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Complimentary Reference Material

This PDF has been made available as a complimentary service for you to assist in evaluating this model for your testing requirements.

TMG offers a wide range of test equipment solutions, from renting short to long term, buying refurbished and purchasing new. Financing options, such as Financial Rental, and Leasing are also available on application.

TMG will assist if you are unsure whether this model will suit your requirements.

Call TMG if you need to organise repair and/or calibrate your unit.

If you click on the "Click-to-Call" logo below, you can all us for FREE!

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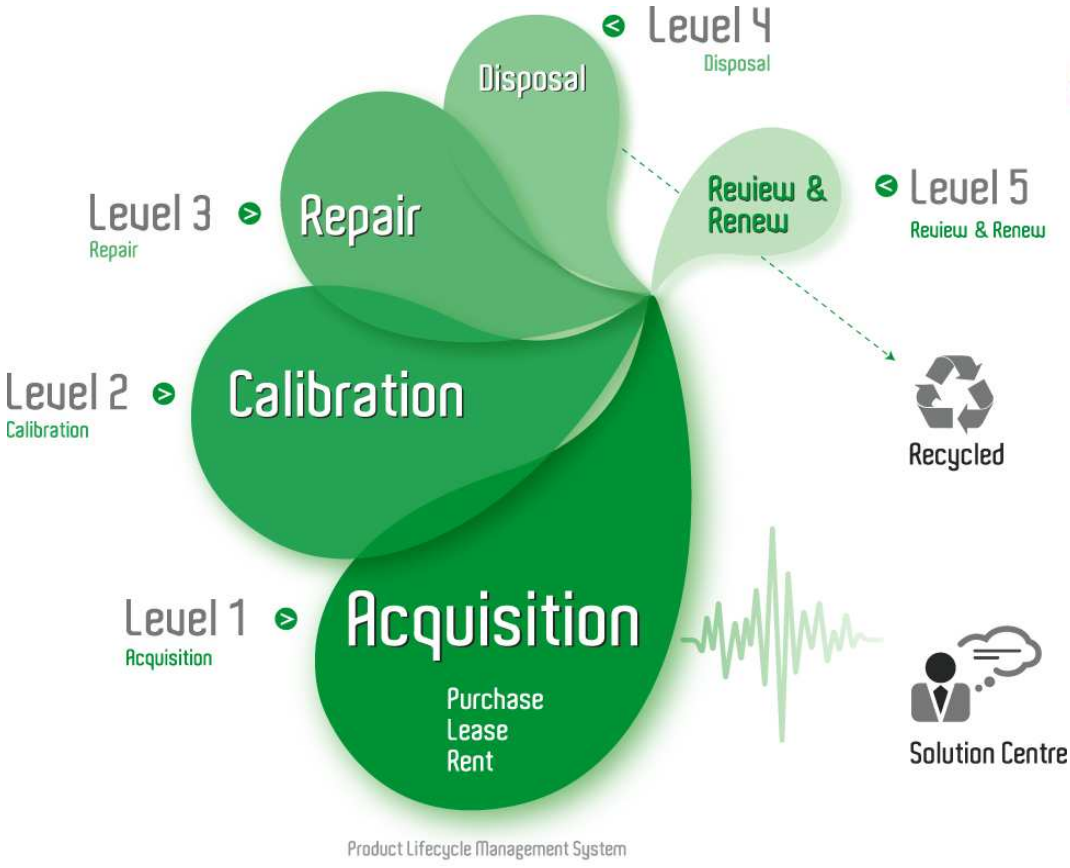

IQ-6100

Erbium Doped Fiber Amplifier

Instruction Manual

July 1999
P/N: MAN-114-I .2ACE

Second Edition

CE

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.*

CONTENTS

FIGURES

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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 A digital device, pursuant to Part 15 (Subpart B) of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the unit is operated in a commercial environment. 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. Operation of this unit in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

WARNING

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

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 A digital device. Please see the Declaration of Conformity.

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1 INTRODUCTION

EXFO E. O. Engineering, Inc. (EXFO) is pleased to introduce the IQ-6100 EDFA module as part of the IQ-200 Optical Test System product line.

EXFO's commitment to superior design in all its fiber-optic instrumentation is respected throughout the industry and is based on the following four goals:

- reliable and accurate performance
- simple operation
- extensive features
- dedicated interest in customer needs

The IQ-6100 EDFA will provide many years of reliable operation. To benefit fully from the many features offered by the IQ-6100, it is important to read the following instructions thoroughly.

1.1 IQ-200 Product Line

The IQ-200 product line is a modular optical test system designed for laboratory applications. Thanks to the Windows compatible IQ Software, the IQ-200 Optical Test System combines power, performance, flexibility with a user-friendly interface. The main components of the system are the IQ-203 Mainframe, which can house three modules, and the IQ-206 Expansion Unit, which can house six modules. It is also possible to control one or several IQ-206 Expansion Units with an IQ-206 PC Expansion Card.

For more information on the IQ-200 Optical Test System and the IQ Software, please refer to the *IQ-200 Optical Test System Instruction Manual*.

1.2 Unpacking and Inspection

The IQ-6100 is delivered with the following standard items:

- IQ-6100 Instruction Manual
- Certificate of Compliance
- Warranty Validation Card
- Declaration of Comformity
- test report
- accessory kit (optional)

The IQ-6100 EDFA module has been thoroughly inspected before shipment. If any damage has occurred during transportation or if any item is missing, please notify EXFO immediately. Retain the original packing material in case you need to return the IQ-6100.

1.3 Safety Conventions

The following conventions should be understood before operating the unit:

WARNING	Refers to a potential *personal* hazard. It requires a procedure which, if not correctly followed, may result in bodily harm or injury. Do not proceed beyond a **WARNING** unless the required conditions are fully understood and met.
CAUTION	Refers to a potential *product* hazard. It requires a procedure which, if not correctly followed, may result in component damage. Do not proceed beyond a **CAUTION** unless the required conditions are fully understood and met.
IMPORTANT	Refers to any information regarding the operation of the product which should not be overlooked.

1.4 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.

1.5 Getting Help

If any difficulty is encountered while operating the unit, please call EXFO at one of the offices listed below. The Customer Service Group is available from 7:30 a.m. to 8:00 p.m. eastern time, Monday to Friday.

EXFO Electro-Optical Engineering
(Corporate Headquarters)
465 Godin Avenue
Vanier QC 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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2 HARDWARE DESCRIPTION

2.1 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.

CAUTION

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

Invisible laser radiation may be encountered at the output port of the IQ-6100 EDFA. Do not stare into the port.

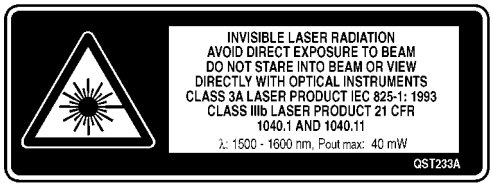

Figure 2-1. Warning and Information Label on Side Panel

The IQ-6100 is a booster EDFA that can provide a maximum output of +15 dBm in the 1550 nm wavelength region. The IQ-6100 is a potentially harmful instrument if not used with extreme caution.

Light in the 1550 nm wavelength region is invisible to the human eye and can cause unexpected, permanent eye damage. Use caution at all times when working with the IQ-6100 EDFA and other Class 3A laser products. Wear appropriate eye protection and follow laser safety precautions.

WARNING

When the IQ-6100 is powered on, with or without an optical signal provided at the IQ-6100 input connector, the output port protector shall never be opened.

Figure 2-2. Aperture Label on Output Port Protector

The IQ-6100 uses a mechanical beam attenuator to prevent exposure to potentially harmful invisible radiation. Extreme caution must be used when handling the IQ-6100 and its optical connections. Before powering on the IQ-6100, follow these safety procedures:

1. Make sure the IQ-6100 is powered off and that there is no signal at the input port.

2. Lift the output port protector. Do not stare into the output port of the IQ-6100.

3. Connect a test jumper to the output port.

4. Connect the other end of the test jumper to a terminal instrument, such as a power meter or another device, or terminate using a mandrel or other instrument.

5. Connect a test jumper to the input port of the IQ-6100.

Always make sure that the IQ-6100 is powered off and that there is no optical signal at its input port when the output port protector needs to be opened (to connect a test jumper or to clean the connector).

Always make sure that the test jumpers connected to the input and output ports of the IQ-6100 are connected to other instruments or devices before powering on the IQ-6100.

Always make sure that the optical connections are performed, that there is no radiation being emitted from the output port, and that the whole transmission line is completely terminated before powering on the IQ-6100.

IMPORTANT

If the previous procedures are not strictly followed, EXFO discharges itself of any legal responsibility and shall not be held responsible for misuse, improper operation of the IQ-6100, and misunderstanding of the importance of safety procedures.

2.2 General Description

The IQ-6100 is an erbium doped fiber amplifier (EDFA) designed to be used as a booster post-amplifier or power amplifier. The IQ-6100 is particularly well suited for the most demanding laboratory applications.

Applications for the IQ-6100 include

- testing of fiber-optic components, systems, or subsystems simulating the high power available in field transmission links;
- verifying power meters, attenuators, etc. for compliance with high power handling; and
- Testing linearity of power meters to high input power regime.

The IQ-6100 is designed for laboratory and manufacturing measurement applications using the IQ-203 Mainframe or IQ-206 Expansion Unit.

The IQ-6100 supports both local and remote control. Local control is via the Windows compatible software preinstalled on the IQ-203 or installed on a host PC when using the IQ-206 PC Expansion Card.

Remote control of the IQ-6100 is accomplished through one of these four ways:

- a GPIB interface
- an RS-232 external interface
- Windows OLE (Object Linking and Embedding) automation
- a Windows DDE (Dynamic Data Exchange) communication channel

Please refer to the *IQ-200 GPIB and Application Development Guide* for detailed information about remote control of the IQ instruments.

The product nameplate is located on a side panel near the rear of the module.

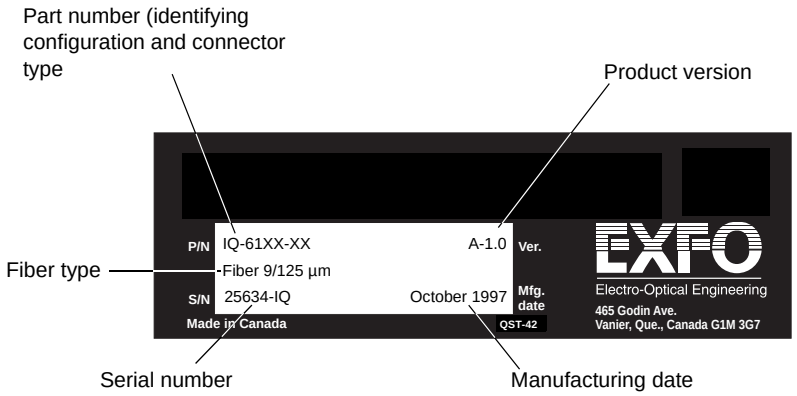

Figure 2-3. Module Nameplate

Note: *The information found on the nameplate will differ according to the module configuration.*

2.3 Front Panel Description

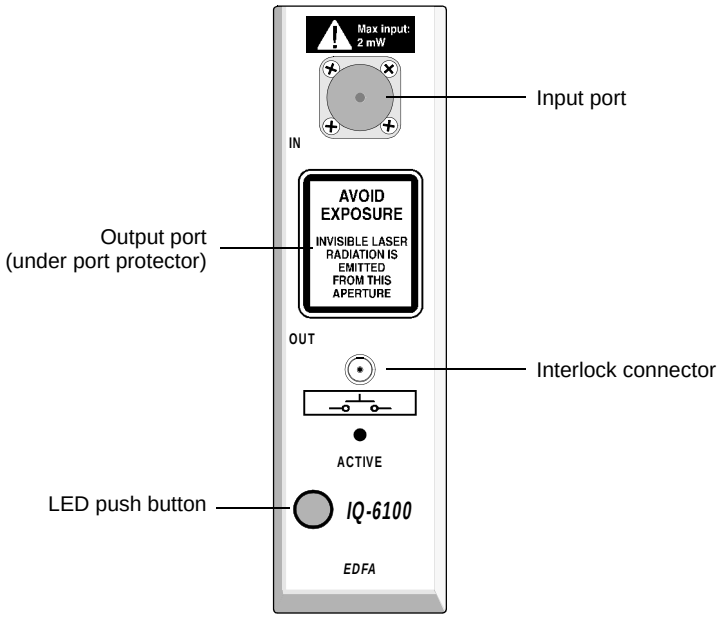

Figure 2-4. IQ-6100 EDFA Module

2.3.1 Input Port

Input and output ports have FC/PC connectors. The upper port is the input port, labeled **IN**.

Figure 2-5. Maximum Input Sticker over Input Port

WARNING

Maximum input power at the input port is 2 mW (3 dBm).

WARNING

Do not cascade amplifiers. Doing this might result in a dangerously high invisible laser radiation output beyond product specifications.

2.3.2 Output Port

The lower port is the output port, labeled **OUT**. The output port is protected by a spring shutter (output port protector).

WARNING

Never stare into the output port when the port protector is open.

Figure 2-6. Aperture Label on Output Port Protector

The following label is also found on the side panel of the IQ-6100 module.

Figure 2-7. Laser Radiation Hazard Sticker on Side Panel

2.3.3 Interlock Connector

All of the IQ-6100 module have an interlock connector which allows you to install a security switch or panic button. The interlock circuit has the following characteristics:

- When the interlock circuit is open, the EDFA cannot be activated

- If the EDFA is active before the interlock circuit is opened, the EDFA becomes inactive. Upon closing the interlock circuit, the EDFA will become active after a five second safety delay. Pressing the software application stop button will shut down the EDFA at any time and will prevent reactivation of the EDFA upon closing the interlock circuit.

For more information, see *Use of Safety Measures*, on page 4-1.

2.3.4 LED Push Button

The LED push button, on the front panel, has the following three functions:

- Illuminates when system is powered ON.
- Pressing the LED push button activates the main window.
- Pressing the LED push button when the main window is open activates the monitor window.

Note: *The monitor window is a compact window displaying basic data and is fully explained in* Monitor Window*, on page 3-5.*

2.4 Module Insertion

WARNING

Never insert or remove any module while the IQ-203/IQ-206 is powered on. This will result in damage to the module and to the IQ-203/IQ-206.

To insert a module

1. Power off the IQ-203/IQ-206.

2. Insert the module into any available slot. The IQ-203/IQ-206 will automatically recognize the module no matter what slot it is inserted in.

IMPORTANT

Be sure to insert the module all the way to the back of the IQ-203/IQ-206 to ensure the backplane connectors are properly mated. The module is correctly inserted when the module front panel is flush with the IQ-203/IQ-206 front panel.

2.5 Optical Connections

For information on important safety procedures to follow when making optical connections, see Section 2.1, *Safety Information*.

IMPORTANT

Always clean fiber end prior to insertion into the port as explained below.

The fiber-optic cable end should be cleaned at all times to ensure optimum performance and avoid erroneous readings.

To clean the fiber end,

1. Gently wipe the end with a lint-free swab dipped in isopropyl alcohol.

2. Dry using clean compressed air.

To connect the fiber-optic cable to the port,

1. Ensure that the connector is dry.

2. Align the connector and port to keep the fiber end from touching the outside of the port or rubbing against other surfaces.

3. Do not overtighten.

There are four different connection cases. The first two cases require the port protector to be closed to avoid laser exposure hazard. In the other two cases, a test jumper is connected to the output port; therefore, the port protector is not completely closed. However, to avoid exposure hazard, it is necessary that the test jumper connected to the output port be connected to another device or terminated before powering on the IQ-6100.

2.5.1 Case 1

In case 1, as illustrated in Figure 2-8, no input signal is provided and the output port is free of connections. The IQ-6100 EDFA module could be on or off, but the port protector must be down.

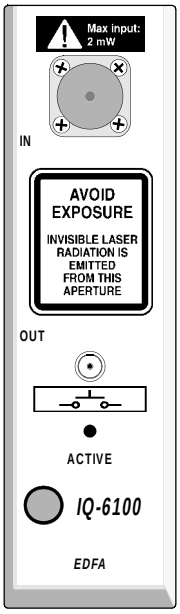

Figure 2-8. Optical Connections: Case 1

2.5.2 Case 2

In case 2, as illustrated in Figure 2-9, an input signal is provided and the output port is free of connections. The IQ-6100 EDFA module must be powered off, and the port protector must be down.

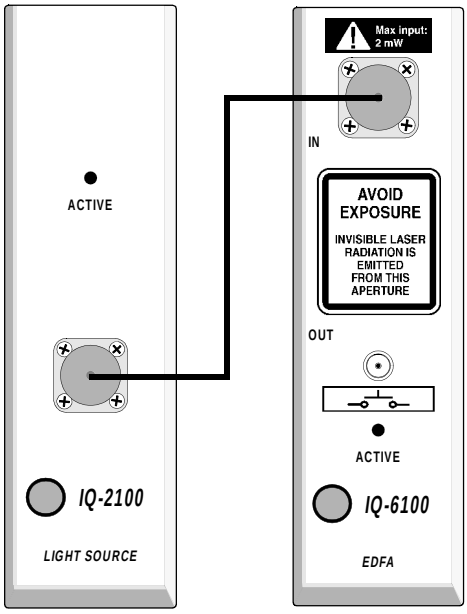

Figure 2-9. Optical Connections: Case 2

2.5.3 Case 3

In case 3, as illustrated in Figure 2-10, an input signal is provided, and the output port is connected to another device. The IQ-6100 EDFA module could be on or off, and the port protector is open.

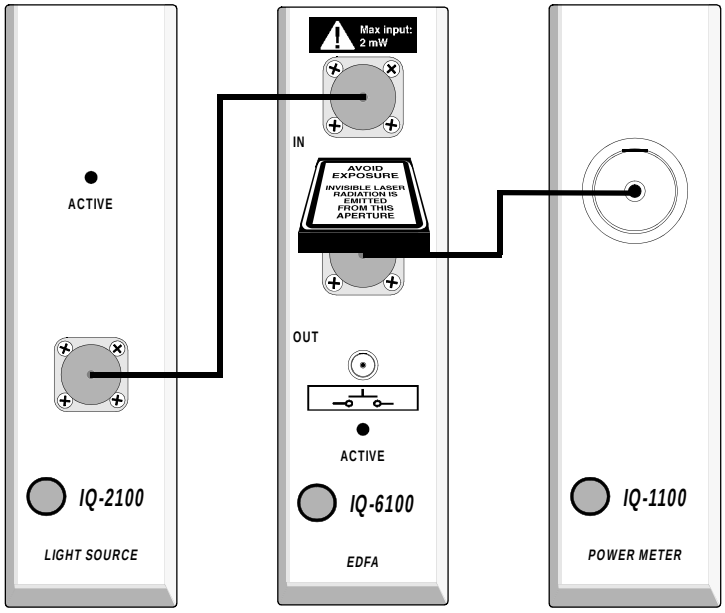

Figure 2-10. Optical Connections: Case 3

2.5.4 Case 4

In case 4, as illustrated in Figure 2-11, no input signal is provided and the output port is connected to another device. The IQ-6100 EDFA module could be on or off, and the port protector is open.

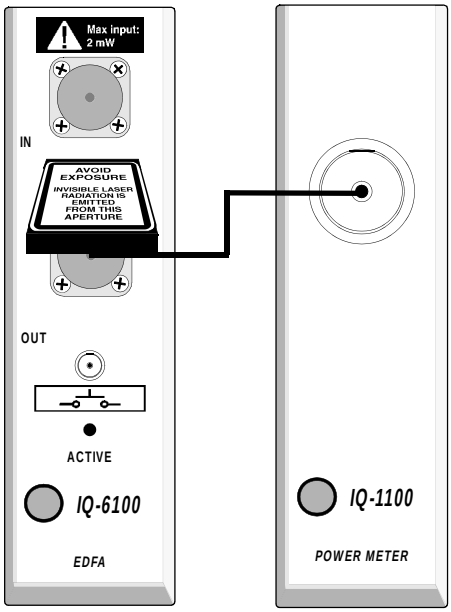

Figure 2-11. Optical Connections: Case 4

2.6 Module Removal

CAUTION

Never insert or remove any module when the IQ-203 Mainframe or the IQ-206 Expansion Unit is powered on. This will result in immediate irreparable damage to the module and IQ-203/IQ-206.

To remove module from IQ-203/IQ-206

1. Make sure the IQ-203 /IQ-206 is powered off.

2. If your module has a locking mechanism, push up the locking mechanism under the front panel of the module, as shown in Figure 2-12. Otherwise, simply place your fingers under the front panel of the module.

3. Firmly pull the module outward.

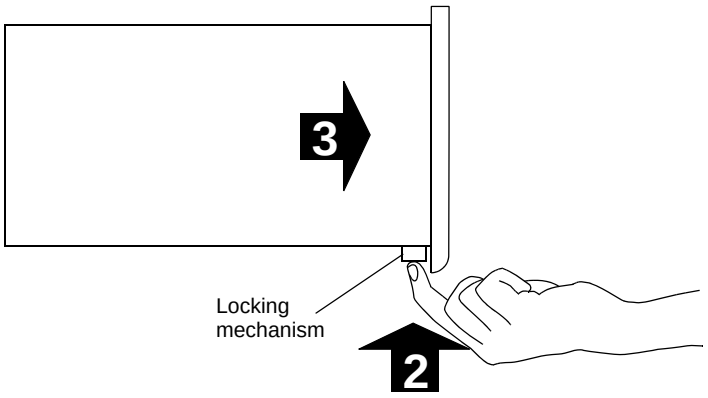

Figure 2-12. Removing an IQ Module

4. Put one of the supplied protective covers over the empty slot to prevent dust from entering the module housing.

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3 SOFTWARE DESCRIPTION

3.1 Main Window Description

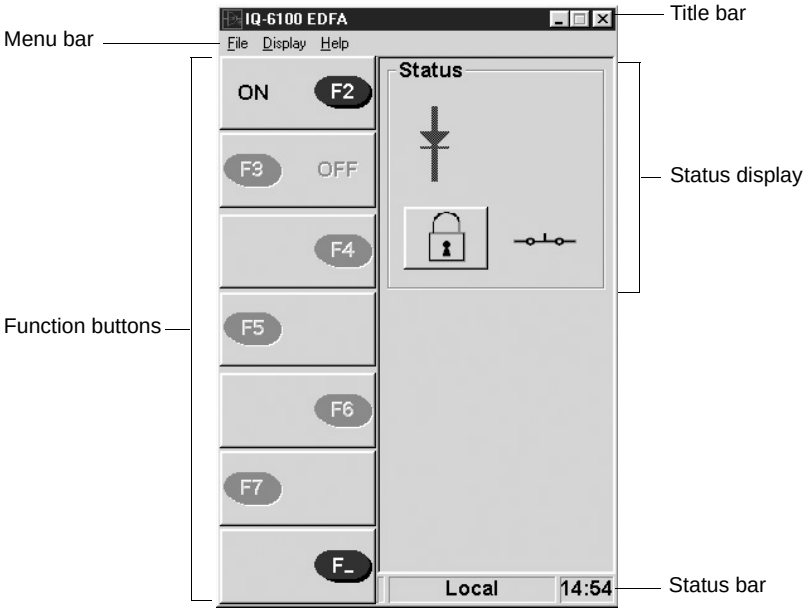


Figure 3-1. Main Window

The main window can be divided into four sections:

- title bar and menu bar
- function buttons
- status display
- status bar

3.2 Title Bar and Menu Bar

The title bar and menu bar are at the top of the main window. The title bar indicates the name of the application. The menu bar contains five drop-down menus.

Menu	Option	Function
File	Open Config...	Opens a previous configuration file.
	Save Config...	Saves actual configuration setup to be used in following testing sessions.
	Exit	Closes the application.
Display	Monitor	Opens the monitor window associated with the EDFA module.
Help	Hardware	Opens a window providing general hardware information.
	About	Opens a window providing the following information: name and version of the application Customer Service phone numbers EXFO web site and e-mail address system information

Table 3-1. Main Window Drop-Down Menus

3.3 Function Buttons

Button	Description
	Turns on the IQ-6100 EDFA module.
	Turns off the IQ-6100 EDFA module.
	Transfers control to the IQ-203 front panel function keys. Refer to the *IQ-200 Optical Test System Instruction Manual*.

Table 3-2. Function Buttons Description

3.4 Status Display

Amplifier operation is represented by an icon on the status display.

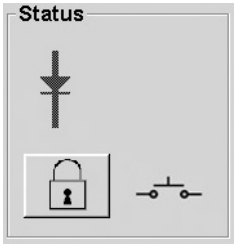
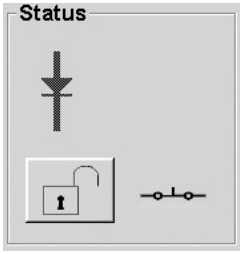
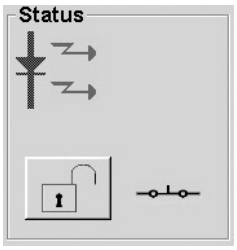
Icon	Meaning
	The gray diode icon indicates that the IQ-6100 EDFA is OFF. The closed lock button indicates that the master control is OFF. The open circuit icon indicates that the interlock circuit is open
	The gray diode icon indicates that the IQ-6100 EDFA is OFF. The open lock button indicates that the master control is ON. The closed circuit icon indicates that the interlock circuit is closed
	The red diode icon indicates that the IQ-6100 EDFA is ON.

Table 3-3. IQ-6100 Status Icons

3.5 Status Bar

On the status bar, you may find the inscription **Local**, **Remote**, or **Lockout**, which indicates if the IQ-6100 EDFA module is controlled locally or through a GPIB link. Table 3-4 explains the meaning of these indications. For more information on how to control the different IQ modules through a GPIB link, refer to the *IQ-200 GPIB and Application Development Guide*. The status bar also displays the time.

Indication	Meaning
Local	The unit is controlled locally.
Remote	The unit is controlled through a GPIB link but local commands can still be used.
Lockout	The unit is exclusively controlled through a GPIB link. All IQ peripherals are disabled.

Table 3-4. Module Control Status

3.6 Monitor Window

The monitor window displays basic status data. Using the monitor window in conjunction with other module monitor windows allows the creation of an integrated data display screen (refer to the *IQ-200 Optical Test System Instruction Manual*). The size and position of the monitor window can be customized.

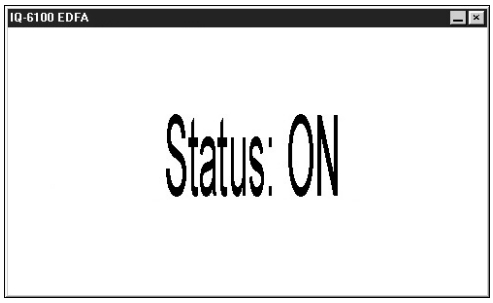


Figure 3-2. Monitor Window

3.6.1 Opening the Monitor Window

There are three ways to open the monitor window:

- In the main window, choose **Monitor** from the *Display* menu.
- In the main window, click on the bar icon in the upper right corner.
- Push the LED button on the front panel of the module.

3.6.2 Closing the Monitor Window

There are two ways to close the monitor window and to return to the main window:

- Double-click anywhere in the monitor window.
- Push the LED push button on the front panel of the module.

Note: *The function buttons can be accessed while in monitor window view by positioning the cursor inside the monitor window and clicking the right mouse button. The function button keypad will appear to the left of the monitor window.*

4 GENERAL OPERATION

4.1 Use of Safety Measures

To comply with section 21 CFR 1040.10 and 1040.11 of the *Radiation Control for Health and Safety Act* of 1968, the following safety features have been implemented on the IQ-6100:

- an integrated remote interlock connector which allows the introduction of external remote interlocks,
- a software key-activated master control, and
- an emission indicator which provides a visible signal sufficiently before emission to allow appropriate action to avoid exposure to the laser radiation.

4.1.1 Interlock Connector

The IQ-6100 has an integrated remote interlock connector which allows you to install a security switch or panic button. The EDFA module is shipped with an internally shorted interlock cap. It is the user's responsibility to install external remote interlocks to ensure safe use of the EDFA.

The interlock circuit has the following characteristics:

- When the interlock circuit is open, the EDFA cannot be activated
- If the EDFA is active before the interlock circuit is opened, it becomes inactive. Upon closing the interlock, the EDFA will become active after a five second safety delay, unless the EDFA application **Off** button was pressed while the interlock circuit was open.

The state of the interlock circuit (open or closed) is indicated by an icon in the **Status** display box of the IQ-6100 applications (see Figure 4-1).

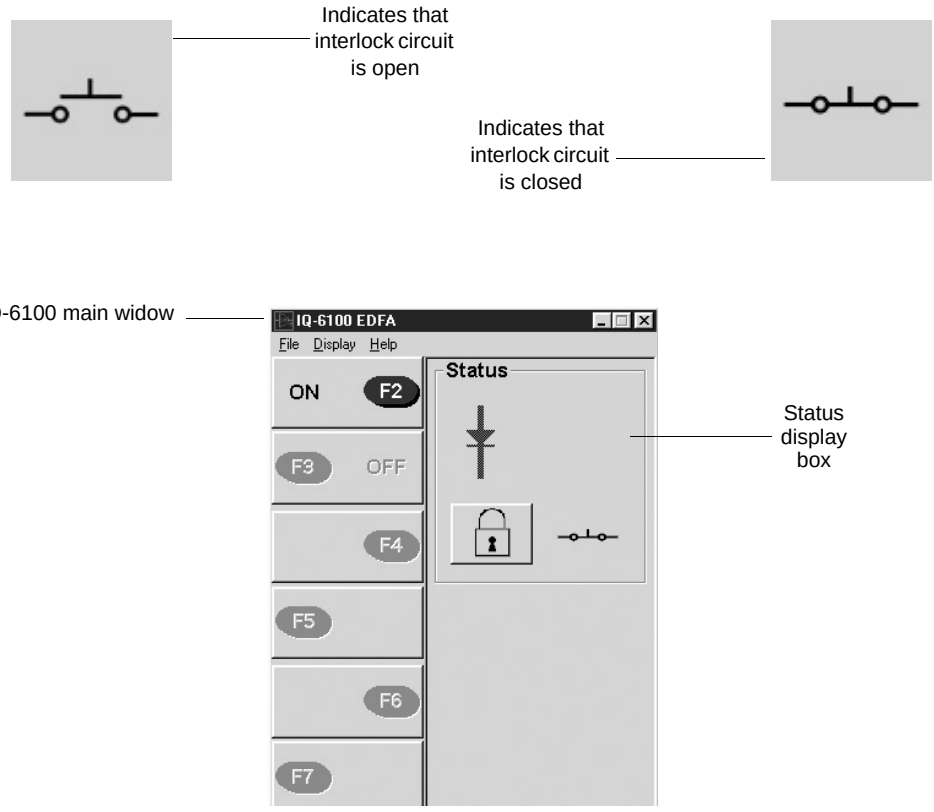


Figure 4-1. IQ-6100 Interlock State Display

The interlock cannot be opened or closed via the applications.

4.1.2 Software Key-Activated Master Control

In order for the **On** button to turn on the EDFA, the software key must be turned on by entering the security password when prompted to do so.

The state of the master control (on or off) is indicated on the button in the **Status** display box of the IQ-6100 application (see Figure 4-2).

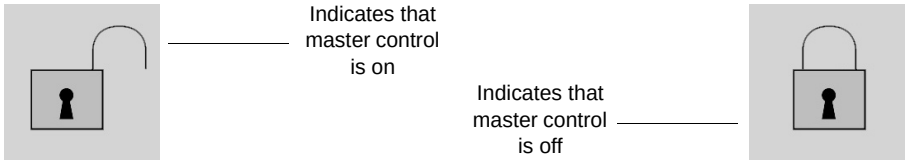


Figure 4-2. IQ-6100 Software Key State Display

When the master control is off, it is impossible to activate the EDFA.

4.1.3 Five Second Safety Delay

The IQ-6100 applications provide a five second safety delay between clicking the EDFA activation **On** button and the actual emission of the EDFA. During this five second delay, you may alter the output power level, or cancel the activation of the EDFA by clicking on the EDFA deactivation **Off** button by opening the interlock circuit or by pushing on the software key button.

4.2 EDFA Activation

The software key password is “safekey”. This password cannot be modified and is the same for all IQ modules requiring a software key.

To activate the IQ-6100 EDFA

1. Setup the EFDA and sources as described in *Optical Connections*, on page 2-8.

2. Make sure that the interlock circuit is closed. The interlock status icon indicates whether the interlock circuit is closed or open.

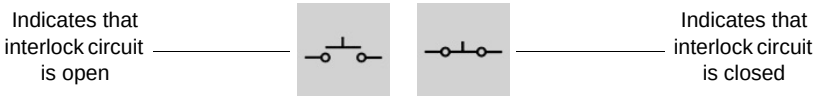


Figure 4-3. Interlock Status Icon

3. Activate the software key by clicking on the lock button. When prompted, enter the password “safekey”.

4. Choose **ON** to activate the EDFA. The active LED on the module front panel will then light up indicating that the source is active or will be after the five second safety delay.

   Two red right-pointing arrows will appear in the Status box, as shown in Figure 4-4, indicating that the source is on. These will blink during the five second safety delay.

To deactivate the IQ-6100 EDFA, choose **OFF.** The active LED on the module front panel will then turn off, indicating that the EDFA is inactive.

The two right-pointing arrows will disappear from the Status box indicating that the source has been deactivated. The diode symbol will also return to its original grayed-out color.

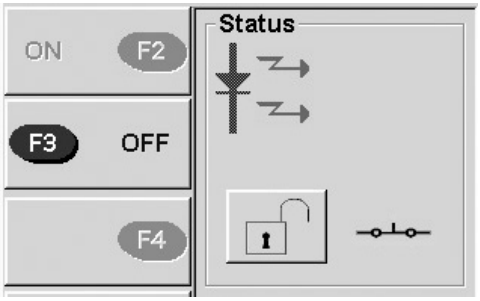


Figure 4-4. EDFA Activation/Deactivation Buttons and Status Box

5 GPIB COMMANDS

5.1 Command Structure

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

FORM(0..26):READ[:DATA]<space><digit>

is used to change the measurement display resolution (number of digits after the decimal point) of a given module.

In this particular example,

- FORM identifies that the command is part of the SCPI FORMat subset of commands
- (0..26) is a whole number between 0 and 26 that identifies the module
- READ and DATA are keywords that define the function of the command
- [ ] indicates that a keyword or parameter is optional
- <space> is included to indicate that a space is required
- <digit> is the command parameter

All keywords are separated by a colon. A typical command would be

FORM4:READ:DATA 1

This command instructs the module to display a power measurement with 1 digit after the decimal point.

5.2 General Commands

The SCPI Manager recognizes all of the common commands identified as mandatory by IEEE-488.2. These commands, as well as some optional common commands, are summarized in Table 5-1.

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
*REM	Set Remote programming state
*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 5-1. Common Commands Summary

The commands are fully explained on the following pages.

*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.

*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 IQ system identification string.

Syntax *IDN?

Response “EXFO E.-O. Eng IQ-200 OTS 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 SCPI Manager to generate the operation complete message in the Standard Event Status Register (ESR) when all pending selected SCPI Manager’s operations have been completed.

Syntax *OPC

Example *OPC;*IDN?

*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"

*REM

Description This command is used to set the Remote programming state.

Syntax *REM

*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>

*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

*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

5.3 Specific Commands

AMPlifier:PROTection:HARdExist?

Description This query returns whether integrated remote interlock connector is present.

Syntax AMP(0..26):PROT:HARE?

Response A boolean value:
"1" -interlock connector is present
"0" -interlock connector is not present

Example AMP3:PROT:HARE?

AMPlifier:PROTection:HARdState?

Description This query returns integrated interlock connector status (open or closed).

Syntax AMP(0..26):PROT:HARS?

Response A boolean value:
"1" -interlock connector is open
"0" -interlock connector is closed

Example AMP3:PROT:HARS?

AMPlifier:PROTection:RemovePassWorD

Description This command allows you to remove the software protection password.

Syntax AMP(0..26):RPWD

Example AMP3:PROT:RPWD

See also AMP:PROT:SOFS? and AMP:PROT:SOFE?

AMPlifier:PROTection:SetPassWorD

Description This command allows you to enter the software protection password.

Syntax AMP(0..26):PROT:SPWD<string>

Parameters The string “safekey”.

Note Entering the password is necessary to activate EDFA

Example AMP3:PROT:SPWDsafekey

See also AMP:PROT:SOFS? and AMP:PROT:SOFE?

AMPlifier:PROTection:SOFtExist?

Description This query returns whether a software key-activated master control is present.

Syntax AMP(0..26):PROT:SOFE?

Response A boolean value:
“1” -software key is present
“0” -software key is not present

Note This software key-activated master control is only present if you clicked yes in the safety dialogue box during installation.

Example AMP3:PROT:SOFE?

See also AMP:PROT:SPWD and AMP:PROT:RPWD

AMPlifier:PROTection:SOFtState?

Description This query returns software key-activated master control status (on or off).

Syntax AMP(0.26):PROT:SOFS?

Response A boolean value:
"1" -software key is on
"0" -software key is off

Example AMP3:PROT:SOFS?

See also AMP:PROT:SPWD, AMP:PROT:RPWD and AMP:PROT:SOFE?

AMPlifier:STATe

Description This function turns on and off the EDFA. When the EDFA is on, the red LED on the front of the module illuminates.

Syntax AMP(0..26):STAT<space><state>

Parameters The <state> parameter is a boolean parameter:
"1" -turn on the source
"0" -turn off the source

Example AMP3:STAT 1

AMPlifier:STATe?

Description This query returns the state of the EDFA (on or off).

Syntax AMP(0..26):STAT?

Response A boolean value indicating the state of the EDFA:
"1" -the source is on
"0" -the source is off

Example AMP3:STAT?

5.4 Quick Reference Command Tree

Command	Parameter/ Response	Description
AMP		
PROT HARE?	(0|1)	Interlock connector present?
HARS?	(0|1)	Interlock connector open or closed?
RPWD		Remove software protection password
SPWD	“safekey”	Enter software protection password
SOFE?	(0|1)	Software key is present?
SOFS?	(0|1)	Software key on or off?
AMP STA	<0|1>	Turn source on or off
STA?	(0|1)	Know whether or not source is active?

Table 5-2. IQ-6100 EDFA Command Tree

5.5 Error Messages

Error Number	Description	Probable Cause
1	“Unknown command.”	The EDFA has received a command that it does not recognize.

Table 5-3. IQ-6100 EDFA Error Messages

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6 TECHNICAL SPECIFICATIONS

Description	Performance
Wavelength range (nm)	1530–1560
Residual pump power (dBm)	≤ -55
Output power at saturation[a] (dBm)	13+; 15[b]
Power stability, short term (5 minutes) at saturation (dB)[c]	± 0.003
Stabilization time at power on (min)	30
Stabilization time[d] (min)	30
Polarization sensibility (dB)	< 0.1
Back reflection[e] loss (dB)	> 35

Table 6-1 Technical Specifications

a. For a 2 mW output power.
b. For a 2 mW input, maximum output power is 15 dBm. However, this value may be of up to 16 dBm if power meter accuracy, connector loss, and insertion loss incertitudes are taken into account.
c. After a warm-up period of 30 minutes.
d. At input.
e. From output to input, including connectors.

Specifications are subject to change without notice.

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7 MAINTENANCE AND TROUBLESHOOTING

There are no user-serviceable components in the IQ-6100. The module has been designed to require a minimum of maintenance and provide accurate operation for many years.

7.1 General Maintenance

To help ensure long, trouble-free operation

- Keep the IQ module free of dust.
- If the unit should get wet, turn the power off immediately and let the unit dry completely before turning it on again.
- Clean the IQ module casing with a cloth slightly dampened with water.

7.2 Cleaning the Optical Ports

To ensure maximum power output, the fiber end must be kept clean at all times, as explained in *Optical Connections*, on page 2-8. However, the source port should be cleaned occasionally to ensure minimum insertion loss.

IMPORTANT

When the module is not being used, the protective cap should be fitted over the source port.

To clean the source port of the light source

1. Remove the protective cap.
2. Gently wipe the source port with a lint-free swab dipped in isopropyl alcohol.
3. Dry the port using clean compressed air.

If any abnormal power loss is observed, the source port and pigtail behind the front panel of the module may require cleaning. Contact EXFO for further information.

7.3 EDFA Calibration

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

7.4 Troubleshooting

Problem	Probable Cause	Recommended Action
LED push button does not illuminate.	Power not on.	Check AC power cord and power ON the IQ-203 and IQ-206 Refer to *IQ-200 Optical Test System Instruction Manual* to verify fuse.
	Module is not properly inserted.	Power OFF the IQ-203 and IQ-206, remove and reinstall the module.
	Computer is locked up.	Reboot the IQ-203.
	LED is burnt.	Contact EXFO.
Pushing the LED push button does not open the module Main window.	Computer is locked up.	Reboot the IQ-203.

Table 7-1. Problems, Possible Causes, and Recommended Actions

In all cases, if problem persists after performing a recommended action, contact EXFO immediately.

8 WARRANTY

8.1 General Information

EXFO E. O. Engineering (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 one year 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.

8.2 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.

8.3 Exclusions

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

8.4 Certification

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

8.5 Service and Repairs

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

To obtain service or repair for any equipment, follow the procedure below.

1. Call EXFO Sales and Product Support 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.

3. 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.

IMPORTANT

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

4. 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 which does not bear an RMA.

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

5. 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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APPENDIX A – EDFA THEORY

Fiber amplifiers use rare-earth dopants — erbium, praseodynium, thulium, and others — in glass optical fibers and are optically pumped by an energy source until population inversion is obtained. During population inversion, higher energy states are more densely populated than lower energy states. When the signal passes through the fiber, the medium is stimulated to emit photons, thus amplifying the signal.

An EDFA consists of several meters of erbium-doped fiber, together with an optical pump — a semiconductor diode laser. When 980-nm pump light is used, electrons are pumped into a state that readily decays into a metastable state. From the metastable state, electrons can be stimulated to emit by photons in the amplification range. Other pump wavelengths, such as 1480 nm, are also available.

Erbium doped fiber amplifiers amplify signals in a 3-THz-wide band from 1530 nm to 1560 nm, the exact wavelengths at the absolute minimum of silica fiber attenuation.

An EDFA amplifies an optical input signal to its maximum power available defined by its saturation regime. For example, if a light signal of typically 0 dBm is provided at the amplifier input, a signal of the order of +16 dBm could be provided at the output port. In saturation regime, the amplifier gain is low (16 dB in the previous example) and the noise figure is high (typically 6-7 dB), but the output power is the highest available.

Figure A-1 shows the relationship between the output power (P_{out}) the input power (P_{in}) and the gain (G) of an EDFA.

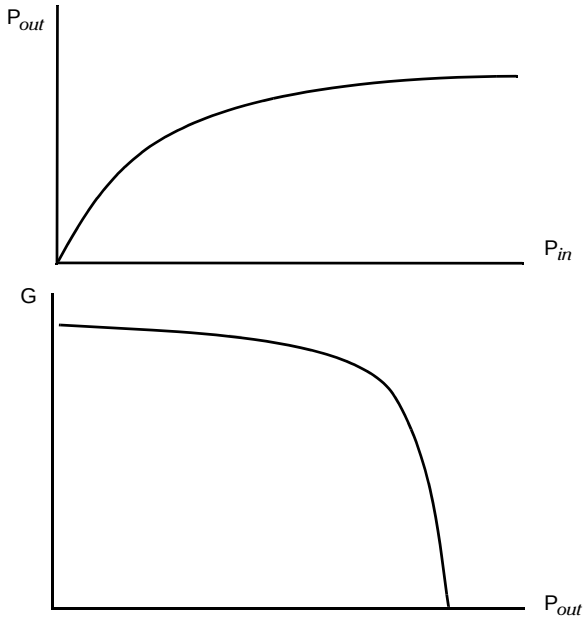

Figure A-1. Relationship between Output Power, Input Power, and Gain

Three types of EDFAs can be considered in fiber-optic telecommunication applications: power or booster amplifiers, preamplifiers, and in-line amplifiers or repeaters. EDFAs can be classified by their output power and noise figure as a function of the input power, see Figure A-2.

Power amplifiers are installed immediately after the source to increase the transmitter power in order to use less repeaters. Power amplifiers are used in saturation regime as a function of the input power with a relatively high noise figure. Noise figure is more important, however, in preamplifiers, where the highest gain is necessary. The power amplifier will be of interest in a laboratory environment to increase the power of a 1550-nm window source to simulate or study the operating conditions of a transmission network. Power amplifiers operating in the 1310-nm window are possible by using praseodynium in fluoride glass fibers.

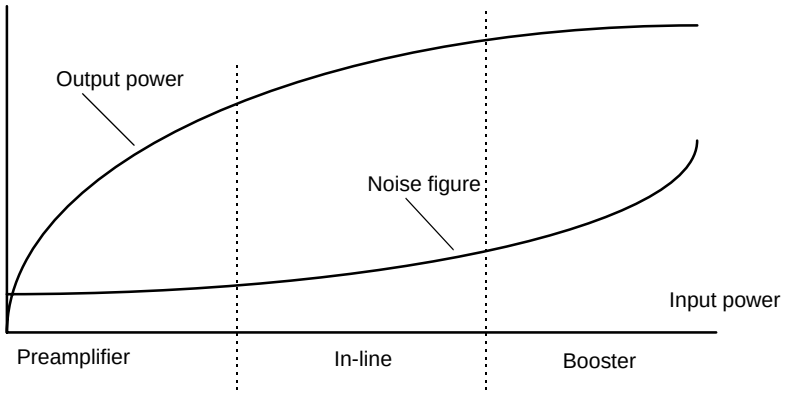

Figure A-2. EDFA Classification

At the end of the fiber-optic transmission line, fiber preamplifiers are used to improve receiver performances. In this case, the input signal is weak, see Figure A-2, and high net gain values and low noise figures are essential. Insertion losses and contributions to the noise of the EDFA amplified spontaneous emission must be minimized in this case.

Along the fiber-optic transmission line, repeaters are used to maintain an acceptable signal level. Gain, output power, and noise figure are moderate, see Figure A-2. This type of amplifier is used in the compressed gain regime, where a decrease in the input power increases the gain, while an increase in the input power decreases the gain. The amplifier works much like an automatic gain controller to maintain the output power at a relatively constant and stable level in conditions of varying input levels. Return losses between repeaters must be minimized to avoid unwanted and noisy oscillations.

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GLOSSARY

a	Abbreviation for atto, which indicates 10^{-18} units.
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.
Bellcore	Bell communications research, an organization that contains much of the former Bell labs. It specializes in telephone network technology, standards and interfaces.
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 = 2.997925 x 10^{8} 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.
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
dynamic range	For an optical instrument, generally defined as the ratio (in dB) of the smallest signal that can be observed (at a specified wavelength separation) in the presence of a strong, nearly saturating signal.
E	Abbreviation for exa, which indicates 10^{18} units.
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.
E	Abbreviation for exa, which indicates 10^{18} units.
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
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.
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.
k	Abbreviation for kilo, which indicates 10^3 units.
jumper	Fiber-optic cable that has connectors terminated on both ends. Used to connect two pieces of equipment, modules, or components.
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.
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.
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 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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