB driver. For more information, refer to the IEEE-488.2 standard definition <PROGRAM MESSAGE TERMINATOR> on page 49.

Common Commands and Queries

This section contains a list of the common commands and queries which are supported by the FOM-7900B. These commands are distinguished by the * (asterisk) which begin each mnemonic. The common commands and queries are listed in alphabetical order, and a brief description of their functions and syntax is given below. For more information on thesecommands, refer to the ANSI/IEEE 488.2-1987 standards reference.

Table 6.6 GPIB Common Commands

Command	Description
***CLS**	Clears existing errors.
***ESE**	Sets the Event Status Enable Register.
***ESE?**	Queries the Event Status Enable Register.
***ESR?**	Queries the Event Status Register.
***IDN?**	Identification query.
***OPC**	Sets Operation Complete bit.
***OPC?**	Queries Operation Complete.
***PSC**	Clears registers at power-up.
***PSC?**	Queries Power-On-Status-Clear flag.
***PUD**	Enters Protected User Data.
***PUD?**	Retrieves Protected User Data.
***RST**	Resets the instrument.
***SRE**	Sets Service Request Enable Register.
***SRE?**	Queries the Service Request Enable Register.
***STB?**	Queries the Status Byte.
***TRG**	Triggers all modules.
***WAI**	Wait for No-Operation-Pending Flag.

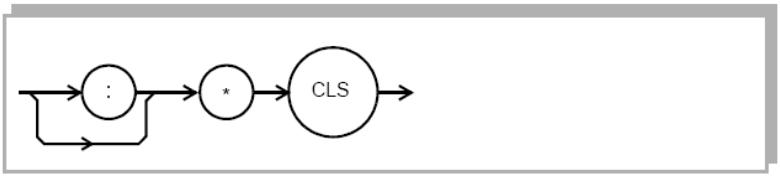
Common Command Reference

The following pages contain a reference for common commands of the FOM-7900B Multi-Channel Fiber Optic Test System. This reference contains useful information for both local and remote operation of the FOM-7900B.

*CLS
Clear Status

COMMON
FRONT PANEL
DEVICE DEPENDENT

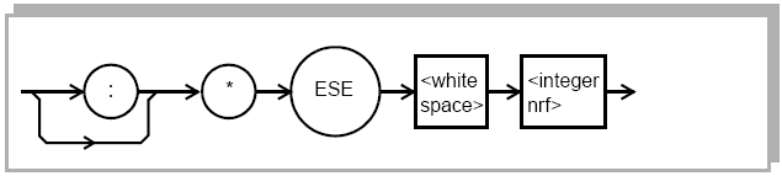
Action	Resets the Standard Event Register (*ESR?), Status Byte (*STB?) and Error Queue (ERR?) to zero.
Notes	This command may be used to clear the status registers before enabling SRQ generation from instrument events.
Example	*CLS
Syntax	



*ESE
Standard Event Status Enable

COMMON
FRONT PANEL
DEVICE DEPENDENT

Action	Configures the Standard Event Status Enable Register.
Notes	The Standard Event Status Enable Register is logically ANDed to the Standard Event Register (Figure 7.9). If the result is non-zero then the Event Summary Bit (bit #5) in the Status Byte is set to one. The *ESE command is useful for assigning which events are capable of generating an SRQ.
Example	*ESE 27
Syntax	



where, the <integer nrf> is the binary integer sum of the enabled bits in Figure 6.9. The value must be between 0 and 255.

*ESE?
Standard Event Status Enable Query

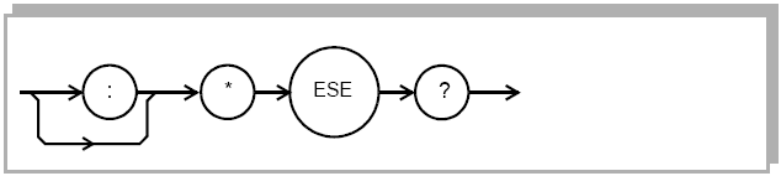
COMMON
FRONT PANEL
DEVICE DEPENDENT

Action — Returns the sum of the enabled bits in the Standard Event Status Enable Register.

Notes — Allows the user to determine which status bits can set the summary bit (bit 5) in the Status Byte.

Example — *ESE?

Syntax



Response — Binary Integer Sum of enabled bits in Figure 6.9. The value must be between 0 and 255.

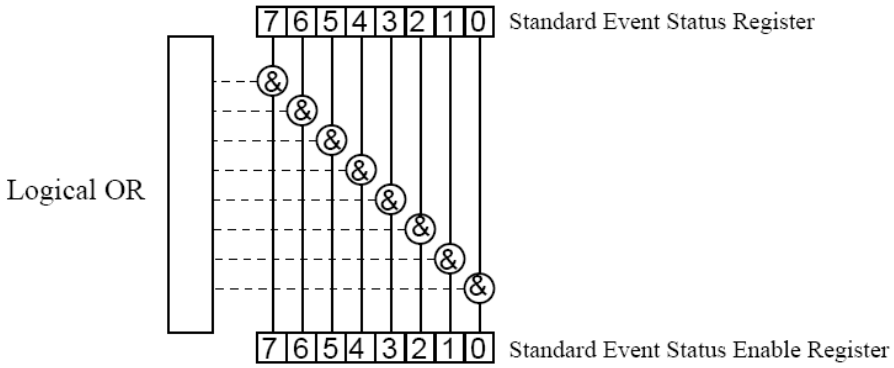


Figure 6.9 Standard Event Status/Status Enable Register

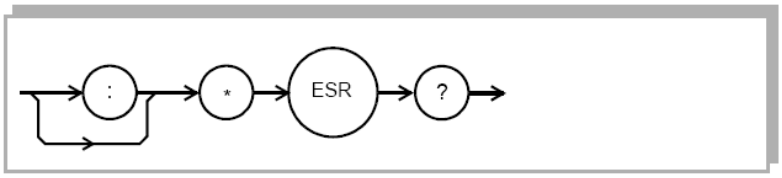
Table 6.7 Standard Event Status/Status Enable Register Bit Reference

Bit Reference	
0 - Operation Complete	4 - Execution Error
1 - N/A	5 - Command Error
2 - Query Error	6 - N/A
3 - Device Dependent Error	7 - Power On

*ESR?
Standard Event Status Register Query

COMMON
FRONT PANEL
DEVICE DEPENDENT

Action Returns the value of the Standard Event Status Register.
Notes Allows for a determination of which type of error has occurred.
Example *ESR?
Syntax

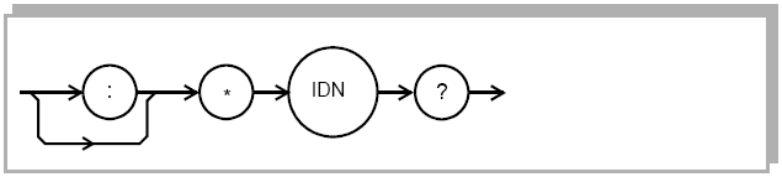


Response Binary Integer Sum of bits shown in Figure 6.9. The value must be between 0 and 255.

*IDN?
Instrument Identification

COMMON
FRONT PANEL
DEVICE DEPENDENT

Action Returns the mainframe identification string.
Notes The returned string is 39 bytes long.
Example *IDN?
Syntax



Response ILX Lightwave,7900 System 7900xxxx,3.40

*OPC
Operation Complete

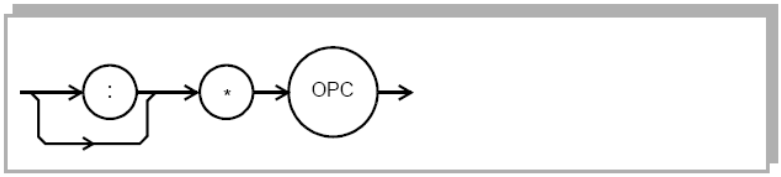
COMMON
FRONT PANEL
DEVICE DEPENDENT

Action — Allows for the generation of an Operation Complete message in the Standard Event Status Register when all pending commands have been completed.

Notes — Refer to Figure 6.9.

Example — *OPC

Syntax



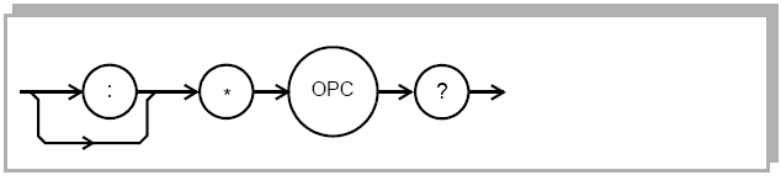
*OPC?
Operation Complete Query

COMMON
FRONT PANEL
DEVICE DEPENDENT

Action — Places an ASCII character 1 into the FOM-7900B's Output Queue when all pending commands have been completed.

Example — *OPC?

Syntax



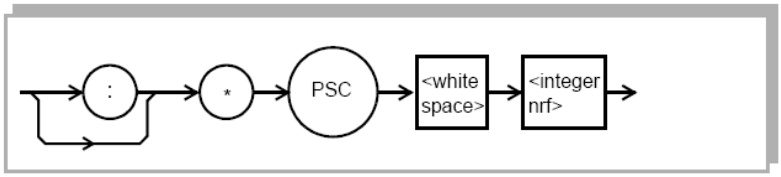
Response — 1 - when all overlapped commands are complete.

*PSC
Power-On Status Clear

COMMON
FRONT PANEL
DEVICE DEPENDENT

Action — The **POWER-ON STATUS CLEAR** command controls the automatic power-on clearing of the Service Request Enable Register (*SRE), Standard Event Status Enable Register (*ESE), Event Status Enable Register (:ENAB:EVE), Condition Status Enable Register (:ENAB:COND), (:ENAB:EVE), (ENAB:COND). This may be used to avoid undesirable service requests when the device is powered up.

Example Syntax — *PSC



where, the <integer nrf> is a boolean value:

0 – Power-on-status-clear flag is set false, therefore allowing SRQ interrupts after power-on.

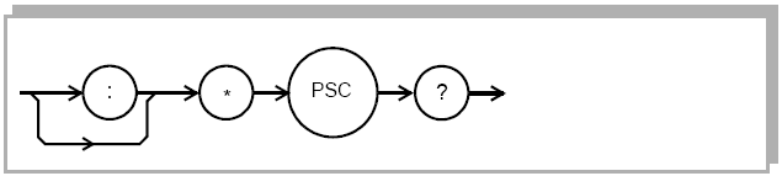
1 – Power-on-status-clear flag is set true, therefore clearing all enable registers and disallowing SRQ interrupts to be asserted after power-on.

*PSC?
Power-On Status Clear Query

COMMON
FRONT PANEL
DEVICE DEPENDENT

Action — The **POWER-ON STATUS CLEAR Query** allows the programmer to query the FOM-7900B's power-on-status-clear flag.

Example Syntax — *PSC?



Response — 0 – The Standard Event Status Register (*ESE), Service Request Enable Register (*SRE), Event Status Enable Register (ENAB:EVE), Condition Status Enable Register (ENAB:COND), Power Event Status Enable Register (ENAB:EVE), Power Condition Status Enable Register retain their values when power is cycled to the FOM-7900B.

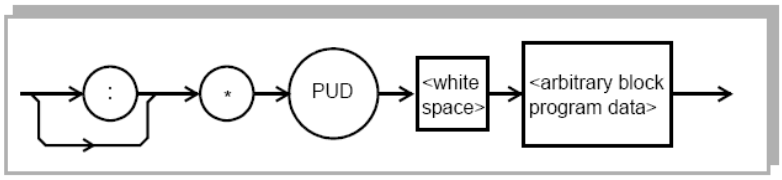
1 – The registers listed above are cleared (set to zero) when the FOM-7900B power is cycled.

*PUD
Protected User Data

COMMON
FRONT PANEL
DEVICE DEPENDENT

Action — The **PROTECTED USER DATA** command stores data unique to the FOM-7900B, such as calibration date and serial number. The PUD data is entered by the factory and protected from change by the "SECURE" command. The arbitrary block program data is 25 bytes long.

Syntax

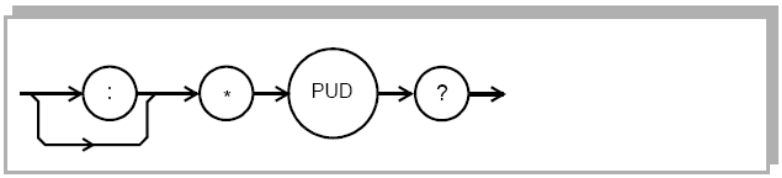


*PUD?
Protected User Data Query

COMMON
FRONT PANEL
DEVICE DEPENDENT

Action — The **PROTECTED USER DATA QUERY** allows the user to retrieve the contents of the *PUD storage area. The response is the contents of the unique data which was last entered.

Syntax



Response — The factory set response to the *PUD? is: #221nnnnnnnnvvgrMMDDYYABC

where,
- n – unit serial number
- v – firmware revision number
- gr – GPIB enabled / RS232 enabled
- MMDDYY – date of last factory calibration
- ABC – initials of calibrating technician

*RST
System Reset

COMMON
FRONT PANEL
DEVICE DEPENDENT

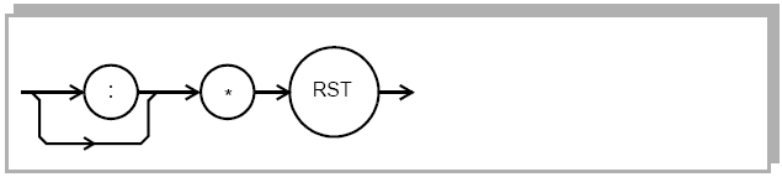
Action

The **RESET** command performs a device reset. The Operation Complete Command Idle State (OCIS) is the state which the FOM-7900B is in when it is no longer waiting for any operation to complete, after an *OPC command has been executed.

The Operation Complete Query Idle State (OQIS) is the state which the FOM-7900B is in when it is no longer waiting for any operation to complete, after an *OPC? query has been executed.

These idle states allow the FOM-7900B to complete it's reset process before continuing with any other commands after the *RST is executed. Table 6.2 describes the state of the FOM-7900B following the *RST command.

Syntax



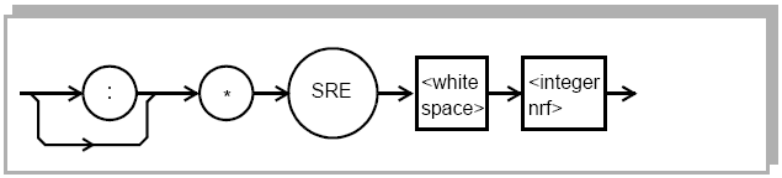
*SRE
Service Request Enable

COMMON
FRONT PANEL
DEVICE DEPENDENT

Action

The **SERVICE REQUEST ENABLE** command sets the Service Request Enable Register bits to allow the FOM-7900B to generate the user-selectable service requests (SRQ). The Service Request Enable Register is logically ANDed to the Status Byte. If the result is non-zero then bit #6 of the Status Byte is set to 1 and an SRQ interrupt is initiated.

Syntax



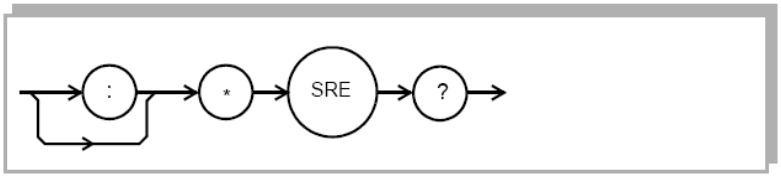
where, the <integer nrf> is the binary integer sum of the enabled bits in Figure 6.10.

*SRE?
Service Request Enable Query

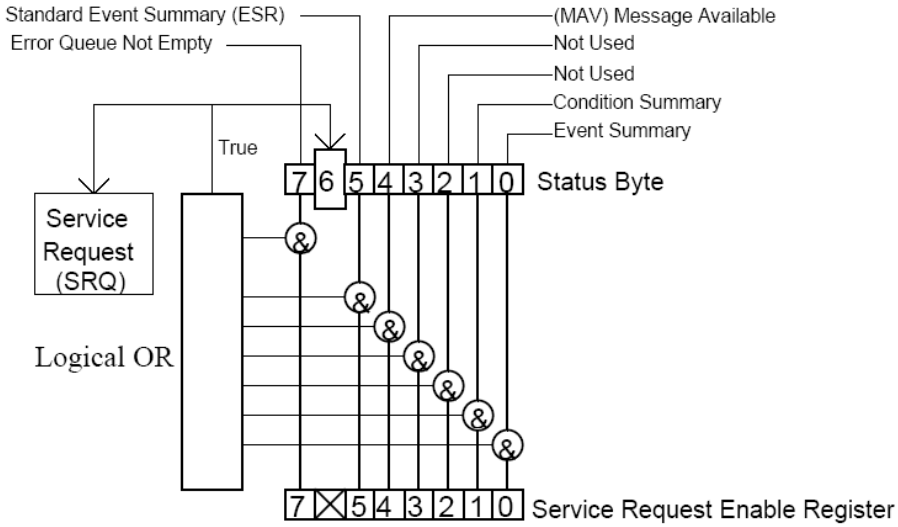
COMMON
FRONT PANEL
DEVICE DEPENDENT

Action — The **SERVICE REQUEST ENABLE QUERY** allows the user to determine the contents of the Service Request Enable Register.

Syntax



Response — Binary Integer Sum of enabled bits in Figure 6.10. The value must be between 0 and 255.



Bit Reference

0- Event Summary4- Message Available
1- Condition Summary5- Event Status Summary
2- Not Used6- Request Service/Master Status Summary
3- Not Used7- Error Message Available

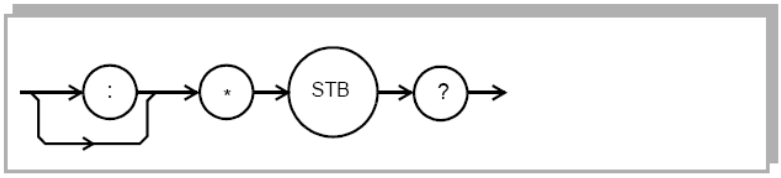
Figure 6.10 Service Request Enable Register

*STB?
Status Byte Query

COMMON
FRONT PANEL
DEVICE DEPENDENT

Action — The **STATUS BYTE QUERY** allows the user to read the Status Byte described in Figure 6.11.

Syntax



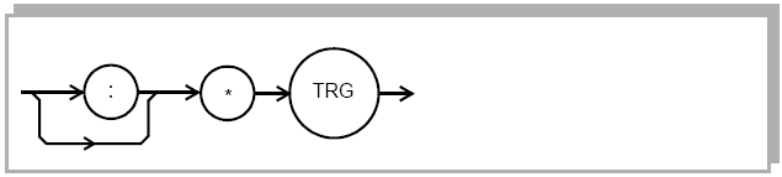
Response — Binary Integer Sum of bits in Figure 6.11. The value must be between 0 and 255.

*TRG
Trigger

COMMON
FRONT PANEL
DEVICE DEPENDENT

Action — The **TRIGGER** command is equivalent to the Group Execute Trigger which sends a trigger signal to all modules in the FOM-7900B Mainframe.

Syntax



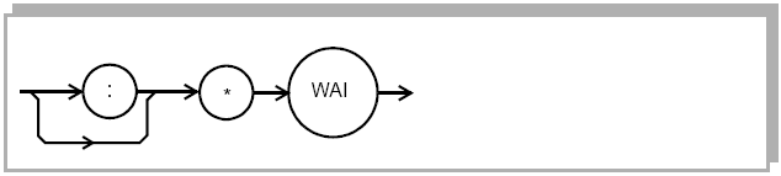
*WAI
Wait To Continue

COMMON
FRONT PANEL
DEVICE DEPENDENT

Action

The **WAIT-TO-CONTINUE** command prevents the instrument from executing any further commands until the No-Operation-Pending flag is true. This allows the user to make the FOM-7900B wait for the completion of an operation before continuing.

Syntax



Error Messages

Error messages may appear on the display. These errors are also held for retrieval through GPIB. The error queue can be read by issuing the "**ERR?**" command. This command returns a string containing up to ten error messages from the error message queue.

If "**ERR?**" is sent when the error queue is empty an ASCII zero (0) is returned. If the error queue is active bit #7 in the Status Byte is also set to one (1). Each installed module has its own error queue.

Chapter 12 contains an explanation of the error messages which may be reported remotely by the FOM-7900B.

Status Reporting

Figure 6.11 shows the status reporting scheme for the FOM-7900B Fiber Optic System. Each of the internal status reporting registers which may be accessed by a command or query have the appropriate GPIB command or query written above or below the register definition. For example, the Condition Register may be queried with the "COND?" query, as shown by its register heading in Figure 6.11.

The condition or event registers are logically ANDed with their respective enable registers (e.g. ENAB:COND). These bits are then logically ORed to form a summary message in the status byte for that particular type of register. For example, suppose the internal modulation on condition is enabled, and that condition occurs, then bit #1 of the Status Byte Register would be set.

Device Dependent Event and Condition Registers

The Event Registers are used to report events which occur during the operation of the instrument. Events differ from conditions in that events signal an occurrence once, and are not reset until the Event Register is queried or the FOM-7900B is powered off. Conditions reflect the current state of the device, and therefore may change many times during operation. Querying a Condition Register does not change its contents.

Operation Complete Definition

Note that bit #0 of the Standard Event Status Register contains the Operation Complete flag (see *OPC, on page 60). This bit may be used to signal an SRQ to the controlling software for more efficient, interrupt driven software. Enable the SRQ by setting bit #0 in the Standard Event Status Enable Register (*ESE) and bit #5 in the Service Request Enable Register (*SRE). This may be used to initiate service request routines which depend on the completion of all previous commands.

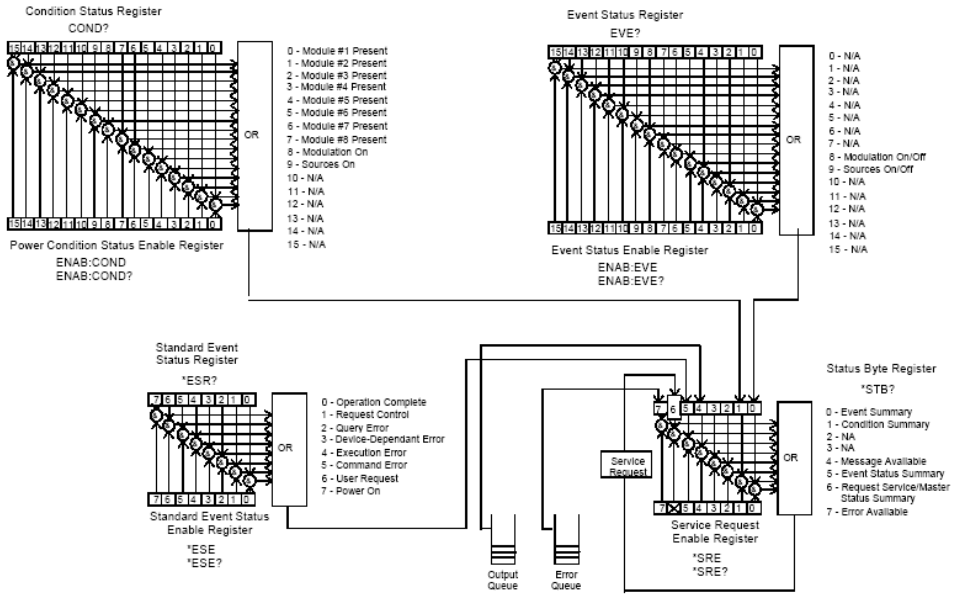


Figure 6.11 FOM-7900B Status Reporting Scheme

Command Timing and Completion

This section describes, for each device-dependent command, whether that command is performed in an overlapped or sequential manner. In other words, it states whether the next command may begin while the present command is being executed, or if the next command must wait until the present command is completed before its execution begins.

All FOM-7900B device-dependent commands are executed in an overlapped manner, using the operation complete flag.

The *WAI (common command) is an example of a sequential command which forces the next command to wait until the no-operation-pending flag is true. This is essentially the same as waiting for the OPC flag to become true, because the no-operations-pending flag is used to set the OPC flag (bit 0 of the Standard Event Status Register).

In normal operation, the overlapped commands execute faster than would appear by querying the OPC flag. This is due to the nature of the non-volatile memory storage process. This is done to ensure that the OPC flag is never set prematurely. However, in most cases, the individual operation will be completed immediately.

Whenever there is response data in the Output Queue, bit 4 is set in the Status Byte Register. Whenever there is any error message in the Error Queue, bit 7 is set in the Status Byte Register.

Input Buffer and Output Data

The input buffer is 256 bytes long and the <PROGRAM MESSAGE> must not exceed this length. The output buffer is also 256 bytes long. The user may enter as many queries as is desired in a single input message, and the FOM-7900B responds to all of them in the same output message, if possible.

All query responses are evaluated at the time the query is parsed, and not at the time the response message is sent. In most cases this does not create a problem since the time between parsing a query and sending its response is small, unless the GPIB controller takes a long time to request the response.

Remote Interface Messages

The following sections are intended as a reference for using the FOM-7900B with the GPIB option when an understanding of the lower level interface messages is required. These sections deal with the remote interface messages which are available with the instrument, and they contain a list of the Interface Function subsets. This information is generally not required by the user unless there is a question of compatibility of the instrument with a specific controller.

The interface messages listed in this chapter are handled by the National Instruments TNT4882 GPIB interface IC and the AMD186EM microcontroller in the FOM-7900B, and are transparent to the higher level commands. However, they may be explicitly used in some GPIB programs. A list of the FOM-7900B's allowable interface messages is shown in Table 6.8. A list of interface messages which are not supported by the FOM-7900B is shown in Table 6.9. These messages will be ignored by the FOM-7900B.

Interface Function Subsets

Table 6.1 contains the remote Interface Function Subsets which are supported by the FOM-7900B. For more information, see the ANSI/ IEEE-488.1-1987 standard.

Remote Messages

The following list contains GPIB remote messages which are compatible with the FOM-7900B GPIB driver.

Table 6.8 FOM-7900B Allowed GPIB Interface Messages

ACG	GET	MTA	SCG	UCG
ATN	GTL	OTA	SPD	UNL
DAB	IFC	PCG	SPE	UNT
DAC	LAG	REN	SRQ	
DAV	LLO	RFD	STB	
END	MLA	RQS	TAG	

Remote Interface Messages Not Supported by FOM-7900B

Table 6.9 contains GPIB interface messages which are known to be incompatible with the FOM-7900B. Other interface messages which are not listed may also be incompatible with the FOM-7900B.

Table 6.9 GPIB Interface Messages Not Supported

DCL	NUL	PPE	PPR4	PPR8
EOS	OSA	PPR1	PPR5	PPU
IDY	PPC	PPR2	PPR6	SDC
MSA	PPD	PPR3	PPR7	TCT

CHAPTER 7

COMMAND REFERENCE

This chapter is a guide to the syntax and usage of the various device-dependent commands for the FOM-7900B System. It contains a reference for all of the FOM-7900B mainframe and module commands in alphabetical order.

The error messages which may be displayed on the FOM-7900B front panel are listed in Chapter 11.

Terminology

Terminology required to successfully communicate with the FOM-7900B Mainframe using GPIB is described in Chapter 7 GPIB Remote Operation & Common Commands. The terms frequently used in this chapter are repeated below.

<white space> refers to ASCII characters (such as Space Bar) which are used as separators in the command syntax.

<nrf value> refers to the IEEE-488.2 standard for numeric format notation. It is a generic label which means either integer, floating point or scientific notation number representation.

<suffix> refers to the IEEE-488.2 standard for suffixes. Suffixes are not used.

Commands and Queries

There are two types of device communication: commands, which tell the device to do something and do not return anything, and queries, which return a stored value or instrument state but do not change the device state. Queries must be terminated with a question mark (?), while commands may require one or more parameters.

COMMAND **FREQ 100.00**
Internal Modulation Frequency is set to 100.00 kHz

QUERY **FREQ?**
Returns the Internal Modulation Frequency

Substitute Parameter Names

For clarity in programming, the Boolean values of one and zero may be represented by the appropriate substitute parameter names (Refer to Table 7.5). The commands **MODULATION 1**, **MODULATION ON** and **MODULATION TRUE** are identical.

Compound Command Structure

Some FOM-7900B GPIB commands require a compound structure. This is done to distinguish between different commands of the same type.

The compound command structure is similar to a directory path structure, as found in DOS. For example, commands which deal with FOS-79800F calibration have the path **CAL:**, as in the command **CAL:LEVEL 2.50** to calibrate the displayed output power for a FOS-79800F Precision Source Module to 2.50 dBm.

Table 7.1 lists all FOM-7900B device-dependent commands, with the full path shown for each command and a brief description. Detailed syntax diagrams and descriptions start on page 76.

Common Commands

The GPIB Common Commands which are defined by the ANSI/IEEE-488.2-1987 standard are described in Chapter 7. These commands do not necessarily reflect front panel operations but are useful for generic device control. Some of the common commands are useful for advanced programming techniques, such as generating service requests (SRQ).

Device-Specific Commands

Tables 8.1 through 8.4 list the device-specific commands for the mainframe and the different module types.

Note: The CHannel command must be sent before a device specific command (shown in Table 8.2 and 8.3) so that the proper module will be addressed. An example of the use of the CHannel command is shown below.

CHAN 3
Future commands (except common commands) are directed to the module in channel 3.

CHAN?
Returns the active channel number.

CHANNEL 6
Future commands are directed to channel 6.

Table 7.1 FOM-7900B Mainframe-Specific Commands

Command	Parameter	Description
CHannel	1	Selects the channel (module).
CHannel?	NONE	Returns the current channel.
COHerence	ON/OFF	Enables/Disables the Coherence Control in all modules.
COHerence?	NONE	Returns the status of the Coherence Control.
CONDition?	NONE	Returns the status of the Condition Status Register.
ENAB:COND	1	Sets the Condition Enable Register.
ENAB:COND?	NONE	Returns the value of the Condition Enable Register.
ENAB:EVENT	1	Sets the Event Enable Register.
ENAB:EVENT?	NONE	Returns the value of the Event Enable Register.
ERRors?	NONE	Returns the errors generated since last error query.
EVEnt?	NONE	Returns the value of the Event Status Register.
FREQuency	1	Sets the internal modulation in units of kHz.
FREQuency?	NONE	Returns the internal modulation frequency in units of kHz.
MESsage	1	Used to enter a string message of up to 16 characters.
MESsage?	NONE	Returns the previously stored ASCII message.
MODulation	ON/OFF	Enables/Disables internal modulation.
MODulation?	NONE	Returns the status of the internal modulation.
OUTput	ON/OFF	Enables/Disables module output.
OUTput?	NONE	Returns status of moduel output.
RADix	1	Used to set radix type for numerical data.

Table 7.1 FOM-7900B Mainframe-Specific Commands (Continued)

RADix?	NONE	Returns currently set radix type for numerical data.
SECURE	1	Used by service personnel to access PUD.
SOURCE	1	Used to set source of modulation signal.
SOURCE?	NONE	Returns the source of modulation.
TERM	TRUE/FALSE	Used to add a <CR> to GPIB terminations.
TIME?	NONE	Returns the elapsed time since power-up.
TIMEOUT	1	Sets the response time-out for banked remote systems.
TIMEOUT?	NONE	Returns the response time-out for banked remote systems.
TIMER?	NONE	Returns the elapsed time since the last TIMER? query.
TRIGger	NONE	Used to trigger compatible modules.

Table 7.2 FOS-79800F Module-Specific Commands

Command	Parameters	Description
CAL:LEVEL	##.##	Sets the Power User Calibration.
CAL:RESET	NONE	Resets the User Calibration.
CAL:WAVE	####.###	Sets the Wavelength User Calibration.
ERRor?	NONE	Returns errors generated since last error query.
IDN?	NONE	Returns the module identification string.
LEVEL	±##.##	Sets the output power level in units of dBm.
LEVEL?	NONE	Returns the output power level in units of dBm.
OUT	#	Enables/Disables module output.
OUT?	NONE	Returns the module output status.
SHUTPRES?	NONE	Returns the presence of the shutter option.
SHUTTER	ON/OFF	Opens (ON) and closes (OFF) the shutter.
SHUTTER?	NONE	Returns the state of the shutter.
WAVE	####.###	Sets the output wavelength.
WAVE?	NONE	Returns the wavelength setting.
WAVEMAX?	NONE	Returns the maximum wavelength setting.
WAVEMIN?	NONE	Returns the minimum wavelength setting.

Table 7.3 FOS-79710 Module-Specific Commands

Command	Parameters	Description
ERR?	NONE	Returns errors generated since last error query.
IDN?	NONE	Returns the module identification string.
INTERVAL	##.##	Sets the timer interval in units of seconds.
INTERVAL?	NONE	Returns the timer interval in units of seconds.
PORT	#	Sets the port that is switched to the common port.
PORT?	NONE	Returns the currently-selected switch port.
SEQ:DEFAULT	NONE	Initializes the Trigger/Timer switch sequence.
SEQ:SW*n*	#	Sets the *n*th position from the sequence array.
SEQ:SW*n*?	NONE	Returns the *n*th position from the sequence array.
SEQ:TMR	ON/OFF	Enables/Disables the Interval Timer.
SEQ:TMR?	NONE	Returns the state of the Timer Mode.
SEQ:TRG	ON/OFF	Enables/Disables the External Trigger.
SEQ:TRG?	NONE	REturns the state of the Trigger Mode.

FOM-7900B Mainframe & Module Command Reference

CAL:LEVEL <nrf value>

COMMON
FRONT PANEL
DEVICE DEPENDENT

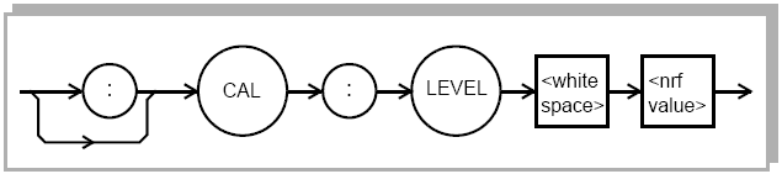
FOM-7900B FOS-79800F FOS-79710

Action The **CAL:LEVEL** command is used to field-calibrate the module's output power.

Parameters An <nrf value> that is the actual, measured output power of the module, in dBm.

Notes The User Calibration can be used when the measured output power does not match the front panel setting or to compensate for losses induced by patch cords. Use the **CAL:LEVEL** command to enter the measured power in dBm for a particular channel. The effects of the User Calibration are removed with the **CAL:RESET** command.

Syntax



Examples **CAL:LEVEL +1.12**

Adjusts the displayed power setpoint to match the actual measured output.

CAL:RESET

COMMON
FRONT PANEL
DEVICE DEPENDENT

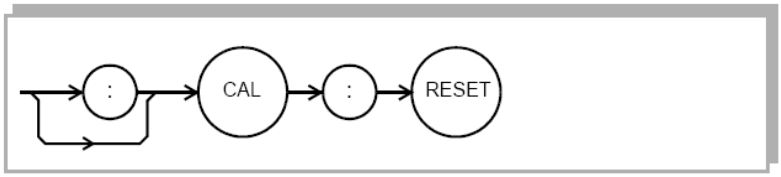
FOM-7900B FOS-79800F FOS-79710

Action The **CAL:RESET** command removes any user calibration that may have been set.

Parameters None.

Notes The User Calibration is an offset that is applied to all future power levels and wavelength settings. Resetting the User Calibration returns these offsets to 0.00 dB and 0.000 nm.

Syntax



Examples **CAL:RESET**

Removes any user calibration constants that may have been applied to the module.

CAL:WAVE <nrf value>

COMMON
FRONT PANEL
DEVICE DEPENDENT

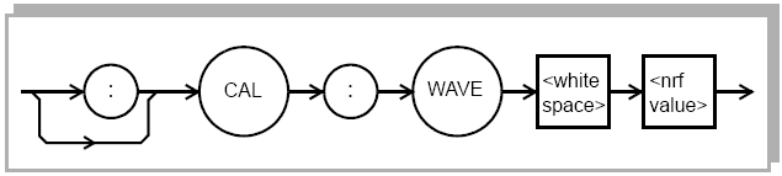
FOM-7900B FOS-79800F FOS-79710

Action The **CAL:WAVE** command is used to field-calibrate the output wavelength.

Parameters The <nrf value> is the actual, measured output wavelength of the module.

Notes The User Calibration can be used when the measured wavelength does not match the front panel setting. Use the **CAL:WAVE** command to enter the measured wavelength in nanometers. The effects of the User Calibration are removed with the **CAL:RESET** command.

Syntax



Examples **CAL:WAVE 1555.230**

Sets the displayed wavelength to show the actual measured wavelength of 1555.230 nm.

CHannel <nrf value>

COMMON
FRONT PANEL
DEVICE DEPENDENT

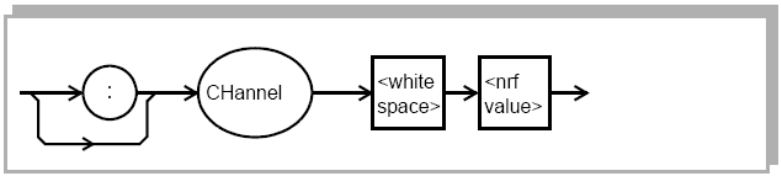
FOM-7900B FOS-79800F FOS-79710

Action The **CHannel** command is used to select a module channel number for future commands and queries.

Parameters An integer <nrf value> ranging from 0 to 249.

Notes Zero is the channel selection for mainframe-specific commands to bank address zero. Select channel 0 to set parameters specifically to the mainframe. The channel numbers for the FOM-7900B System are determined as shown in Table 8.5.

Syntax



Examples **CH 0**

Selects channel 0 of bank 0 (mainframe only commands)

CHANNEL 22

Selects channel 22 (module #2 in bank #2)

CHAN 79

Selects channel 79 (all modules in bank #7)

Table 7.4 FOM-7900B Channel Numbers

Bank	Channel	Notes
0	0	Bank 0 mainframe only commands
0	1-8	Specific modules in bank 0
0	9	All channels in bank 0
1	10	Bank 1 mainframe only commands
1	11-18	Specific modules in bank 1
1	19	All channels in bank 1
2	20	Bank 2 mainframe only commands

CHannel?

COMMON
FRONT PANEL
DEVICE DEPENDENT

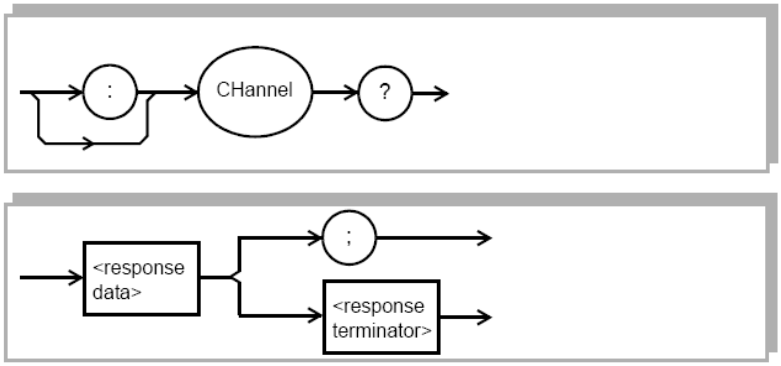
FOM-7900B FOS-79800F FOS-79710

Action The **CHannel?** query is used to determine which channel is currently selected.

Parameters None.

Notes Returns an integer value from 0 to 249 representing the channel number formatted as shown in Table 8.5.

Syntax



Examples **CH?** Response – 35
The fifth module in the third bank is selected.

COHerence <nrf value>

COMMON
FRONT PANEL
DEVICE DEPENDENT

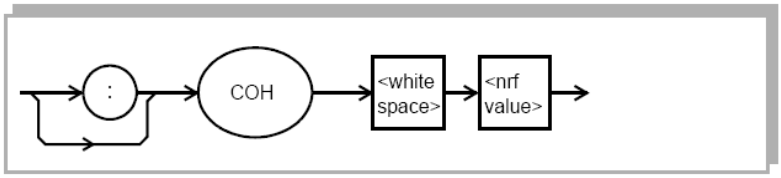
FOM-7900B FOS-79800F FOS-79710

Action The **COHerence** command enables or disables the coherence control feature on compatible modules.

Parameters A boolean <nrf value>.

Notes This command will enable or disable the coherence control feature. Some modules may not have this feature and will not be affected.

Syntax



Examples **COH 1**
Enables coherence control.
COH off
Disables coherence control.

COHerence?

COMMON
FRONT PANEL
DEVICE DEPENDENT

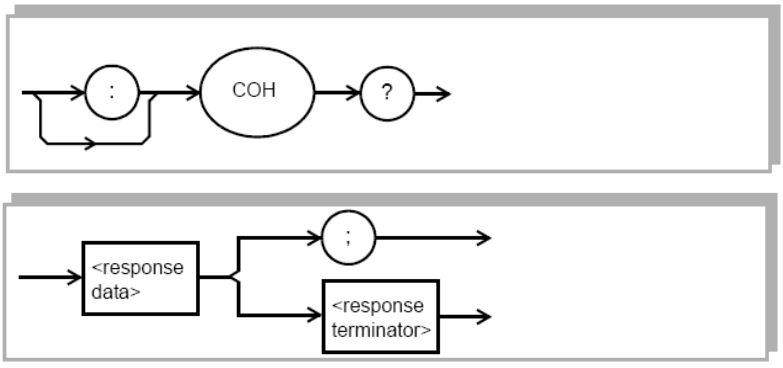
FOM-7900B FOS-79800F FOS-79710

Action The **COHerence?** query returns the ON/OFF status of the coherence control feature.

Parameters None.

Notes Use the query to verify the state of the coherence control feature.

Syntax



Examples **COH?** Response – 0
Coherence control is disabled.

CONDition?

COMMON
FRONT PANEL
DEVICE DEPENDENT

FOM-7900B FOS-79800F FOS-79710

Action The **COND?** query returns the value of the FOM-7900B Condition Status Register.

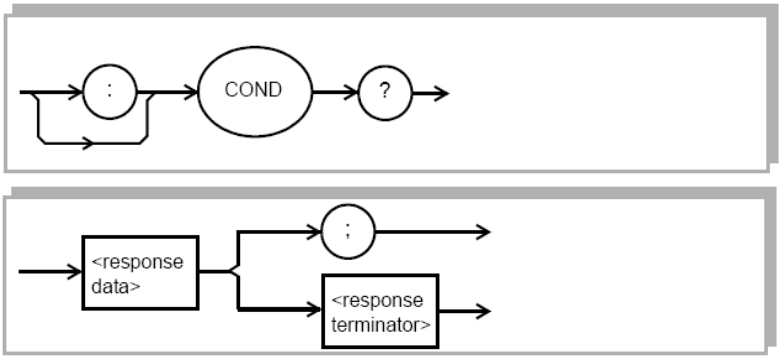
Parameters None.

Notes Returns an <nrf value> that is the binary sum of all status register bits detailed in Table 8.6.

The condition status may be constantly changing. This register is ***not*** cleared (set to zero) when queried or when the ***CLS** command is sent. In other words, this register always reflects the real time condition of the instrument.

The conditions above are filtered by the Condition Enable Register (See **ENABle:COND**) before being summarized in the status byte. Refer to the status reporting diagram in Figure 7.11.

Syntax



Examples **COND?** Response – 97
Modules 1, 6 and 7 are installed.

Table 7.5 Condition Status Register Bits

1	Module #1 Present	256	Modulation Enabled
2	Module #2 Present	512	Source Output Enabled
4	Module #3 Present	1024	Not Used
8	Module #4 Present	2048	Not Used
16	Module #5 Present	4096	Not Used
32	Module #6 Present	8192	Not Used
64	Module #7 Present	16384	Not Used
128	Module #8 Present	32768	Not Used

ENABle:COND <nrf value>

COMMON
FRONT PANEL
DEVICE DEPENDENT

FOM-7900B FOS-79800F FOS-79710

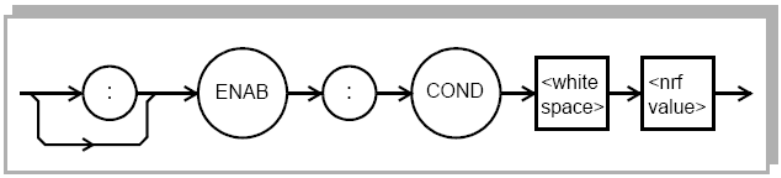
Action — The **ENABle:COND** command sets the Condition Status Enable Register. This register is a filter which is logically ANDed to the condition register. If the result is non-zero, bit #1 in the Status Byte is set.

Parameters — An <nrf value> whose sum represents the enabled bits referenced in Table 8.6 on page 81.

Notes — The Condition Enable Register can be read using the **ENABle:COND?** query. The Condition Status Register can be monitored using the **COND?** query. If any of the enabled bits in the Condition Register are true, bit #1 of the Status Byte is set. Refer to the Status reporting diagram in Figure 7.11.

The enable registers retain their values at power-up unless the power-on status clear flag is set true. See ***PSC** in Chapter 7.

Syntax



Examples — **ENAB:COND 513**

Allows an SRQ interrupt to be sent to the host computer when the output of any source is enabled or if Module #1 is present.

ENABle:COND?

COMMON
FRONT PANEL
DEVICE DEPENDENT

FOM-7900B FOS-79800F FOS-79710

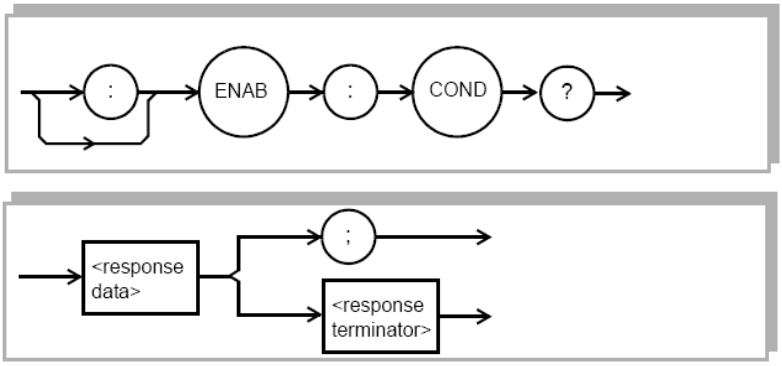
Action The **ENABle:COND?** query returns the value of the Condition Status Enable Register.

Parameters None.

Notes The value returned is the sum of the status bits shown in Table 8.6 on page 81.

The Condition Enable Register can be set by using the **ENABle:COND** command. The condition status can be monitored by the **COND?** command. Refer to the Status reporting diagram in Figure 7.11.

Syntax



Examples **ENAB:COND?** Response – 144

The presence of module 5 and 8 are allowed to be summarized in the Status Byte.

ENABle:EVEnt <nrf value>

COMMON
FRONT PANEL
DEVICE DEPENDENT

FOM-7900B FOS-79800F FOS-79710

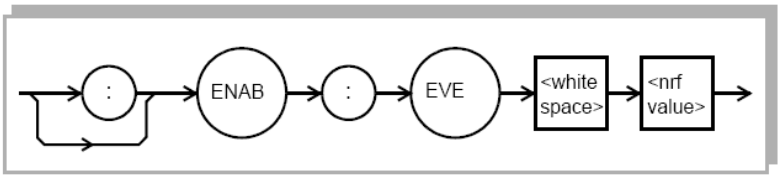
Action The **ENABle:EVEnt** command sets the Event Status Enable Register. This register is a filter which is logically ANDed to the event register. If the result is non-zero, bit #1 in the Status Byte is set.

Parameters An <nrf value> whose sum represents the enabled bits referenced in Table 8.7 below.

Notes The Event Enable Register can be read using the **ENABle:EVEnt?** query. The Event Status Register can be monitored using the **EVEnt?** query. If any of the enabled bits in the Event Register are true, bit #0 of the status register is set. Refer to the status reporting diagram in Figure 7.11.

The enable registers retain their values at power-up unless the power-on status clear flag is set true see ***PSC** in Chapter 7.

Syntax



Examples **ENAB:EVE 256**
Modulation ON or OFF updates bit #0 of the Status Byte.

Table 7.6 Event Status Register Bits

1	Not Used	256	Modulation ON/OFF
2	Not Used	512	Sources ON/OFF
4	Not Used	1024	Not Used
8	Not Used	2048	Not Used
16	Not Used	4096	Not Used
32	Not Used	8192	Not Used
64	Not Used	16384	Not Used
128	Not Used	32768	Not Used

ENABle:EVEnt?

COMMON
FRONT PANEL
DEVICE DEPENDENT

FOM-7900B FOS-79800F FOS-79710

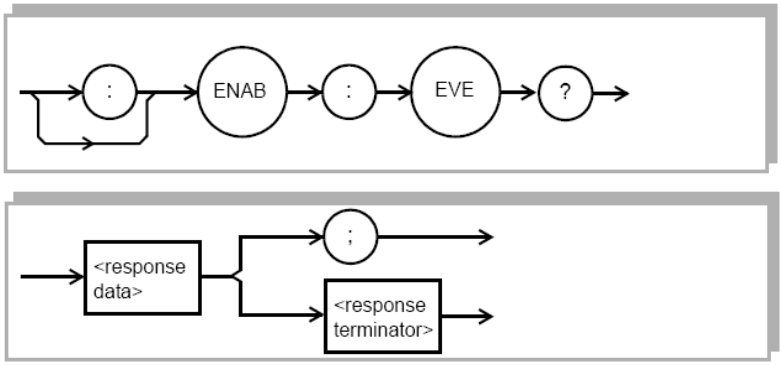
Action The **ENABle:EVEnt?** query returns the value of the Status Event Enable Register.

Parameters None.

Notes The value returned is the sum of the status bits shown in Table 8.7 on page 84.

The Event Enable Register can be set by using the **ENABle:EVEnt** command. The condition status can be monitored by the **EVEnt?** command. Refer to the Status reporting diagram in Figure 7.11.

Syntax



Examples **ENAB:EVE?** Response – 512
The sources ON and OFF events are allowed to be summarized in the Status Byte.

ERRor?

COMMON
FRONT PANEL
DEVICE DEPENDENT

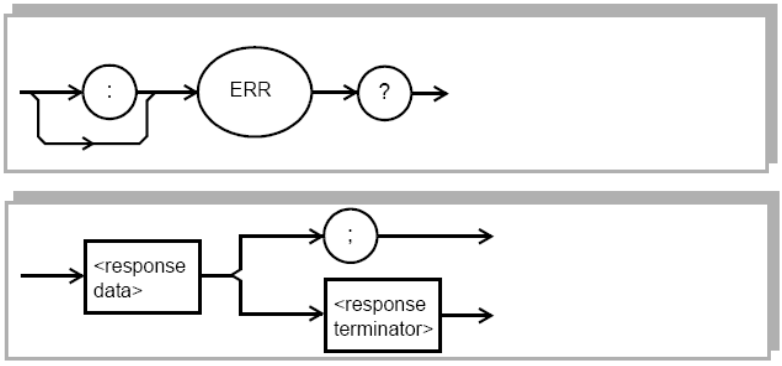
FOM-7900B FOS-79800F FOS-79710

Action The **ERRor?** query returns a list of command, execution and device errors which have occurred since the last **ERRor?** query or ***CLS** command. The error codes are listed in Tables 8.8, 8.9 and 8.10 on page 107. Each module has its own separate error queue.

Parameters None.

Notes The response data is a list of the current error codes represented by numbers and separated by commas. A response of zero indicates that there are no errors to report. The response is sent as character data. The error query should be directed to the mainframe or specific module by issuing the **CHan** command first.

Syntax



Examples **ERR?** Response – 0
No errors to report.
ERRor? Response – 403
The internal modulation frequency is out of range.

Table 7.7 FOS-79710 Error Codes

Error Code	Description
123	Command Syntax Error
201	Value Out of Range Error
220	Parameter Missing Error
504	Switch Mechanism Failure

Table 7.8 FOS-79800F Error Codes

Error Code	Description
123	Command Syntax Error
501	Laser Diode Case Temperature Control Error
502	Laser Diode Internal Temperature Control Error
503	Laser Diode Current Limit Error
508	Calibration Data Error
509	Setpoint Data Error

Table 7.9 FOM-7900B Error Codes

Error Code	Description
401	Channel number out of range (0 – 9 legal).
402	Bank address number out of range (0 – 24 legal).
403	Internal modulation frequency out of range (1 – 500 kHz legal).
404	Command or query sent to empty channel (no module installed in channel).

EVEnt?

COMMON
FRONT PANEL
DEVICE DEPENDENT

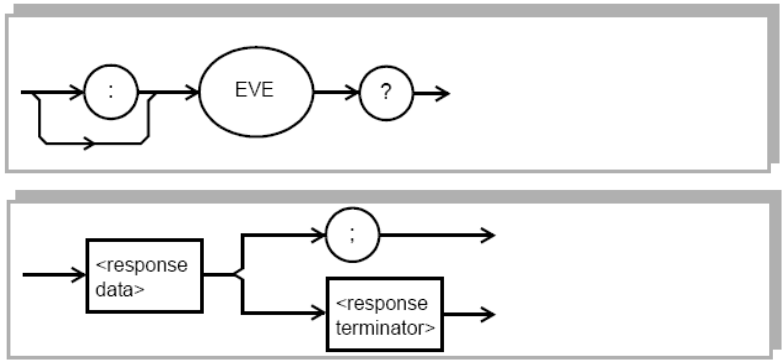
FOM-7900B FOS-79800F FOS-79710

Action The **EVEnt?** query returns the value of the FOM-7900B Status Event Register.

Parameters None.

Notes The response is the binary sum of the bits shown in Table 8.7 on page 84. The events which are summarized in bit #0 of the Status Byte can be set by using the **ENABle:EVEnt** command. The Event Status Register is cleared when this query is sent or when the ***CLS** command is issued. Refer to the Status reporting diagram in Figure 7.11.

Syntax



Examples **EVE?** Response – 256
Internal modulation has been turned either ON or OFF.

FREQuency <nrf value>

COMMON
FRONT PANEL
DEVICE DEPENDENT

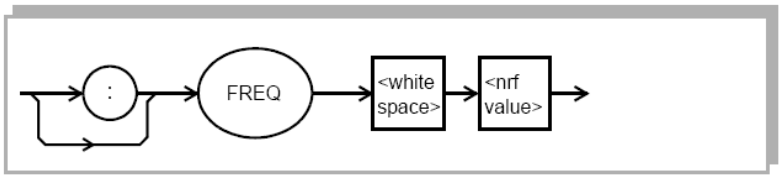
FOM-7900B FOS-79800F FOS-79710

Action The **FREQuency** command sets the internal modulation frequency.

Parameters A floating point <nrf value> representing the internal modulation frequency in kHz with a valid range of 1.00 to 500.00.

Notes The internal modulation signal is common to all modules. This signal can be set between 1 kHz and 500 kHz.

Syntax



Examples **FREQ 100.00**
Sets the internal modulation frequency to 100.00 kHz.

FREQuency?

COMMON
FRONT PANEL
DEVICE DEPENDENT

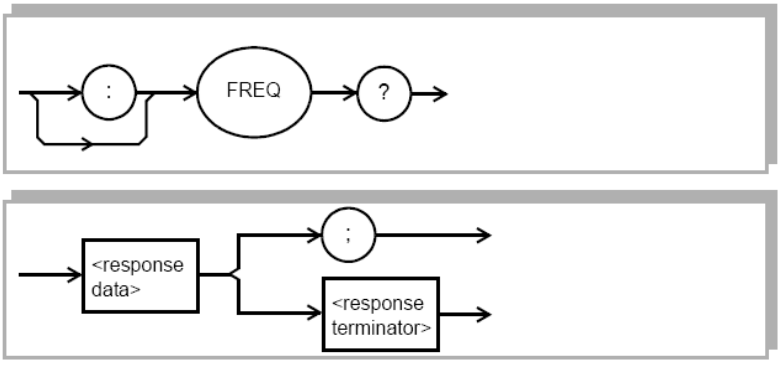
FOM-7900B FOS-79800F FOS-79710

Action The **FREQuency?** query returns the modulation frequency in kHz.

Parameters None.

Notes Returns a floating point <nrf value> representing the modlation frequency.

Syntax



Examples **FREQ?** Response – 10.50
Internal modulation frequency has been set to 10.5 kHz.
frequency? Response – 50.55
Internal modulation frequency has been set to 50.55 kHz.

IDN?

COMMON
FRONT PANEL
DEVICE DEPENDENT

FOM-7900B FOS-79800F FOS-79710

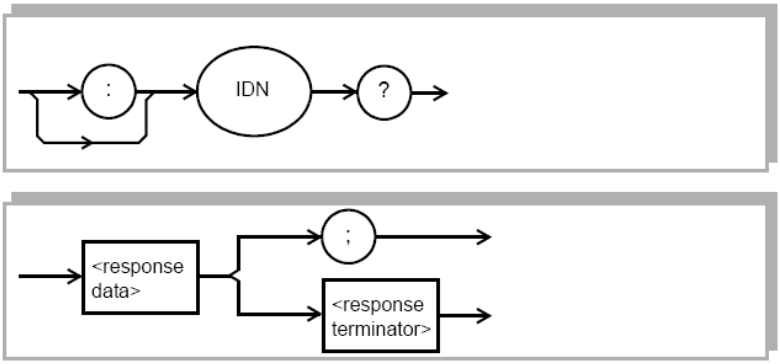
Action The **IDN?** query returns a string identifying the module.

Parameters None.

Notes Use this command to verify the identification and location of each module in question.

This command has the same effect as repeatedly pressing the **PARAM** key until the module title is displayed.

Syntax



Examples **IDN?** Response – 79800F
The module in question is a FOS-79800F.

INTERVAL <nrf value>

COMMON
FRONT PANEL
DEVICE DEPENDENT

FOM-7900B FOS-79800F FOS-79710

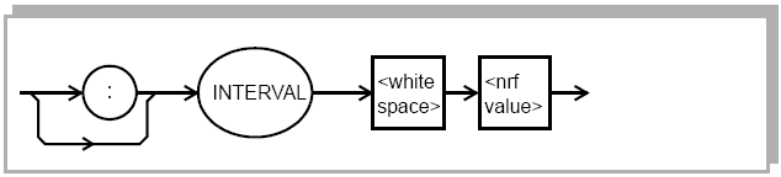
Action — The **INTERVAL** command sets the time interval used in the timer mode. When the time interval has elapsed, the module automatically moves the switch to the next port in the sequence array.

Parameters — An <nrf value> representing the interval time value, in seconds, with a valid range of 1.00 to 60.00.

Notes — When the timer is enabled, the module will automatically move the switch position to the next port in the sequence at the rate determined by the timer interval. The switch sequence is described by the **SEQ:SWn** commands.

The time interval range is 1.00 to 60.00 seconds. The resolution of the timer itself is 10 ms, however, the absolute resolution of the switch is 16 ms.

Syntax



Examples — **interval 10.55**

The interval timer is set to 10.55 seconds.

INTERVAL?

COMMON
FRONT PANEL
DEVICE DEPENDENT

FOM-7900B FOS-79800F FOS-79710

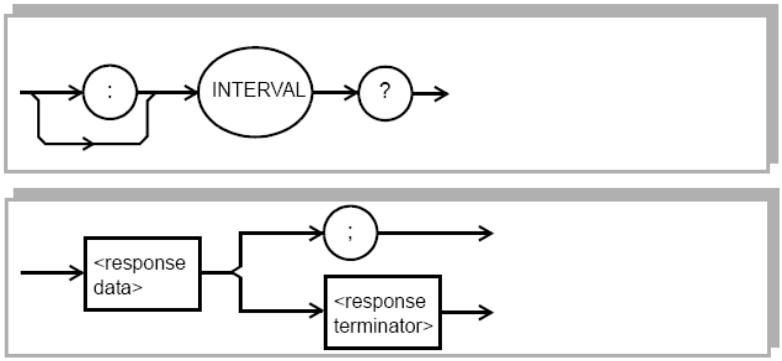
Action The **INTERVAL?** query returns value of the interval timer, in seconds.

Parameters None.

Notes When the timer is enabled, the module will automatically move the switch position to the next switch in the sequence at the rate determined by the timer interval. The switch sequence is described in by the **SEQ:SW*n*** commands.

The time interval range is 1.00 to 60.00 seconds. The resolution of the timer is 10 ms, however, the absolute resolution is 16 ms.

Syntax



Examples **INTERVAL?** Response – 5.55
The interval timer is set to 5.55 seconds.

LEVEL <nrf value>

COMMON
FRONT PANEL
DEVICE DEPENDENT

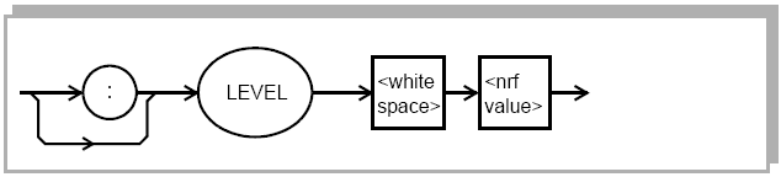
FOM-7900B FOS-79800F FOS-79710

Action The **LEVEL** command sets the output power from the fiber optic source.

Parameters An <nrf value> representing the output power in dBm.

Notes The source output is enabled and disabled using the **OUT** command.

Syntax



Examples **level -3.0**
The output power level is set to -3.00 dBm.

LEVEL?

COMMON
FRONT PANEL
DEVICE DEPENDENT

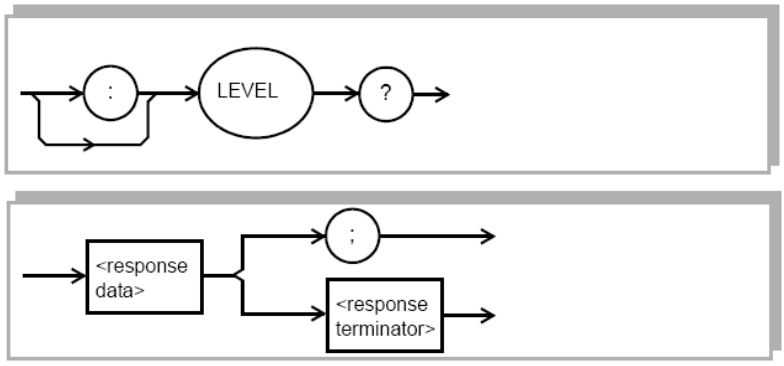
FOM-7900B FOS-79800F FOS-79710

Action The **LEVEL?** query returns the output power setpoint.

Parameters None.

Notes The response received is the output power setpoint in dBm.

Syntax



Examples **LEVEL?** Response – 10.5
The output power setpoint is 10.5 dBm.

MESsage <nrf value>

COMMON
FRONT PANEL
DEVICE DEPENDENT

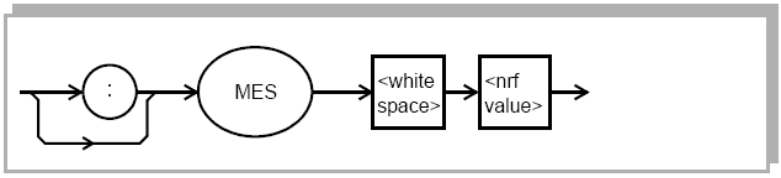
FOM-7900B FOS-79800F FOS-79710

Action — The **MESsage** command allows the user to enter an ASCII string of up to 16 non-zero characters plus enclosing quotes. This command may be useful for storing messages which relate to a test or configuration.

Parameters — An <nrf value> representing an ASCII string of up to 16 bytes in length.

Notes — The message may contain any ASCII character, but will be terminated when a NULL terminator character is received. If the message has less than 16 bytes, the FOM-7900B will fill the remaining message space with the space character. After 16 bytes have been entered, the FOM-7900B will null-terminate the string.

Syntax



Examples

message “This is a test.”
The string “This is a test. ” (without quotes) will be stored in non-volatile memory.

mes “TESTabc”
The string “TESTabc “ will be stored in non-volatile memory.

MESsage?

COMMON
FRONT PANEL
DEVICE DEPENDENT

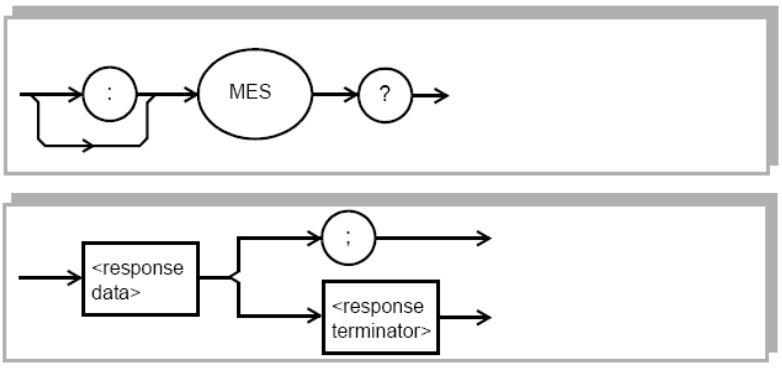
FOM-7900B FOS-79800F FOS-79710

Action The **MESsage?** query returns the previously stored message. This message will always be 16 bytes long and enclosed in quotes. Do not include quotes when counting the characters.

Parameters None.

Notes The response data will be a 16 byte long string. If there is no previously stored message, the response will be all spaces. The message is entered using the MESsage command.

Syntax



Examples **mes?** Response – “TESTabc “
The previously stored text from the last example was “TESTabc “.

MODulation <nrf value>

COMMON
FRONT PANEL
DEVICE DEPENDENT

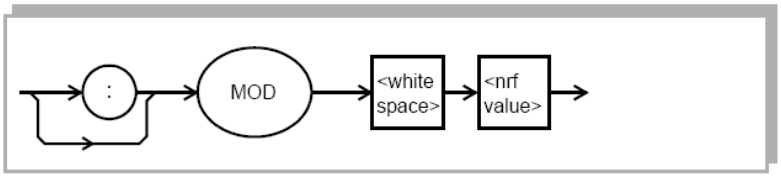
FOM-7900B FOS-79800F FOS-79710

Action The **MODulation** command enables and disables internal modulation of the mainframe.

Parameters A boolean <nrf value> to enable (1) or disable (0) the modulation.

Notes None.

Syntax



Examples **MOD 1**
Enables internal modulation.
mod off
Disables internal modulation.

MODulation?

COMMON
FRONT PANEL
DEVICE DEPENDENT

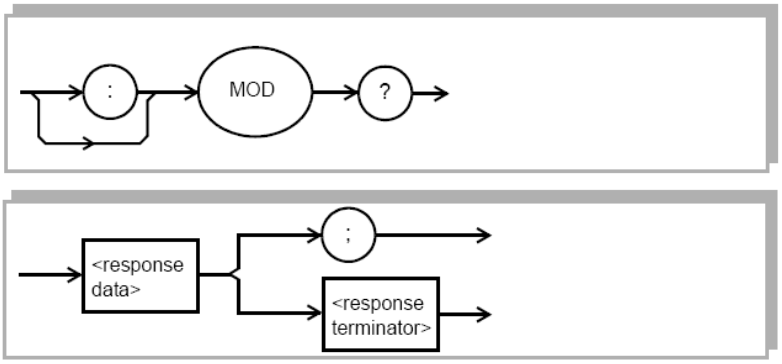
FOM-7900B FOS-79800F FOS-79710

Action The **MODulation?** query returns the ON/OFF status of the internal modulation.

Parameters None. The response is a boolean <nrf value> indicating the ON/OFF status.

Notes This is a convenient way to verify that the modulation has been enabled/disabled after issuing the mod on/off command.

Syntax



Examples **mod?** Response – 1
Internal modulation is enabled.

OUTput <nrf value>

COMMON
FRONT PANEL
DEVICE DEPENDENT

FOM-7900B FOS-79800F FOS-79710

Action The **OUTput** command enables and disables the fiber optic source output.

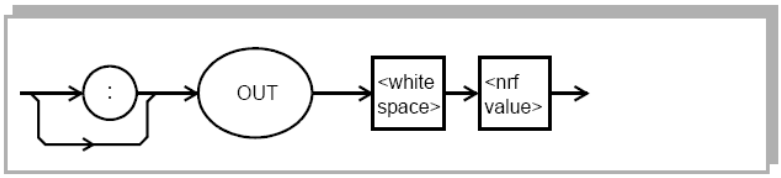
Parameters A boolean <nrf value> to enable (1) or disable (0) the output.

Notes If this command is sent to channel 0 or 9 then all sources within the mainframe are turned ON/OFF.

If sent to a specific module (1-8) in the mainframe, then only that channel is turned ON/OFF.

The green LED on the front of the module indicates the state of the source. When the output is turned on there is a three second safety startup. During the startup period the front panel ON LED blinks rapidly.

Syntax



Examples **OUT on**
Enables laser output.

OUTput?

COMMON
FRONT PANEL
DEVICE DEPENDENT

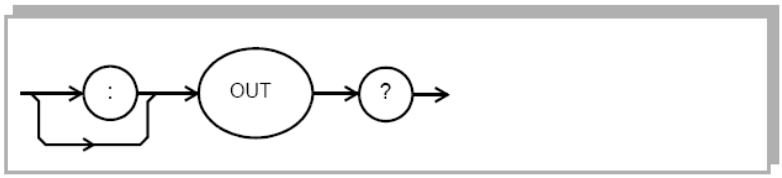
FOM-7900B FOS-79800F FOS-79710

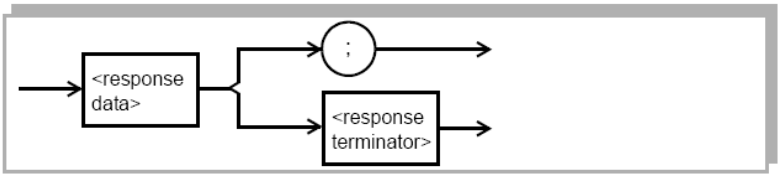
Action The **OUTput?** query returns the ON/OFF status of the laser output.

Parameters None. The response is a boolean <nrf value> indicating the ON/OFF status.

Notes None.

Syntax





Examples **out?** Response – 0
The selected channel output is disabled.

PORT <nrf value>

COMMON
FRONT PANEL
DEVICE DEPENDENT

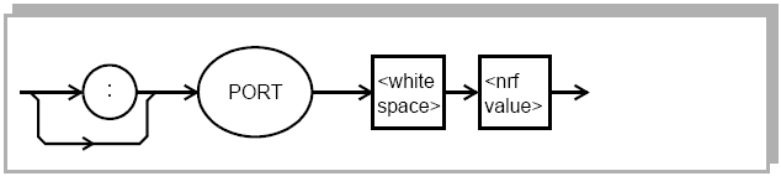
FOM-7900B FOS-79800F FOS-79710

Action The **PORT** command is used to switch any port to the common port.

Parameters An <nrf value> from 0 to 4 representing the port number to be connected to the common port.

Notes 0 corresponds to all ports being disconnected from the common port.

Syntax



Examples **PORT 2**
Port #2 is switched to the common port.

PORT?

COMMON
FRONT PANEL
DEVICE DEPENDENT

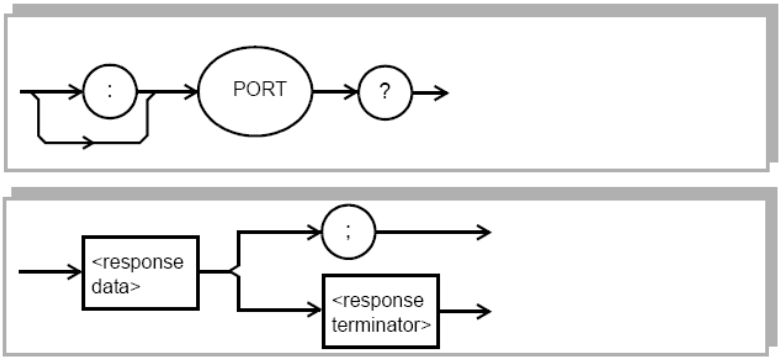
FOM-7900B FOS-79800F FOS-79710

Action The **PORT?** query returns the current port number that is switched to the common port.

Parameters None. The response is an <nrf value> from 0 to 4 representing the connected port.

Notes A value of 0 corresponds to all ports being disconnected from the common port.

Syntax



Examples **port?** Response – 0
The common port is switched to the optically terminated position.

RADix <nrf value>

COMMON
FRONT PANEL
DEVICE DEPENDENT

FOM-7900B FOS-79800F FOS-79710

Action The **RADix** command allows the user to select the radix type for status, condition, and event query response data. Decimal, binary, hexadecimal, and octal are allowed.

Parameters Character program data is expected as shown in the syntax detail.

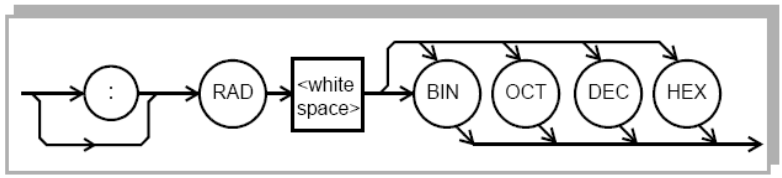
Notes **DECimal** is the default type. Only the first three letters of the words decimal, hexadecimal, binary, or octal are required.

When the **RADIX** is selected, all status, condition, and event queries will return values in the new radix. In the cases where the radix is not **DECimal**, the flexible numeric type <nrf value> (as shown in the Command Reference diagrams) will be replaced by **HEX**, **BIN**, or **OCT** representation.

All of the above radixes may be used to enter program data at any time, without the need for issuing the **RADix** command. The proper prefix must also be used with Hex (#H), binary (#B), or octal (#O).

This command may be useful for setting up status reporting blocks. The bit-wise status representation may be more easily read in BIN, HEX, or OCT.

Syntax



Examples **RAD DEC**

The decimal radix is selected.

rad hex; *ESR? Response – #H80

Hexadecimal radix is selected and power on was detected.

RADix?

COMMON
FRONT PANEL
DEVICE DEPENDENT

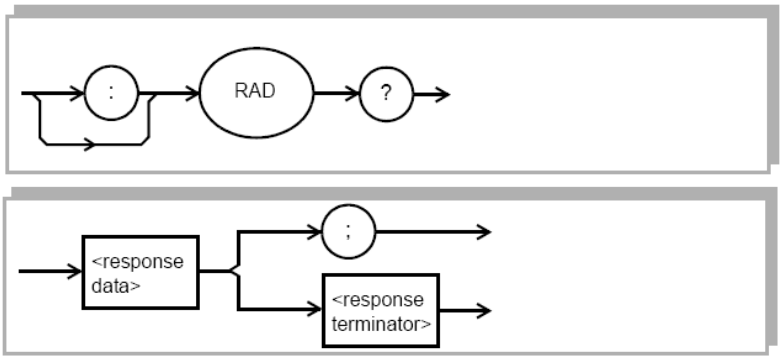
FOM-7900B FOS-79800F FOS-79710

Action — The **RADix?** query allows the user to determine which radix type for status, condition, and event query response data is currently selected. Decimal, binary, octal, and hexadecimal are allowed.

Parameters — None. Response will be an ASCII string corresponding to **DEC** for the decimal radix, **BIN** for the binary radix, **HEX** for the hexadecimal radix, or **OCT** for the octal radix.

Notes — **DEC** is the default type. The **RADix** command is used to select the form which GPIB status registers are returned (Binary, Octal, Decimal or Hexadecimal). Once changed, the new radix will remain in effect until the power is shut off or a new **RADix** command is issued.

Syntax



Examples — **rad?** Response – Dec
The selected radix is decimal.

rad? Response – Hex
The selected radix is hexadecimal.

SEQ:DEFAULT

COMMON
FRONT PANEL
DEVICE DEPENDENT

FOM-7900B FOS-79800F FOS-79710

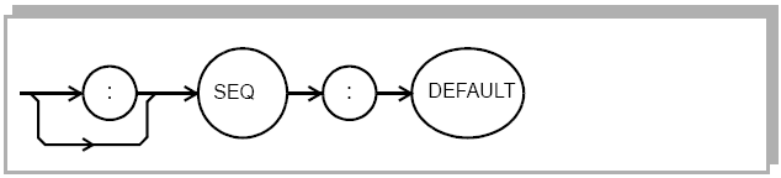
Action The **SEQ:DEFAULT** command initializes the switch sequence array to its default sequence.

Parameters None.

Notes This command initializes the trigger/timer switch sequence array to the following default sequence:

1 → 2 → 3 → 4

Syntax



Examples **seq:default**

Initializes the trigger/timer switch sequence.

SEQ:SW*n* <nrf value>

COMMON
FRONT PANEL
DEVICE DEPENDENT

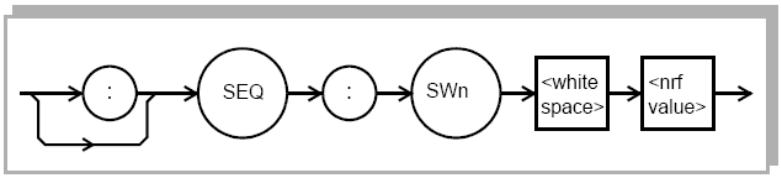
FOM-7900B FOS-79800F FOS-79710

Action The **SEQ:SW*n*** command is used to set the *n*th switch position in the trigger/timer sequence array, where the array index *n* is between 1 and 4.

Parameters The <nrf value> is the port value, between 0 and 4, where zero denotes the optically off position.

Notes Use this command to customize the switch sequence for the external trigger or internal timer modes. This command places the port number into the *n*th position in the switch sequence array. Entering a value here does not change the current switch position but merely places the new switch into the sequence array.

Syntax



Examples **SEQ:SW1 3**

Places port 3 into the first position in the sequence array.

SEQ:SW*n*?

COMMON
FRONT PANEL
DEVICE DEPENDENT

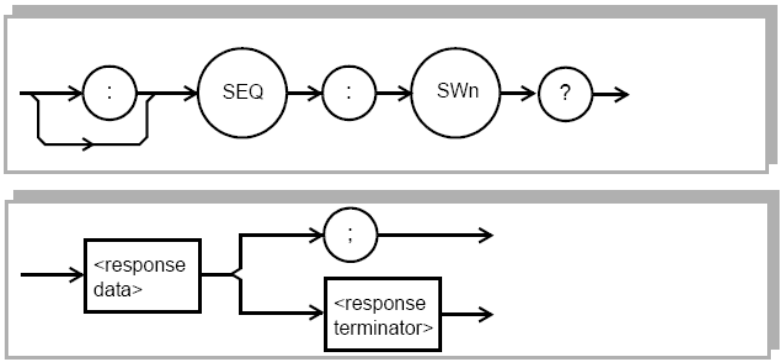
FOM-7900B FOS-79800F FOS-79710

Action The **SEQ:SW*n*?** query returns the port number that is in the *n*th position in the switch sequency array.

Parameters None. The value *n* is the switch sequence array index, between 1 and 4.

Notes Use this command to query the port number in the nth position of the trigger/timer switch sequence array.

Syntax



Examples **SEQ:SW3?** Response – 2
Indicates that port 2 is in the third position of the switch sequency array.

SEQ:TMR <nrf value>

COMMON
FRONT PANEL
DEVICE DEPENDENT

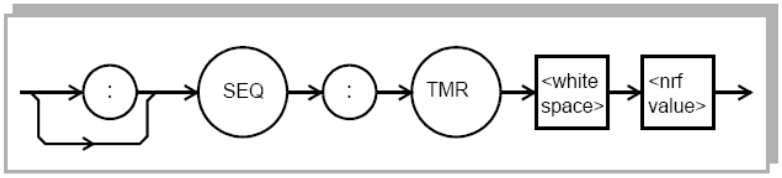
FOM-7900B FOS-79800F FOS-79710

Action The **SEQ:TMR** command is used to enable or disable the interval timer.

Parameters The boolean <nrf value> is a 1 or 0 to enable or disable the interval timer.

Notes Use this command to enable or disable the automatic switching of the built-in timer. When the timer is enabled the module will automatically move the switch position to the next port in the trigger/timer sequence at the rate determined by the timer interval set by the **INTERVAL** command.

Syntax



Examples **SEQ:tmr 0**
Timer mode is disabled.

SEQ:TMR?

COMMON
FRONT PANEL
DEVICE DEPENDENT

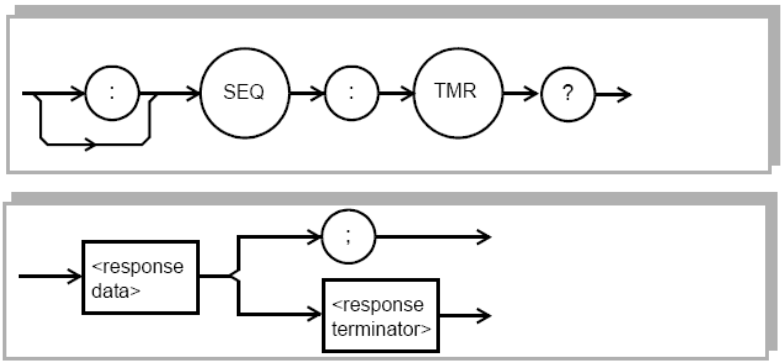
FOM-7900B FOS-79800F FOS-79710

Action The **SEQ:TMR?** query returns the state of the timer mode (enabled or disabled).

Parameters None. Response is a 1 to indicate timer is enabled or a 0 to indicate timer is disabled.

Notes Use this command to query the status of the timer mode. When the timer is enabled the module will automatically move to the next port in the sequence at the rate determined by the **INTERVAL** command.

Syntax



Examples **SEQ:TMR?** Response – 1
Indicates that timer mode is enabled

SEQ:TRG <nrf value>

COMMON
FRONT PANEL
DEVICE DEPENDENT

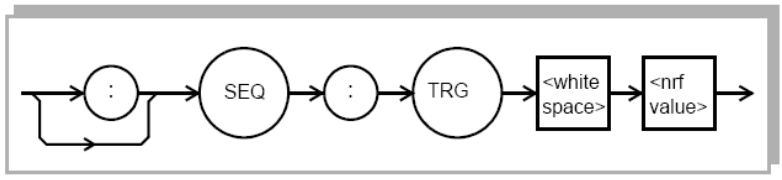
FOM-7900B FOS-79800F FOS-79710

Action The **SEQ:TRG** command is used to enable or disable the external trigger mode.

Parameters The boolean <nrf value> is a 1 or 0 to enable or disable the external trigger.

Notes Use this command to enable or disable the effects of the external trigger signal. When the external trigger is enabled the module will automatically move the switch position to the next switch in the sequence whenever a trigger signal is received at the FOM-7900B rear panel or when the **TRIG** command is sent through GPIB.

Syntax



Examples **SEQ:trg 0**
The external trigger is disabled.

SEQ:TRG?

COMMON
FRONT PANEL
DEVICE DEPENDENT

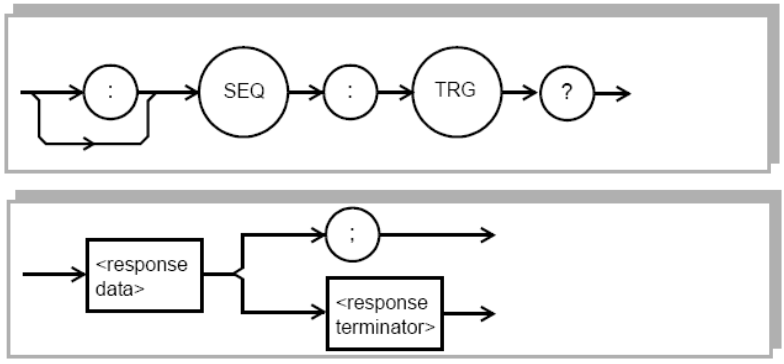
FOM-7900B FOS-79800F FOS-79710

Action The **SEQ:TRG?** query returns the state of the externa trigger (enabled or disabled).

Parameters None. Response is a 1 to indicate trigger is enabled or a 0 to indicate trigger is disabled.

Notes Use this command to query the status of the external trigger. When the trigger is enabled the module will automatically move to the next switch in the sequence whenever a trigger signal is received at the FOM-7900B rear panel or whenever the TRIG command is sent through GPIB.

Syntax



Examples **SEQ:TRG?** Response – 1
Indicates that external trigger mode is enabled

SERNUM?

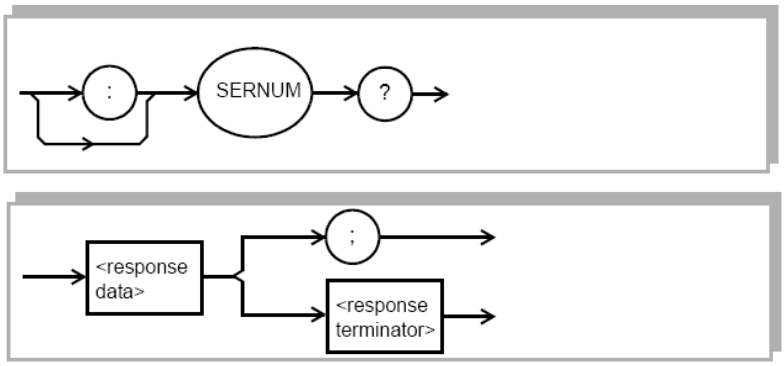
COMMON
FRONT PANEL
DEVICE DEPENDENT

FOM-7900B FOS-79800F FOS-79710

Action The **SERNUM?** query returns the serial number of the source module. To query the mainframe serial number, refer to the common command *IDN?, on page 75. To query the power meter serial number, refer to the device dependent command IDN? on page 112.

Parameters None. Response is the serial number of the module.

Syntax



Examples **SERNUM?** Response – F109
The queried module serial number is F109.

SHUTTER <nrf value>

COMMON
FRONT PANEL
DEVICE DEPENDENT

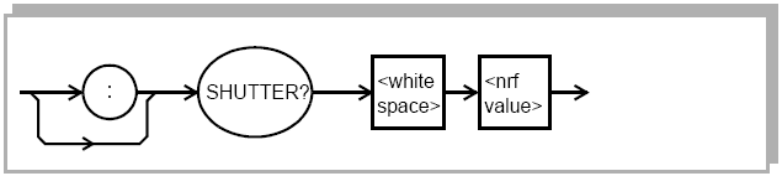
FOM-7900B FOS-79800F FOS-79710

Action The **SHUTTER** command is used to open or close the source shutter.

Parameters The boolean <nrf value> is a 1 or 0 to onen or close the source shutter.

Notes Use this command to set the state of the source shutter. The laser is energized by using the **OUT** command. The laser must be energized and the source shutter must be open for light to emit from the connector.

Syntax



Examples **Shutter 0**
The source shutter is closed.
Shutter on
The source shutter is opened.

SHUTTER?

COMMON
FRONT PANEL
DEVICE DEPENDENT

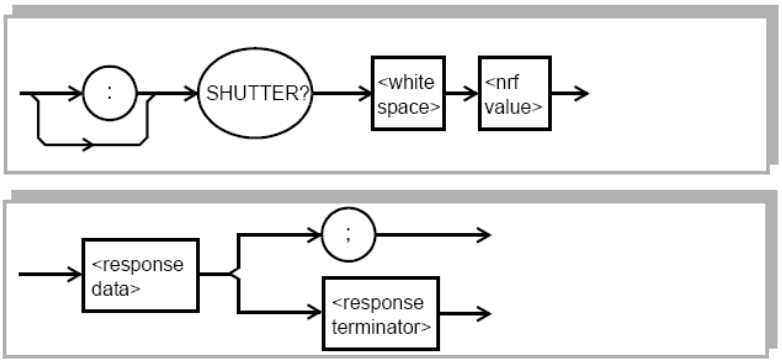
FOM-7900B FOS-79800F FOS-79710

Action The **SHUTTER?** query returns the state of the source shutter, 1 for open and 0 for shut. The **SHUTTER** command is used to open and shut the source shutter option. The normal state upon power up of the source shutter is OPEN.

Parameters None. Response is the shutter open/closed status.

Notes This command returns state of the source shutter. The state of the shutter is set with the **SHUTTER** command and the laser is energized with the **OUT** command.

Syntax



Examples **Shutter?** Response – 1
The source shutter is open.

SHUTPRES?

COMMON
FRONT PANEL
DEVICE DEPENDENT

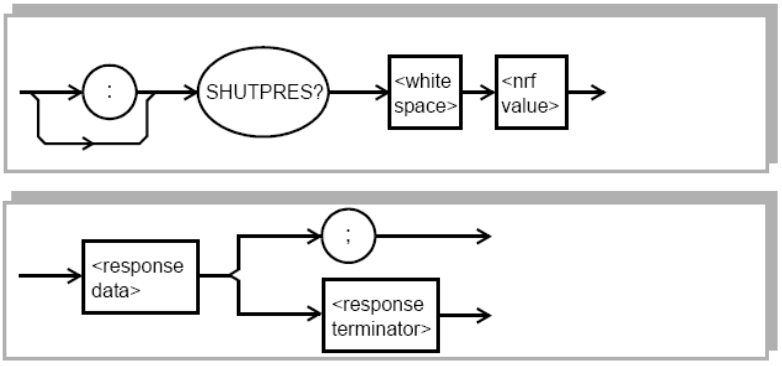
FOM-7900B FOS-79800F FOS-79710

Action The **SHUTPRES?** query is used to determine if a shutter has been installed in a module (present or not present). The **SHUTTER?** query returns the state of the source shutter (open or shut). The **SHUTTER** command is used to open and shut the source shutter option. The normal state upon power up of the source shutter is open.

Parameters None. Response is whether or not a shutter is installed.

Notes This command returns presence of the source shutter. The state of the shutter is set with the **SHUTTER** command and the laser is energized with the **OUT** command.

Syntax



Examples **Shutpres?** Response – 1
A source shutter is installed in the queried module.

SOURCE <nrf value>

COMMON
FRONT PANEL
DEVICE DEPENDENT

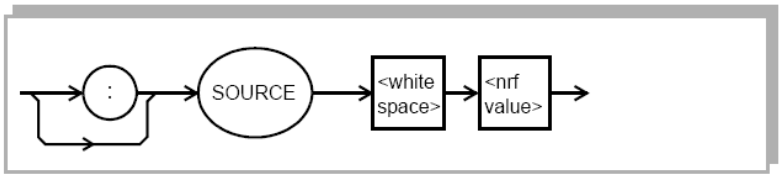
FOM-7900B FOS-79800F FOS-79710

Action The **SOURCE** command is used to select either the internal or external modulation source.

Parameters The boolean <nrf value> is a 0 for internally generated modulation or a 1 for esternal modulation.

Notes This command is used to select the source of the modulation signal that goes to each module. INTERNAL modulation is generated within the OM-7900B Mainframe. EXTERNAL modulation is provided to the mainframe through a rear panel BNC connector.

Syntax



Examples **source 0**
The modulation source is internal.
source 1
The modulation source is external.

SOURCE?

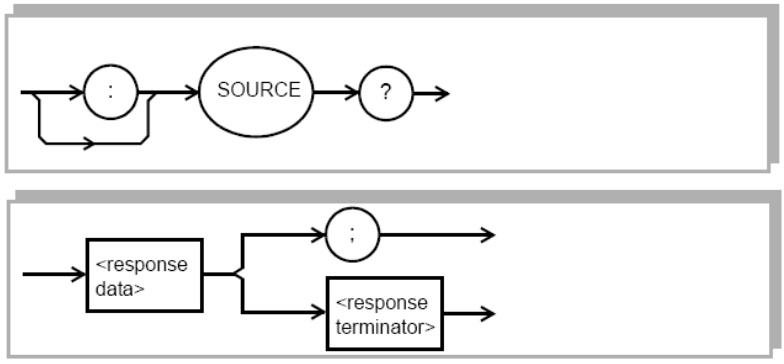
COMMON
FRONT PANEL
DEVICE DEPENDENT

FOM-7900B FOS-79800F FOS-79710

Action The **SOURCE?** query returns the source of the modulation signal as either external or internal.

Parameters None. Response is a boolean <nrf value> indicating whether the modulation source is internal (0) or external (1).

Syntax



Examples **source?** Response – 1
The modulation source is set to external.

TERM <nrf value>

COMMON
FRONT PANEL
DEVICE DEPENDENT

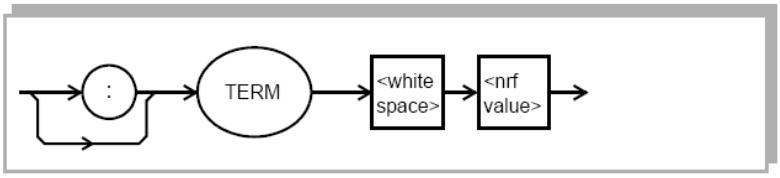
FOM-7900B FOS-79800F FOS-79710

Action The **TERM** command is used to add a carriage return to the GPIB response termination from the FOM-7900B.

Parameters The boolean <nrf value> is a 0 (false) or a 1 (true).

Notes The IEEE-488.2 standard for GPIB requires all commands and responses to be terminated with [LF][EOI]. The FOM-7900B is IEEE-488.2 compliant, however, some older GPIB control cards still expect the termination sequence to be [CR][LF][EOI]. Sending the TERM TRUE command will add a carriage return to the termination sequence. TERM FALSE will remove the carriage return from the termination.

Syntax



Examples **term true**
The GPIB termination sequence is [CR][LF][EOI].
term 0
The GPIB termination sequence is [LF][EOI].

TERM?

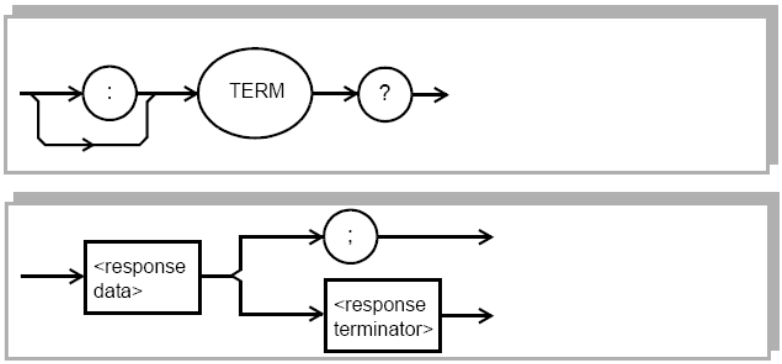
COMMON
FRONT PANEL
DEVICE DEPENDENT

FOM-7900B FOS-79800F FOS-79710

Action The **TERM?** query returns a 1 if the GPIB response terminator is [CR][LF][EOI] and returns a 0 if the response terminator is [LF][EOI].

Parameters None. Response is a boolean <nrf value> indicating whether a [CR] is added (1) or not (0).

Syntax



Examples **term?** Response – 1
The GPIB response terminator is [CR][LF][EIO] which technically takes the operation out of the IEEE-488.2 standard.

TIME?

COMMON
FRONT PANEL
DEVICE DEPENDENT

FOM-7900B FOS-79800F FOS-79710

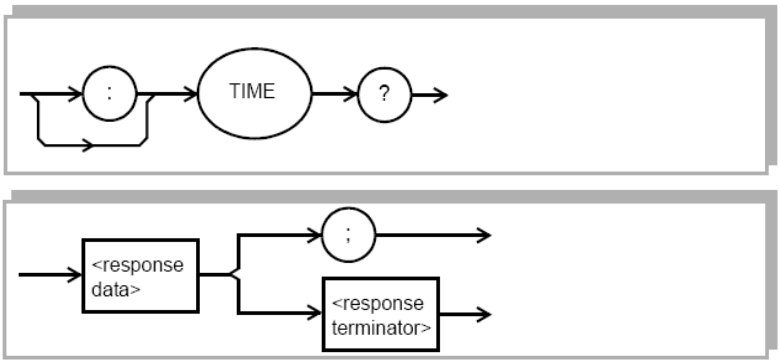
Action The **TIME?** query allows the user to determine how much time has passed since the FOM-7900B System was last powered up.

Parameters None. Response is character data in the form: hours:minutes:seconds.

Notes The TIME clock is independent of the TIMER clock.

The clock “turns over” after approximately 1193 hours.

Syntax



Examples **time?** Response – 0:01:02.36

One minute and 2.36 seconds have passed since the FOM-7900B was powered up.

TIMEOUT <nrf value>

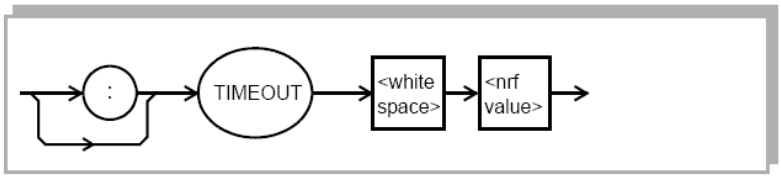
COMMON
FRONT PANEL
DEVICE DEPENDENT

FOM-7900B FOS-79800F FOS-79710

Action The **TIMEOUT** command selects a time-out value (in milliseconds) to use in detecting other 7900 systems in a banked RS232 configuration. If a particular channel does not respond to a query within this time, the query response "Bank not found: <banknumber>" will be returned. The default value for the time-out is 10000 milliseconds (10 seconds).

Parameters An integer <nrf value> between 0 and 2^{31} - 1.

Syntax



Examples **timeout 20000**
Remote unit response timeout is set to 20 seconds.
term 0
The GPIB termination sequence is [LF][EOI].

TIMEOUT?

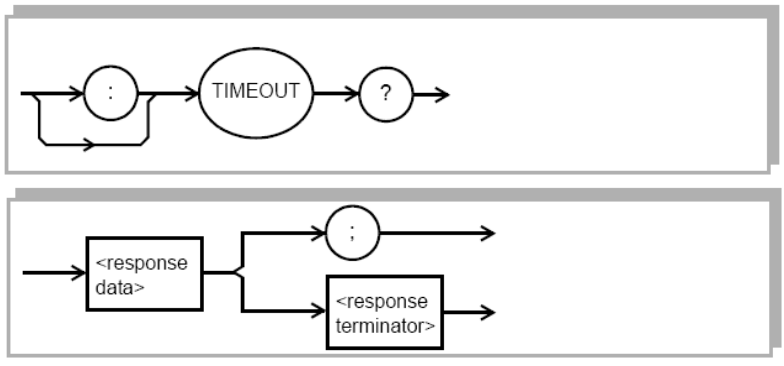
COMMON
FRONT PANEL
DEVICE DEPENDENT

FOM-7900B FOS-79800F FOS-79710

Action The **TIMEOUT?** query is used to determine what the timeout time in ms is when searching for other 7900 systems.

Parameters None. Response is an integer ranging from 0 to 2^{31} - 1 representing the timeout time in milliseconds.

Syntax



Examples **timeout?** Response – 15000
7900 search timeout is 15 seconds.

TIMER?

COMMON
FRONT PANEL
DEVICE DEPENDENT

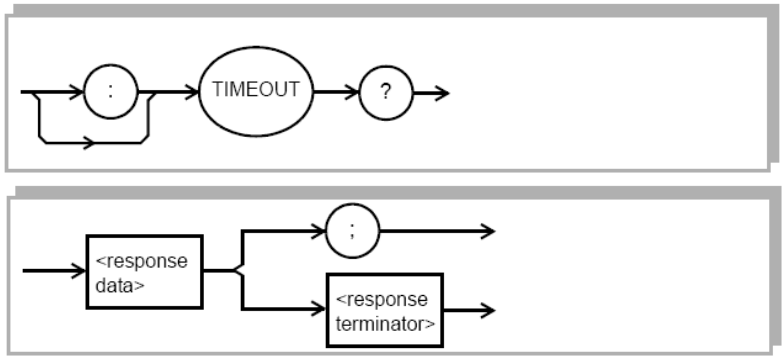
FOM-7900B FOS-79800F FOS-79710

Action The **TIMER?** query is used to determine how much time as elapsed since the last **TIMER?** query.

Parameters None. Response is character data in the form: hours:minutes:seconds.

Notes Each time the **TIMER?** query is issued, the timer is reset to 00:00:00.0 and the elapsed time since the last **TIMER?** query is returned. The timer counter is initialized at power-up. The first time the **TIMER?** query is issued its response is the same as the **TIME?** query. The clock "turns over" after about 1193 hours.

Syntax



Examples **timer?** Response – 6:44:21.74
Six hours, 44 minutes and 21.74 seconds have elapsed since the last **TIMER?** query was issued.

TRIGger

COMMON
FRONT PANEL
DEVICE DEPENDENT

FOM-7900B FOS-79800F FOS-79710

Action The **TRIGger** command activates the trigger signal down the backplane of the FOM-7900B mainframe and triggers all compatible modules.

Parameters None.

Notes The trigger signal will be sent to all modules within a FOM-7900B mainframe. The signal will be present at the **TRIGGER OUT** connector on the back panel. Refer to individual chapter on modules for details regarding how the trigger affects each module.

Examples **trig**
Triggers all compatible modules in a FOM-7900B mainframe.

WAVE <nrf value>

COMMON
FRONT PANEL
DEVICE DEPENDENT

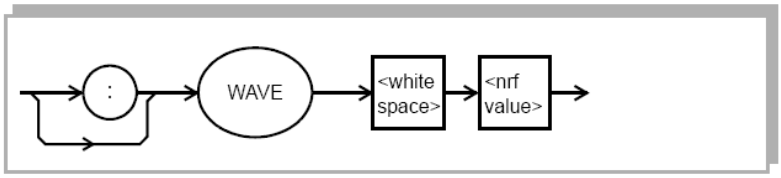
FOM-7900B FOS-79800F FOS-79710

Action The **WAVE** command sets the wavelength of the FOS-79800F Precision Fiber Optic Source.

Parameters An <nrf value> corresponding to the desired wavelength, in nm.

Notes Use this command to set the wavelength of the source. The source is enabled and disabled using the **OUT** command.

Syntax



Examples **wave 1564.775**
Sets the output wavelength to 1654.775 nm.

WAVE?

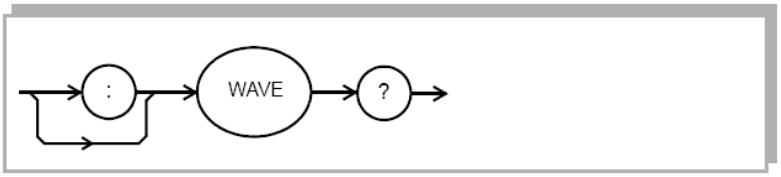
COMMON
FRONT PANEL
DEVICE DEPENDENT

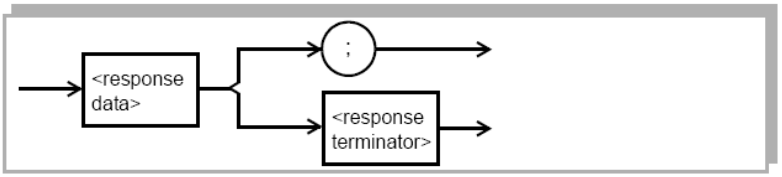
FOM-7900B FOS-79800F FOS-79710

Action The **WAVE?** query returns the source's wavelength setpoint in nm.

Parameters None. The response is an <nrf value> corresponding to the wavelength setpoint.

Syntax





Examples **wave?** Response – 1625.325
The queried module's output wavelength is 1625.325 nm.

WAVEMAX?

COMMON
FRONT PANEL
DEVICE DEPENDENT

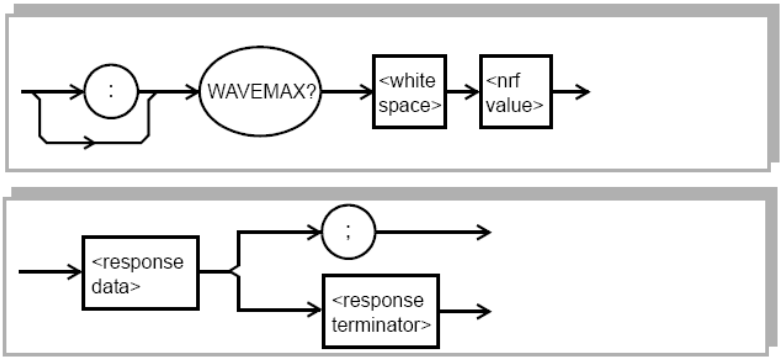
FOM-7900B FOS-79800F FOS-79710

Action The **WAVEMAX?** query returns the module's maximum wavelength setting in nm.

Parameters None. The response is an <nrf value> corresponding to the max wavelength in nm.

Notes The wavelength is set with the **WAVE** command and cannot be greater than the **WAVEMAX?** value.

Syntax



Examples **wavemax?** Response – 1551.256
The maximum wavelength is set to 1551.256 nm.

WAVEMIN?

COMMON
FRONT PANEL
DEVICE DEPENDENT

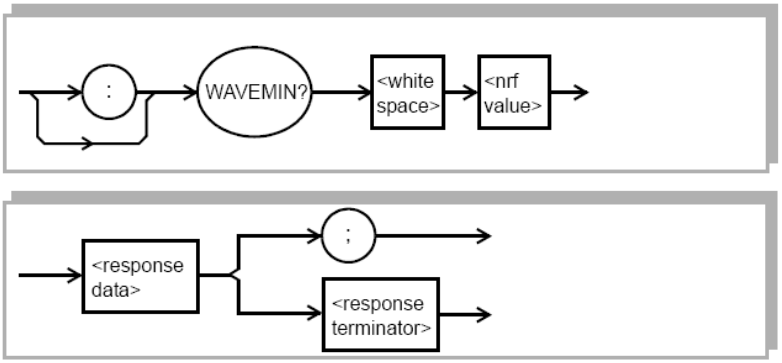
FOM-7900B FOS-79800F FOS-79710

Action The **WAVEMIN?** query returns the module's minimum wavelength setting in nm.

Parameters None. The response is an <nrf value> corresponding to the min wavelength in nm.

Notes The wavelength is set with the **WAVE** command and cannot be less than the **WAVEMIN?** value.

Syntax



Examples **wavemin?** Response – 1549.308
The minimum wavelength is set to 1549.308 nm.

CHAPTER 8

PROGRAMMING EXAMPLES

This section provides examples of programming the FOM-7900B using GPIB. These examples are written in QuickBASIC for the National Instruments NI-488.2 GPIB card. The first is an example of a “driver” for GPIB communications with the FOM-7900B. The second is an example of an output power and wavelength display calibration. These examples are not complete, and will not execute by themselves. The initialization of some variables and files have been purposely omitted.

Table 8.1 GPIB Driver

```
10    SUB 7900dvr(Device_id,Command$,Response$,Err$)
20    'This driver provides bus time-out protection and looks for device dependent errors.
30
40    ON ERROR GOTO handler ' Watch for software errors
50    CALL Ibtmo(Device_id, 10) ' Provide 300 mSec time-out on GPIB
60
70    Cmd_len% = LEN(Command$) ' Get length of command string
80    IF (Cmd_len% > 0) THEN
90        CALL Ibwrt(Device_id,Command$) ' Send the command
100   END IF
110   IF (INSTR(Command$,"?") THEN ' Is the command a query?
120       CALL Ibrd(Device_id,Response$) ' Get the response
130   END IF
140
150   CALL Ibwrt(Device_id,"*STB?") ' Get the Status Byte
160   CALL Ibrd(Device_id,Status_byte%)
```

Table 8.1 GPIB Driver (Continued)

170 Err_bit% = Status_byte% AND 128 ' Is the error queue active bit set?
180 IF (Err_bit% > 0) THEN
190 CALL Ibwrt(Device_id,”ERR?”) ' Get the Error queue
200 CALL Ibrd(Device_id,Err$) ' Report the Errors
210 PRINT “ERROR IN 7900B COMMUNICATIONS - DEVICE DEPENDENT ERROR”
220 PRINT “ERRORS ARE: “ Err$
230 END IF
240 IF (Ibsta AND Timo) THEN PRINT “7900B GPIB TIMEOUT “ ' Did the bus timeout?
250 EXIT SUB
260 Handler: ' Did the software bomb?
270 PRINT “MISC SOFTWARE GENERATED ERRORS IN 7900B DRIVER SUB”
280 END SUB

Table 8.2 Display Calibration

10 SUB Cal_Display(Device_id, Level, Wave)
20 ' Enters the level and wavelength display cal points for a 79800E Fiber Optic Source Module
30
40 CALL 7900dvr(Device_id,”CH 1",Response$,Err$)' Set the channel number
50 CALL 7900dvr(Device_id,”CAL:LEVEL Level”,Response$,Err$) 'Cal the output display
60 CALL 7900dvr(Device_id,”CAL:WAVE Wave”,Response$,Err$)' Cal the wavelength disp.
70 CALL 7900dvr(Device_id,”LEVEL 1.00",Response$,Err$)' Set output level to 1.00 dBm
80 CALL 7900dvr(Device_id,”LEVEL?”,Response$,Err$)' Verify level setpoint
90 Lev = VAL(Response$)
100 PRINT “The current output level setpoint is “; Lev
110 END SUB

CHAPTER 9

MAINTENANCE

This chapter describes how to maintain the FOM-7900B System. Included are sections covering fuse replacement and line voltage information. Details concerning the cleaning of the module fiber optic connectors is provided as well.

WARNING

To avoid electrical shock hazard, connect the FOM-7900B System to a properly earth grounded, three prong receptacle only. Failure to observe this precaution can result in severe injury or death.

CAUTION

Do not insert or remove any module while the FOM-7900B is powered up. This could damage the module and/or mainframe. Be sure the module is properly installed before applying power to the FOM-7900B.

WARNING

CAUTION: RISK OF ELECTRICAL SHOCK. DO NOT OPEN

VORSICHT: HOCHSPANNUNG NICHT OFFNEN.

ATTENTION: RISQUE D'ELECTROCUTION. NE PAS OUVRIR.

ATTENZIONE: RISCHIO DI SHOCK ELECTRICO. NON APRIRE.

WARNING

CONNECT THE INSTRUMENT TO A PROPERLY EARTH GROUNDED, THREE PRONG RECEPTACLE.

ANSHLIESS DAS INSTRUMENTIERE BIS EIN ANGEBRACHT ERDE GROUNDED, DREIPRONG RECEPTACLE.

ABOUCHENT LA INSTRUMENT POUR CONVENABLE EARTH GROUNDED, TROIS PRONG RECEPTACLE.

CONNECT GLI STRUMENTANO A UN PROPER TERRA GROUNDED, TRE PRONG RICETTACOLO.

Fuse Replacement

Fuses are accessed from the rear panel of the FOM-7900B. Before replacing the fuses, turn the power off and disconnect the power cord. Then remove the fuse holder with a regular, flatblade screwdriver.

Only use fuses rated for the local power line voltage as indicated on the rear panel.

LINE VOLTAGE	FUSE (5 X 20mm)
100-120V ~	T 2.0A, 250V
220-240V ~	T 1.6A, 250V

CAUTION

FOR CONTINUED PROTECTION, REPLACE FUSE ONLY WITH SPECIFIED TYPE AND RATING.

ZUM FORTBESTEHENDEN SCHUTZ, ERSETZEN SIE DIE SICHERUNG NUR MIT DEM SPEZIFIZIERTEM TYP AND NENNWERT.

POUR ASSURER LA PROTECTION FUTURE, LE FUSIBLE DE REMPLACEMENT DOIT ETRE AUX MEMES SPECIFICATIONS.

PER UNA CORRETA PROTEZIONE, SOSTITUIRE IL FUSIBILE SOLO CON UNO DI IDENTICO TIPO E POTENZA.

Line Voltage Selection

The AC line voltage is preset at the factory and cannot be changed in the field. Permitted fluctuations from rated line voltages are +6% and -10%. Contact ILX Lightwave should it be necessary to change the AC line voltage.

Module Replacement

Use the following instructions when replacing modules in the FOM-7900B Mainframe.

CAUTION

Do not insert or remove any module while the FOM-7900B is powered up. This could damage the module and/or mainframe. Be sure the module is properly installed before applying power to the FOM-7900B.

CAUTION

The Fiber Optic Source Module is a static sensitive device. Installing or removing any module from the FOM-7900B System should take place at an ESD protected workbench. The operator should be properly earth grounded.

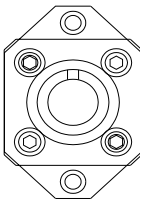
1. Make sure the power to the FOM-7900B Mainframe is turned off.
2. Select any available mainframe channel and, if necessary, remove the blank plate that covers the channel. The plate is removed by looseining the screw at the bottom left corner.
3. Position the module and guide it into the bay using the mounting rails on the top and bottom of the mainframe bay.
4. Press the module firmly into the bay. The module should “snap” securely into place.
5. Secure the module using the screw at the bottom left corner of the front panel.

FOS-79800F and FOS-79710 Module Maintenance

The FOS-79800F Fiber Optic Source Module and the FOS-79710 1x4 Fiber Optic Switch Module should not require maintenance, however, the fiber optic connectors may become contaminated with foreign material over time. When this happens, power output may drop or become unstable.

Cleaning Fiber Optic Connectors

1. Turn off the mainframe by placing the power switch in the O position.
2. Loosen the module front panel screw at the bottom corner of the module and grasp the module handle. Pull the module outward from the mainframe chassis.



3. Remove the two #2 socket-head capscrews that hold the fiber connector bulkhead to the front panel of the module. Gently slide the connector bulkhead away from the front panel and allow the internal fiber connector to extend beyond the front panel.
4. Unscrew one of the fiber connectors from the connector bulkhead. It is recommended that only one fiber be disconnected at a time to avoid getting the fibers in the wrong place after cleaning.
5. Clean the fiber ferrule by gently wiping the end with a soft tissue wetted with methanol, or with similar fiber optic cleaning equipment. Screw the fiber ferrule back onto the bulkhead connector.
6. Carefully reinstall the connector bulkhead onto the module front panel and secure it with the two #2 socket-head capscrews the were previously removed.
7. Repeat the above process with any remaining connector bulkheads attached to the module's front panel.
8. Re-insert the module into the mainframe and repeat the above procedure with any remaining modules whose connector quality may be suspect.

User Calibraton of the FOS-79800F Module

User Calibration(s) can be utilized when the measured output power and/ or wavelength do not match front panel settings. Use the procedures below to field calibrate the power and wavelength.

Wavelength Calibration

The Wavelength User Calibration can be used when the measured wavelength does not match the front panel setting. Use the steps below to enter a Wavelength User Calibration. This calibration generates a single point offset that is applied to all future wavelength settings.

1. Connect an optical wavelength meter to the end of a fiber optic patch cord that is also connected to the 79800F Precision Fiber Optic Source. Setup the meter for a measurement in a vacuum.
2. Set the 79800F Precision Fiber Optic Source Module to a wavelength near that of the test application. Turn the source on.
3. Proceed to the Cal Wavelength display on the front panel.
4. Give the system enough time to warm up and stabilize - at least one hour. Measure the wavelength with the wavemeter. Enter this measurement as the Cal Wavelength value.

Power Calibration

The Power User Calibration can be used when the measured output power does not match the front panel setting or to compensate for losses induced by patch cords. Use the steps below to enter a Power User Calibration. This calibration generates a single point offset that is applied to all future power levels.

1. Connect an optical power meter to the end of a fiber optic patch cord that is also connected to the 79800F Precision Fiber Optic Source. Program the power meter to the wavelength of the 79800F. Zero the power meter.
2. Set the 79800F Precision Fiber Optic Source Module to a level near that of the test application. Turn the source on.
3. Proceed to the Cal Level display on the front panel.
4. Give the system enough time to warm up and stabilize. Measure the output power with the power meter. Enter this power measurement as the Cal Level value.

CHAPTER 10

ERROR MESSAGES

Error messages may appear on the display when problems occur within the FOM-7900B. Error messages are shown on the front panel display. In remote operation, the current error list can be read by issuing the “ERR?” query. When this is done, a string is returned containing all of the error messages that are currently in the error message queue. The mainframe and each module contain their own error queue. Direct the ERR? query to a specific module or mainframe by issuing the CH x command first.

The error codes are numerically divided into areas of operation. Refer to Table 10.1

Table 10.1 Error Code Classification

Error Code Range	Ares of Operation
001 – 099	Internal Program Errors
100 – 199	Parser Errors
200 – 299	Execution Control Errors
300 – 399	GPIB Errors
400 – 499	Mainframe-Specific Errors
500 – 599	Module-Specific Errors

Tables 10.2 through 10.6 contain all of the error messages that may be generated by the device. Not all of these messages may appear on the front panel display. Some refer to GPIB communication only.

FOM-7900B Fiber Optic System Errors

Table 10.2 Parser Errors

Error Code	Explanation
101	<program mnemonic> is too long.
102	<PROGRAM MESSAGE UNIT> is too long.
103	<DEFINITE LENGTH ARBITRARY BLOCK PROGRAM DATA> length is too long.
104	<NON-DECIMAL NUMERIC PROGRAM DATA> type not defined.
105	<DECIMAL PROGRAM DATA> exponent not valid.
106	<DECIMAL PROGRAM DATA> digit expected.
107	<DECIMAL PROGRAM DATA> digit not expected.
108	<DECIMAL PROGRAM DATA> more than one decimal point.
109	<DECIMAL PROGRAM DATA> more than one exponential indicator (E)
110	<SUFFIX PROGRAM DATA> must have digit following sign.
111	<SUFFIX PROGRAM DATA> must have alpha character following operator.
113	<ARBITRARY BLOCK PROGRAM DATA> length less than digit count.
114	<DEFINITE LENGTH BLOCK PROGRAM DATA> premature end of data.
115	<PLACEHOLDER PROGRAM DATA> identifier not valid.
116	Parser syntax error, character was not expected.
120	<program mnemonic> Lookup, word as part of a header path, has no commands.
121	<program mnemonic> Lookup, word as part of a header path, is not found.
122	<program mnemonic> Lookup, cannot find a null entry.
123	<program mnemonic> Lookup, word within context of current path, is not found.
124	<program mnemonic> Lookup, failed because query/command type match failed.
125	<program mnemonic> Lookup, work within context of common command path, is not found.
126	Too few or too many program data elements.

Table 10.3 Execution Control Errors

Error Code	Explanation
201	<PROGRAM DATA> value out of range.
202	<PROGRAM DATA> will not convert to valid type.
203	Security violation, command is not available without clearance.
204	<PROGRAM DATA> suffix type is not valid.
205	<PROGRAM DATA> is not a Boolean value or word.
206	<PROGRAM DATA> will not convert to a signed 16-bit value.
207	<PROGRAM DATA> will not convert to an unsigned 16-bit value.
208	<PROGRAM DATA> will not convert to a signed 32-bit value.
209	<PROGRAM DATA> will not convert to an unsigned 32-bit value.
210	<PROGRAM DATA> will not convert to a floating point value.
211	<PROGRAM DATA> will not convert to a character value.
212	<PROGRAM DATA> will not convert to a byte array pointer.
213	<PROGRAM DATA> is incorrect block data length.
214	<PROGRAM DATA> length exceeds maximum.
219	Present modular configuration doesn't match that of stored setting.
220	Required parameter is missing from command.

Table 10.4 GPIB Errors

Error Code	Explanation
301	A <RESPONSE MESSAGE> was ready, but controller failed to read it. (Query error).
302	Device was addressed to talk, but controller failed to read all of the <RESPONSE MESSAGE>. (Query error).

Table 10.5 Mainframe-Specific Errors

Error Code	Explanation
401	Channel number out of range (0 to 9 legal).
402	Bank address number out of range (0 to 24 legal).
403	Internal modulation frequency out of range (1 to 500 kHz legal).
404	Command or query sent to empty channel (no module installed in channel).

Table 10.6 Module-Specific Errors

Error Code	Explanation
501	Case Temperature Error (79800F and 79880 modules only).
502	Temperature Control Error (79800F and 79880 modules only).
503	Current Limit Error (79800F and 79880 modules only).
504	Self Test Error (79710).
507	Single Mode Limit Error (79880 modules only).
508	Calibration Data Error. Calibration data in EEPROM is invalid; module must be recalibrated (79800F and 79880 modules only). Contact ILX Lightwave Customer Service.
509	Setpoint Read Error. Invalid setpoints stored in EEPROM; setpoints are reset to module defaults (79800F and 79880 modules only).

Table 10.7 FOS-79710 Switch Error Messages

Error Code	Explanation
123	Command Syntax Error
201	Value Out of Range Error
220	Parameter Missing Error
504	Switch Mechanism Failure

CHAPTER 11

TROUBLESHOOTING

This chapter is intended to be used as a guide when the FOM-7900B mainframe or modules do not perform as expected. It is not a service manual, rather a guide to alleviate basic problems which may arise during operation. Some of the common causes and corrective actions for problems are listed in this chapter. If additional symptoms persist, contact your ILX Lightwave representative, or ILX Lightwave Customer Service.

System Troubleshooting Guide

Table 11.1 System Troubleshooting

Symptom	Causes and Corrective Actions
FOM-7900B will not power-up	Check the power cord to make sure it is properly connected. Check the fuse for continuity and proper rating. If the above suggestion fails, verify the line voltage selection on the rear panel is compatible with the AC mains voltage.
Channel Output will not turn on or will not stay on.	Check to be certain the channel output has been turned on and that the output level setpoint is correct. Make sure an appropriate fiber patchcord has been correctly installed on the output connector. A TEC Open Circuit, Current Limit, or Power Limit condition could be disabling output.

GPIB Troubleshooting Guide

If you have difficulty operating the FOM-7900B through GPIB, refer to the symptoms listed here.

Table 11.2 GPIB Troubleshooting

Symptom	Causes and Corrective Actions
No response from FOM-7900B upon a GPIB command (remote indicator does not come on).	Check that a GPIB (or RS-232) cable is connected between the FOM-7900B and the host computer. This cable should be less than 3 meters long. Check that the GPIB address is set properly and the controlling software is sending commands to the proper address. Make sure no two devices have the same GPIB address. Check that there are fewer than 15 devices on the bus and there is less than 20 meters of total cable length. Check that the GPIB controller card in the host computer is configured properly. Try isolating the FOM-7900B by removing all other instruments from the bus.
Slow or unexpected response to GPIB commands.	Make sure no two devices have the same GPIB address. Check that there are fewer than 15 devices on the bus and there is less than 20 meters of total cable length. Make sure the GPIB controller card in the host computer is configured correctly. Isolate the FOM-7900B by removing all other instruments from the bus.

Table 11.2 GPIB Troubleshooting (Continued)

Device does not respond to command (remote indicator is on).	Read the error queue remotely (ERR?). The command syntax or command structure may be in error. Read the status byte (*STB?) and condition register (COND?) for possible device problems. Make sure the GPIB controller card in the host computer is configured properly.
Bus hangs.	Place a software timeout around the command in question to prevent the hang. Check the syntax of the command that is causing the hang; especially if the command is a query and software is waiting for a response. Make sure the controlling software is not requesting information from the FOM-7900B without first sending the proper query. Make sure the GPIB controller card is configured correctly. Check the GPIB cables and the GPIB address.

Table 11.3 FOS-79710 Switch Module Errors

Symptom	Causes and Corrective Actions
Persistent ERROR 504	Power down the FOM-7900B. Remove the switch module and reinsert it. Ensure the module is seated well into the FOM-7900B Mainframe. Power up the FOM-7900B and recheck the switch module for ERROR 504. Call ILX Lightwave Customer Service.
Unstable power levels or unequal power from different ports.	Clean fiber optic connectors and bulkhead connectos. Make sure the input source to the switch module is stable.

Table 11.4 FOS-79800F Source Module Errors

Symptom	Causes and Corrective Actions
ERROR 501 when laser is first turned on.	The laser is being turned on before the laser case temperature has stabilized. The error should reset when the system has warmed up adequately. The output power may not be stable during this warm-up period.
Unstable power level from the module.	Clean the fiber optic bulkhead connectors on the front panel of the module. Make sure the FOM-7900B has warmed up adequately. Enable Coherence Control.
ERROR 503	The laser source is being overdriven. Reduce the output level and try again.
ERROR 508	The calibration data stored in the 79800F non-volatile memory (EEPROM) has become corrupt. Th module must be recalibrated or reprogrammed with the original calibration data.
ERROR 509	The values of the user-adjustable setpoints such as level and wavelength currently stored in non-volatile memory (EEPROM) have become corrupt. These values must be set to factory defaults based on the module calibration, and the error condition will be cleared. If this happens frequently, the external AC power being supplied to the FOM-7900B may not be within specification.
Output power is substantially different than displayed output level.	Make sure the patchcord is clean, free of defects and properly connected to the 79800F. The internal fiber ferrule may be contaminated. It may be necessary to clean it. The display calibration may not be accurate. Perform a user calibration. Try resetting the User Calibration first.
Measured wavelength is substantially different than the displayed setting or the wavelength will not tune.	The display calibration may not be accurate. Perform a user calibration. Try resetting the User Calibration first.