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FLS-2600

Tunable Laser Source



Instruction Manual

Second Edition

P/N: MAN-141-I .2ACE

If the equipment described herein bears the CE *symbol, the said equipment complies with the European Community Directive and Standards found in the Declaration of Conformity.*

If the equipment described herein bears an **FCC** *statement, the said equipment complies with the relevant Federal Communications Commission standards.*

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Certification Information

F.C.C. Information to User

This unit has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 (Subpart B) of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This unit generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this unit does cause harmful interference to radio or television reception, which can be determined by turning the unit off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the unit and receiver.
- Connect the unit into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Warning

Changes or modifications not expressly approved by EXFO Electro-Optical Engineering Inc. could void the user's authority to operate the unit.

- This unit is equipped with a shielded three-wire power cord and plug. Use this power cord in conjunction with a properly grounded electrical outlet to avoid electrical shock and to reduce radio frequency interference that may emanate from the power cord.

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- Use of shielded remote I/O cables, with properly grounded shields and metal connectors, is recommended in order to reduce radio frequency interference that may emanate from these cables.
- When the GPIB option is present, this unit is equipped with a shielded GPIB cable.

INDEPENDENT LABORATORY TESTING

This unit has undergone extensive CE certification testing both internally, at EXFO, and externally, at an independent, qualified laboratory. All pre-qualification tests were performed at EXFO while all final tests were performed at UltraTech Engineering Labs Inc., a renowned test laboratory from Mississauga, Canada. This guarantees the unerring objectivity and authoritative compliance of all test results.

CE INFORMATION TO USER

This unit has been tested and found to comply with the limits for a Class B digital device. Please see the Declaration of Conformity.

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1 Introduction

FLS-2600 General Description

The FLS-2600 Tunable Laser Source combines a tunable laser with a broadband source covering the 1520 to 1570 nm range. The FLS-2600 has been specially designed for testing passive components. Its coherence length is perfectly suited for detecting parasitic etalon or other interference effects inside components. This medium coherence also avoids problems such as connector-induced interference, which is common when using high-coherence, external cavity lasers. Its ruggedness and immunity to vibration make it perfect for production testing, product qualification, and R&D use.

The 60 dB sidemode suppression ratio of the FLS-2600 Tunable Laser Source provides a better dynamic range than what is possible with a traditional external cavity laser, thus allowing you to measure crosstalk at the higher level that is required for passive component testing.

FLS-2600 Main Applications

Main applications include the complete characterization or alignment of filters, multiplexers, Bragg gratings, and other DWDM components. For EDFA testing, use the FLS-2600 Tunable Laser Source to check wavelength-dependent gain, noise contribution, and saturation properties. It is also very useful for determining the spectral sensitivity of receivers and detectors.

Furthermore, the FLS-2600 Tunable Laser Source is also equipped to operate in amplified spontaneous emission mode as a non-coherent broadband source with a spectrum of non-flattened erbium-doped fiber. This operation mode is ideal for high-loss tests (isolation, directivity, and return loss) on passive components.

The FLS-2600 Tunable Laser Source is controlled by supplied software that offers both manual and programmed specifications of wavelength output and power level, as well as a range of sweep options. This easy-to-use, flexible software allows the FLS-2600 Tunable Laser Source to be combined with a wide variety of other test equipment to perform automated measurements.

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The FLS-2600 Tunable Laser Source can be controlled through standard GPIB and RS-232 interfaces from any compatible PC or test station.

The FLS-2600 is particularly well suited to the most demanding laboratory and manufacturing qualification applications.

FLS-2600 Models and Connector Types

Model	Connector Type
FLS-2600B-EA-YY	EXFO APC Universal Interface
FLS-2600B-EI-YY	EXFO UPC Universal Interface
Options YY	
89	FC connector adapter
90	ST connector adapter (UPC only)
91	SC connector adapter
95	E-2000 connector adapter

Table 1-1. *FLS-2600 Model and Connector Types*

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2 Safety Information

Safety Conventions

You should understand the following conventions before using the product described in this manual:

WARNING

Refers to a potential *personal* hazard. It requires a procedure that, if not correctly followed, may result in bodily harm or injury. Do not proceed beyond a **WARNING** unless you understand and meet the required conditions.

CAUTION

Refers to a potential *product* hazard. It requires a procedure that, if not correctly followed, may result in component damage. Do not proceed beyond a **CAUTION** unless you understand and meet the required conditions.

IMPORTANT

Refers to any information regarding the operation of the product that you should not overlook.

General Safety Information

WARNING

Do not install or terminate fibers while a laser source is active. Never look directly into a live fiber and ensure that your eyes are protected at all times.

CAUTION

Use of controls, adjustments, and procedures for operation and maintenance other than those specified herein may result in hazardous radiation exposure.

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CAUTION

Use of optical instruments with this product will increase eye hazard.

Safety Precautions

While handling optical fibers, laser radiation may be encountered at source output ports and at fiber ends. Avoid long-term exposure to laser radiation.



Figure 2-1. *Laser Warning Label*

The following safety precautions must be observed during the operation and servicing of the units. Failure to comply with these precautions or with specific indications elsewhere in this manual violates safety standards of intended use of the unit. EXFO assumes no liability for the user's failure to comply with these requirements.

- This unit is intended for indoor use only.
- Unit covers can only be opened by an EXFO trained employee.
- Before powering on the unit, all grounding terminals, extension cords, and devices connected to it should be connected to a protective ground via a ground socket. Any interruption of the protective grounding is a potential shock hazard and may cause personal injury.
- Whenever the ground protection is impaired, the unit is not to be used and must be secured against any accidental or unintended operation.
- Only fuses with the required rated current and specified type (IEC, 250 V, 2 A, fast blow, 0.197 in. x 0.787 in./5 mm x 20 mm) may be used for replacement. Do not use repaired fuses or short-circuited fuse holders.

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- The unit must be positioned in a way not to block the ventilation holes located on each side of the unit.
- Any adjustments, maintenance, and repair of opened units under voltage should be avoided and carried out only by skilled personnel aware of the hazards involved. Do not attempt internal service or adjustment unless another person qualified in first aid is present. Do not replace any components while power cable is connected.
- Operation of any electrical instrument around flammable gases or fumes constitutes a major safety hazard.
- Installation of replacement parts or modification of the unit should be carried out by authorized personnel only.
- Capacitors inside the unit may be charged even if the unit has been disconnected from its electrical supply.

AC Requirements

The FLS-2600 can operate from any single-phase AC power source between 100 and 240 V (50/60 Hz). The maximum input current is 2 A.

Power Cable

The FLS-2600 uses an international safety standard three-wire power cable. This cable serves as a ground when connected to an appropriate AC power receptacle. The type of power cable supplied with each unit is determined according to the country of destination.

Only qualified electricians should connect a new plug if needed. The color coding used in the electric cable depends on the cable. New plugs should meet the local safety requirements and include the following features:

- adequate load-carrying capacity
- ground connection
- cable clamp

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WARNING

To avoid electrical shock, do not operate the unit if there are signs of damage to any part of the outer surface (covers, panels, etc.).

To avoid serious injury, the following precautions must be observed before powering on the unit.

- If the unit is to be powered via an auto-transformer for voltage reduction, the common terminal must be connected to the grounded power source pole.
- Insert the plug into a power outlet with a protective ground contact. Do not use an extension cord without a protective conductor.
- Before powering on the unit, the protective ground terminal of the unit must be connected to a protective conductor using the unit power cord.
- Do not tamper with the protective ground terminal.

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3 Getting Started

This section presents a description of the hardware, provides information on how to turn the FLS-2600 on and off, and describes the software main menu.

Hardware Description

Front Panel

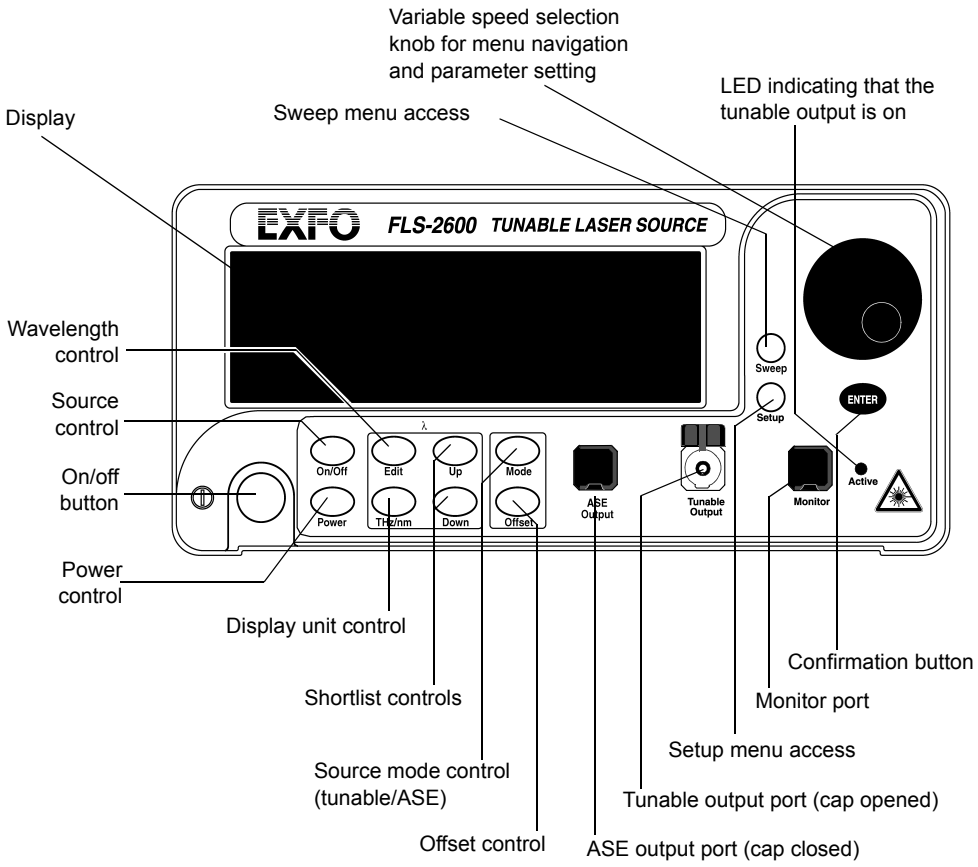


Figure 3-1. *FLS-2600 Front Panel*

Note: *Your FLS-2600 may slightly differ from the above illustration.*

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Back Panel

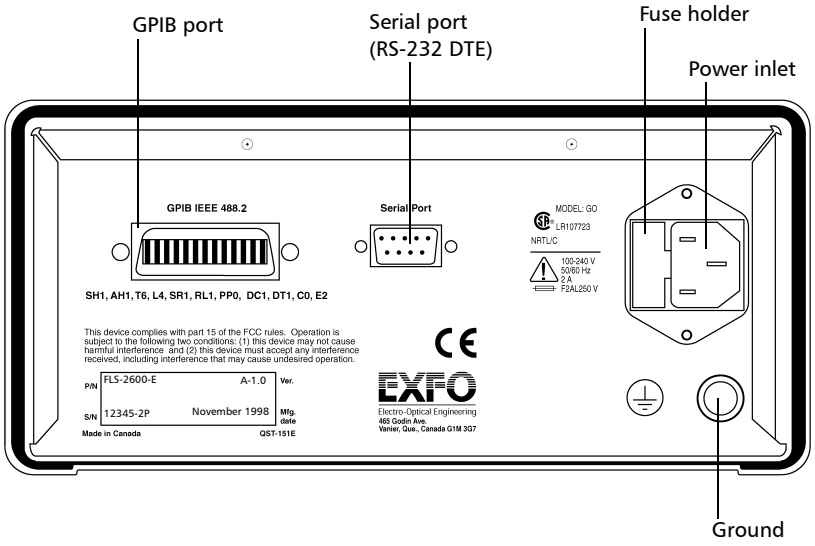


Figure 3-2. *FLS-2600 Back Panel*

Note: *Your FLS-2600 may slightly differ from the above illustration.*

Product Nameplate

The product nameplate, shown in Figure 3-3, provides the following information:

- the part number (*P/N*) identifying configuration and connector type
- the serial number (*S/N*)
- the product version (*Ver.*)
- the date of manufacturing (*Mfg. date*)

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Figure 3-3. *FLS-2600 Product Nameplate*

RS-232 Connector Pinout

The RS-232 connector (serial port) at the back of the FLS-2600 uses a DTE pinout configuration.

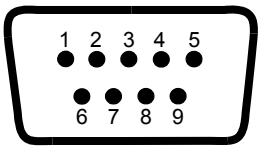


Figure 3-4. *RS-232 Connector Pinout*

Pin	Description	Direction
2	Receive (Rc)	Input
3	Transmit (Tx)	Output
5	Signal ground (Gnd)	—

Table 3-1. *RS-232 Connector Pinout Configuration*

Turning the FLS-2600 On and Off

IMPORTANT

Before turning on the FLS-2600, please read the *General Safety Information* on page 3.

To turn the FLS-2600 on and off, press the red button in the lower left-hand corner of the front panel.

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Upon startup, the unit beeps twice, performs a self-test, and then enters the main menu (in tunable mode) with the same settings that were active when the unit was last turned off, with the source deactivated.

When the unit is turned off, the following items remain in non-volatile memory:

- current power setting
- current wavelength setting
- current source (tunable/ASE)
- current display mode (wavelength/power)
- current wavelength display unit (nm/THz)
- shortlisted wavelengths (up to 400)
- offset setting (up to 5)
- remote control settings
- saved configurations (up to 10)

Note: *The power cord is the most effective disconnecting device. To ensure the power is completely turned off, disconnect the power cord.*

Certain internal mechanisms can sometimes take a few seconds to adjust, depending on the operation. If the FLS-2600 is performing internal adjustments (for example after having changed the wavelength or the source mode), no buttons should be pressed while data flashes on the display.

Resetting the FLS-2600

While turning on the unit, press *ENTER* until the unit beeps repeatedly. All the user-defined parameters are reset to their default values.

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Accessing Menus

The blue buttons to the right of the display give access to single-level menus: *Sweep* and *Setup*. Access to these menus is possible in any situation of the main menu in tunable operation, even while the source is active. The following diagram shows these two menus and their items.

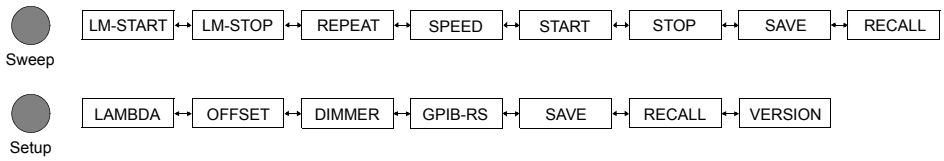


Figure 3-5. *Menu Diagram*

To move between menu items, rotate the selection knob.

To exit a menu, press the button that gave access to the menu (the FLS-2600 will return to the state in which it was prior to entering the menu).

It is not possible to toggle between the *Sweep* and *Setup* menus without first exiting the active menu.

Note: *The unit will beep whenever the FLS-2600 does not allow an operation.*

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4 Using the FLS-2600 Main Menu

The FLS-2600 main menu gives access to the following options (which are explained in the next sections):

- wavelength mode (see *Setting the Wavelength* on page 13)
- power mode (see *Setting the Output Power* on page 14)
- source activation/deactivation (see *Activating/Deactivating the Source* on page 15)
- source selection (tunable/ASE) (see *Setting the Source* on page 16)
- wavelength display unit (see *Setting the Wavelength Display Unit* on page 17)
- offset activation (see *Activating the Wavelength Offset* on page 17)

Setting the Wavelength

There are two ways of setting the wavelength: You can either use the knob or select a wavelength from the shortlist of wavelengths. Both ways are explained below.

To set the wavelength,

1. Press *Edit*. The *Edit* marker appears in the upper left-hand corner of the display, indicating that you have entered the wavelength mode.

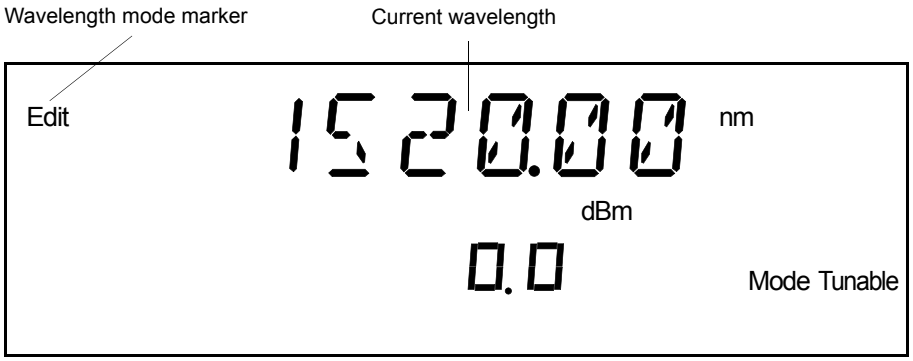


Figure 4-1. *Wavelength Mode*

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2. Rotate the knob clockwise or counter-clockwise until the desired wavelength is displayed. (You can select a wavelength between 1520.00 and 1570.00 nm at a resolution of 0.01 nm.) The *Press Enter* marker starts blinking on the display.
3. Press *ENTER* to validate the new wavelength output.

Note: *If you change the wavelength while the source is active, the new wavelength output will not be activated until you press ENTER.*

It is also possible to select a wavelength from a shortlist of wavelengths used most often, by pressing the *Up* or *Down* button and then *ENTER*. Keep the *Up* or *Down* button pressed continuously to accelerate the scan in the shortlist.

To modify the shortlist of available wavelengths, see *Adding a Wavelength to the Shortlist* on page 19 and *Deleting a Wavelength from the Shortlist* on page 21.

Setting the Output Power

The output power mode is only accessible from the main menu (i.e., not in the *Sweep* or *Setup* menu). To set the output power mode,

1. Press *Power*. The *Power* marker appears on the display, indicating that you have entered the power mode.



Figure 4-2. *Power Mode*

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2. Rotate the knob clockwise or counter-clockwise until the desired output power level is displayed. You can select a power level up to 6.0 dBm (see below) by increments of 0.1 dBm. If you change the power while the source is active, the new output power changes accordingly (i.e., with no need to validate the new output power).

Choosing between Target Power and Actual Power

You can select a power level between the minimum and maximum values established during calibration (the calibration values are between 0.0 and 6.0 dBm). However, since the FLS-2600 will start saturating at a given output power, typically around 3.5 dBm, the actual power will differ from the target power. The target power will be displayed in power mode, while the actual power will be displayed in wavelength mode after some stabilization time (with active source).

Note: *It is possible to select a wavelength from the shortlist while in power mode by pressing the* Up *or* Down *button, then* ENTER.

Activating/Deactivating the Source

1. Press *On/Off*. The *Source On* marker appears on the display.

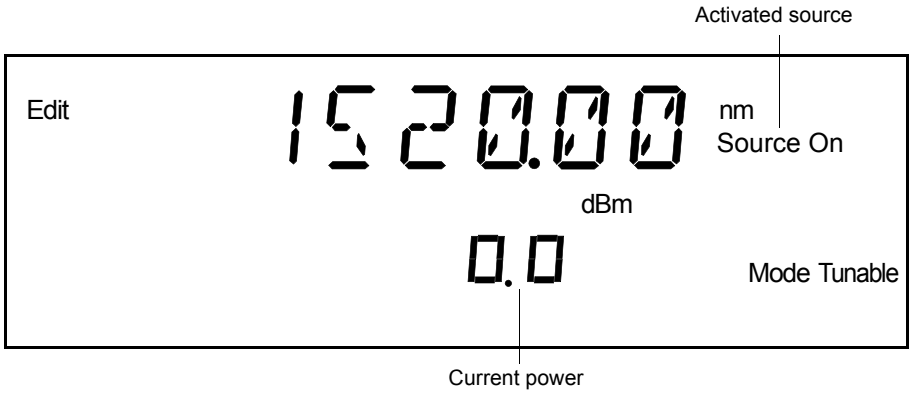


Figure 4-3. *Activated Source*

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2. After approximately one second, the *Active* LED lights up on the fascia to indicate that the source is active at the wavelength, at the output power, and in the mode currently selected.
3. To deactivate the source, press *On/Off* again.

Setting the Source

Press *Mode* to toggle the source between tunable and ASE (amplified spontaneous emission) operation.

In ASE mode, the laser cavity is appropriately modified so that the laser operates in a non-coherent broadband mode, with a spectrum typical of a non-flattened erbium-doped fiber source. In ASE mode, the FLS-2600 operates at 1550 nm with an output power over 4 dBm. The only operations possible in this mode are source activation/deactivation and mode selection.

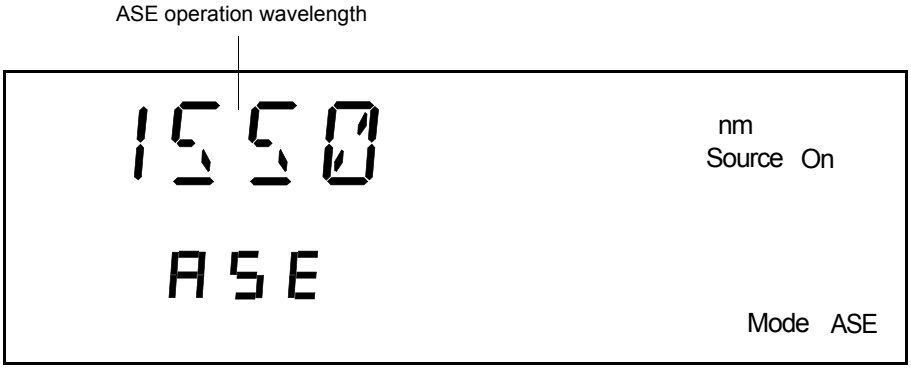


Figure 4-4. *ASE Mode*

Note: *Changing the source mode when the source is active will switch off the source.*

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Setting the Wavelength Display Unit

Press *THz/nm* to toggle between the nanometer (nm) and terahertz (THz) wavelength display units. The *nm* or *THz* marker appears on the display according to your selection.

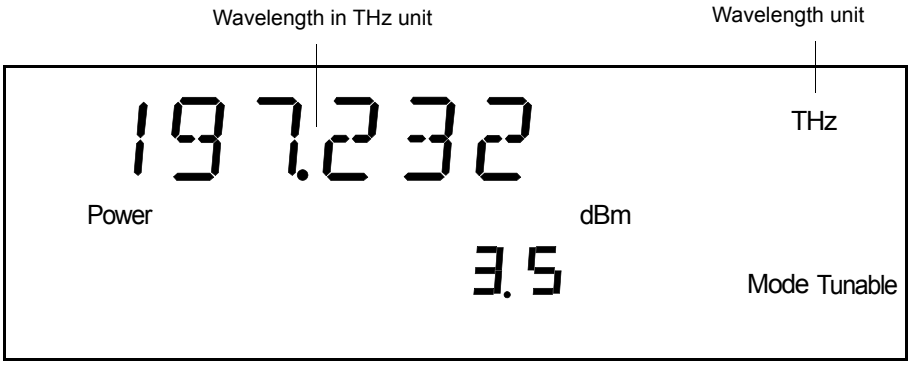


Figure 4-5. *Wavelength Unit*

The wavelength unit selection affects all the wavelength settings concerned, except for the wavelength settings in the *Sweep* menu (in the *Sweep* menu, the wavelength unit is always expressed in nm).

Activating the Wavelength Offset

This function allows you to activate the preset wavelength offset value. It is mainly used for calibration purposes and actually has an effect on the display only. The offset function is accessible in power and wavelength modes when the source is in tunable operation.

The offset does not modify the tuning range of the FLS-2600, but shifts it accordingly (on the display). For example, applying an offset of -02.00 nm will result in a displayed tuning range of 1518.00 to 1568 nm if the offset is activated.

To change the offset value, see *Setting the Offset Value* on page 21.

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To activate the offset, press *Offset*. The *Offset On* marker appears on the display, and the wavelength displayed changes according to the offset value.

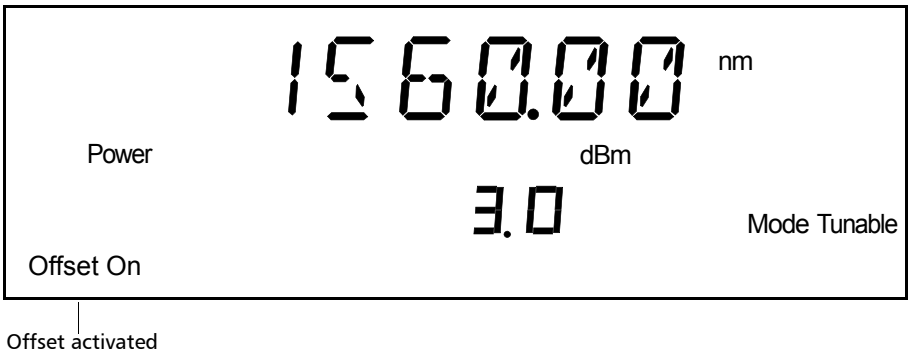


Figure 4-6. *Offset Activated*

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5 Using the FLS-2600 Setup Menu

The first item in the *Setup* menu is the shortlist of wavelengths (LAMBDA mode), i.e., the preset wavelengths that will be readily available in the main menu by simply pressing *Up* or *Down*. Up to 80 wavelengths can be stored in the shortlist for each configuration (see *Saving a Setup Configuration* on page 23).

Note: *By default, 32 different ITU wavelengths are saved in the shortlist of wavelengths. It is possible to modify this preset list of wavelengths, but they will be recalled automatically in configuration 1 of the* Setup *menu after a reset of the unit.*

Consulting the Shortlist of Wavelengths

To consult the shortlist of wavelengths,

1. Press *Setup*. The *Lambda* marker appears on the display.
2. Press *ENTER* to enter LAMBDA mode. The *Edit* marker appears in the lower part of the display.
3. Rotate the knob clockwise to see the wavelengths included in the shortlist.

Adding a Wavelength to the Shortlist

To add a wavelength to the shortlist,

1. Press *Setup*. The *Lambda* marker appears on the display.
2. Press *ENTER* to enter LAMBDA mode. The *Edit* marker appears in the lower part of the display.
3. Rotate the knob clockwise until *Add* is displayed (if the shortlist is empty, *Add* is immediately displayed).
4. Press *Edit*. A default wavelength is suggested, in nm or THz, as selected in the main menu, and the *Edit* marker starts blinking in the lower part of the display.

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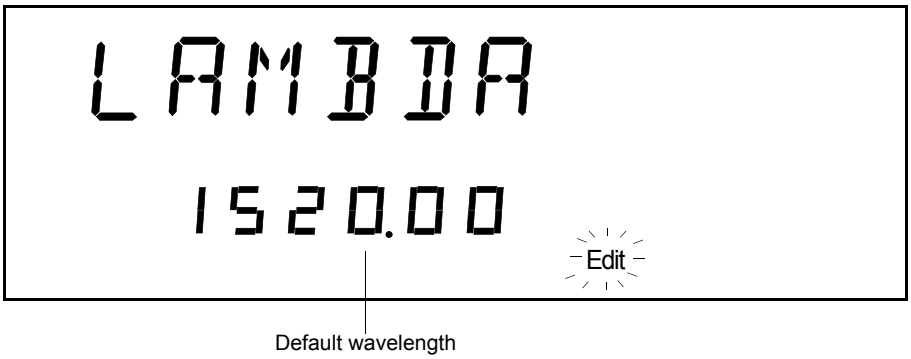


Figure 5-1. *Default Wavelength Display*

5. Rotate the knob clockwise or counter-clockwise until the desired wavelength is displayed, then press *ENTER* (pressing *Edit* at this step will cancel the operation). The *Edit* marker stops blinking.

6. If you want the selected wavelength to be readily available from the main menu, press *Up*. A ✔ marker appears after the wavelength on the display. If you do want the selected wavelength to be included in the shortlist but not available in the main menu, press *Up* again (the ✔ marker disappears).

Note: *Wavelengths are stored in the shortlist in ascending order. If a wavelength is already included in the shortlist, the unit will beep and the wavelength will not be added to the shortlist.*

It is also possible to **modify** a wavelength in the shortlist. Rotate the knob clockwise or counter-clockwise until the desired preset wavelength is displayed, then press *Edit*. The *Edit* marker starts blinking in the lower part of the display. Then follow the instructions of step 5 above.

7. To exit the *Setup* menu, press *ENTER* (the *Edit* markers disappears), then *Setup*.

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Deleting a Wavelength from the Shortlist

To delete a wavelength from the shortlist,

1. Press *Setup*.
2. Press *ENTER* to enter LAMBDA mode. The *Edit* marker appears in the lower part of the display.
3. Rotate the knob clockwise until *dEL* is displayed.
4. Press *Edit*. The first shortlisted wavelength blinks on the display.
5. Rotate the knob clockwise or counter-clockwise until the shortlisted wavelength to be deleted is displayed, then press *ENTER* (pressing *Edit* at this step will cancel the operation).
6. To exit the *Setup* menu, press *ENTER* (the *Edit* marker disappears), then *Setup*.

Setting the Offset Value

1. Press *Setup*.
2. Rotate the knob clockwise until *OFFSET* is displayed. The current offset value appears, in nm or THz, as selected in the main menu.

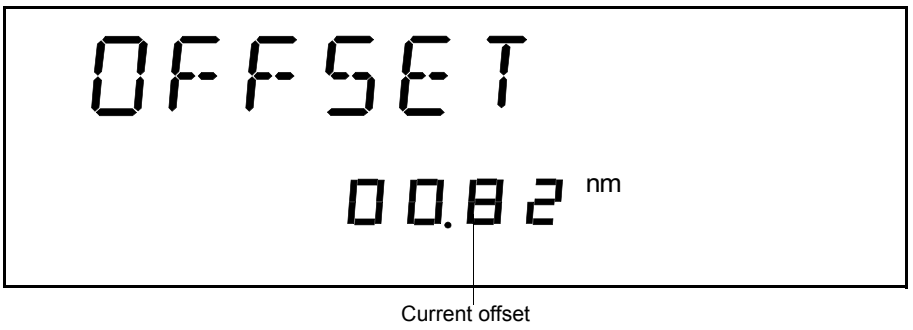


Figure 5-2. *Offset Value Display*

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3. Press *ENTER*. The *Edit* marker starts blinking in the lower part of the display.
4. Rotate the knob clockwise or counter-clockwise until the desired offset value is displayed, then press *ENTER*. You can select a value between -99.99 and 99.99 nm (i.e., between -12.564 and 12.564 THz if the THz unit was selected in the main menu).
5. To exit the *Setup* menu, press *Setup*.

Setting the Display Intensity

To set display intensity,

1. Press *Setup*.
2. Rotate the knob clockwise until *DIMMER* is displayed. The current dimmer status appears.

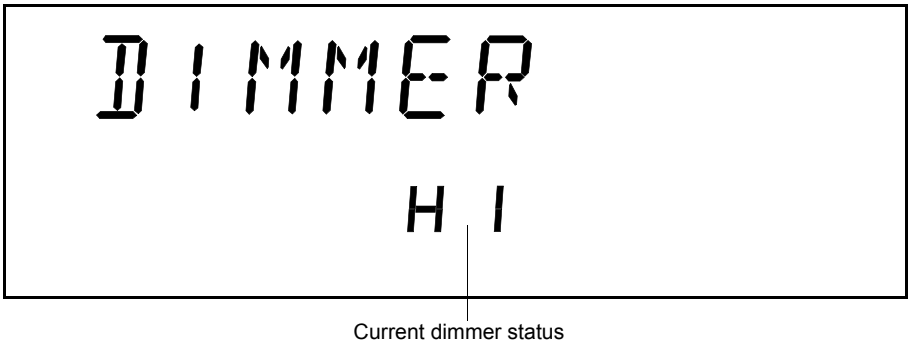


Figure 5-3. *Dimmer Status*

3. Press *ENTER*. The *Edit* marker starts blinking in the lower part of the display.
4. Rotate the knob until the desired display intensity is displayed (*LO*, *HI*, or *OFF*), then press *ENTER*.

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Note: *Setting the dimmer to* OFF *turns off the display. Press any key to turn the display back on.*

5. To exit the *Setup* menu, press *Setup*.

Saving a Setup Configuration

Once the FLS-2600 has been customized for a specific application or user, it is possible to save the configuration of the parameters that have been set in the *Setup* menu, with the exception of the dimmer status and the GPIB-RS setting. Up to five setup configurations can be saved and recalled. Saved parameters are

- shortlisted wavelengths (up to 80 per configuration)
- offset setting

To save a setup configuration,

1. Press *Setup*.

2. Rotate the knob clockwise until *SAVE* is displayed. The current configuration number appears.

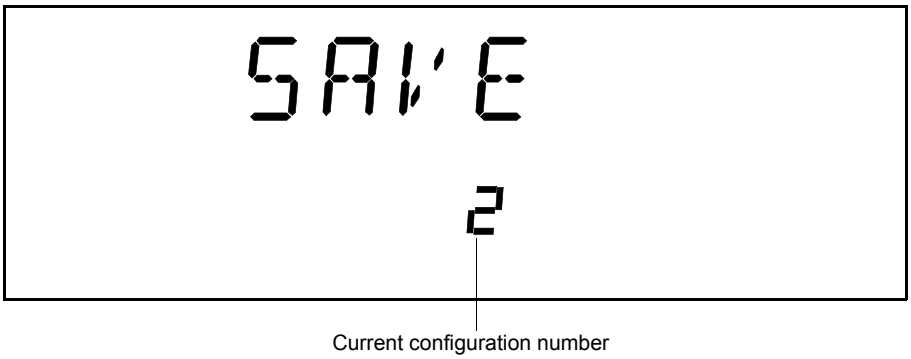


Figure 5-4. *Current Configuration Number*

3. Press *ENTER*. The *Edit* marker starts blinking in the lower part of the display.

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4. Rotate the knob until the desired configuration number is displayed, then press *ENTER*. It takes a few seconds to save a setup configuration.

Note: *Upon startup, the last configuration saved will be recalled.*

5. To exit the *Setup* menu, press *Setup*.

Recalling a Setup Configuration

Once you have saved a setup configuration, you can recall it at any time.

1. Press *Setup*.
2. Rotate the knob clockwise until *RECALL* is displayed.

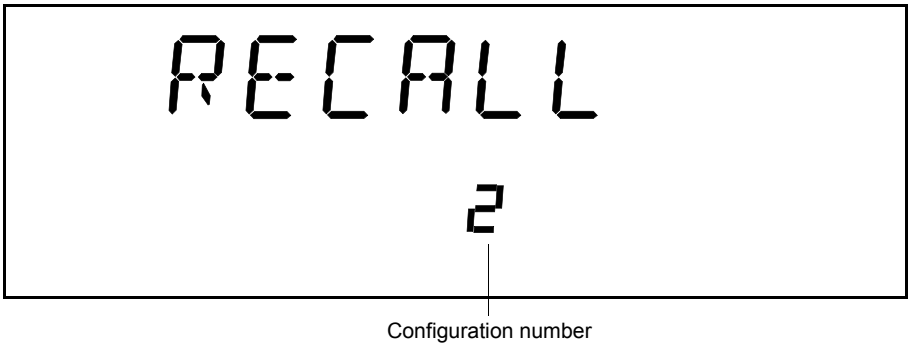


Figure 5-5. *Recalled Configuration*

3. Press *ENTER*. The *Edit* marker starts blinking in the lower part of the display.
4. Rotate the knob until the desired configuration number is displayed, then press *ENTER*.
5. To exit the *Setup* menu, press *Setup*.

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Displaying the Software Version Number

This option allows you to see the software version currently installed in the FLS-2600. No action is possible here.

1. Press *Setup*.
2. Rotate the knob clockwise until *VERSION* is displayed.

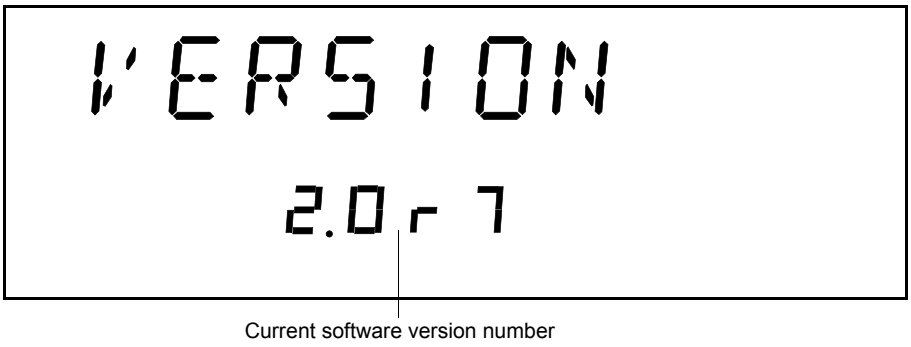


Figure 5-6. *Software Version Number*

3. To exit the *Setup* menu, press *Setup*.

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6 Using the FLS-2600 Sweep Menu

The *Sweep* menu allows access to automatic wavelength scans and program speeds according to user-defined parameters.

Setting the Start Wavelength of the Sweep

1. Press *Sweep*. A default start wavelength is suggested.

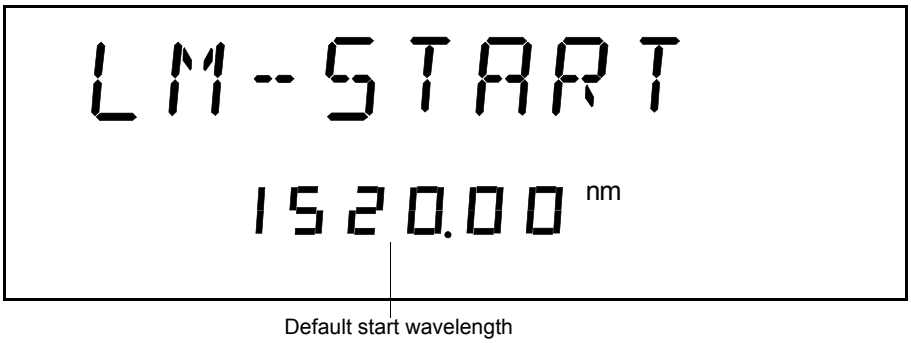


Figure 6-1. *Default Start Wavelength*

2. Press *ENTER*. The *Edit* marker starts blinking in the lower part of the display.
3. Rotate the knob clockwise or counter-clockwise until the desired wavelength is displayed. You can select a wavelength between 1520.00 and 1570.00 nm at a resolution of 0.01 nm.
4. Press *ENTER*.

Note: *Setting the start and end wavelengths of the sweep will automatically use the nm unit, even if the THz unit was selected in the main menu.*

5. To exit the *Sweep* menu, press *Sweep*.

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Setting the End Wavelength of the Sweep

To set the end wavelength of the sweep,

1. Press *Sweep*.
2. Rotate the knob clockwise until *LM-STOP* is displayed. A default end wavelength is suggested.

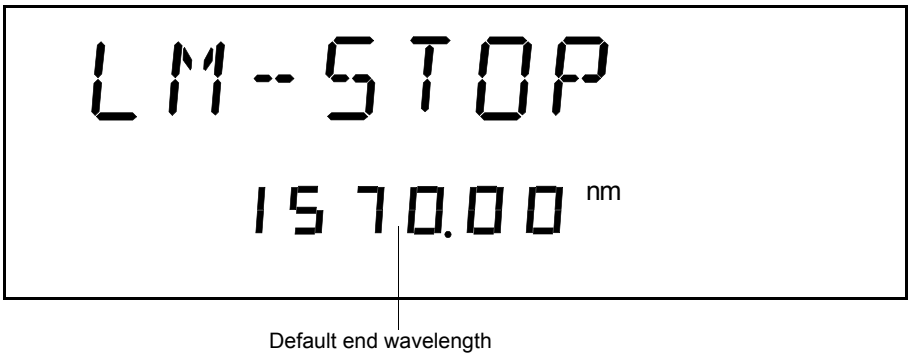


Figure 6-2. *Default End Wavelength*

3. Press *ENTER*. The *Edit* marker starts blinking in the lower part of the display.
4. Rotate the knob clockwise or counter-clockwise until the desired wavelength is displayed. You can select a wavelength between 1520.00 and 1570.00 nm at a resolution of 0.01 nm.
5. Press *ENTER*.

Note: *The start and end wavelengths of the sweep can be set in the ascending or in the descending order. The sweep will be executed accordingly.*

6. To exit the *Sweep* menu, press *Sweep*.

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Setting the Number of Sweeps

1. Press *Sweep*.
2. Rotate the knob clockwise until *REPEAT* is displayed. The default setting is 1, i.e., the sweep will be executed only once by default.

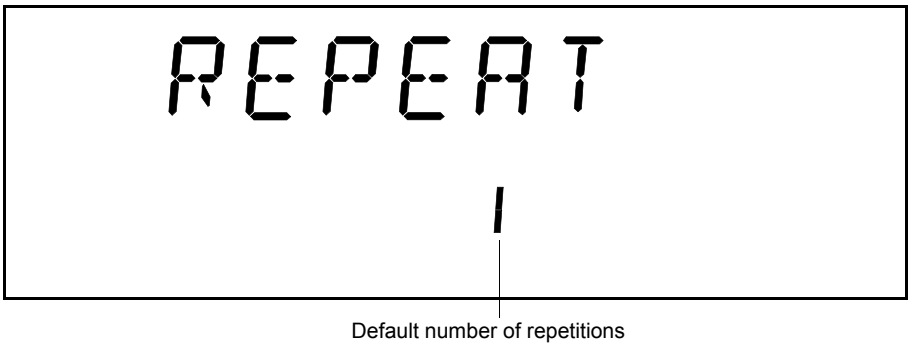


Figure 6-3. *Default Number of Repetition*

3. Press *ENTER*. The *Edit* marker starts blinking in the lower part of the display.
4. Rotate the knob clockwise or counter-clockwise until the desired number of repetitions is displayed. You can select a value between 0 and 99 (0 meaning that you are in continuous mode, i.e., the sweep will be performed until you stop it manually).
5. Press *ENTER*.
6. To exit the *Sweep* menu, press *Sweep*.

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Setting the Speed of the Sweep

To set the speed of the sweep,

1. Press *Sweep*.
2. Rotate the knob clockwise until *SPEED* is displayed. The default setting is 0.10 nm/s, i.e., the sweep will be executed at a speed of 0.10 nm per second by default.

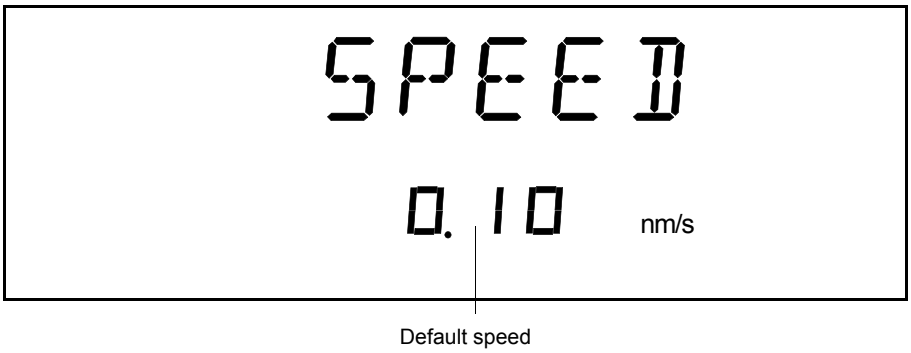


Figure 6-4. *Default Speed*

3. Press *ENTER*. The *Edit* marker starts blinking in the lower part of the display.
4. Rotate the knob clockwise or counter-clockwise until the desired speed for the sweep is displayed. You can select a speed between 0.10 and 2.50 nm/s.
5. Press *ENTER*.

Note: *Selecting a larger speed allows for faster sweeping.*

6. To exit the *Sweep* menu, press *Sweep*.

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Starting the Sweep

To start the sweep,

1. Set the wavelength, the output power, the display mode, and the wavelength display unit, and activate the tunable source, as explained in the *Using the FLS-2600 Main Menu* chapter on page 13.
2. Press *Sweep*.
3. Rotate the knob clockwise until *START* is displayed.

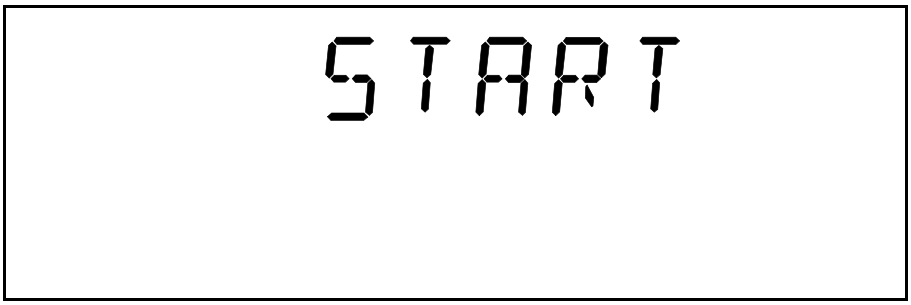


Figure 6-5. *Start Display*

4. Press *ENTER*. The unit returns to the main menu, the *Sweep* marker appears on the display, and the sweep is executed according to the parameters set.
5. While the sweep is active, you can press *Sweep* and rotate the knob to toggle between the different items of the *Sweep* menu. Even if you set new parameters for the sweep and save them in a configuration, the current sweep will not be affected.

Note: *It is possible to toggle between the display units during the sweep by pressing THz/nm.*

6. At the end of the sweep, the unit will beep.

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Stopping the Sweep

To stop the sweep,

1. Press *Sweep*. *STOP* is immediately displayed when performing a sweep.

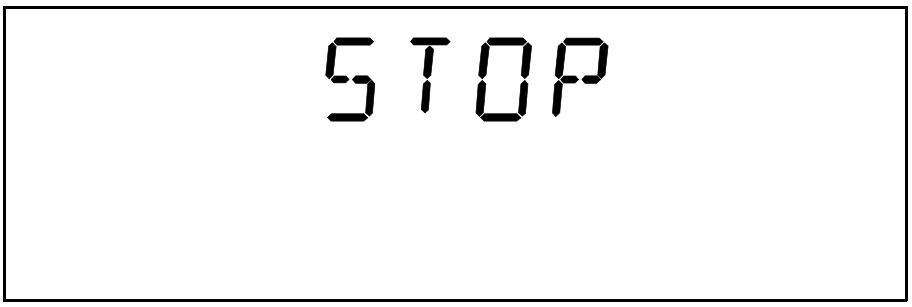


Figure 6-6. *Stop Display*

2. Press *ENTER*. The sweep is stopped, and the unit beeps.

Saving a Sweep Configuration

Once the FLS-2600 has been customized for a specific application or user, it is possible to save the configuration of the parameters that have been set in the *Sweep* menu. Up to five sweep configurations can be saved and recalled. Saved parameters are

- start wavelength of the sweep
- end wavelength of the sweep
- number of sweeps (1 to 99)
- speed of the sweep

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To save a sweep configuration,

1. Press *Sweep*.
2. Rotate the knob clockwise until *SAVE* is displayed. The current configuration number appears.

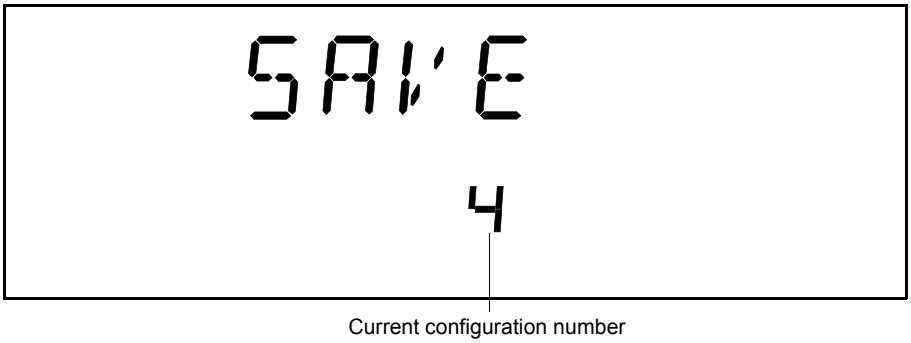


Figure 6-7. *Current Configuration Number*

3. Press *ENTER*. The *Edit* marker starts blinking in the lower part of the display.
4. Rotate the knob until the desired configuration number is displayed, then press *ENTER*.

Note: *Upon startup, the last configuration saved will be recalled.*

5. To exit the *Sweep* menu, press *Sweep*.

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Recalling a Sweep Configuration

Once you have saved a sweep configuration, you can recall it at any time.

1. Press *Sweep*.
2. Rotate the knob clockwise until *RECALL* is displayed.

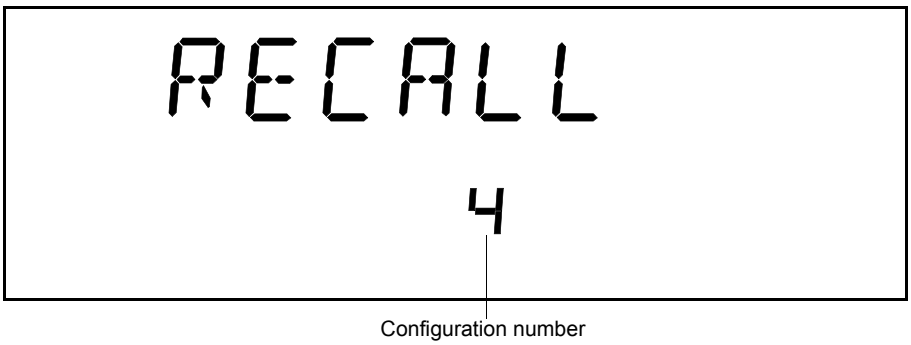


Figure 6-8. *Configuration Number*

3. Press *ENTER*. The *Edit* marker starts blinking in the lower part of the display.
4. Rotate the knob until the desired configuration number is displayed, then press *ENTER*.
5. To exit the *Sweep* menu, press *Sweep*.

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7 Remote Control

The FLS-2600 can be remotely controlled either by

➤ a GPIB interface (through a GPIB cable connected to the GPIB port)

OR

➤ an RS-232 interface (through a serial cable connected to the serial port).

The commands used in both protocols are the same and are described in the following pages. When the FLS-2600 is being remotely controlled, *Remote* appears in the lower left-hand corner of the display.

Note: *If you have already designed a GPIB program to control a tunable laser source from EXFO's IQ series (IQ-2600), you can reuse sections for the FLS-2600.*

Setting the FLS-2600 for Remote Control

To remotely control the FLS-2600, you need to set a GPIB address or activate the RS-232 port.

1. Press *Setup*.
2. Rotate the knob clockwise until *GPIB-RS* is displayed. The current setting appears.

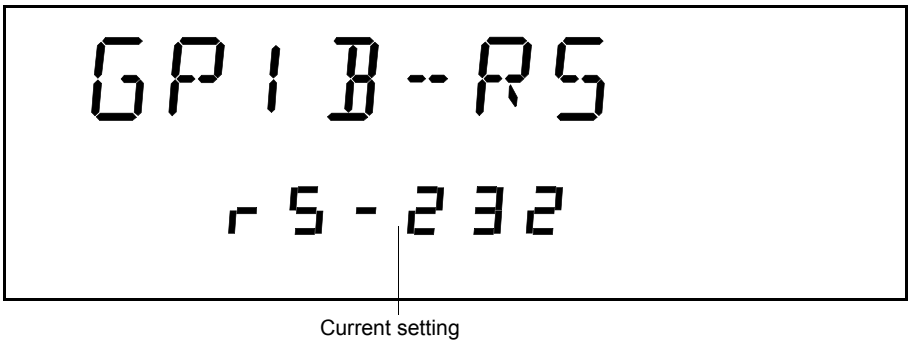


Figure 7-1. *Current Setting*

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3. Press *ENTER*. The *Edit* marker starts blinking in the lower part of the display.
4. Rotate the knob clockwise or counter-clockwise to enter the new setting:
   - ➤ A numbered setting represents a GPIB address (between 1 and 30).
   - ➤ For RS-232 control, rotate the knob clockwise until RS-232 is displayed (after setting 30).
5. Press *ENTER*.
6. To exit the *Setup* menu, press *Setup*.

Communication Parameters

For GPIB Communication	
Terminate Read on EOS	Yes
Set EOI with EOS on Writes	Yes
Type of compare on EOS	8-bits
EOS byte	0Ah
Sens EOI at end of Writes	Yes
GPIB primary address	see Section
GPIB secondary address	None

Table 7-1. *GPIB Communication Parameters*

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For RS-232 Communication			
EOS bytes	0Ah	Stop bits	1 bit
Baud rate	9600 bps	Flow control	None
Parity	None	Activation	see Section
Data bits	8 bits		

Table 7-2. *RS-232 Communication Parameters*

Note: *EOS means "End of String". EOI means "End or Identify".*

Standard Status Data Structure

Figure 7-1 on next page illustrates the four common Status and Enable registers as defined by IEEE 488.3. This diagram is a useful aid in understanding the general commands and how a service request (SRQ) is generated. The four registers are

- Standard Event Status Register (ESR)
- Standard Event Status Enable Register (ESE)
- Status Byte Register (STB)
- Service Request Enable Register (SRE)

Bit	ESR	ESE	STB	SRE
0	Operation Complete	Operation Complete	Source Status	Source Status
1	Request Control	Request Control	N/A	N/A
2	Query Error	Query Error	Error Bit	Error Summary Bit

Table 7-3. *Standard Registers (Part 1 of 2)*

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Bit	ESR	ESE	STB	SRE
3	Device Dependent Error	Device Dependent Error	Questionable Status	Questionable Status
4	Execution Error	Execution Error	Message Available	Event Status Summary Bit
5	Command Error	Command Error	Event Status Summary Bit	Message Available
6	User Request	User Request	Master Summary Status	Request Service / Master Summary Status
7	Power On	Power On	Operation Status	Operation Status

Table 7-3. *Standard Registers (Part 2 of 2)*

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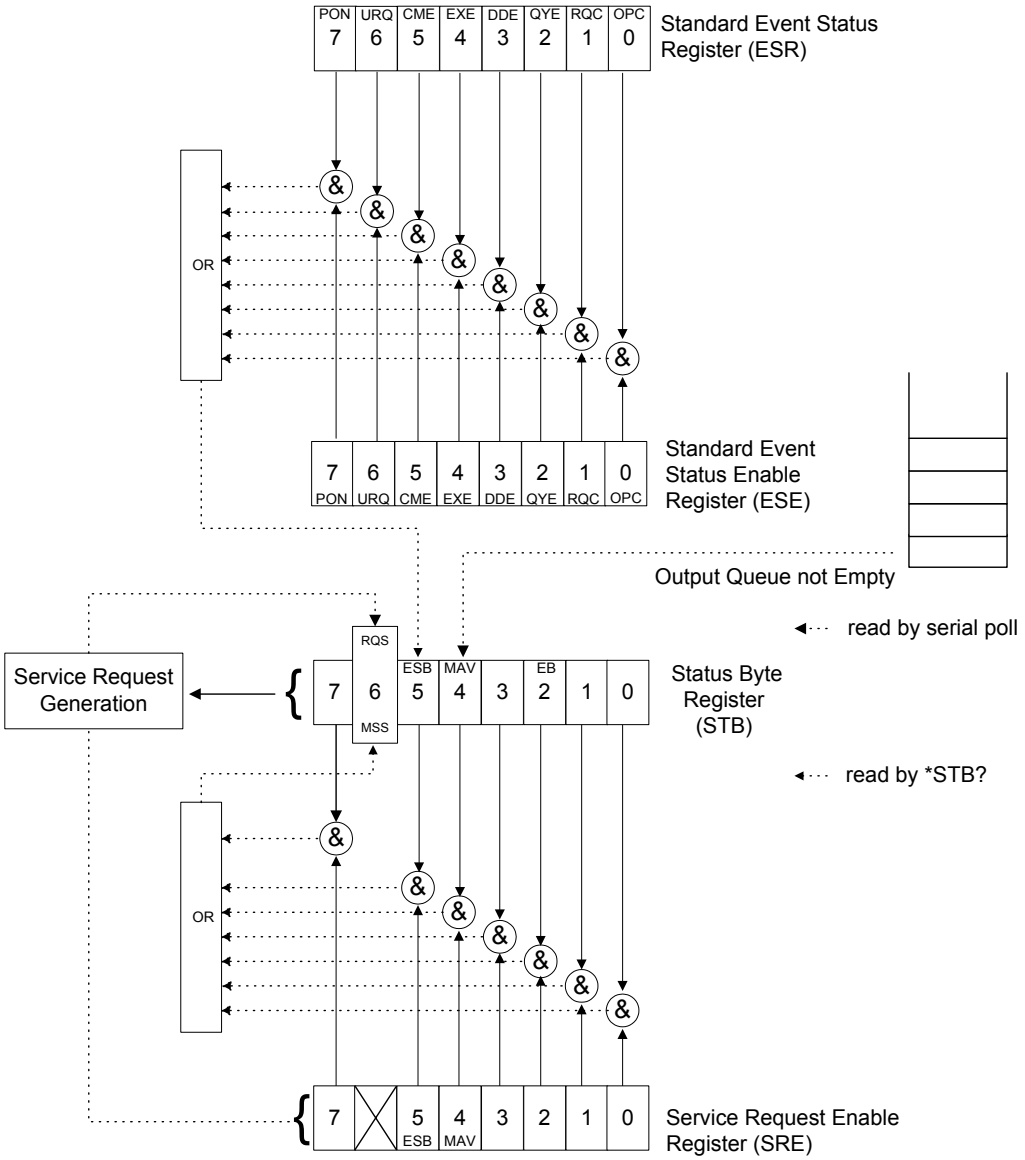


Figure 7-1. Standard Status Data Structures (IEEE 488.3)

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An SRQ is forced when a bit is set in the STB and, at the same time, the corresponding SRE bit is set. When the SRQ is generated, the RQS bit is set to 1, and remains set until read by a serial poll. Once the RQS is read, it returns to 0.

Command Structure

The GPIB and RS-232 commands follow the guidelines determined by the Standard Commands for Programmable Instruments (SCPI) consortium. For example, the

OUT:STAT<space><state> command syntax

is used to activate or deactivate the source.

- OUT and STAT are keywords that define the function of the command.
- [ ] indicates that a keyword or a parameter is optional.
- <space> is included to indicate that a space is required.
- <state> is the command parameter.
- Keywords must be separated by a colon.

Note: *It is recommended to fetch the response immediately after each query.*

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General Commands—Quick Reference

The FLS-2600 recognizes the main commands identified in IEEE 4888.3. The following table summarizes these commands.

Command	Function
*CLS	Clear status command
*ESE	Standard event status enable command
*ESE?	Standard event status enable query
*ESR?	Standard event status register query
*IDN?	Identification query
*LOK	Set Remote Lockout programming state
*OPC	Operation complete command
*OPC?	Operation complete query
*RST	Reset command
*SRE	Service request enable command
*SRE?	Service request enable query
*STB?	Read status byte query
*TRG	Not supported
*TST?	Self-test query
*WAI	Not supported

Table 7-4. *General Commands Quick Reference*

The commands are fully explained hereafter.

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General Commands

*CLS

Description This command sets the contents of the Standard Event Register (ESR), the Status Byte Register (STB), and the Error Queue (ERR) to zero. This command is commonly used to clear the status registers before enabling SRQ. Note that the output queue, Standard Event Status Enable Register (ESE), and Service Request Enable Register (SRE) are not affected.

Syntax *CLS

*ESE

Description This command is used to set bits in the Standard Event Status Enable Register (ESE) to a new value (initial value is 255). The contents of the ESE register are logically ANDed with the ESR register. A non-zero result will set the Event Summary Bit (ESB) of the Status Byte Register (STB). This command is useful for selecting which events may generate an SRQ.

Syntax *ESE<space><value>

Parameter The <value> parameter must be between 0 and 255.

*ESE?

Description This query reads the contents of the Standard Event Status Enable Register (ESE).

Syntax *ESE?

Response A binary integer between 0 and 255.

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*ESR?

Description	This query reads the contents of the Standard Event Status Register (ESR).
Syntax	*ESR?
Response	A binary integer between 0 and 255.

*IDN?

Description	This query reads the FLS-2600 system identification string.
Syntax	*IDN?
Response	“EXFO E.-O. Eng FLS-2600 Vxx.xx”, where xx.xx is the current product version.

*LOK

Description	This command is used to set the Remote Lockout programming state.
Syntax	*LOK

*OPC

Description	This command will cause the FLS-2600 to generate the operation complete message in the Standard Event Status Register (ESR) when all pending selected FLS-2600 operations have been completed.
Syntax	*OPC
Example	*OPC;*IDN?

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*OPC?

Description This query puts an ASCII 1 in the output queue when the content of the input queue has been processed. This query is useful to prevent another command from processing until the current command is complete.

Syntax *OPC?

Response “1”

*RST

Description This command empties the step response list. It is only seen when it is part of another multiple command. In the example below, by adding this command after *IDN?, you will not be able to access the answer. The *RST, in this instance, erases the identification string. In addition, this command performs the following operations:

1. Return to initial state before command was sent, and not necessarily to previous settings.
2. Force the device to enter into an Operation Complete Command Idle State (OCIS).
3. Force the device to enter into an Operation Complete Query Active State (OQAS).
4. Initialize previous responses unless there has been a program message terminator preceded by an *RST.

Syntax *RST

Example *IDN?;*RST<NL>

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*SRE

Description This command sets bits in the Service Request Enable Register (SRE; initial value is 255) and enables the corresponding bit in the Status Byte Register (STB). The command can be used to select which events can initiate a service request.

Syntax *SRE<space><value>

Parameter The <value> parameter must be between 0 and 255.

*SRE?

Description This query returns the contents of the Service Request Enable Register (SRE).

Syntax *SRE?

Response A binary integer between 0 and 255.

*STB?

Description This query returns the contents of the Status Byte Register (STB).

Syntax *STB?

Response A binary integer between 0 and 255.

*TRG

Description Not supported

Syntax *TRG

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*TST?

Description	This query initiates an internal self-test and returns a binary value indicating the results of the test.
Syntax	*TST?
Response	A binary value: “0”-test is complete with no errors “1”-test is complete with errors

*WAI

Description	Not supported
Syntax	*WAI

SYSTem:ERRor?

Description	This query returns the next error in the list. When an error is generated, an error number is sent to the error list. The error list is accessed with the SYST:ERR? query. If the list contains 20 errors and a new error occurs, the new error will replace the first error in the list.
Syntax	SYST:ERR?
Response	The next error in the list. See error list and descriptions in the *Error Messages Format* on page 66.
Note	This query is equivalent to the ERR and LERR commands. They all give the same result.

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SYSTem:VERSion?

Description	This query reads the FLS-2600 identification string.
Syntax	SYST:VERS?
Response	“EXFO E.-O. Eng FLS-2600 Vxx.xx”, where xx.xx is the current product version.

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Specific Commands—Quick Reference

The following table contains a summary of the FLS-2600 specific commands.

Command					Parameter/ Response	Description
OUT	ASE?				(0|1)	Source available?
	MODE				<0|1>	Set source mode
	MODE?				(0|1)	Get source mode
	STAT				<0|1>	Turn source on or off
	STAT?				(0|1)	Source active?
SOUR	POW	LEV	IMM	AMPL	<±9.9>	Set source power
				AMPL?	(±9.9)	Get source power
		LIM	HIGH?		(±9.9)	Get max. output power
			LOW?		(±9.9)	Get min. output power
			STEP?		(±9.9)	Get min. power step
SOUR	SWE	CENT?			(9999.99) [NM] (999.999) [THZ]	Get central wavelength
		COUN			<99>	Set repetitions
		COUN?			(99)	Get repetitions

Table 7-5. *Specific Commands Quick Reference (Part 1 of 3)*

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Command				Parameter/ Response	Description
		PROG?		(9999.99;99.99; 999:99:99) [NM] (999.999;9.999; 9999:99:99) [THZ]	Set sweep parameters
SOUR	SWE	REPE		<0|1>	Set loop
		REPE?		(0|1)	Loop active?
		REV		<0|1>	Set reverse function
		REV?		(0|1)	Reverse function active?
		SPAN?		(9999.99) [NM] (999.999) [THZ]	Get wavelength span
		STAT		<0|1>	Turn sweep on or off
		STAT?		(0|1)	Sweep active?
		TIME?		(9999:99:99)	Get sweep duration
	WAVE	LENG		<9999.99> [NM] <999.999> [THZ]	Set wavelength
		LENG?		(9999.99) [NM] (999.999) [THZ]	Get wavelength
		LIM	HIGH?	<9999.99> [NM] <999.999> [THZ]	Get max. wavelength
			LOW?	<9999.99> [NM] <999.999> [THZ]	Get min. wavelength
			STEP?	<9999.99> [NM] <999.999> [THZ]	Get min. wavelength step

Table 7-5. *Specific Commands Quick Reference (Part 2 of 3)*

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Command		Parameter/ Response	Description
UNIT	WAVE	<0|1>	Set wavelength unit
	WAVE?	(0|1)	Get wavelength unit

Table 7-5. *Specific Commands Quick Reference (Part 3 of 3)*

The commands are fully explained hereafter.

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Specific Commands

OUTput:ASE?

Description	This query returns a value indicating whether the ASE option is available on the tunable laser source.
Syntax	OUT:ASE?
Response	A boolean value indicating whether the ASE option is available on the FLS-2600 Tunable Laser Source: “0”-the ASE option is not available “1”-the ASE option is available
Example	OUT:ASE?
Note	Since the ASE mode is a standard feature of the FLS-2600, the return value will always be “1”.
See also	OUT:MODE and OUT:MODE?

OUTput:MODE

Description	This command is used to set the source mode (tunable or ASE).
Syntax	OUT:MODE<space><mode>
Parameters	The <mode> parameter is a boolean parameter representing the source mode: “0”-set tunable mode “1”-set ASE mode
Note	This command cannot be performed if the FLS-2600 is in Sweep mode.
Example	OUT:MODE 1
See also	OUT:ASE? and OUT:MODE?

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OUTput:MODE?	
Description	This query returns the current source mode (tunable or ASE).
Syntax	OUT:MODE?
Response	A boolean value representing the current source mode: “0”-the source is in tunable mode “1”-the source is in ASE mode
Example	OUT:MODE?
See also	OUT:ASE? and OUT:MODE

OUTput:STATe	
Description	This command is used to activate or deactivate the source.
Syntax	OUT:STAT<space><state>
Parameters	The <state> parameter is a boolean parameter representing the source state: “0”-deactivate the source “1”-activate the source
Example	OUT:STAT 1
Note	This command cannot be performed if the module is in sweep mode.

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OUTput:STATe?

Description	This query returns the current source state.
Syntax	OUT:STAT?
Response	A boolean value representing the current source state: "0"-the source is deactivated "1"-the source is activated
Example	OUT:STAT?

SOURce:POWer:LEVel:IMMediate:AMPLitude

Description	This command is used to set the source output power (in dBm).
Syntax	SOUR:POW:LEV:IMM:AMPL<space><power>
Parameters	The <power> parameter represents the new source output power (in dBm) in the "±9.9" format.
Note	This command cannot be performed if the module is in ASE mode or in sweep mode. If the entered value is out of range, the closest available value will be selected.
Example	SOUR:POW:LEV:IMM:AMPL 3.4
See also	SOUR:POW:LEV:IMM:AMPL?, SOUR:POW:LIM:HIGH?, SOUR:POW:LIM:LOW?, and SOUR:POW:LIM:STEP?

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SOURce:POWer:LEVel:IMMediate:AMPLitude?

Description	This query returns the source output power (in dBm).
Syntax	SOUR:POW:LEV:IMM:AMPL?
Response	The current source output power (in dBm) in the "±9.9" format.
Note	When in ASE mode, this command will return an invalid value. In case of no power, the "-----" message is returned.
Example	SOUR:POW:LEV:IMM:AMPL?
See also	SOUR:POW:LEV:IMM:AMPL, SOUR:POW:LIM:HIGH?, SOUR:POW:LIM:LOW?, and SOUR:POW:LIM:STEP?

SOURce:POWer:LIMit:HIGH?

Description	This query returns the maximum source output power (in dBm) that can be set with the SOUR:POW:LEV:IMM:AMPL command.
Syntax	SOUR:POW:LIM:HIGH?
Response	The maximum source output power (in dBm) in the "±9.9" format.
Example	SOUR:POW:LIM:HIGH?
See also	SOUR:POW:LEV:IMM:AMPL, SOUR:POW:LEV:IMM:AMPL?, SOUR:POW:LIM:LOW?, and SOUR:POW:LIM:STEP?

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SOURce:POWer:LIMit:LOW?

Description	This query returns the minimum source output power (in dBm) that can be set with the SOUR:POW:LEV:IMM:AMPL command.
Syntax	SOUR:POW:LIM:LOW?
Response	The minimum source output power (in dBm) in the "±9.9" format.
Example	SOUR:POW:LIM:LOW?
See also	SOUR:POW:LEV:IMM:AMPL, SOUR:POW:LEV:IMM:AMPL?, SOUR:POW:LIM:HIGH?, and SOUR:POW:LIM:STEP?

SOURce:POWer:LIMit:STEP?

Description	This query returns the minimum output power step (in dBm) that can be used when changing the source output power with the SOUR:POW:LEV:IMM:AMPL command.
Syntax	SOUR:POW:LIM:STEP?
Response	The minimum output power step (in dBm) in the "±9.9" format.
Example	SOUR:POW:LIM:STEP?
See also	SOUR:POW:LEV:IMM:AMPL, SOUR:POW:LEV:IMM:AMPL?, SOUR:POW:LIM:HIGH?, and SOUR:POW:LIM:LOW?

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SOURce:SWEep:CENTer?

Description	This query returns the central wavelength for the current sweep program in the current spectral units (nm or THz).
Syntax	SOUR:SWE:CENT?
Response	The central wavelength for the current sweep program in the current spectral units in the “9999.99” (nm) or “999.999” (THz) format.
Example	SOUR:SWE:CENT?

SOURce:SWEep:COUNt

Description	This command is used to specify how many times you want the sweep program to loop. To specify whether or not you want the sweep program to loop, use the SOUR:SWE:REPE command.
Syntax	SOUR:SWE:COUN<space><count>
Parameters	The <count> parameter represents the new number of loops in the “99” format. For continuous repetition, enter “0”.
Example	SOUR:SWE:COUN 32

SOURce:SWEep:COUNt?

Description	This query returns the number of repetitions set for the sweep program.
Syntax	SOUR:SWE:COUN?
Response	The number of repetitions set for the sweep program. “0” makes the program loop continuously.
Example	SOUR:SWE:COUN?

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SOURce:SWEep:PROGram?

Description This function is used to set the parameters for a sweep program. During a sweep program, the application sweeps between two wavelengths: the minimum and maximum wavelengths. This function also returns the validated parameters.

Syntax SOUR:SWE:PROG?<space><central>,,<time>

Parameters The <central> parameter represents the central wavelength (the wavelength halfway between the minimum and maximum wavelengths). The current spectral measurement units apply (nm or THz). The format must be “9999.99” (nm) or “999.999” (THz).

The parameter represents the wavelength range to be swept below and above the central wavelength: span = (max. wavelength – min. wavelength) / 2. The current spectral measurement units apply (nm or THz). The format must be “9999.99” (nm) or “999.999” (THz).

The <time> parameter represents the duration of the sweep. The format must be “HHHH:MM:SS”. The time is automatically adjusted according to the sweep minimum and maximum speed (which is between 0.10 and 2.50 nm/s).

Response A value confirming the new settings. If the parameters entered are not valid, the application will make the necessary changes. The format is “9999.99;99.99;999:99:99” (when the current spectral units are nm) or “999.999;9.999;9999:99:99” (when the current spectral units are THz).

Note It is strongly recommended that you perform the SOUR:SWE:REV command before the SOUR:SWE:PROG? command.

Example SOUR:SWE:PROG? 1552.52,10.00,0000:01:00

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SOURce:SWEep:REPEat

Description This command is used to specify whether or not you want the sweep program to loop. If activated, the sweep program will loop the number of times set by the SOUR:SWE:COUN command.

Syntax SOUR:SWE:REPE<space><loop>

Parameters The <loop> parameter is a boolean parameter indicating whether or not the sweep program will loop:
"1"-the sweep program will loop
"0"-the sweep program will not loop

Example SOUR:SWE:REPE 1

SOURce:SWEep:REPEat?

Description This query is used to check whether the sweep repeat function is activated. If activated, the sweep program will loop the number of times set by the SOUR:SWE:COUN command.

Syntax SOUR:SWE:REPE?

Response A boolean value indicating the state of the sweep repeat function:
"1"-the sweep repeat function is activated
"0"-the sweep repeat function is deactivated

Example SOUR:SWE:REPE?

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SOURce:SWEep:REV

Description This command is used to enable and disable the sweep reverse function. When the sweep reverse function is enabled, the sweep program is performed in both directions: in the wavelength ascending and descending order.

Syntax SOUR:SWE:REV<space><sweep>

Parameters The <sweep> parameter is a boolean parameter indicating whether or not the sweep will be done in both directions:
"1"-enable the sweep reverse function
"0"-disable the sweep reverse function

Example SOUR:SWE:REV 1

SOURce:SWEep:REV?

Description This query returns a value indicating whether the sweep reverse function is enabled.

Syntax SOUR:SWE:REV?

Response A boolean parameter representing the state of the sweep reverse function:
"1"-the sweep reverse function is enabled
"0"-the sweep reverse function is disabled

Example SOUR:SWE:REV?

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SOURce:SWEep:SPAN?

Description	This query returns the wavelength range to be swept below and above the central wavelength.
Syntax	SOUR:SWE:SPAN?
Response	A value representing the wavelength range to be swept below and above the central wavelength. The current spectral measurement units apply (nm or THz). The format is “9999.99” (nm) or “999.999” (THz).
Example	SOUR:SWE:SPAN?

SOURce:SWEep:STATe

Description	This function starts or stops the sweep program.
Syntax	SOUR:SWE:STAT<space><state>
Parameters	The <state> parameter is a boolean parameter representing the new state of the sweep program: “1”-start the sweep program “0”-stop the sweep program
Note	This command cannot be performed if the application is running in ASE mode.
Example	SOUR:SWE:STAT 1

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SOURce:SWEep:STATe?

Description	This query returns a value indicating the state of the sweep program.
Syntax	SOUR:SWE:STAT?
Response	A boolean value representing the current state of the sweep program: “1”-the sweep program is in progress “0”-the sweep program is not in progress
Example	SOUR:SWE:STAT?

SOURce:SWEep:TIME?

Description	This query returns the duration currently set for the sweep.
Syntax	SOUR:SWE:TIME?
Response	A value representing the duration currently set for the sweep in the “HHHH:MM:SS” format.
Example	SOUR:SWE:TIME?

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SOURce:WAVElength:LENGth

Description	This command selects a new source wavelength. The current spectral units (nm or THz) apply.
Syntax	SOUR:WAVE:LENG<space><wave>
Parameters	The <wave> parameter represents the new wavelength in the “9999.99” (nm) or “999.999” (THz) format.
Note	This function cannot be performed if the application is running in ASE or Sweep mode. If the value is out of range, the closest available value will be selected.
Example	SOUR:WAVE:LENG 1550.00
See also	SOUR:WAVE:LENG?, SOUR:WAVE:LIM:HIGH?, SOUR:WAVE:LIM:LOW?, SOUR:WAVE:LIM:STEP?, UNIT:WAVE, and UNIT:WAVE?

SOURce:WAVElength:LENGth?

Description	This query returns the current source wavelength in the current spectral unit (nm or THz).
Syntax	SOUR:WAVE:LENG?
Response	A value representing the current wavelength in the “9999.99” (nm) or “999.999” (THz) format.
Example	SOUR:WAVE:LENG?
See also	SOUR:WAVE:LENG, SOUR:WAVE:LIM:HIGH?, SOUR:WAVE:LIM:LOW?, SOUR:WAVE:LIM:STEP?, UNIT:WAVE, and UNIT:WAVE?

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SOURce:WAVElength:LIMit:HIGH?

Description This query returns the maximum wavelength that can be set with the SOUR:WAVE:LENG command. The return value will be in the current spectral units (nm or THz).

Syntax SOUR:WAVE:LIM:HIGH?

Response A value representing the maximum available wavelength in the “9999.99” (nm) or “999.999” (THz) format.

Example SOUR:WAVE:LIM:HIGH?

See also SOUR:WAVE:LENG, SOUR:WAVE:LENG?, SOUR:WAVE:LIM:LOW?, SOUR:WAVE:LIM:STEP?, UNIT:WAVE, and UNIT:WAVE?

SOURce:WAVElength:LIMit:LOW?

Description This query returns the minimum wavelength that can be set with the SOUR:WAVE:LENG command. The return value will be in the current spectral units (nm or THz).

Syntax SOUR:WAVE:LIM:LOW?

Response A value representing the maximum available wavelength in the “9999.99” (nm) or “999.999” (THz) format.

Example SOUR:WAVE:LIM:LOW?

See also SOUR:WAVE:LENG, SOUR:WAVE:LENG?, SOUR:WAVE:LIM:HIGH?, SOUR:WAVE:LIM:STEP?, UNIT:WAVE, and UNIT:WAVE?

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SOURce:WAVElength:LIMit:STEP?

Description	This query returns the minimum wavelength step that can be used when changing the wavelength with the SOUR:WAVE:LENG command. The return value will be in the current spectral units (nm or THz).
Syntax	SOUR:WAVE:LIM:STEP?
Response	A value representing the minimum wavelength step available in the “9999.99” (nm) or “999.999” (THz) format.
Example	SOUR:WAVE:LIM:STEP?
See also	SOUR:WAVE:LENG, SOUR:WAVE:LENG?, SOUR:WAVE:LIM:HIGH?, SOUR:WAVE:LIM:LOW?, UNIT:WAVE, and UNIT:WAVE?

UNITe:WAVElength

Description	This command changes the spectral measurement units (nm or THz). This command cannot be used in ASE mode.
Syntax	UNIT:WAVE<space><unit>
Parameters	The <unit> parameter is a boolean parameter representing the new spectral measurement units: “1”-use THz “0”-use nm
Example	UNIT:WAVE 1

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UNITe:WAVElength?

Description	This query returns the current spectral measurement units.
Syntax	UNIT:WAVE?
Response	A boolean value representing the current spectral measurement units: “1”-indicate THz “0”-indicate nm
Example	UNIT:WAVE?

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Error Messages Format

System and device specific errors are managed by the FLS-2600. The generic format for error messages is illustrated in Figure 7-2.

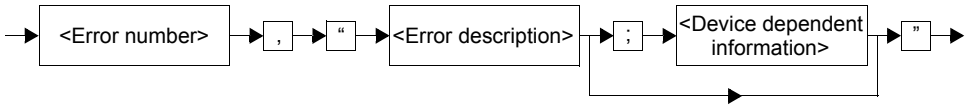


Figure 7-2. *Error Message Format*

As shown in the above figure, the message contains three parts:

- error number
- error description
- device dependent information

All error messages are stacked in a FIFO buffer. When there is at least one message in the buffer, bit 2 of the Status Byte Register is set to 1. Use the SYST:ERR? command to read the most recent message. The error message buffer is initialized when starting the FLS-2600, when executing the *CLS command, or by reading the last message stored in the buffer.

- Error messages ending in a negative number are SCPI-based errors.
- Error messages ending in a positive number are specific to the FLS-2600.

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SCPI Management Errors (System Errors)

Error Number	Description	Probable Cause
-100	“Command error”	The SCPI Manager does not recognize the command, likely due to invalid module address.
-101	“Undefined header”	The SCPI Manager does not recognize the command, likely due to incorrect grammar.
-102	“Missing parameter”	A required data parameter was not detected.
-103	“Parameter not allowed”	Too many parameters were detected for the specified command.
-104	“Data type error”	A data parameter is not the expected data type.
-200	“Execution error”	An error occurred while executing the command.
-300	“Device dependent error”	The device (module application) did not respond to the command within the given time-out value.
-400	“Query error”	Attempt to read an empty buffer or buffer data has been lost.
-500	“System error”	System is out of memory.

Table 7-6. *SCPI Management Error Messages*

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FLS-2600 Error Messages

Error Number	Description	Probable Cause
1101	“Parameter out of range”	The Tunable Laser Source has received a data parameter outside the valid range.
1102	“Invalid parameter”	The Tunable Laser Source has received a data parameter that it was not expecting.
1103	“Cannot execute command”	A command was sent while unallowed by the application state.
1104	“Query error”	Internal error.

Table 7-7. *FLS-2600 Error Messages*

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8 Technical Specifications

Specifications are subject to change without notice.

Optical Specifications

Tunable Mode	
Wavelength range (nm)	1520 to 1570
Wavelength tuning resolution (nm)	0.01
Effective spectral linewidth FWHM[a](nm)	0.01
Wavelength accuracy[b](nm)	±0.3
Wavelength repeatability (nm)	±0.02
Wavelength stability[c](nm)	±0.01
Sidemode suppression ratio[d](dB)	65
Maximum sweep rate[e](nm)	2.5
Typical output power (dBm)	+5
Minimum output power (dBm)	+5
Power stability over 15 minutes (dB)	±0.01
Power flatness across tuning range (dB)	maximum 0.5

Table 8-1. *Optical Specifications—Tunable Mode*

a. FWHM = Full width half maximum.
b. At 25±3°C.
c. Over 1 hour at constant temperature.
d. Measured with OSA at 0.2 nm resolution bandwidth at ±2.0 nm from peak over the full tuning range.
e. Continuously tunable sweep.

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ASE Mode	
Nominal wavelength (nm)	1550
Typical output power (dBm)	>+5
Minimum output power (dBm)	>+4
Power stability over 10 hours (dB)	±0.05

Table 8-1 Optical Specifications—ASE Mode

General Specifications

The FLS-2600 is intended for indoor use only.

General Specifications		
Dimensions	Width	8.75 in. / 21.8 cm
	Height	4.575 in. / 11.1 cm
	Length	11.25 in. / 28.5 cm
Operating temperature	32 to 104°F / 0 to 40°C	
Storage temperature	-40 to 140°F / -40 to 60°C	
Relative humidity[a]	0 to 80% non-condensing	
Maximum operation altitude	6150 ft./2000 m	
Pollution degree	2	
Installation category	II	
Power supply rating	100 to 240 V (50/60 Hz)	
	maximum 2 A	

Table 8-2 FLS-2600 General Specifications

a. Measured at 32 to 104°F / 0 to 40°C temperature range.

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9 Maintenance and Troubleshooting

There are no user-serviceable components in the FLS-2600, notwithstanding the routine maintenance described in this section. The FLS-2600 has been designed to require minimum maintenance and provide reliable operation for many years.

General Maintenance

To help ensure long, trouble-free operation,

- Keep the FLS-2600 free of dust.
- Do not to spill liquids on or into the unit. If the unit does get wet, turn off the power immediately and let the unit dry completely.
- Clean the FLS-2600 casing with a slightly damp (with water) cloth.

Cleaning Optical Ports

Regular cleaning of the optical ports will help maintain optimum performance. The cleaning swabs supplied with EXFO test equipment are specially designed to clean inside the ports without having to disassemble the unit. No cleaning solution is required as the tips are used dry.

1. Take a swab from the package without touching the soft end.
2. Push and rotate the connector adapter counter-clockwise and remove it. You have now access to the ferrule inside the connector interface.
3. Slowly insert the swab into the ferrule (a slight clockwise rotating movement may help).
4. Applying moderate pressure, turn the swab one full turn.
5. Continue to turn as you withdraw the swab.
6. Replace the connector adapter, push and rotate it clockwise until it clicks into place.
7. Dispose of the used swab after five uses or as soon as it is visibly dirty.

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IMPORTANT

To help keep the ports clean, it is recommended that the protective caps be closed when the unit is not being used and that the fiber ends be always cleaned before connecting them to the ports.

The cleaning swabs can also be used to clean adapters before inserting connectors. Note, however, that individual connectors still need to be cleaned according to standard cleaning methods.

Fuse Replacement

The FLS-2600 contains two fuses of type IEC, 250 V, 2 A, fast blow 0.197 in. x 0.787 in./5 mm x 20 mm. The fuse holder is located at the back of the FLS-2600, just beside the power inlet.



This symbol, found at the back of the FLS-2600, indicates that the user should refer to the instruction manual for fuse replacement.

To replace fuses,

1. Unplug the power cord from the FLS-2600.
2. Pull the fuse holder out of the FLS-2600.

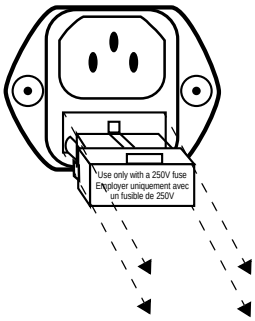


Figure 9-1. *Pulling Out the Fuse Holder*

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3. Verify and replace the fuses if necessary.

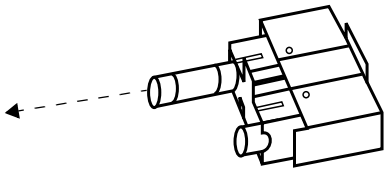


Figure 9-2. *Replacing the Fuses*

4. Make sure the fuses are placed firmly in the holder prior to reinsertion.
5. Firmly push the holder into place.

Periodic Source Verification

To make sure that the FLS-2600 remains within the published specifications, EXFO recommends that the unit be sent back to the factory every year for verification and adjustment. Please contact EXFO for further information.

Software Upgrade

To upgrade the FLS-2600 embedded software using a disk, you must connect your FLS-2600 to a computer through a null modem cable.

Note: *The software upgrade may be performed in DOS, Windows™ 3.1, or Windows 95. If problems occur, please contact EXFO.*

IMPORTANT

When using a notebook computer to upgrade the FLS-2600 software, you should perform the upgrade in a DOS environment.

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Proceed with the software upgrade only if the version indicated on the disk is more recent than the software version currently installed on your unit. To check the software version installed on your unit, see *Displaying the Software Version Number* on page 25.

To perform a software upgrade,

1. Turn off the FLS-2600.
2. Connect one end of a null modem cable to the FLS-2600 RS-232 serial port and the other end to an unused communication port on your computer (ex.: COM2).
3. Insert the upgrade disk into the computer floppy drive.
4. Create a new directory on the computer hard drive, then copy the contents of the disk into the new directory.
5. Execute the “lo0006.exe” file to start the software upgrade.

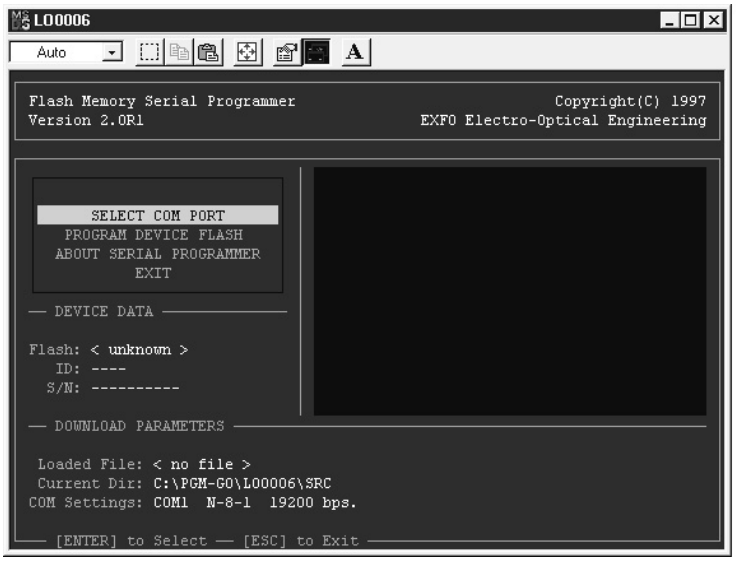


Figure 9-3. *Software Upgrade Utility*

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6. Highlight the “SELECT COM PORT” command and then press *Enter*.
7. Select the COM port to which the null modem cable is connected on your computer and then press *Enter*.
8. Highlight the “PROGRAM DEVICE FLASH” command and then press *Enter*.
9. Once you see the “Waiting for device handshake” message, turn on the FLS-2600. The FLS-2600 screen will remain off; the unit will beep once and programming will start automatically. A progress bar on the computer screen will indicate the status of the software upgrade.
10. Once the software upgrade is complete, the “Reboot device for self-test” message will appear.
11. Turn off the FLS-2600 and then on again to use the upgraded software.

Recalibration

To make sure that the unit remains within the published specifications, EXFO recommends that an annual calibration be performed. Please contact EXFO for further information.

Transportation and Storage

Maintain a temperature range within specifications when transporting or storing the unit. Transportation damage can occur from improper handling. The following steps are recommended to minimize the possibility of damage:

- Pack the unit in the original packing material when shipping.
- Store unit at room temperature in a clean and dry area. Avoid high humidity or large temperature fluctuations.
- Keep the unit out of direct sunlight.
- Avoid unnecessary shock and vibration.

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Contacting the Customer Service Group

If you encounter any difficulty while using this product, please call EXFO at one of the offices listed below. Our Customer Service Group is available in North America from 7:30 a.m. to 8:00 p.m. (Eastern time), Monday to Friday.

EXFO Electro-Optical Engineering Inc.
(Corporate Headquarters)
465 Godin Avenue
Vanier (Quebec) G1M 3G7
CANADA

1 800 663-3936 (USA and Canada)
Tel.: (418) 683-0211
Fax: (418) 683-2170
support@exfo.com
www.exfo.com

EXFO Europe
Centre d'Affaires Les Metz
100, rue Albert Calmette
78353 Jouy-en-Josas
FRANCE

Tel.: +33.1.34.63.00.20
Fax: +33.1.34.65.90.93

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10 Warranty

General Information

EXFO Electro-Optical Engineering Inc. (EXFO) warrants this equipment against defects in material and workmanship for a period of two years from the date of original shipment. EXFO also warrants that this equipment will meet applicable specifications under normal use.

During the warranty period, EXFO will, at its discretion, repair, replace, or issue credit for any defective product. This warranty also covers recalibration during a two-year period if the equipment is repaired or if the original calibration is erroneous.

IMPORTANT

The warranty can become null and void if

- **the equipment has been tampered with, repaired, or worked upon by unauthorized individuals or non-EXFO personnel**
- **the warranty sticker has been removed**
- **case screws, other than those specified in this manual, have been removed**
- **the case has been opened, other than as explained in this manual**
- **the equipment serial number has been altered, erased, or removed**
- **the equipment has been misused, neglected, or damaged by accident**

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL EXFO BE LIABLE FOR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

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Liability

EXFO shall not be liable for damages resulting from the use of the purchased product, nor shall be responsible for any failure in the performance of other items to which the purchased product is connected or the operation of any system of which the purchased product may be a part.

EXFO shall not be liable for damages resulting from improper usage or unauthorized modification of the product, its accompanying accessories and software.

Exclusions

EXFO reserves the right to make changes in the design or construction of any of its products at any time without incurring obligation to make any changes whatsoever on units purchased. Accessories, including but not limited to fuses, pilot lamps, and batteries used with EXFO products are not covered by this warranty.

Certification

EXFO certifies that this equipment met its published specifications at the time of shipment from the factory.

Service and Repairs

EXFO commits to providing product service and repair for five years after the date of purchase.

For service or repair of any equipment, follow the procedure below:

1. Call EXFO Customer Service Group. Support personnel will determine if the equipment requires service, repair, or calibration.
2. If the equipment must be returned to EXFO or an authorized service center, support personnel will issue a Return Merchandise Authorization (RMA) and an address for return.

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IMPORTANT

Never send any unit or accessory back to EXFO without a Return Merchandise Authorization (RMA).

3. If the unit has an internal storage device, do a backup of your data before sending the unit for repairs.
4. Pack the equipment in its original shipping material. Be sure to include a statement or report fully detailing the defect and the conditions under which it was observed.
5. Return the equipment, prepaid, to the address given by the support personnel. Be sure to write the RMA on the shipping slip. EXFO will refuse and return any package that does not bear an RMA.

Note: *A test setup fee will apply to any returned unit that, after test, is found to meet the applicable specifications.*

After repair, the equipment will be returned with a repair report. If the equipment is not under warranty, the customer will be invoiced for the cost appearing on this report. Return-to-customer shipping costs will be paid by EXFO for equipment under warranty. Shipping insurance is at the customer's expense.

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Glossary

adapter	A device for coupling two connectors.
amplitude	The distance between high and low points of a waveform or signal.
ASCII	American Standard Code for Information Interchange. A system used to represent letters, numbers, symbols, and punctuation as bytes of binary signals.
attenuation	The diminution of average optical power. Attenuation results from absorption, scattering, and other radiation losses. Attenuation is generally expressed in dB without a negative sign.
attenuation coefficient	A factor expressing attenuation per unit length, expressed in dB/km.
attenuator	An optical device, either fixed or adjustable, that reduces the intensity of light propagating through it.
backscattering	That portion of scattered light that returns in a direction generally opposite to the direction of propagation.
baud rate	Measurement of data transmission speed, expressed in bits per second or bps.
BER	Bit error rate. On a transmission link, the number of digital “highs” that are interpreted as “lows”, and vice versa, divided by the total number of bits received. In modern networks, BERs much better than 10^{-9} are expected.
c	Velocity of light in a vacuum = 299 792 458 m/s
°C	Degree Celsius. To convert to Fahrenheit: $F = \frac{9}{5}C + 32$.
CFR	Code of Federal Regulations
connector	A junction that allows an optical fiber or cable to be repeatedly connected or disconnected to a device such as a source or detector.

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coupler	A device whose purpose is to distribute optical power among two or more ports or to combine optical power from two or more fibers into a single port.
CW	Abbreviation for continuous wave. Refers to non-modulated, constant-intensity light.
dB	Decibel
dBm	Decibel referenced to a milliwatt.
DDE	Dynamic Data Exchange
decibel (dB)	The standard unit used to express gain or loss of optical power. A standard logarithmic unit for the ratio of two powers.
directivity	In a 3-port optical circulator, the ratio of power launched into port 1 that exits via port 2 vs. the fraction that exits via port 3.
DLL	Dynamic Link Library
DMA	Direct Memory Addressing
DUT	Device under test
EDFFA	Erbium doped fluoride fiber amplifier
EDFSA	Erbium doped silica fiber amplifier
EIA	Electronics Industries Association
electromagnetic interference	Any electrical or electromagnetic interference that causes degradation, failure in electronic equipment, or undesirable response. Optical fibers neither emit nor are affected by EMI.
EMI	Electromagnetic interference
EOI	End of Image Marker
EOS	Effective Opening Size
ESB	Event Summary Bit
ESE	Standard Event Status Enable Register
ESR	Standard Event Status Register

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f	Abbreviation for femto, which indicates 10^{-15} units.
f	Frequency, often also designated by ν.
FCC	Federal Communications Commission. A U.S. government body overseeing and regulating national electrical and radio communications. The FCC, formed in 1934, also deals with licences, tariffs, and limitations. The members of the commission are appointed by the U.S. president.
FIFO	First In First Out
frequency	The number of cycles per second, denoted by hertz (Hz).
G	Abbreviation for giga, which indicates 10^{9} units.
Ge	Germanium
GeX	High power germanium
GPIB	General Purpose Interface Bus
hr	Hour
Hz	Hertz. Denotes number of cycles per second.
IEC	International Electrotechnical Commission. A standardization body at the same level as ISO.
IEE	Institute of Electronic Engineering. It is a professional body covering all aspects of electronics and electrical engineering, including software, network, and computer engineering.
IEEE	Institute of Electrical and Electronics Engineering. It is a professional body very active, among other things, in many fiber-optic and opto-electronic related fields.
index matching material	A material, often a liquid or a cement, whose refractive index is nearly equal to the core index, used to reduce Fresnel reflections from a fiber's endface.
index of refraction	The ratio of the group velocity of light in a vacuum to the group velocity of light in a given medium.
InGaAs	Indium gallium arsenide

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ISA	Industry Standard Architecture
ISO	International Organization for Standardization. Commonly believed to stand for International Standards Organization. In fact, ISO is not an abbreviation—it is intended to signify uniformity (derived from the Greek *iso* meaning “equal”). ISO is responsible for many standards including those for data communications and computing.
ITU	International Telecommunications Union. The ruling body for telecommunications and the source of many network standards.
jumper	Fiber-optic cable that has connectors terminated on both ends. Used to connect two pieces of equipment, modules, or components.
k	Abbreviation for kilo, which indicates 10^3 units.
LD	Laser diode
LED	Light emitting diode
loopback	Type of diagnostic test in which the transmitted signal is returned to the sending device after passing through a communications link or network.
M	Abbreviation for mega, which indicates 10^6 units.
m	Abbreviation for milli, which indicates 10^{-3} units.
min	Minute
n	Abbreviation for nano, which indicates 10^{-9} units.
n	Refractive index. For the silica glass used in optical fibers, $n \approx 1.465$.
NIST	National Institute of Standards and Technology. U.S. governmental body that provides the assistance in developing standards. It was formerly the National Bureau of Standards.
noise figure	A measure of the quality of an amplifier, defined as the ratio of output to input SNRs.

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P	Abbreviation for peta, which indicates 10^{15} units.
p	Abbreviation for pico, which indicates 10^{-12} units
P	Power
PCS	Plastic-clad silica (fiber)
RMA	Return merchandise authorization
s	Second
SCPI	Standard Commands for Programmable Instruments
sensitivity	For an optical instrument, the smallest signal that can be detected in the absence of any other signal.
Si	Silicon
SNR	Signal-to-noise ratio. The ratio of the received optical power, divided by the noise floor for the optical system.
SRE	Service Request Enable Register
SRQ	Service Request
STB	Status Byte Register
t	Time
T	Abbreviation for tera, which indicates 10^{12} units.
Telcordia	Organization that contains much of the former Bell labs. It specializes in telephone network technology, standards and interfaces.
V	volt
VA	volt-ampere
W	watt
wavelength	For monochromatic light, the distance between two successive peaks (or troughs) of the sinusoidally-varying electric-field amplitude. Note that, unlike frequency, the wavelength of light is inversely proportional to the refractive index of the medium through which it propagates. It is for this reason that accurate wavelength measurements are

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	generally specified as being determined in “air” or in “vacuum”.
λ	lambda. Greek letter used to denote wavelength.
μ	Abbreviation for micro, which indicates 10^{-6} units.
ν	nu. Greek letter used to denote frequency. Traditionally, the physics community uses “ν” to denote frequency whereas the engineering community uses “*f*”.

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