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IQ-3100/IQ-3300

Variable Attenuator/Variable Reflector



Instruction Manual

Fifth Edition

P/N: MAN-108-I .5ACE

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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EXFO's Commerce And Government Entities (CAGE) code under the North Atlantic Treaty Organization (NATO) is 0L8C3.

The information contained in this manual is subject to change without notice.

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July 2001

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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.

Important

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

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- 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.
- 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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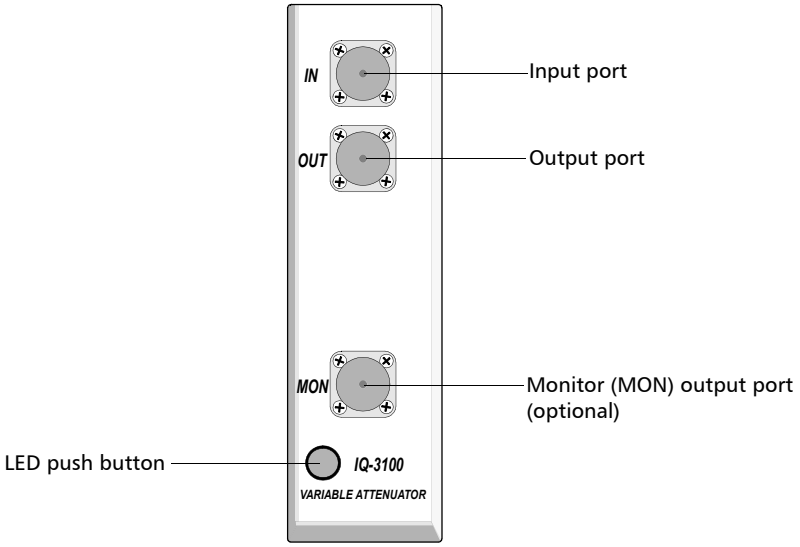
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1 Introducing the IQ-3100/IQ-3300

IQ-3100 Variable Attenuator

The IQ-3100 Variable Attenuator module is a high performance attenuator that is part of the IQ-200 Optical Test System product line. High quality components and meticulous calibration procedures ensure that the IQ-3100 Variable Attenuator achieves repeatable and precise attenuation settings (up to 100 dB). It is ideal for manufacturing and laboratory applications such as erbium doped amplifier (EDFA) characterization, component and system loss simulation, optical margin analysis, instrument calibration, power meter linearity measurement and spectral tuning.



The IQ-3100 Variable Attenuator is configured for singlemode or multimode fibers. Its calibration extends over the entire wavelength range (1200 nm to 1650 nm and 700 nm to 1350 nm). The optical return loss (ORL) specification for the singlemode attenuator yields stable test results.

Test equipment complies with transmission equipment ORL standards. Return loss for a singlemode IQ-3100B unit is higher than 55 dB; for a singlemode IQ-3100BW, it is higher than 50 dB. Its polarization-dependent

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loss (PDL) may attain a maximum of 0.3 dB. Keeping in mind that attenuation is polarization-dependent and that a slight movement of equipment patchcords can alter input signal polarization, low PDL means that the polarization of the input signal has a minimal effect on the attenuation setting.

The IQ-3100BM features a monitor output port for accurate power level monitoring.

The IQ-3100BW offers high spectral uniformity in the WDM range from 1520 nm to 1570 nm. It is perfectly suited for WDM applications providing the same attenuation level to all WDM channels simultaneously. This allows complete characterization of amplifiers or subsystems.

Note: *Both IQ-3100 and IQ-3300 modules are designed for laboratory and industry applications using the IQ-200 Optical Test System.*

Definition of Attenuation

The attenuation displayed by the IQ-3100 is the actual loss between the input and output ports including the attenuator's internal connectors.

The attenuation value is a negative number. The *B* value in the X+B mode is a correction factor applied to a specific wavelength. The offset value may be positive or negative and is systematically added to the displayed attenuation value. The offset value takes different factors into account such as a component's insertion loss. In the latter case, it is negative, thus increasing the displayed attenuation value.

At EXFO, an IQ-3100 attenuation would be measured as follows:

- Use two fiber-optic test jumpers and a bulkhead connector to connect an IQ-1100 Power Meter to an IQ-2100 Light Source.
- Reference the power meter.
- Replace the bulkhead connector with the IQ-3100. The attenuation displayed by the power meter is equal (within the limits of the absolute accuracy) to the attenuation setting of the IQ-3100.

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Variable Attenuator Typical Applications

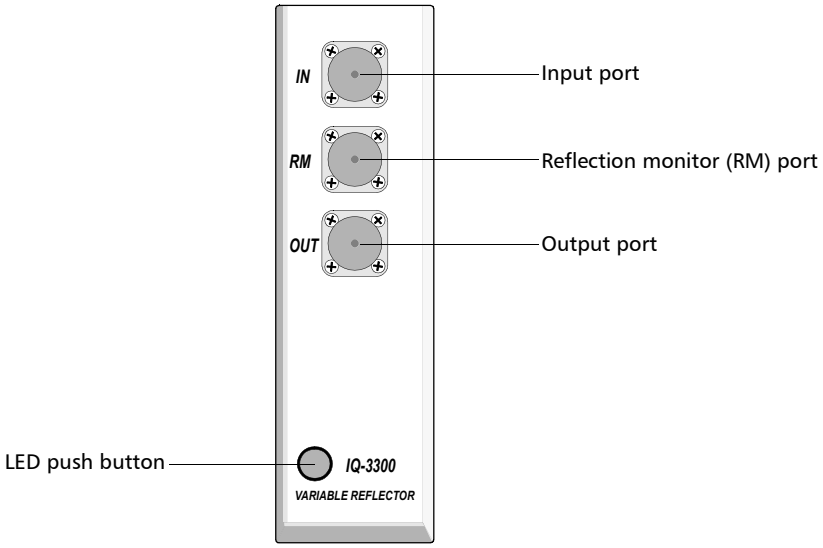
Applications for the IQ-3100 Variable Attenuator include the following:

- Accurate variable output power levels over a large dynamic range when used with an optical source (e.g., IQ-2100)
- Power meter calibration and linearity verification
- Fiber-optic system or component testing and acceptance such as erbium-doped fiber amplifier (EDFA) characterization
- Simulation of fiber-optic system loss
- Optical margin analysis
- Spectral tuning

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IQ-3300 Variable Reflector

The IQ-3300 Variable Reflector is ideal for source power and spectral stability measurements, system noise performance tests, and applications characterizing bit error against return loss.



Note: *Actual ports may differ from those depicted in the illustration.*

Definition of Reflection

The reflection displayed by the IQ-3300 is the actual reflection sent back to the light source connected at the input port.

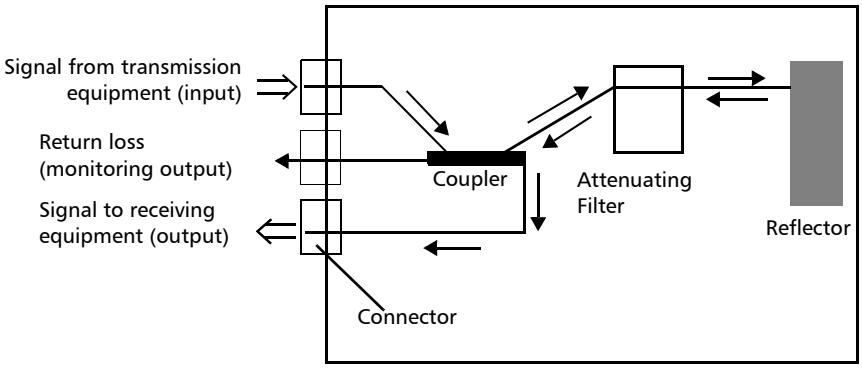
- With a monitor port, it is possible to infer the reflection because the internal coupler distributes 50% of the reflection signal towards the input port and another 50% towards the monitor port.
- With an output port, it is possible to evaluate the influence of the reflection on the light source.

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Measurement Principles

EXFO's IQ-3300 consists of a variable attenuator and a precision mirror coupled to an input port, an output port, and a monitor port. Light from the transmitter or source under test is connected to the input port then split through a coupler. One beam goes to the output port, the other goes through the internal variable attenuator to the precision mirror and is reflected back through the attenuator to the input port. Part of the reflected light is also coupled to the monitor port where an optical power meter can be used to individually measure the intensity of the reflection.

The output port provides optical continuity (with less than 5 dB loss); a network receiver, a BER tester or power meter is normally connected to this port. The standard IQ-3300 is supplied with a 50% coupler offering a -15 dB to -55 dB dynamic range. On request, a different ratio coupler can be used to increase the range up to -14 dB simulating a maximum air-glass optical interface reflection.



The IQ-3300 Variable Reflector is designed around a variable attenuator/mirror assembly coupled to an input port, output port, and monitoring port. Optical energy entering the input port is coupled to the attenuator/mirror assembly and to the output port. There is less than 5 dB loss between the input and output ports.

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Optical energy passes through the attenuator, is reflected by the mirror, returns through the attenuator, and is coupled back to the input port and reflection monitor port. The intensity of the reflected optical energy is determined by the attenuation introduced by the internal variable attenuator.

The Variable Reflector is calibrated to provide between -15 dB and -55 dB reflection.

Variable Reflector Typical Applications

The IQ-3300 Variable Reflector module is used to generate a calibrated optical reflection back into the fiber connected to the input port. This module will help to determine a system's or component's sensitivity to reflected power.

Applications for the IQ-3300 Variable Reflector include the following:

- bit error rate vs. return loss characterization
- source power and spectral stability measurements
- system noise performance tests
- distortion tests and return loss meter certification

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IQ-3100/IQ-3300 Software and Display Modes

The IQ-3100 and IQ-3300 software module operates in three display modes: absolute, relative, and reference.

Remote Control for Both Modules

The IQ-3100 and IQ-3300 support local and remote control. Local control is via the Windows-compatible software preinstalled on the IQ-203 Control Unit, or installed on a host PC using the IQ-206 PC Expansion Card, and using one of the following links:

- a GPIB interface or an RS-232 external interface
- Windows OLE/OCX (object linking and embedding) automation
- a Windows DDE (dynamic data exchange) communication channel

Note: *Please refer to the* IQ-200 GPIB and IQ Applications *development guide for detailed information about remote control of IQ components.*

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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 which, 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 which, 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 which you should not overlook.

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3 Getting Started with Your Variable Attenuator or Reflector

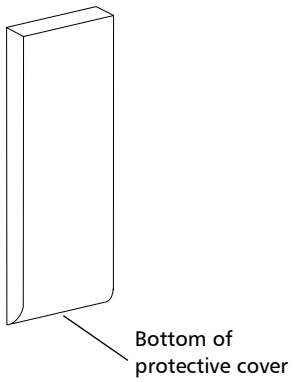
Inserting and Removing Modules

CAUTION

Never insert or remove a module while the IQ-203 Mainframe or IQ-206 PC Expansion Card is powered on. This will result in immediate and irreparable damage to the module and the IQ-203 or IQ-206.

To insert an IQ module in the IQ-200 Optical Test System,

1. Exit the IQ-200 software and power off the IQ-203 and IQ-206. If you are controlling modules from a PC, you do not need to turn the PC off.
2. Remove the protective cover of any unused module slot, by pulling the bottom of the cover and removing it completely.



3. Insert the IQ module into the empty slot. The IQ-203 or IQ-206 will automatically recognize which slot you selected.

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IMPORTANT

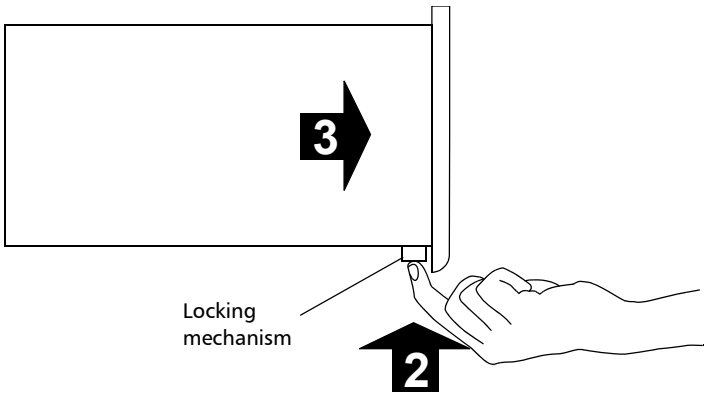
Be sure to insert the module all the way to the back of the IQ-203 or IQ-206 so that the backplane connectors are properly mated. The module is correctly inserted when its front panel is flush with the IQ-203 or IQ-206 front panel.

Depending on the locking system design, there are two ways to remove an IQ module from the IQ-203 Mainframe or IQ-206 PC Expansion Unit.

1. Exit the IQ-200 software and power off the IQ-203 and IQ-206. If you are controlling modules from a PC, you do not need to turn the PC off.
2. Place your fingers under the module's front panel.

   OR

   Push up the locking mechanism under the module's front panel, as shown below.



3. Firmly pull the module outward.
4. Put one of the supplied protective covers over the empty slot to prevent dust from entering the module's housing.

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LED Push Button

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

- When the system is powered ON, the LED will illuminate.
- Pressing the LED push button activates the main window.
- Pressing the LED push button when the main window is open activates the smaller monitor window.

Note: *The monitor window is a compact window displaying basic data (see on page 22).*

Setting Up Optical Connections

IMPORTANT

Always clean fiber end prior to insertion into the port.

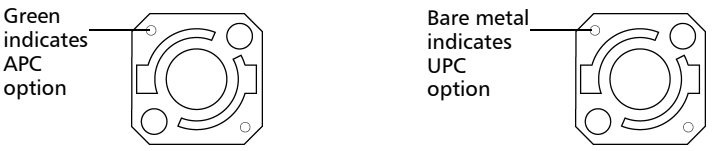
1. Gently wipe the fiber-optic cable end with a lint-free swab dipped in isopropyl alcohol.
2. Dry using clean compressed air.
3. Align the connector and port to avoid the fiber end touching the outside of the port or rubbing against other surfaces.
4. Do not overtighten.

Note: *The IQ-3300 uses APC (angled physical contact) connectors.*

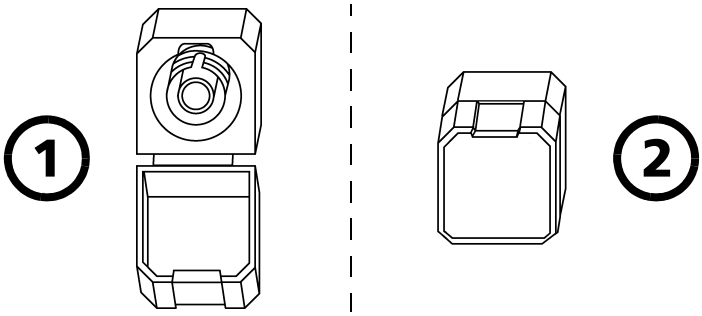
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Using the EXFO Universal Interface (EUI)

The EUI fixed baseplate is available for connectors with angled (APC) or non-angled (UPC) polishing. A green dot in the top left corner of the baseplate indicates that it is for APC type connectors.

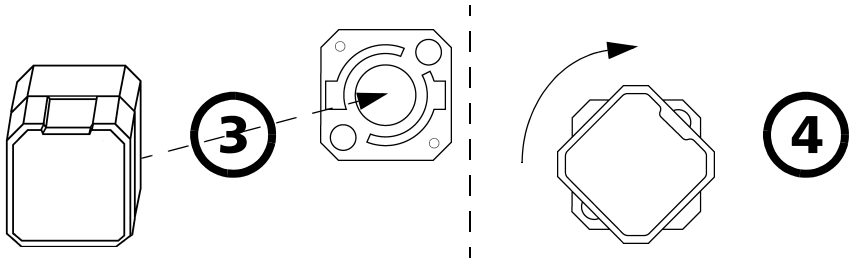


1. Hold the EUI connector adapter so the dust cap opens downwards as depicted below.
2. Close the dust cap in order to hold the connector adapter more firmly.



3. Insert the connector adapter into the baseplate.
4. Turn the connector adapter clockwise to lock it in place.

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Note: *For details on cleaning these connectors, see* Cleaning Connectors Equipped with EUI/EUA Adapters *on page 86*.

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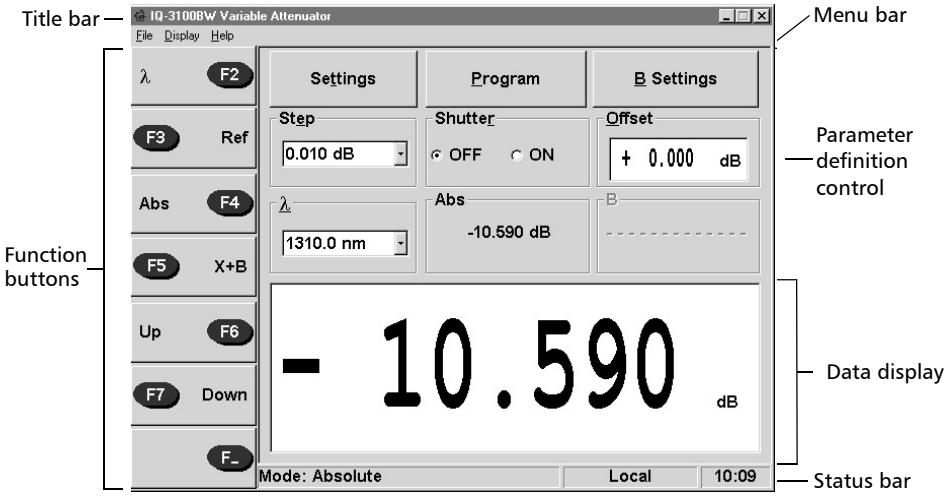
Loading and Using the Software

The many features of the variable attenuator/reflector are controlled using the Windows-compatible IQ software. Please refer to the *IQ-200 Optical Test System* instruction manual for information regarding the IQ-200 Optical Test System.

There are two ways to load the application software:

- Push the LED push button on the module front panel.
- Double-click on the corresponding icon in the IQ-200 Optical Test System main window.

Once the software is loaded, the main window appears. This window contains all necessary commands to control the module.



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Using the Title Bar and Menu Bar

The title bar and the menu bar are at the top of the main window. The title bar indicates the type of module in use. The menu bar contains three pull-down menus that are explained in the following table.

Menu	Option	Function
File	Open config...	Opens to a previously saved configuration.
	Save config...	Saves the current configuration.
	Exit	Closes the application.
Display	Monitor	Opens the monitor window, which displays basic attenuator/reflector data (for detailed information on the monitor window, see on page 22).
Help	Online Manual	Opens the application Help file, which contains this manual.
	About...	Opens a window which provides the following information: ➤ software version ➤ technical assistance telephone numbers, e-mail, and Web-site addresses ➤ available IQ-203 system memory (RAM) ➤ remaining hard drive storage space

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Using Function Buttons

The function buttons, located on the left side of the main window, are used for immediate control of the module. You can either use the buttons on the left of the window or the software buttons on the screen.

Button	Description
	The F2 button ➤ Switches to the next wavelength defined by the contents of the λ list box (see *Setting the Wavelength on page 45)*. ➤ Displays the B settings window defining the value of B. (see *Defining a B Value* on page 38). ➤ Selects by clicking on Settings and selecting the appropriate option in the *F2 Button Behavior* section.
	Switches to *Reference* attenuation/reflection mode (see *Reference Mode* on page 36).
	Switches to *Absolute* attenuation/reflection mode (see *Absolute Mode* on page 35).
	Switches to *X+B* attenuation/reflection mode (see *X+B Mode* on page 37).
	Increases the attenuation/reflection (larger negative number) by the amount indicated in the *Step* list box (see *Setting the Attenuation on the IQ-3100* on page 39).
	Decreases the attenuation/reflection (smaller negative number) by the amount indicated in the *Step* list box (see *Setting the Attenuation on the IQ-3100* on page 39).
	Transfers control between software function buttons and IQ-203 front panel hardware function keys (refer to the *IQ-200 Optical Test System* instruction manual).

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Using Parameter Definition Buttons

Choosing any of the parameter definition buttons opens a window permitting the definition and customization of various modules' operating parameters. The table below describes the function of these buttons.

Button	Description
Settings	Opens the *Settings* window where the contents of the λ and *Step* list boxes may be customized as well as the *F2 Button Behavior* (see *Customizing the Step Size List* on page 29).
Program	Opens the *Program* window where program mode parameters may be defined (see *Defining an Automatic Program Mode* on page 47).
B Settings	Opens the *B* window where a B value for each available wavelength may be defined (see *Defining a B Value on page 46*).

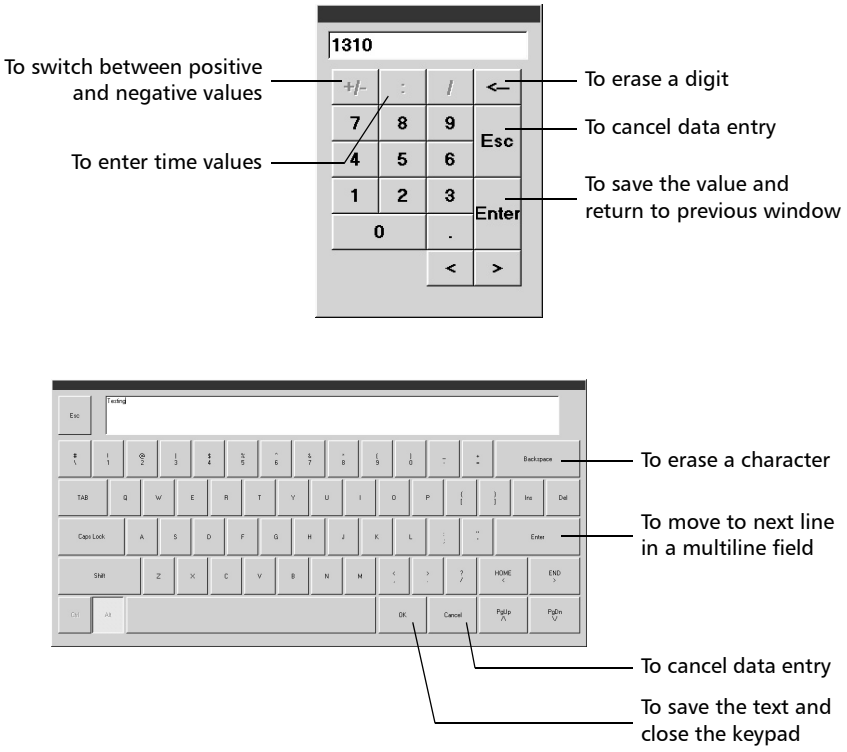
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Typing Values with the Software Keypad

When an external keyboard is not available, you can use the numeric or alphanumeric software keypad to enter data in the IQ-200 software.

To enter values using the software keypad,

1. Double-click in the box or field where a value must be entered to display the appropriate keypad window.



2. By clicking on the buttons, type the text or numbers you want. You may use the special keys shown in the above illustration while typing.

3. Save the value you typed or leave the keypad without saving the value. Keys are described in the above illustrations.

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Understanding the Data Display

Box	Description
Step	Displays the currently selected step size. Open the list box to select a different step size.
λ	Displays the currently selected wavelength. Open the list box to select a different wavelength.
Data Display (IQ-3100 only)	➤ In *Absolute* mode, the displayed data is the sum of the absolute attenuation value (including the insertion loss of the instrument) and the offset value. ➤ *X+B* mode displays the sum of the absolute attenuation value, the offset value and the wavelength dependent correction factor. ➤ The *Reference* mode displays the sum of the absolute attenuation value and the offset value minus the reference value. Edit the displayed value to change the attenuation setting. ***Note:*** The attenuation is a negative number.
Data Display (IQ-3300 only)	In *Absolute* mode, the displayed data is the sum of the absolute reflection value and the offset value. Edit the displayed value to change the reflection setting.
Shutter	Select the *ON* or *OFF* radio button to activate or deactivate the shutter.
Abs	(IQ-3100) Displays the absolute attenuation value, independent of the mode. (IQ-3300) Displays the absolute reflection value, independent of the mode.
B	Displays the B value when in *X+B* mode.
Ref	Displays the reference value (in the same box as the B value) when in *Reference* mode

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Status Bar

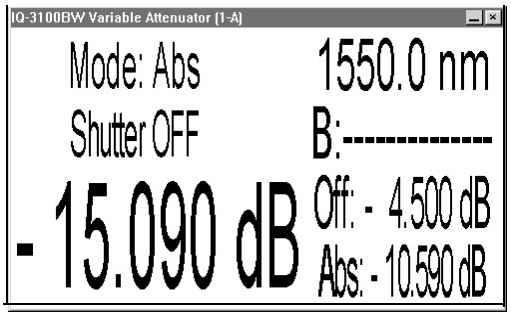
On the status bar, you will find the selected display mode and one of the following terms: Local, Remote, or Lockout. The table below explains these terms. For more information on how to control the different IQ modules remotely, refer to the *IQ-200 GPIB and IQ Applications* development guide. Finally, the status bar also displays the time.

Indication	Meaning
Local	The unit is controlled locally.
Remote	The unit is controlled remotely but local commands can still be used.
Lockout	The unit is exclusively controlled remotely.

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Using the Monitor Window

The monitor window of a module is a small window containing basic operation information for quick reference. The monitor window displays basic variable attenuator/reflector data. Using the monitor window in conjunction with other IQ monitor windows allows you create an integrated data display screen (for further information, refer to the *IQ-200 Optical Test System* instruction manual). The size and position of the monitor window can be adjusted.



Opening the Monitor Window

There are three ways to open the monitor window:

- In the main window, click on *Monitor* in the *Display* menu.
- In the main window, click on _ (in the upper right corner).
- Press the LED button (on the front panel of the module).

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Exiting the Software

From the monitor window,

1. Click on  (in the upper right corner of the monitor window).

   OR

2. Push the LED push button (on the front panel of the module).

From the main window,

1. Click on  (in the upper right corner of the main window).

   OR

2. Click on *Exit* in the *File* menu.

   OR

3. Click on the module icon (in the top left corner of the main window) and click on *Close*.

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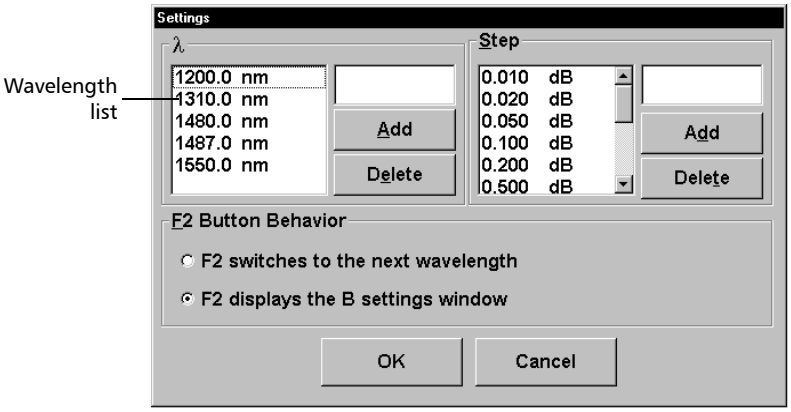
4 Setting up Your IQ-3100 and/or IQ-3300

IMPORTANT

For ALL versions of the IQ-3100 and the IQ-3300 modules, the operational use of the software is exactly the same. The only aspect that varies is the limit of the parameters to be entered.

Customizing the Wavelength List

The contents of the λ and *Step* list boxes can be customized from the *Settings* window shown below. The values contained in these boxes determine which settings are directly available during operation.

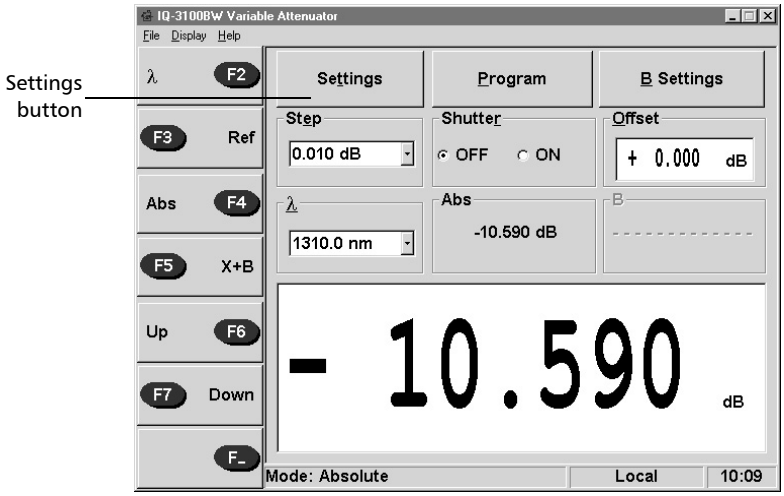


- The λ list box contains the available wavelengths.
- The *Step* list box contains the available attenuation or reflection step sizes.
- The step size determines how much the attenuation will change when clicking on the *Up* or *Down* function button.
- The *F2 Button Behavior* section allows you to select which of the two functions you will use. For more details, see *Using Function Buttons* on page 18.

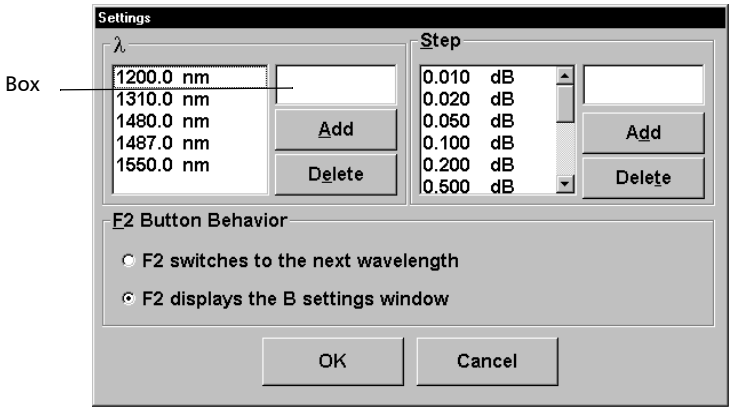
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Adding a Value to the λ List Box

1. If the *Settings* window is not open, click on *Settings*.



2. Double-click on the box above the *Add* button, or use an external keyboard.



3. Enter the wavelength value to be added.

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Note: *For a singlemode attenuator/reflector, wavelengths between 1200 nm and 1650 nm (at 0.1 nm resolution) may be entered.*

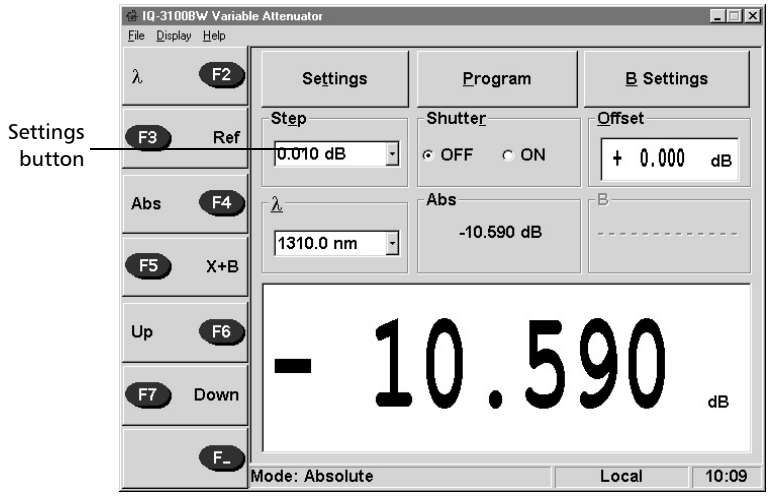
4. Click on *Add* to confirm the new wavelength.

Note: *When using the optional keyboard, pressing* Enter *has the same effect as clicking on* Add.

5. Once all values have been added, click on *OK* to close the *Settings* window.

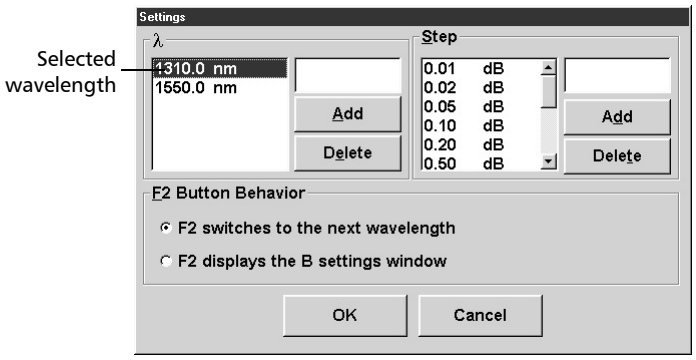
Deleting a Value from the λ List Box

1. If the *Settings* window is not open, click on *Settings*.



2. Highlight the wavelength to be deleted by dragging the cursor on the value.

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3. Click on *Delete* to confirm the deletion.

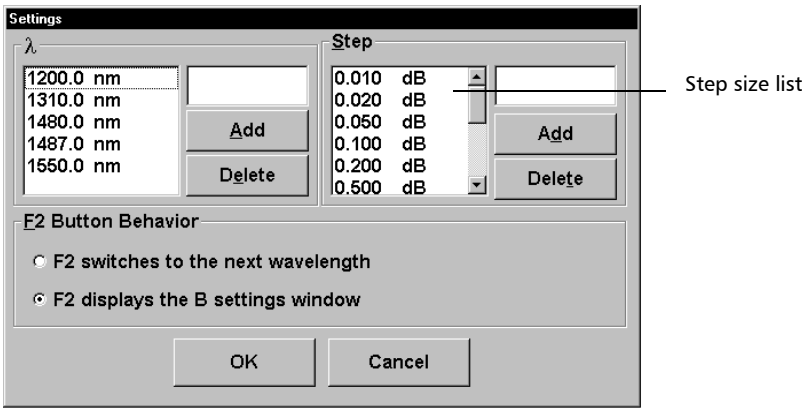
4. Click on *OK* to close the *Settings* window.

Note: *To close* Settings *without recording the current changes, click on* Cancel.

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Customizing the Step Size List

The contents of the λ and *Step* list boxes can be customized from the *Settings* window (shown below). The values contained in these boxes determine which settings are directly available during operation.

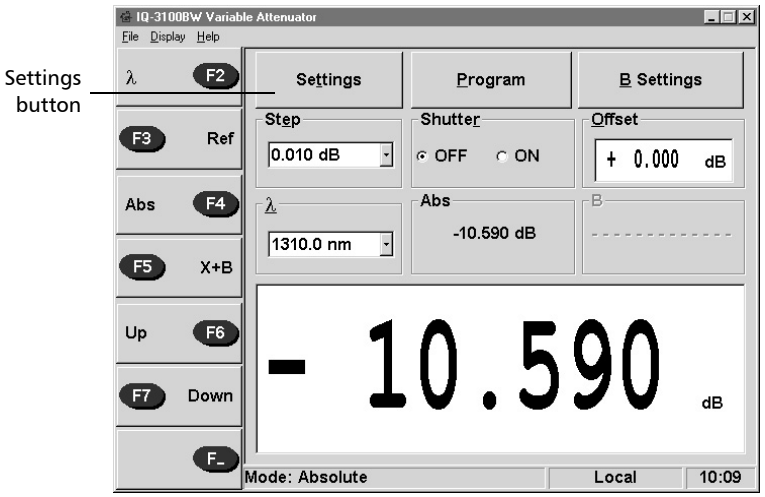


- The λ list box contains the available wavelengths.
- The step list box contains the available attenuation or reflection step sizes.
- The step size determines how much the attenuation will change when clicking on the *Up* or *Down* function buttons.
- The *F2 Button Behavior* section allows you to select which of the two functions you will use. For more details, see *Using Function Buttons* on page 18.

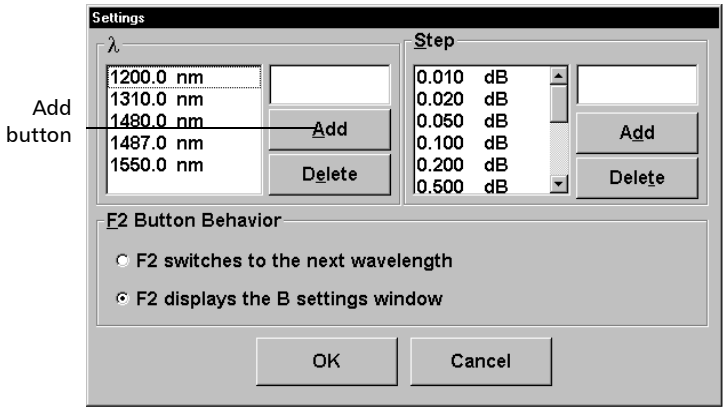
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Adding a Value to the *Step* List Box

1. If the *Settings* window is not open, click on *Settings*.



2. Double-click on the edit box above the *Add* button, or use an external keyboard.



3. Enter the step size to be added.

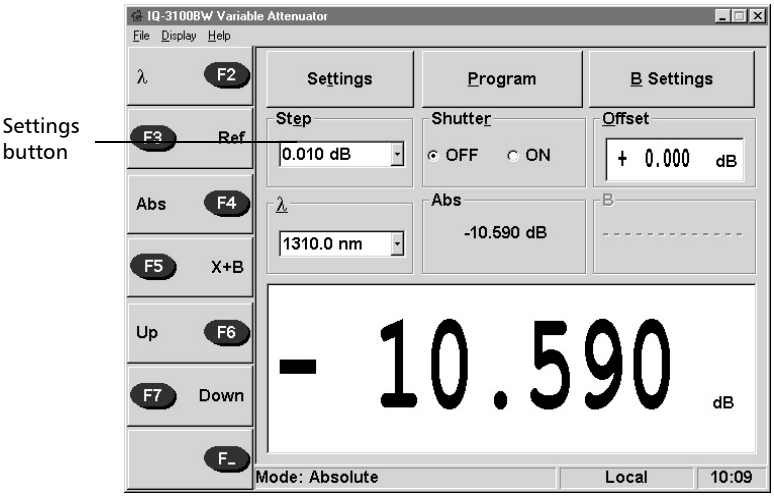
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Note: *Step sizes of 0.005 dB (0.01 dB for multimode units) and 100.000 dB can be entered. Although 100.000 dB can be entered as a step size on several models, the maximum attenuation step size that can be introduced is limited by minimum insertion loss and maximum attenuation. Since both these values are a function of wavelength, the maximum usable step size is also a function of wavelength.*

4. Confirm the new step size value by clicking on *Add*.
5. When all values have been added, close the *Settings* window by clicking on *OK*.

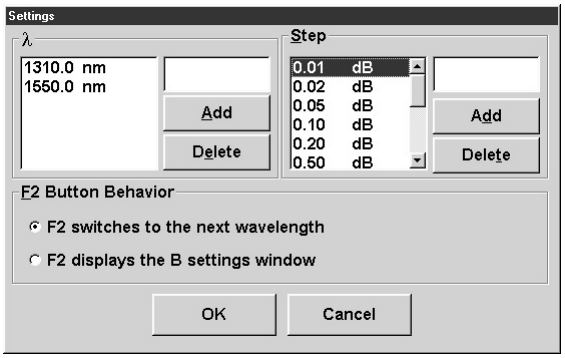
Deleting a Value from the *Step* List Box

1. If the *Settings* window is not open, click on *Settings*.



2. Highlight the step size to be deleted by dragging the cursor on the value.

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3. Confirm the deletion by clicking on *Delete*.

4. Close the *Settings* window by clicking on *OK*.

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IQ-3100/IQ-3300 Display Modes

As a key player in the IQ-200 Optical Test System, the IQ-3100 offers you reliable and repeatable performance attenuation up to 100 dB due to its flexible programmability.

Unlike other attenuators, the IQ-3100 Variable Attenuator has the versatility of the following three display modes:

- The *Absolute* mode displays the sum of the absolute attenuation value and the offset value. In absolute mode, the attenuation displayed includes the insertion loss of the instrument.
- The *X+B mode* displays the sum of the absolute attenuation value, the offset value and the wavelength-dependent correction factor B.
- The *Reference* mode displays the sum of the absolute attenuation value and the offset value minus the reference value.

Note: *The* Independent Program *mode, which is not a display mode, lets you create custom programs such as an automatic attenuation scan.*

The IQ-3300 module also offers three display modes:

- *Absolute* mode displays the sum of the absolute reflection value and the offset value.
- *X+B* mode displays the sum of the absolute reflection value, the offset value and the (wavelength-dependent) correction factor.
- *Reference* mode displays the sum of the absolute reflection value and the offset value minus the reference value.

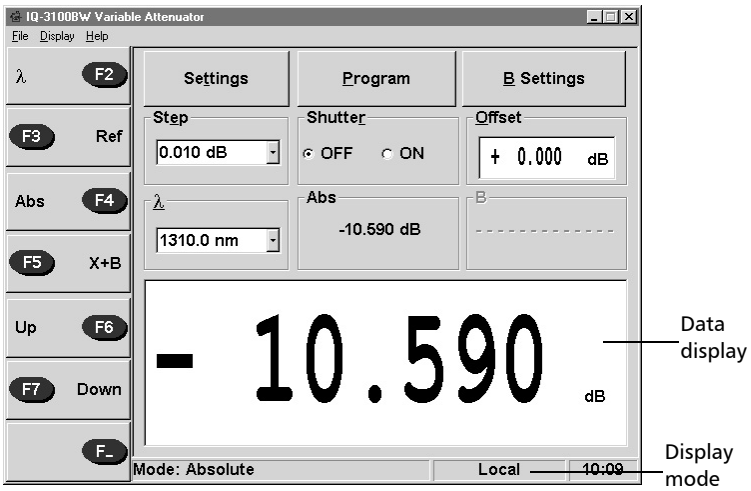
Note: *The* Independent Automatic Program *mode which is not a display mode, lets you create custom programs such as an automatic reflection scan.*

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Selecting a Display Mode

The active display mode determines the significance of the value displayed in the *Attenuation* or *Reflection* data display. This data display indicates,

- Absolute attenuation/reflection in *Absolute* mode.
- Relative attenuation/reflection in *Reference* mode.
- X+B attenuation/reflection in *X+B* mode.



Note: *The active display mode is always indicated in the status bar at the bottom of the main window (unless the shutter is on).*

The three display modes each have their advantages and are explained in the following sections.

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Absolute Mode

By default, *Absolute* mode is selected upon initial activation.

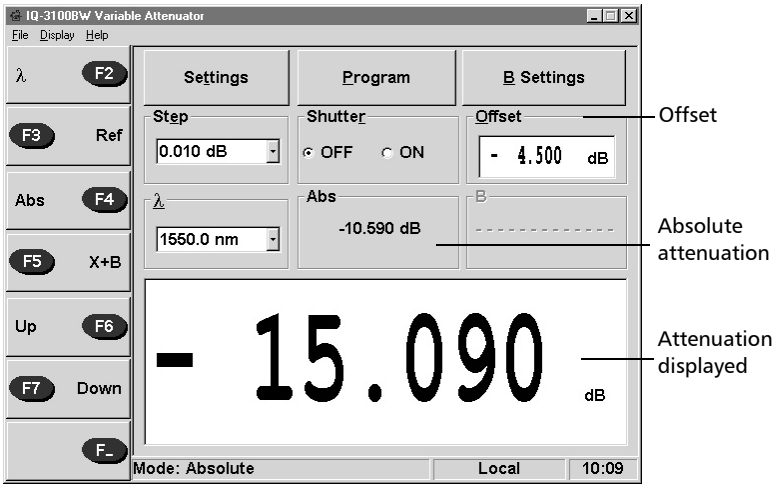
When in *Absolute* mode, the total attenuation or reflection introduced by the module is displayed in the data display. The absolute value and the offset value are also taken into account.

IMPORTANT

For the IQ-3100, the total or absolute attenuation referred to in this manual is the actual optical insertion loss between the input and output ports, including the connectors.

In the figure below, the IQ-3100 BW Variable Attenuator is set in the *Absolute* mode.

Attenuation displayed = absolute attenuation + offset



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Reference Mode

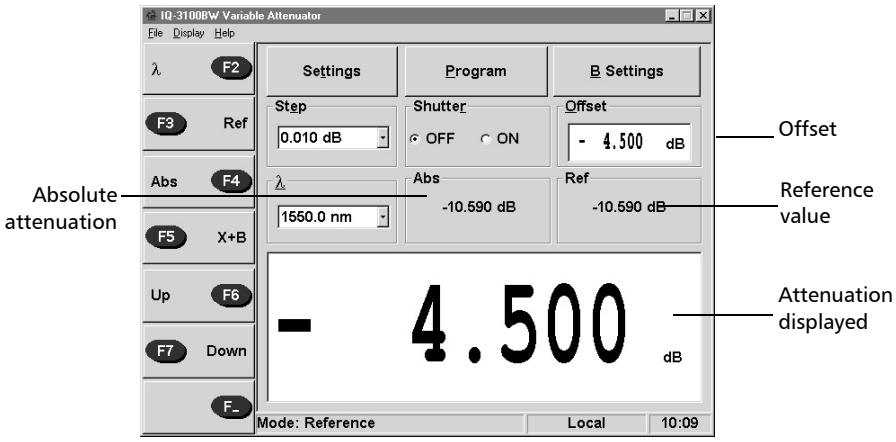
When in *Reference* mode, the value displayed in the data display is the attenuation, relative to a defined reference value. Any value within the attenuation range of the IQ-3100 may be selected as the reference.

To use *Reference* mode,

1. Ensure that the display is first in *Absolute* mode (click on *Abs*).
2. Select the appropriate wavelength by opening the λ list box.
3. Select the appropriate attenuation/reflection to the desired reference value.
4. Click on *Ref.* The instrument takes the actual attenuation/reflection as the reference and the display switches to *Reference* mode.

In the figure below, the IQ-3100 Variable Attenuator is set in *Reference* mode.

Attenuation displayed = Absolute attenuation - reference value + offset



Note: *Clicking on* Ref, *with the* Reference *mode already active, will reset the reference value to the current absolute attenuation/reflection setting. You can always track the absolute value in the* Abs *gray box.*

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X+B Mode

As the name implies, an X+B reflection is the sum of two components, X and B. To understand and effectively use *X+B* mode, it is important to keep in mind that

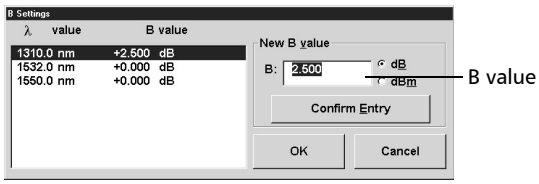
- X is the actual physical attenuation/reflection introduced by the unit
- B is the correction factor.

X+B mode allows you to display attenuation/reflection readings as any value between -99.999 dB and 99.999 dB (or a power value in dBm).

Before enabling *X+B* mode, it is necessary to define the appropriate B value for the operating wavelength. A different B value can be assigned to each wavelength in the λ list box. The B value may be used to compensate for losses along the connecting fibers or for losses displaying the reflection as a power value.

To use *X+B* mode,

1. Ensure that the display is first in *Absolute* mode (click on *Abs*).
2. Select the appropriate wavelength by clicking on *F2* or opening the wavelength list.
3. Click on *B settings* to open the window and make sure that the B value is correct. To see how to define a B value, see *Defining a B Value on page 46*.



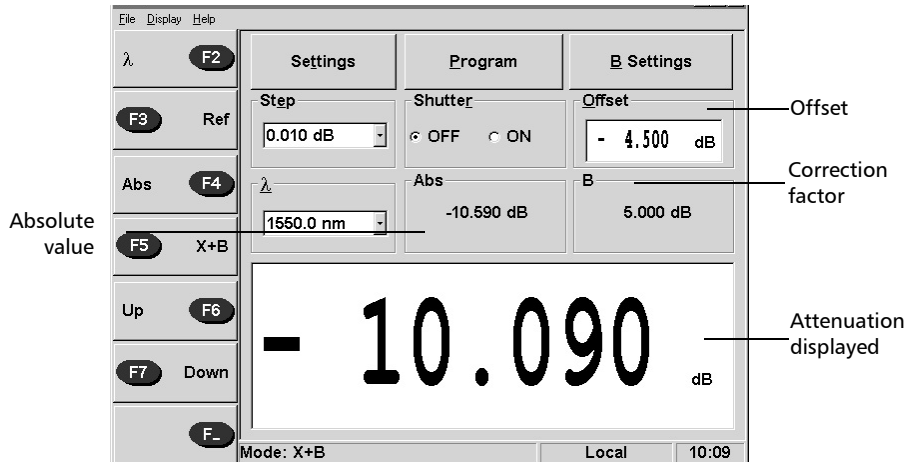
4. Click on the *X+B (F5)* function button . The display will switch to *X+B* mode.

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Note: *The B value can still be modified while* X+B *mode is active. Taking a reference while in* X+B *mode brings you back to Reference Mode. In* Reference *mode, the B correction factor is not taken into account.*

In the figure below, the IQ-3100 Variable Attenuator is set in *X+B* mode.

Attenuation displayed = absolute attenuation + wavelenght correction factor + offset.



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Setting the Attenuation on the IQ-3100

Optical attenuation, between minimum insertion loss and 100.000 dB (function of wavelength) at 0.005 dB resolution (0.01 dB for multimode modules), can be introduced by the IQ-3100. Although EXFO guarantees that the minimum insertion loss is below a specified value (refer to specification sheet), it may vary slightly from one wavelength to another and from one IQ-3100 to another.

To determine the minimum/maximum attenuation at a particular wavelength,

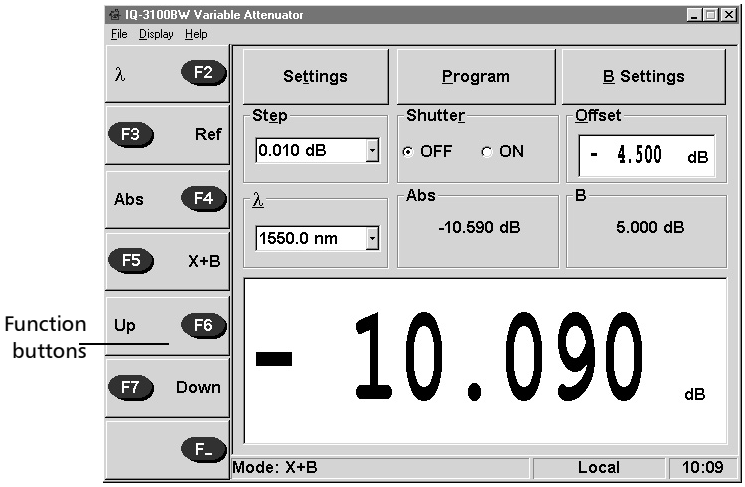
1. Select the appropriate wavelength, by choosing or opening the wavelength list box.
2. Switch to *Absolute* mode by clicking on *Abs (F4)*.
3. Double-click on the display data to edit it to 0.000 dB. It automatically enters the minimum attenuation value. If you enter -100 dB, the instrument edits the maximum value for the selected wavelength.

Note: *Minimum insertion loss and maximum attenuation/reflection settings are wavelength dependent.*

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Using Function Buttons

Changing the setting through the use of *Up* or *Down* buttons permits incremental changes in attenuation.



Editing the Attenuation/Reflection Value

Directly editing the value displayed in the attenuation/reflection box is an efficient way of setting the attenuation/reflection to any specific value. Regardless of step size, the attenuator/reflector will reposition according to the new value.

1. Double-click on the data display.
2. Enter the new attenuation/reflection value.

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Setting the Reflection on the IQ-3300

Calibrated optical reflection between -15.00 db and -55.00 dB at 0.01 dB resolution can be introduced by the IQ-3300. The IQ-3300 will allow the user to set values outside this range; however, the accuracy of these values cannot be guaranteed.

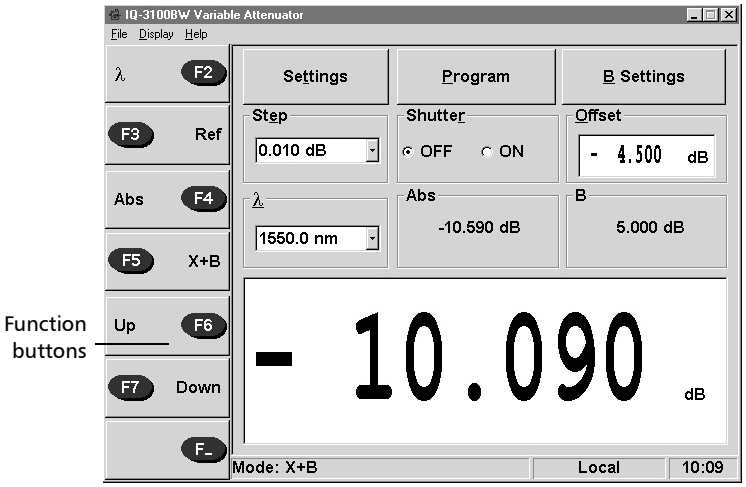
1. Select the appropriate wavelength, by choosing or opening the wavelength list box.
2. Switch to *Absolute* mode by clicking on *Abs* (*F4*).
3. Double-click on the display data to edit it to 0.000 dB. It automatically enters the minimum attenuation value. If you enter -100 dB, the instrument edits the maximum value for the selected wavelength.

Note: *Minimum insertion loss and maximum attenuation/reflection settings are wavelength dependent.*

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Using Function Buttons

Changing the setting through the use of *Up* or *Down* buttons permits incremental changes in reflection.



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Editing the Attenuation/Reflection Value

Directly editing the value displayed in the attenuation/reflection box is an efficient way of setting the attenuation/reflection to any specific value. Regardless of step size, the attenuator/reflector will reposition according to the new value.

1. Double-click on the data display.
2. Enter the new attenuation/reflection value.

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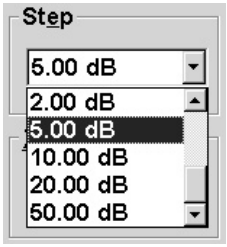
Selecting the Step Size

The operating software offers a wide selection of programmed step sizes that will be used for a manual or programmed scan. The default step sizes can be edited and new values can be added at any time. For information on how to customize the contents of the *Step* list box, see *Customizing the Wavelength List* on page 25.

Note: *When the variable attenuator/reflector is first activated, the minimum step size is selected.*

To select a step size,

1. In the main window, open the *Step* list box.



2. Click on the desired value.

Note: *Selecting a larger step size allows for faster attenuation/reflection scanning.*

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Setting the Wavelength

For accurate optical attenuation/reflection, it is essential that the attenuator/reflector wavelength be set as closely as possible to the wavelength of the optical source. The IQ-3100 module provides calibrated optical attenuation at 0.1 nm resolution over a wide range; 1200 nm to 1650 nm for singlemode modules and 700 nm to 1350 nm for multimode modules. The IQ-3300 provides calibrated optical reflection at 0.1 nm resolution over a wide range; 1200 nm to 1650 nm for singlemode modules.

To set the operating wavelength,

➤ Use the *F2* button

OR

➤ Select a wavelength from the λ list box.

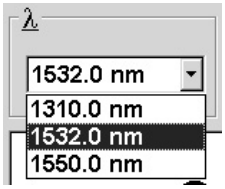
In both cases, the values contained in the λ list box determine which wavelengths may be selected. To find out how to add or delete values, see *Customizing the Wavelength List* on page 25.

Note: *When switching to a new wavelength, the attenuator/reflector will reposition in order to keep the same attenuation/reflection setting for the new wavelength.*

To change the wavelength from the list box,

1. From the main window, open the λ list box (shown below).

2. Click on the desired value.



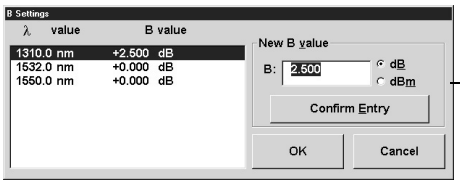
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Defining a B Value

The B value is a correction factor. It can be used to correct a systematic calibration deviance for any wavelength in the wavelength list.
For additional information on the B value, please refer to *X+B Mode* on page 37.

To define a B value for a specific wavelength,

1. Click on the *B settings* button in the main window. This opens the *B Settings* window shown below.



2. Highlight the appropriate λ *value*/*B value* line.
3. Double-click on the *New B value* edit box.
4. Enter the numeric B value.

Note: *B values between -99.999 dB and 99.999 dB may be entered.*

5. Select the *dB* or *dBm* radio button. This determines whether the B and X+B values are displayed in dB or dBm.
   - ➤ Select *dB* when X+B represents a system loss.
   - ➤ Select *dBm* when X+B represents a power level.
6. Click on *Confirm Entry*.
7. Click on *OK* to close the *B Settings* window.

Note: *To close the* B Settings *window without recording the current changes, click on* Cancel.

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Defining an Automatic Program Mode

The IQ-3100 and IQ-3300 can be programmed for automatic operation. The attenuation/reflection and time interval can be defined for each program step.

The programs are defined using the *Program Settings* window. In the *Program Settings* window, the attenuation/reflection setting and step-duration parameters are defined for each program step. Programs are defined using absolute attenuation/reflection values.

Preparing a Program

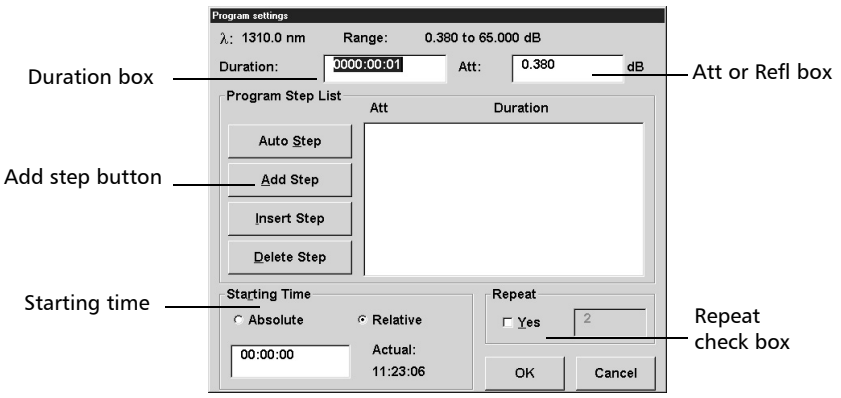
The procedure is the same whether you are defining an attenuation program (IQ-3100) or a reflection program (IQ-3300).

1. From the main window, click on *Program*. The *Program control* window opens.



2. Click on *New*. The *Program settings* window opens.

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3. Double-click on the *Duration* edit box. Enter the duration for the first step (xx hours, xx minutes, xx seconds).
4. Double-click on the *Att:* (IQ-3100) or *Refl:* (IQ-3300) edit box. Enter the desired value.
5. Click on *Add Step*. The program step will be added to the *Program step list* box.
6. Repeat steps 3, 4, and 5 for every step you want to add to the program.
7. Check the appropriate *Starting Time* radio button.
   - ➤ Select *Absolute* when the program is to start running at a specified time (24-hour format, e.g. 18:06:00).
   - ➤ Select *Relative* when the program is to start running after a specified time interval (e.g. 00:10:00, the program will start running 10 minutes after clicking on *Start*).
8. Double-click on the *Starting time* edit box and enter a value. The format for the time value is HH:MM:SS.
9. If you want the program to loop, click on the *Repeat* check box. When repeat is selected, the value displayed in the adjacent edit box determines the number of program loops. Edit the number of loops as needed. Entering “0” makes the program loop continuously.

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10. Click on *OK* to confirm program parameters and close the *Program settings* window.

Note: *To close the* Program settings *window without recording the current changes, click on* Cancel.

11. If you want to save a Program setting, click on Save in the Program control window, select the path where you want the file to be saved, and enter a file name.

Note: *IQ-3100/3300 allow you to create automatic programs such as an automatic attenuation scan of up to 100 steps with a dwell time up to 1000 hours per step by clicking on* Auto Step *button.*

The IQ-3100 and IQ-3300 program principle is illustrated by two sample programs in the table below. The sample programs contain three steps.

Step	Duration	Attenuation (IQ-3100)	Reflection (IQ-3300)
1	10 seconds	2.500 dB	20.000 dB
2	1 minute	5.000 dB	30.000 dB
3	1 hour	4.000 dB	40.000 dB

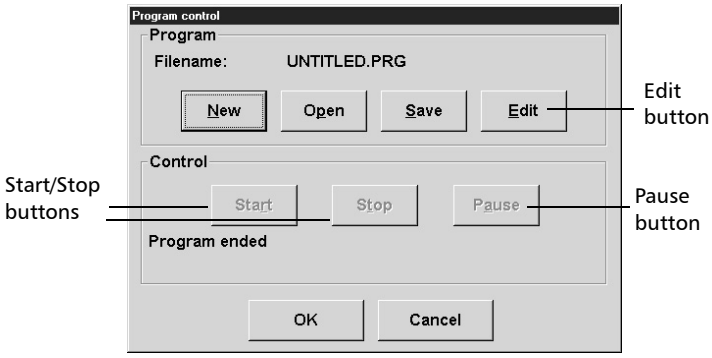
Referring to the sample programs shown above, in the case of the IQ-3100, the incoming signal is first attenuated by 2.500 dB for 10 seconds, then by 5.000 dB for 1 minute, and finally by 4.000.dB for 1 hour.

In the case of the IQ-3300, 20.000 dB is first reflected off the original signal for 10 seconds, then 30.000 dB off the original signal for 1 minute, and finally 40.000 dB off the original signal for 1 hour.

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Running a Program

1. Select the appropriate wavelength.
2. In the main window, click on *Program* to open the *Program control* window as shown below.



3. If you need to edit the program or check the program parameters, click on *Edit* from the *Program control* window (see procedure described below).
4. To start program execution, click on *Start* from the *Program control* window.

You can display the Program status at the bottom of the main window.

You can pause Program execution at any time by clicking on *Pause* from the *Program control* window. To resume execution click on *Continue*.

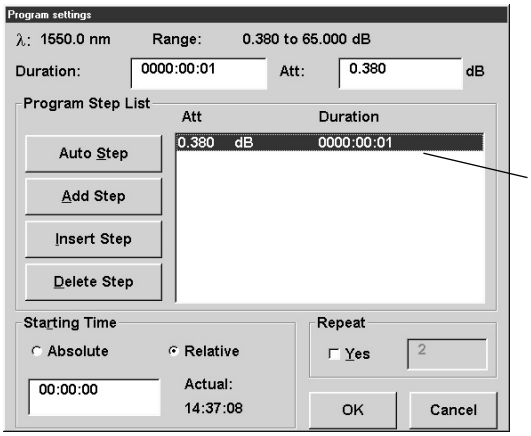
You can terminate Program execution at any time by clicking on *Stop* in the *Program control* window.

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Modifying a Program

You cannot modify program steps directly. You must first delete the erroneous step and insert a new one in its place. You insert and delete program steps in the *Program settings* window.

1. To access the *Program settings* window, click on *Program* in the main window, then in the *Program control* window click on *Edit*.



2. To delete a program step, highlight it in the *Program settings* windows displayed and click on *Delete Step*. To confirm the deletion and to close the *Program settings*, click on *OK*.
3. To insert a program step, with the *Program settings* window displayed, highlight the step where the new line is to be inserted.
4. Enter the duration and attenuation/reflection values in the appropriate edit boxes, and click on *Insert step.* The new program step will be inserted above the highlighted line.
5. Click on *OK* to confirm the changes and to close the *Program settings* window.

Note: *You may or may not want to save the program, in the* Program Control *window, after completing the changes.*

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Defining an Offset Value

The offset value is a correction factor. It does not affect the filter attenuation. It can be used to compensate for the loss generated elsewhere in the system.

To define an offset value,

1. Double-click on the *Offset edit* box.
2. Enter the offset value.

Note: *Offset values between -99.999dB and 99.999dB may be centered.*

3. Click on *enter*.

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Using the Shutter

The optical shutter (figure below) is an electro-mechanical device which, when activated from the main window, blocks light transmission/reflection generation.

CAUTION

Using the shutter continuously at a rate of one cycle per three seconds may damage the instrument permanently or seriously reduce its life cycle.



- Select the *ON* radio button to block light transmission/internal reflection.
- Select the *OFF* radio button to enable light transmission/internal reflection.

Note: *When the shutter is on, the reflection generated by the IQ-3300 is less than -55 dB.*

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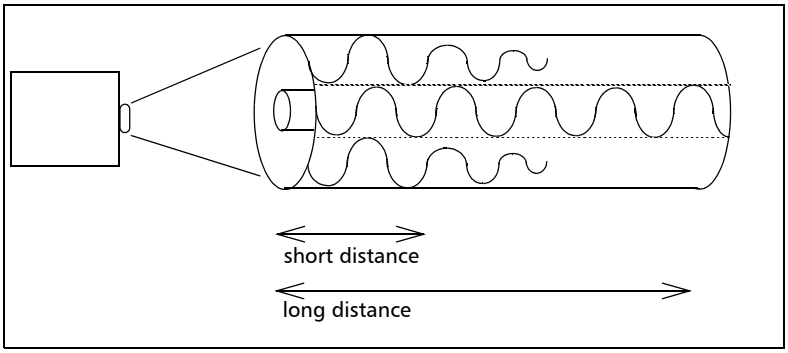
5 IQ-3100/IQ3300 Applications

Before performing the applications suggested below, make sure

- All optical connections are clean and properly mated.
- The IQ-3100 and IQ-3300 have valid calibrations (EXFO recommends yearly calibrations).
- The operating environment is within the specified range for all instruments.

Measuring Multimode Insertion Loss

Often, when using a connectorized multimode source (mostly LED sources), part of the optical energy is transmitted into the fiber cladding. These cladding modes attenuate rapidly, but will affect power meter readings if the source is connected using only a short jumper, as would be the case when taking a reference before measuring insertion loss.



Due to the internal optics of the IQ-3100 (and the majority of attenuators), most of the cladding modes are filtered out. This means, with the attenuator connected, the power meter will display a loss greater than the attenuation setting of the attenuator (cladding modes have been partially stripped).

Cladding modes are not used in communication systems and, therefore, should not have been part of the source power measurement in the first place.

There are several methods of eliminating these cladding modes:

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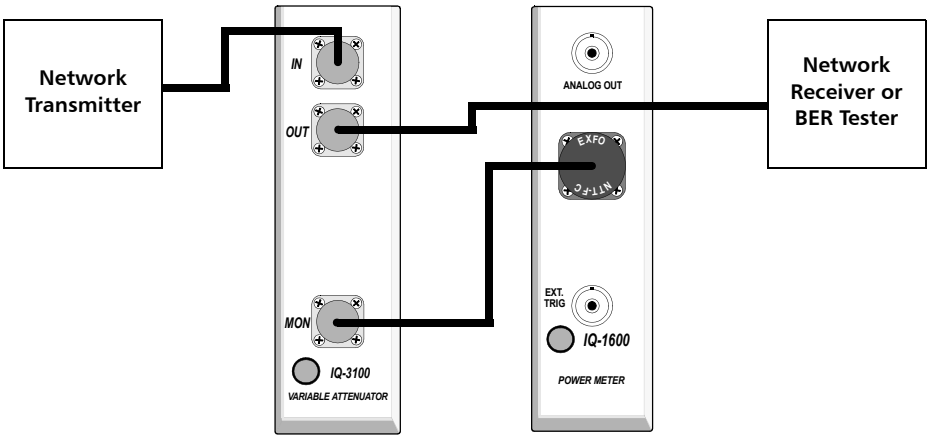
- A cladding mode stripper (preferred method) is a material with a refractive index greater than that of the cladding. With the cladding exposed, the fiber is immersed in the mode stripper (glycerin, oil, or other suitable liquid). Due to the greater refractive index of the stripper, light energy is not reflected at the cladding-stripper interface and passes through the stripper.
- Cladding modes attenuate to insignificant levels over relatively short distances. Therefore, we recommend using a long fiber jumper.
- A mandrel wrap can be introduced by making a minimum of five turns around a 0.5 in. diameter mandrel. This method will introduce slight losses in the multimode core and remove some of the cladding modes. A mandrel wrap is not the preferred method of controlling cladding modes in multimode fibers.

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Performing Accurate Power Level Monitoring

The monitor output of the variable attenuator can be used to determine the impact of the attenuation on a network.

1. Connect the IQ-3100 to the network as shown below.



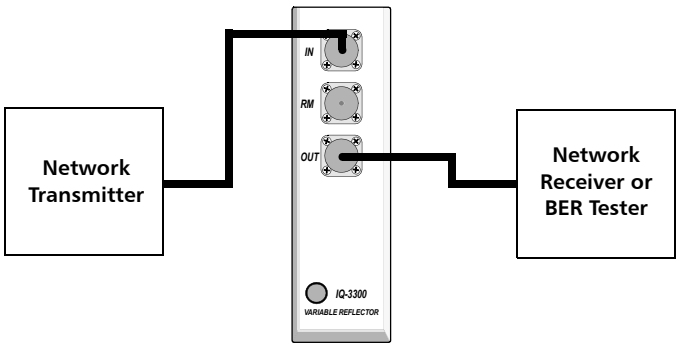
2. Set the attenuator and power meter to the approximate transmitter wavelength as described in *Setting the Wavelength on page 45*.
3. Set the IQ-3100 to minimum insertion loss as described in *Setting the Attenuation on the IQ-3100* on page 39.
4. Reference the power meter to zero by pressing the *Reference (F3)* button on the left of the display and by switching the IQ-3100 to *Reference* mode (click on *Ref*). The power meter and attenuator will both display 0.0 dB.
5. Vary the relative attenuation and the power meter to display the relative power input at the receiver end accurately.

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Testing Network Sensitivity to Optical Reflection

The IQ-3300 Variable Reflector can be used to determine network sensitivity to optical reflection. To perform this test, a bit error rate (BER) tester is also required.

1. Connect the IQ-3300 to the network as shown in the figure below.



2. If desired, a power meter (IQ-1100) may be connected to the monitor port. During the test, this power meter will display the reflected optical power.

3. By varying the reflection and monitoring the error rates, network sensitivity to reflected power is determined.

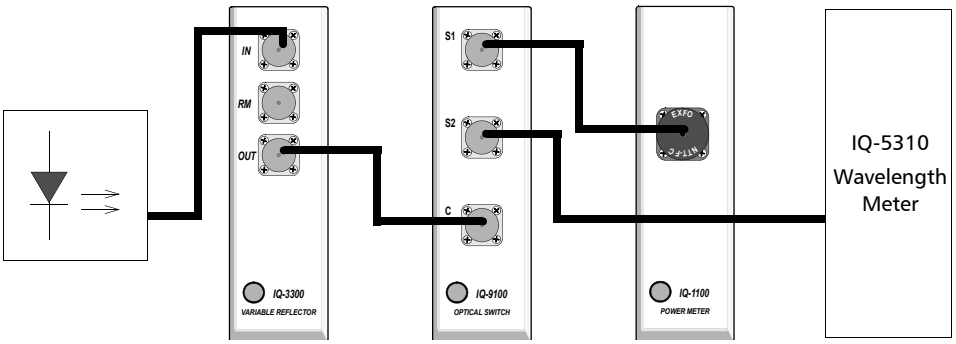
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Evaluating Source Stability

Laser output power, power stability, and spectral stability are affected by reflected optical energy. The IQ-3300 Variable Reflector can be used to evaluate these parameters for any fiber-optic laser source or transmitter.

To verify the extent to which the source is affected by back-reflection,

1. Connect the source under test as shown in the figure below to the input of the IQ-3300 Variable Reflector.
2. Connect the ouput of the IQ-3300 Variable Reflector to the common port of the IQ-9100 switch.
3. Connect the first output of the switch to a powermeter such as the IQ-1100.
4. Connect the second output to the IQ-5310 Wavelength Meter.



5. Vary the IQ-3300 reflection and record the average power and spectral distribution at each reflection step.

This test could be used to determine whether or not the source/transmitter needs to be isolated and whether or not the installed isolator is effective.

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6 IQ-3100 and IQ-3300 Remote Control

GPIB Command Structure

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 a module in the test station.
- READ and DATA are keywords that define the function of the command.
- [ ] indicates that a keyword or parameter is optional.
- <space> indicates 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 one digit after the decimal point.

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Standard Commands

The SCPI Manager recognizes all commands identified as mandatory by IEEE-488.2. These commands, as well as some optional commands, are summarized in table below.

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)

The commands are fully explained on the following pages.

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*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 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

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*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

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*RST

Description This command clears 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. Returns to initial state before command was sent, and not necessarily to previous settings.
2. Forces the device to go into an Operation Complete Command Idle State (OCIS).
3. Forces 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.

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*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

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	*WAI
Description	Not supported
Syntax	*WAI

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IQ-3100/IQ-3300 Specific Commands

The IQ-3100 Variable Attenuator and IQ-3300 Variable Reflector share the same commands. The parameters in the following commands can be either attenuation values (IQ-3100) or reflection values (IQ-3300), depending on the module type.

IMPORTANT

For the purpose of these commands, both attenuation and reflection (return loss) are considered to be positive values.

INPut:ARESolution?	
Description	This query returns the smallest attenuation or reflection step available. Use this command to determine the maximum resolution of the attenuation or reflection setting.
Syntax	INP(0..26):ARES?
Response	An attenuation or reflection value in the “-9.999” format. The units are dB.
Example	INP3:ARES?

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INPut:AATTenuation

Description	This command sets the absolute attenuation or the absolute reflection to a specific value. The valid range of values depends on the type of module, the configuration, and the current wavelength. The resolution of the value is 0.005 dB for singlemode attenuators and 0.01 dB for multimode attenuators and variable reflectors.
Syntax	INP(0..26):AATT<space><value>[<space><units>] The value entered does not include the correction, the offset or the reference value.
Parameters	The <value> parameter can be: a valid attenuation or reflection value followed by the units [DB] OR “MIN”-sets the module to the minimum setting for the current wavelength “MAX”-sets the module to the maximum setting for the current wavelength
Example	INP3:AATT 15.355 DB

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INPut:AATTenuation?

Description	This query returns a value indicating the current absolute attenuation or absolute reflection setting, or the minimum/maximum attenuation or reflection setting.
Syntax	INP(0..26):AATT?[<space><value>] and the value that is received does not include the correction, the offset or the reference value.
Parameters	The <value> parameter is optional and can be: “MIN”-obtains the minimum setting for the current wavelength “MAX”-obtains the maximum setting for the current wavelength
Response	The attenuation or reflection value in the “±999.999” format. The units are in dB.
Example	INP3:AATT? MIN or INP3:AATT?

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INPut:RATTenuation

Description	This command set the relative attenuation or the relative reflection to a specific value. The valid range of values depends on the type of module, the configuration, and the current wavelength. The resolution of the value is 0.005 dB for singlemode attenuators and 0.01 dB for multimode attenuators and variable reflectors.
Syntax	INP(0..26):RATT<space><value> and the value includes the correction, the offset and the reference value.
Parameters	The <value> parameter can be: a valid attenuation or reflection value followed by the units [DB] OR “MIN” obtains the minimum setting for the current wavelength “MAX” obtains the maximum setting for the current wavelength Depending on the mode, the <value> parameter takes different values. In *Absolute* mode, <value> = absolute attenuation and offset value In *Reference* mode, <value> = absolute attenuation - reference value + offset value In *X+B* mode, <value> = absolute attenuation + (wavelength specific) correction factor + offset value
Example	INP3:RATT 15.355 DB

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INPut:RATTenuation?

Description	This query returns a value indicating the current relative attenuation or relative reflection setting.
Syntax	INP(0..26):RATT?[<space><value>]The value received includes the correction, offset and reference values.
Parameters	The <value> parameter is optional and can be: “MIN” obtains the minimum relative setting for the current wavelength. “MAX” obtains the maximum relative setting for the current wavelength.
Response	The attenuation or reflection value in the “±999.999” format.
Example	INP3:RATT? MIN OR INP3:RATT?

INPut:REFerence

Description	This command sets a reference value. When the module is set to *Reference* mode, the displayed attenuation or reflection is relative to this reference value. This command will have no effect when in *Absolute* mode. Before entering this command, you must switch to *Reference* mode by entering OUTP: APM 0
Syntax	INP(0..26):REF<space><value>[<space><DB>] The value entered becomes the reference value. You cannot have both the B value and the reference value at the same time.
Parameters	The <value> parameter can be a valid attenuation or reflection value followed by the (optional) units [DB].
Example	INP3:REF -12.345 DB

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INPut:REFerence?

Description	This query returns the current reference value.
Syntax	INP(0..26):REF?
Response	The current reference in the "±999.999" format. The units are dB.
Example	INP3:REF?

INPut:REFerence:DISPlay

Description	This command sets the reference value to the current absolute attenuation or reflection setting. The displayed attenuation or reflection will be relative to the reference.
Syntax	INP(0..26):REF:DISP
Example	INP3:REF:DISP

INPut:WAVelength

Description	This command selects a specific calibrated wavelength. The wavelength range depends on the type and configuration of the module. See the appropriate module instruction manual for further information.
Syntax	INP(0..26):WAV<space><numeric_value>[<space><NM>]
Parameters	The <numeric_value> parameter is the current wavelength in the format 9999.9[NM]. The units are optional.
Example	INP3:WAV 1310 NM

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INPut:WAVelength?

Description	This query returns a value indicating the currently selected wavelength, the minimum available wavelength, or the maximum available wavelength.
Syntax	INP(0..26):WAV?[<space><min_or_max>]
Parameters	The <min_or_max> parameter is optional and can be “MIN”-requests minimum wavelength “MAX”-requests maximum wavelength
Response	The wavelength in the “9999.9” format. The units are nm.
Example	INP3:WAV? MAX or INP3:WAV?

OFFSET

Description	This command sets an offset value. The offset value will be added to the absolute attenuation or reflection and is applicable for all wavelengths.
Syntax	OFFSET (0..26)<space><value>[<space><DB>]
Parameters	The <value> parameter can be a valid offset followed by the (optional) units [DB].
Example	OFFSET3 - 5.000 DB

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OFFSET?

Description	This query returns the offset value.
Syntax	OFFSET(0..26)?
Response	The current offset is in the "±99.999" format. The units are dB.
Example	OFFSET3?

OUTPut:APMode

Description	This command selects absolute or relative attenuation or reflection display. When "absolute" is selected, the absolute attenuation or reflection introduced by the module is displayed. When "reference" is selected, attenuation or reflection relative to the current reference is displayed. When "X+B" is selected, the attenuation or reflection is modified by the correction factor.
Syntax	OUTP(0..26):APM<space><value>
Parameters	The <value> parameter can be "0" Relative display mode "1" Absolute display mode "2" X+B display mode
Example	OUTP3:APM 1

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OUTPut:APMode?

Description	This query returns values in terms of the selected display mode.
Syntax	OUTP(0..26):APM?
Response	“0”-Relative display mode is selected “1”-Absolute display mode is selected “2” X+B display mode
Example	OUTP3:APM?

OUTPut[:STATus]

Description	This command controls the shutter. With an attenuator, the shutter blocks optical continuity. For a variable reflector, the shutter removes the reflection generating mirror from the circuit and optical continuity is maintained.
Syntax	OUTP(0..26)[:STAT]<space><boolean>
Parameters	The <boolean> parameter can be “0” or “OFF”-closes the shutter optically. “1” or “ON”-opens the shutter optically.
Example	OUTP3:STAT ON

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OUTPut[:STATus]?

Description	This query returns the status of the instrument shutter.
Syntax	OUTP(0..26):[STAT?]
Response	“0” means that the shutter is optically closed. “1” means that the shutter is optically open.
Example	OUTP3:STAT?

PROGram:SELected:EXECute

Description	This command starts execution of the currently loaded attenuation or reflection program.
Syntax	PROG(0..26):SEL:EXEC
Example	PROG3:SEL:EXEC

PROGram:SELected:NAME

Description	This command loads a previously defined attenuation or reflection program into the module's internal memory.
Syntax	PROG(0..26):SEL:NAME<space><string>
Parameters	The <string> parameter is the path and filename of the program to be loaded.
Example	PROG3:SEL:NAME C:\IQ\USERFILE\PROGFVA.PRG

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PROGram:SELected:NAME?

Description	This query returns the name and path of the currently loaded attenuation or reflection program.
Syntax	PROG(0..26):SEL:NAME?
Response	Returns a string identifying the path and name of the program file in the "C:\IQ\USERFILE\PROGFVA.PRG" format.
Example	PROG3:SEL:NAME?

PROGram:SELected:STATus

Description	This command controls the status of the currently loaded program.
Syntax	PROG(0..26):SEL:STAT<space><value>
Parameters	The <value> parameter can be "0" or "RUN"-starts the program "1" or "PAUSe"-pauses the program "2" or "STOP"-stops program execution "3" or "CONTinue"-resumes a paused program
Example	PROG3:SEL:STAT RUN OR PROG3:SEL:STAT 0

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PROGram:SELected:STATus?

Description	This query returns a value indicating the status of the loaded program.
Syntax	PROG(0..26):SEL:STAT?
Response	“STOPPED” means that the program is stopped. “PAUSED” means that the program is paused. “RUNNING” means that the program is in progress.
Example	PROG3:SEL:STAT?

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Command Tree

Command			Parameter/ Response	Description
INP[a]	ARES?		(-9.999)	Obtains max. resolution
INP[b, c]	AATT		<99.999 [DB]|MIN|MAX>	Sets absolute attenuation
INP	AATT?		(±999.999)	Obtains absolute attenuation
INP[b,c]	RATT		<99.999 [DB]|MIN|MAX>	Sets relative attenuation
INP	RATT?		(±999.999)	Obtains relative attenuation
INP[c]	REF		<±999.999> [DB]	Sets reference value
INP	REF?		(±999.999)	Obtains reference value
INP[b]	REF	DISP	—	Sets reference to display
INP[b,c]	WAV		<9999.9> [NM]	Sets wavelength
INP	WAV?		(9999.9)	Obtains wavelength
OFFSET[b]			<±999.999> [DB]	Sets offset value
OFFSET?			(±99.999)	Obtains offset value
OUTP[b]	APM		<0|1|2>	Sets mode, *Absolute*, *Reference* or X+B

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Command			Parameter/ Response	Description
OUTP	APM?		(0|1|2)	Obtains selected display mode
OUTP[b]	[STAT]		<OFF|ON|0|1>	Activates shutter
OUTP	[STAT]?		(0|1)	Gets shutter status
PROG	SEL	EXEC	—	Executes program
PROG[d]	SEL	NAME	<string>	Loads program
PROG	SEL	NAME?	(string)	Obtains program name and path
PROG	SEL	STAT	<0|1|2|3|RUN|PAUS|STOP|CONT>	Controls program
PROG	SEL	STAT?	(STOPPED|PAUSED|RUNNING)	Obtains program state

a. Command developed for high-level applications.
b. Commands ignored when a program is running.
c. Valid parameters are determined by the type of module.
d. The filename must include the drive and the complete path.

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7 Maintenance

CAUTION

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

To help ensure long, trouble-free operation,

- Keep the unit free of dust.
- Clean the unit casing with a tissue that has been slightly dampened with water.
- Store unit at room temperature in a clean and dry area.
- Keep the unit out of direct sunlight.
- Avoid high humidity or significant temperature fluctuations.
- If any liquids are spilled on or into the unit, turn off the power immediately and let the unit dry completely.
- Avoid unnecessary shocks and vibrations.

Cleaning the Front Panel

Clean the front panel of the module regularly to avoid build-up of dust, dirt, and other foreign substances. To do so,

1. Gently wipe the front panel with a cloth that has been dampened with soapy water.
2. Rinse the front panel with a cloth that has been dampened with water.
3. Dry with a clean wiping cloth.

IMPORTANT

To help keep the various connectors and adapters clean, EXFO recommends that you install protective caps when the unit is not in use. You should also clean the fiber ends before every connection.

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Cleaning Fixed Connectors

Regular cleaning of connectors will help maintain optimum performance. There is no need to disassemble the module.

To clean fixed connectors,

1. Fold a lint-free wiping cloth in four to form a square.
2. Moisten the center of the lint-free wiping cloth with *only one drop* of isopropyl alcohol.

IMPORTANT

Alcohol may leave traces if used abundantly. Avoid contact between the tip of the bottle and the wiping cloth, and do not use bottles that distribute too much alcohol at a time.

3. Gently wipe the connector threads three times with the folded and moistened section of the wiping cloth.

IMPORTANT

Isopropyl alcohol takes approximately ten seconds to evaporate. Since isopropyl alcohol is not absolutely pure, evaporation will leave microscopic residue. Make sure you dry the surfaces before evaporation occurs.

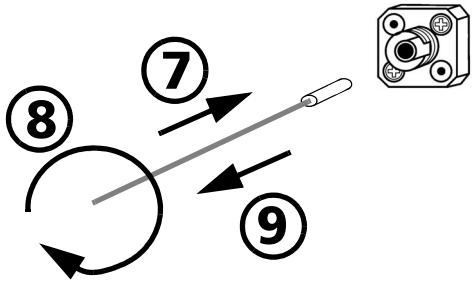
4. With a dry lint-free wiping cloth, gently wipe the same surfaces three times with a rotating movement.
5. Throw out the wiping cloths after one use.
6. Moisten a cleaning tip (2.5 mm tip) provided by EXFO with *only one drop* of isopropyl alcohol.

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IMPORTANT

Alcohol may leave traces if used abundantly. Avoid contact between the tip of the bottle and the cleaning tip, and do not use bottles that distribute too much alcohol at a time.

7. Slowly insert the cleaning tip into the connector until it reaches the ferrule inside (a slow clockwise rotating movement may help).



8. Gently turn the cleaning tip one full turn.

9. Continue to turn as you withdraw the cleaning tip.

10. Perform steps 7 to 9 again, but this time with a dry cleaning tip (2.5 mm tip provided by EXFO).

Note: *Make sure that you do not touch the soft end of the cleaning tip, and verify the cleanliness of the cotton tip.*

11. Throw out the cleaning tips after one use.

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Cleaning Connectors Equipped with EUI/EUA Adapters

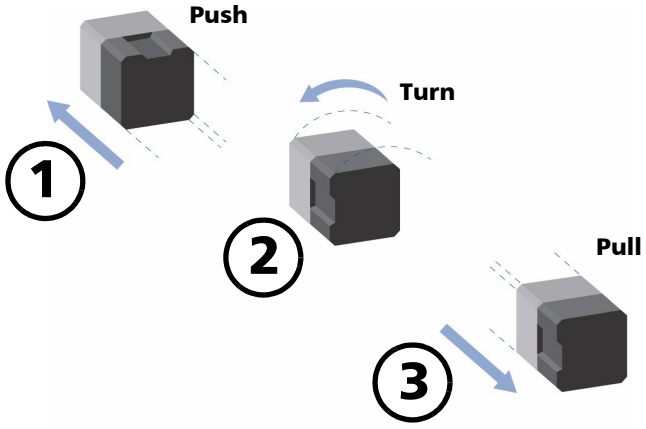
Regular cleaning of connectors equipped with EUI/EUA adapters will help maintain optimum performance. There is no need to disassemble the unit.

IMPORTANT

If any damage occurs to internal connectors, the module casing will have to be opened and a new calibration will be required.

To clean connectors,

1. Remove the EUI/EUA adapter from the module to expose the optical connector baseplate and ferrule.



2. Use a lint-free wiping cloth and deposit *only one drop* of isopropyl alcohol on it.

IMPORTANT

Alcohol may leave traces if used abundantly. Avoid contact between the tip of the bottle and the wiping cloth, and do not use bottles that distribute too much alcohol at a time.

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3. Gently wipe the connector and ferrule.

IMPORTANT

Isopropyl alcohol takes approximately ten seconds to evaporate. Since isopropyl alcohol is not absolutely pure, evaporation will leave microscopic residues. Make sure you dry the surfaces before evaporation occurs.

4. With a dry lint-free wiping cloth, gently wipe the same surfaces in order to be sure that the connector and ferrule are perfectly dry.

5. Throw out the wiping cloths after one use.

WARNING

DO NOT verify the surface of the connector with a fiber-optic microscope WHILE THE UNIT IS ACTIVE. Doing so WILL result in permanent eye damage.

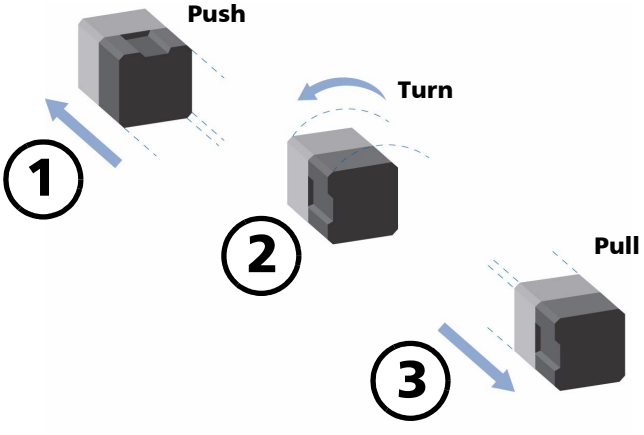
6. After having cleaned the connectors and having made sure that the unit is not active, verify the surface of the connector with a small, portable fiber-optic microscope.

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Cleaning EUI/EUA Adapters

To clean EUI/EUA adapters,

1. Remove the EUI/EUA adapter from the module connector.



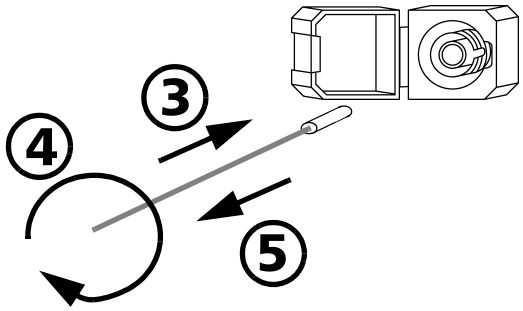
2. Moisten a cleaning tip (2.5 mm tip) provided by EXFO with *only one drop* of isopropyl alcohol.

IMPORTANT

Alcohol may leave traces if used abundantly. Avoid contact between the tip of the bottle and the cleaning tip, and do not use bottles that distribute too much alcohol at a time.

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3. Slowly insert the cleaning tip into the adapter until it comes out on the other side (a slow clockwise rotating movement may help).



4. Gently turn the cleaning tip one full turn.
5. Continue to turn as you withdraw the cleaning tip.
6. Perform steps 3 to 5 again, but this time with a dry cleaning tip (2.5 mm tip provided by EXFO).

Note: *Make sure that you do not touch the soft end of the cleaning tip, and verify the cleanliness of the cotton tip.*

7. Throw out the cleaning tips after one use.

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Cleaning Detector Ports

Regular cleaning of detector ports helps maintain optimum performance.

CAUTION

Never clean a detector with a cleaning tip. When the detector is not in use, cover it with a detector protective cap.

To clean detector ports,

1. Remove the detector protective cap.
2. If the detector is dusty, blow dry with compressed air.
3. Gently wipe both the cap and the detector with a lint-free wiping cloth that has been moistened with isopropyl alcohol.
4. Gently wipe the same surfaces with a dry lint-free wiping cloth or blow dry.

Recalibrating the Unit

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

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8 Troubleshooting

Using the Online Help

Context-sensitive and interactive help is available to guide you through the use of your application.

To obtain online help,

1. Click on the *Help* button or press on *F1*. A question mark will appear next to your pointer.
2. Click on any element and a pop-up window will appear to display a description of the selected element.

Finding FAQs on the EXFO Web Site

The EXFO Web site provides answers to frequently asked questions (FAQs) regarding the use of your product.

To access FAQs,

1. Type the following address in your Internet browser: **www.exfo.com**.
2. Click on the *Support* tab.
3. Click on *FAQs* and follow the on-screen instructions. You will be given a list of questions pertaining to your subject.

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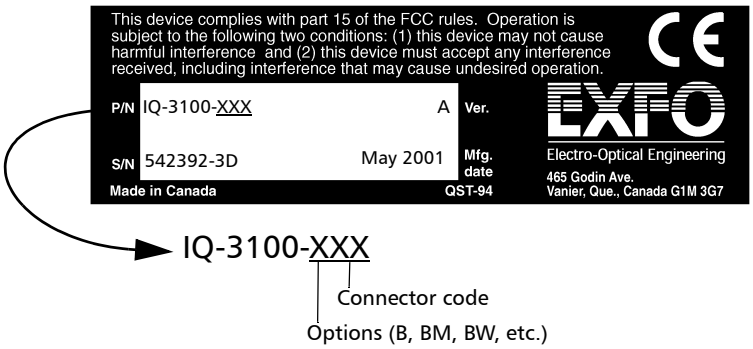
Contacting the Technical Support Group

To obtain after-sales service or technical support for this product, contact EXFO at one of the following numbers. The Technical Support Group is available to take your calls from Monday to Friday, 7:30 a.m. to 8:00 p.m. (Eastern Time in North America).

Technical Support Group
400 Godin Avenue
Vanier (Quebec) G1M 2K2
CANADA

1 866 683-0155 (USA and Canada)
Tel.: (418) 683-5498
Fax: (418) 683-9224
support@exfo.com

To accelerate the process, please have information such as the name and the serial number of your product (see the product identification label shown below) as well as a description of your problem close at hand.



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Transportation

Maintain a temperature range within specifications when transporting 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.
- Avoid high humidity or large temperature fluctuations.
- Keep the unit out of direct sunlight.
- Avoid unnecessary shock and vibration.

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9 Technical Specifications

Note: *Specifications are subject to change without notice.*

IQ-3100 Environmental Specifications

The IQ-3100 is intended for indoor use only.

Parameters	Values	
Size	Width	1.5 in./3.8 cm
	Height	4.75 in./12 cm
	Length	10.3 in./26.2 cm
Operating temperature	32° to 122°F/0° to 50°C	
Storage temperature	-40° to 158°F/-40° to 70°C	
Relative humidity[a]	0 to 95% non-condensing	
Weight	1.40 lb (0.63 kg)	

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

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IQ-3100 Optical Specifications

Model	IQ-3100-B	IQ-3100-C	IQ-3100-D	IQ-3100-E
Fiber (μm)	9/125	50/125	62.5/125	100/140
Wavelength range[a] (nm)	1200 to 1650	700 to 1350		
Spectral resolution (nm)	0.1	0.1		
Optical resolution (dB)	0.005	0.01		
Maximum attenuation (dB)	>100 (1200-1350 nm) >80 (1350-1600 nm) >70 (1600-1650 nm)	>100 (700-1000 nm) >65 (1000-1350 nm)		
Insertion loss[a,b] (dB) typical maximum	 1.5 1.8	 1.5 2.0		
Linearity[c] (dB)	±0.1			
Maximum repeatability (dB)	<±0.03			
Return loss[d] (dB)	≥55	≥25		
Maximum input power[e] (dBm)	25			
Maximum PDL[f] (dB) 20 dB attenuation 50 dB attenuation	 0.2 0.25	 — —		
Shutter isolation (dB)	>100			

a. Calibrated at 1310 nm and 1550 nm for singlemode and at 850 nm and 1300 nm for multimode fiber.
b. Measured with FC/SPC connectors for IQ-3100B and FC/PC for multimode fiber. The insertion loss is dependent on the input numerical aperture.
c. Obtained at 23 ±2°C using a light source of 0.002 dB stability during a 15-minute period (source accuracy of ±0.5 nm), non-polarized light, and at calibrated wavelength.
d. The return loss is limited by the return loss of the connectors. The connectors used are FC/APC for IQ-3100B and FC/PC for multimode fiber.
e. Input power above this limit may damage the unit. The linearity may be higher than specified.
f. Peak-to-peak value.

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Model	IQ-3100BW	IQ-3100BM	IQ-3100BWM	IQ-3100DM
Fiber (µm)	9/125	9/125	9/125	62.5/125
Wavelength range[a] (nm)	1200 to 1650	1270 to 1350 1510 to 1590	1270 to 1350 1510 to 1590	700 to 1350
Spectral resolution (nm)	0.1	0.1	0.1	0.1
Optical resolution (dB)	0.005	0.005	0.005	0.01
Maximum attenuation (dB)	>75 (1200-1400 nm) >70 (1400-1650 nm)	>100(1270-1350 nm) >80 (1510-1590 nm)	>75 (1270-1350nm) >70 (1510-1590nm)	>100 (700-1000 nm) >65 (1000-1350 nm)
Insertion loss[a,b] (dB) typical maximum	 1.5 1.8	 3.0 3.3	 2.0 3.0	 3.0 4.5
Linearity[c] (dB)	±0.1	±0.1	±0.1	±0.12
Spectral uniformity[d] (dB) ≤20 dB ≤50 dB	 ±0.1 ±0.25	 — —	 ±0.1 ±0.25 ±0.35	 — —
Maximum repeatability (dB)	<±0.03	<±0.03	0<0.03	<±0.03
Return loss[e] (dB)	≥50	≥50	≥50	≥25
Maximum input power[f] (dBm)	25	25	25	25
Maximum PDL[g] (dB) 20 dB attenuation 50 dB attenuation	 0.2 0.3	 0.2 0.35	 0.2	 — —
Shutter isolation (dB)	>100	>100	>100	>100
Typical monitor output (dB)	—	13	13	13

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a. Calibrated at 1310 nm and 1550 nm for singlemode and at 850 nm and 1300 nm for multimode fiber.
b. Measured with FC/SPC connectors for IQ-3100BM, FC/UPC for IQ-3100BW, and FC/PC for fiber. The insertion loss is dependent on the input numerical aperture.
c. Obtained at 23 ±2°C using a light source of 0.002 dB stability during a 15-minute period (source accuracy of ±0.5 nm), non-polarized light, and at calibrated wavelength.
d. Measured between 1520 nm and 1570 nm.
e. The return loss is limited by the return loss of the connectors. The connectors used are FC/APC for IQ-3100BM, FC/UPC for IQ-3100BW, and FC/PC for fiber.
f. Input power above this limit may damage the unit. The linearity may be higher than specified.
g. Peak-to-peak value.

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IQ-3300 Environmental Specifications

The IQ-3300 is intented for indoor use only.

Parameters	Values	
Size	Width	1.5 in./3.8 cm
	Height	4.75 in./12 cm
	Length	10.3 in./26.2 cm
Operating temperature	32° to 122°F/0° to 50°C	
Storage temperature	-40° to 158°F/-40° to 70°C	
Relative humidity[a]	0 to 95% non-condensing	
Weight	1.76 lb (0.80 kg)	

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

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IQ-3300 Optical Specifications

Parameters	Values
Fiber type (µm)	9/125
Wavelength range (nm)[a]	1200 to 1650
Reflection range (dB)	-15 to -55
Insertion loss (in-out) (dB)[b]	-5
Resolution (dB)	<0.01
Accuracy (dB)[c]	±0.5
Linearity (dB)[d]	<±0.2
Repeatablity (dB)	<±0.06
Maximum input power (dBm)[e]	22
PDL (dB)	0.4 maximum
Reflection with shutter (dB)	>55

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a. Calibrated at 1310 nm and 1550 nm, wavelength corrections are executed with the help of specialized sofware.
b. Insertion loss includes unit connectors.
c. Using APC connector.
d. Obtained at ±2°C, using a light source of (0.001 dB stability over ±15 minute period (source precision of ±0.5 nm) with non-polarized light and at calibrated wavelength.
e. Maximum input power above this limit may damage the unit. At this power, the linearity specification is not guaranteed.

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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 one year 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, as well as recalibrate the product free of charge should the equipment need to be 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.

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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 one of EXFO's authorized service centers (see *EXFO Service Centers Worldwide* on page 104). 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.

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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EXFO Service Centers Worldwide

If you think your product requires servicing, contact your nearest authorized service center.

EXFO Headquarters Service Center
400 Godin Avenue
Vanier (Quebec) G1M 2K2
CANADA

1 866 683-0155 (USA and Canada)
Tel.: (418) 683-5498
Fax: (418) 683-9224
quebec.service@exfo.com

EXFO Europe Service Center
Le Dynasteur
10/12, rue Andras Beck
92366 Meudon la Forêt Cedex
FRANCE

Tel.: +33.1.40.83.85.85
Fax: +33.1.40.83.04.42
europe.service@exfo.com

Beijing OSIC EXFO Service Center
No. 559 Beijing New Century Hotel
Office Tower
No. 6 Southern Capital Gym Road
Beijing 100044
P.R.CHINA

Tel.: +86 (10) 6849 2738
Fax: +86 (10) 6849 2662
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EXFO Asia Pacific Service Center
151 Chin Swee Road
#03-29 Manhattan House
SINGAPORE 169876

Tel.: +65 333 8241
Fax: +65 333 8242
asiapacific.service@exfo.com

Burleigh Instruments Service Center
7647 Main Street Fishers
Victor, NEW YORK 14564
USA

Tel.: (716) 924-9355
Fax: (716) 924-9072
service@burleigh.com

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(217) 352-9330 | sales@artisantg.com | artisantg.com

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