User Guide

IQS-12008

All-Band Component Analyzer

www.EXFO.com

Telecom Test and Measurement

EXPERTISE REACHING OUT

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

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Trademarks

EXFO's trademarks have been identified as such. However, the presence or absence of such identification does not affect the legal status of any trademark.

Units of Measurement

Units of measurement in this publication conform to SI standards and practices.

Patents

US patent pending, Publ.No. US-2003-0165009-A1.
EXFO's Universal Interface is protected by US patent 6,612,750.

Version number: 1.0.3

Contents

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Certification Information

F.C.C. Information

Electronic test equipment is exempt from Part 15 compliance (FCC) in the United States. However, compliance verification tests are systematically performed on most EXFO equipment.

CE Information

Electronic test equipment is subject to the EMC Directive in the European Union. The EN61326 standard prescribes both emission and immunity requirements for laboratory, measurement, and control equipment. This unit has undergone extensive testing according to the European Union Directive and Standards.

IMPORTANT

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.

EXFO CE DECLARATION OF CONFORMITY

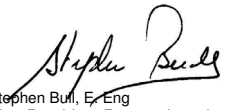
Application of Council Directive(s):	73/23/EEC - The Low Voltage Directive 89/336/EEC - The EMC Directive And their amendments
Manufacturer's Name:	EXFO Electro-Optical Engineering Inc.
Manufacturer's Address:	400 Godin Avenue Quebec, Quebec Canada, G1M 2K2 (418) 683-0211
Equipment Type/Environment:	Test & Measurement / Industrial
Trade Name/Model No.:	All-Band Component Analyzer IQS-12008

Standard(s) to which Conformity is Declared:

EN 61010-1:2001	**Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements.**
EN 61326:1997 +A1:1998 +A2:2001 +A3:2003	**Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements**
EN 60825-1:1994 +A11:1996 +A2: 2001 +A1: 2002	**Safety of laser products – Part 1: Equipment classifications, requirements, and user's guide**
EN 55022: 1998 +A2: 2003	**Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment.**

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive and Standards.

Manufacturer
Signature:



Full Name: Stephen Bull, E. Eng
Position: Vice-President Research and Development
Address: 400 Godin Avenue, Quebec (Quebec), Canada, G1M 2K2
Date: April 19, 2005

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Manufacturer's Name:	EXFO Electro-Optical Engineering Inc.
Manufacturer's Address:	400 Godin Avenue Quebec, Quebec Canada, G1M 2K2 (418) 683-0211
Equipment Type/Environment:	Test & Measurement / Industrial
Trade Name/Model No.:	All-Band Polarization State Adjuster IQS-5150B

Standard(s) to which Conformity is Declared:

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Manufacturer's Address:	400 Godin Avenue Quebec, Quebec Canada, G1M 2K2 (418) 683-0211
Equipment Type/Environment:	Test & Measurement / Industrial
Trade Name/Model No.:	Four-Detector IQS Mini-Module DET-1800

Standard(s) to which Conformity is Declared:

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1 Introducing the IQS-12008 All-Band Component Analyzer

Main Features

The IQS-12008 All-Band Component Analyzer allows test in the O, E, S, C, L and U bands. This one-box system uses a tunable laser source covering the 1260 to 1630 nm range to provide IL, ORL and PDL measurements as a function of wavelength. For bandpass-type devices, it also provides central wavelength, bandwidth, isolation and spectral uniformity measurements with high resolution and accuracy.

The All-Band Component Analyzer allows you to test FTTx, PON, CWDM and all broadband components at any singlemode wavelength.

The rapidity of the test procedure is achieved by scanning a very-low-noise tunable laser source across the DUT's spectral band while power is measured simultaneously on all device ports. Due to the medium coherence and unmatched sidemode suppression of the source, a very high dynamic range is easily attained.

The modular hardware and software flexibility make it easy for you to upgrade or expand your test station.

- You can expand a test system for measuring couplers or splitters to up to 32 channels by simply adding the necessary DET-1843 Four-Detector IQS Mini-Modules. The All-Band Component Analyzer is also very compact: an entire 32-channel system, including PDL testing equipment, will fit into a single IQS-510P/610P Controller Unit.
- The provided software allows you to control the test parameters and sequence while taking advantage of all the flexibility of the All-Band Component Analyzer hardware features.

  In addition, time-saving features such as Pass/Fail testing simplify the job of CWDM component characterization.

  The application calculates complete results at the end of the test scan and displays them both graphically and in a table. You can save results to a file for future processing.

Using COM and LabVIEW to Control the System

In addition to using the provided application, you can develop your own applications with the following tools:

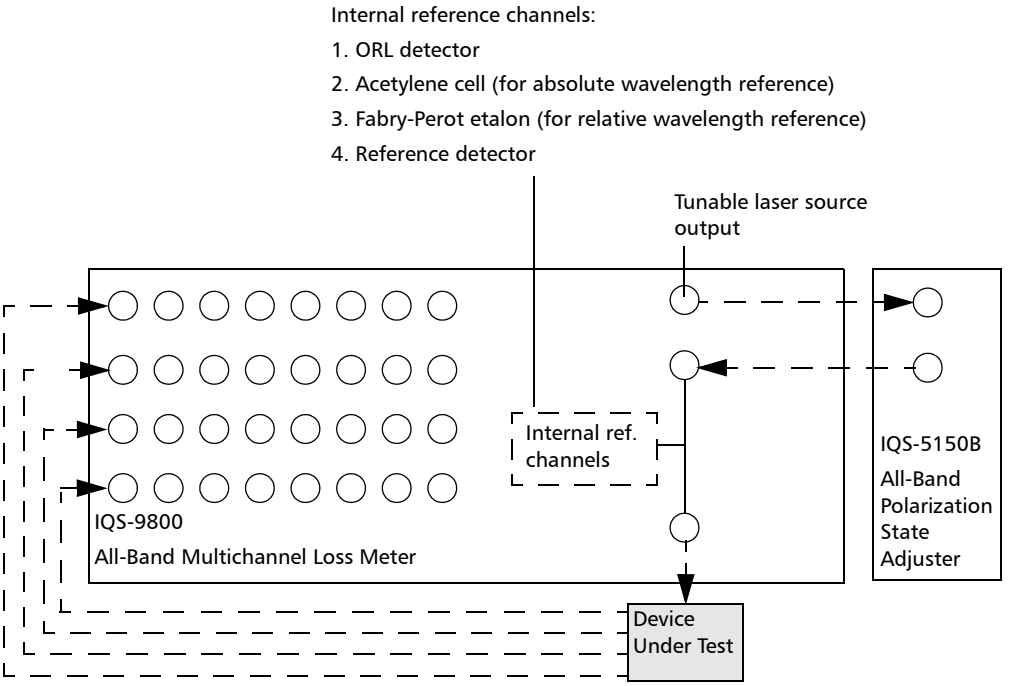
- COM objects (method and properties): refer to the online documentation located in C:\Program Files\EXFO\ IQS12008\.
- LabVIEW demo program (with source code). The program is located in C:\Program Files\EXFO\LabVIEW Getting Started\.

  For more information on how to install and use EXFO LabVIEW drivers, refer to the IQS-500/600 user guide.

System Overview

The IQS-12008 All-Band Component Analyzer consists of a series of IQS modular test and measurement instruments that are completely integrated by the software application.

The standard configuration includes IL and ORL measurements. Adding the IQS-5150B All-Band Polarization State Adjuster enables you to perform PDL measurements using the standardized Mueller-Matrix calculation.



The All-Band Component Analyzer sweeps a very-low-noise laser source across the spectral band of interest (O, E, S, C, L, or U). While the source is sweeping, readings are synchronously acquired on all detectors at a very fast rate (almost 100 kHz), and transferred to the system's main processing board. At the end of the sweep, advanced signal processing is applied to the data, resulting in accurate IL, PDL, and ORL data.

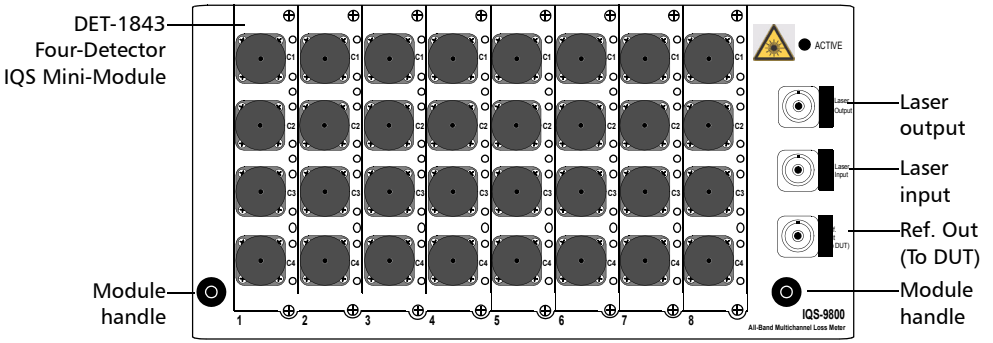
Hardware Components Description

Module or device	Usage
IQS-510P Controller Unit IQS-610P Controller Unit	➤ Houses the instruments required by the system. ➤ Controls the measurement process as well as data interpretation and storage. ➤ Supplied with the necessary equipment for connection to a local area network (LAN). For more information, refer to the IQS-500/600 user guide.
IQS-510E Expansion Units IQS-610E Expansion Units	If necessary, up to nine expansion units may be connected to the controller unit. This extra room can be used to integrate switches, DFB lasers or other test instruments. For more information, refer to the IQS-500/600 user guide.
IQS-9800 All-Band Multichannel Loss Meter	The eight-slot module integrates the all-band tunable laser source, referencing elements and up to 8 DET-1843 detector cards. For more information, see *All-Band Multichannel Loss Meter* on page 5
DET-1843 Four-Detector IQS Mini-Module	Four-channel detector cards that can be inserted into and removed from the IQS-9800 All-Band Multichannel Loss Meter module as required. For more information, see *Four-Detector IQS Mini-Modules* on page 6.
IQS-5150B All-Band Polarization State Adjuster (optional)	Allows PDL measurements throughout the whole wavelength range by generating four orthogonal polarization states.
Bare fiber testing accessory	Allows you to connect bare fiber components to the detectors. Its unique gel-filled cartridge and multimode receiving fiber allow for low loss and repeatable connections.

All-Band Multichannel Loss Meter

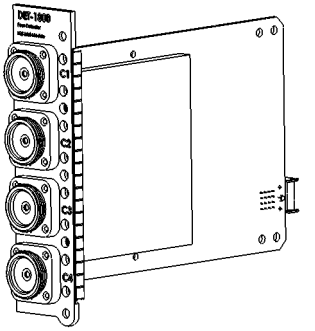
The IQS-9800 All-Band Multichannel Loss Meter is an eight-slot module that integrates all that is required to fully characterize IL and ORL of passive components:

- All-band tunable laser source
- Wavelength and power reference
- Source-detector synchronization
- Housing for detector mini-modules



Four-Detector IQS Mini-Modules

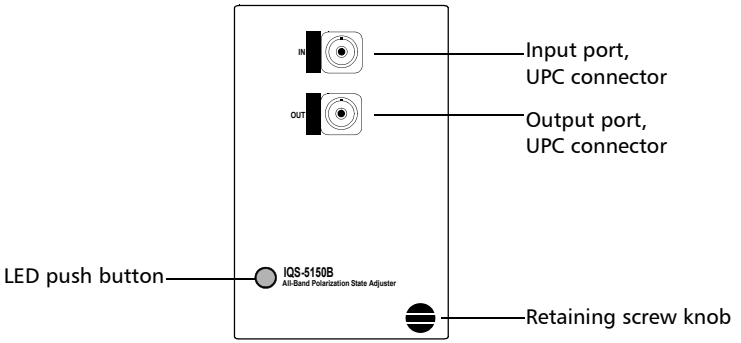
The Four-Detector IQS Mini-Module is a plug-in card that includes four high-speed, autoranging detection channels. These detectors provide low-polarization dependence for accurate PDL measurements.



These modules are the key for system expansion. You can use up to 8 mini-modules in you system, depending on the number of channels you need (4 to 32).

All-Band Polarization State Adjuster (Optional)

The IQS-5150B All-Band Polarization State Adjuster is required for spectral PDL characterization of passive components with the All-Band Component Analyzer. The module uses two slots of the IQS-510P/610P Controller Unit.

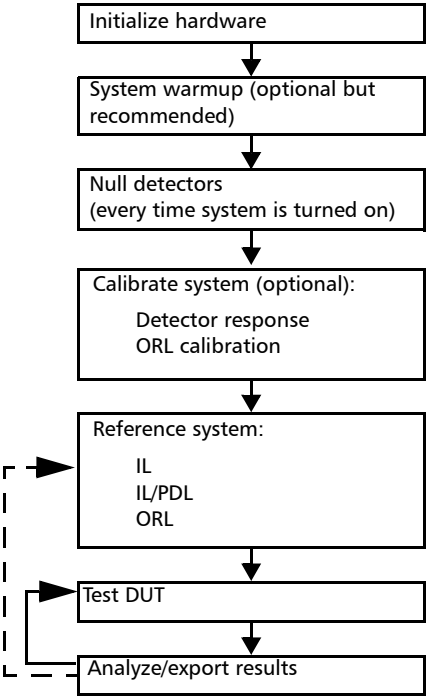


The All-Band Polarization State Adjuster generates four orthogonal and two circular states of polarization to measure PDL using the Mueller Matrix method. It is connected to the source through a polarization-maintaining patchcord and it uses a semi-rigid patchcord with the IQS-9800 internal reference input connector.

Testing Procedure Overview

With the specified test configuration, the application controls the different IQS modules to characterize a device under test (DUT).

Once your configuration is complete, a typical test sequence to perform IL, ORL, and PDL measurements would be similar to this:



Each time you start a new test sequence, the above steps are required or highly recommended, except for the detector response calibration. The latter remains valid as long as the detector cards or the FOAs are not replaced or the system does not undergo temperature changes.

Conventions

Before using the product described in this manual, you should understand the following conventions:

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in *death or serious injury*. Do not proceed unless you understand and meet the required conditions.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in *minor or moderate injury*. Do not proceed unless you understand and meet the required conditions.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in *component damage*. Do not proceed unless you understand and meet the required conditions.

IMPORTANT

Refers to information about this product you should not overlook.

2 Safety Information

WARNING

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

WARNING

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

Your instrument is a Class 1M laser product in compliance with standards IEC 60825-1 Amendment 2: 2001 and 21 CFR 1040.10. Invisible laser radiation may be encountered at the output port.

The product is safe under reasonably foreseeable conditions of operation but it may be hazardous if you use optics within a diverging or collimated beam. *Do not view directly with optical instruments.*

- Wavelength: 1260 to 1630 nm
- Maximum output power at the connector: 8 mW

3 Getting Started with Your All-Band Component Analyzer

Inserting and Removing Test Modules

CAUTION

Never insert or remove a module while the controller unit and its expansion units are turned on. This will result in immediate and irreparable damage to both the module and unit.

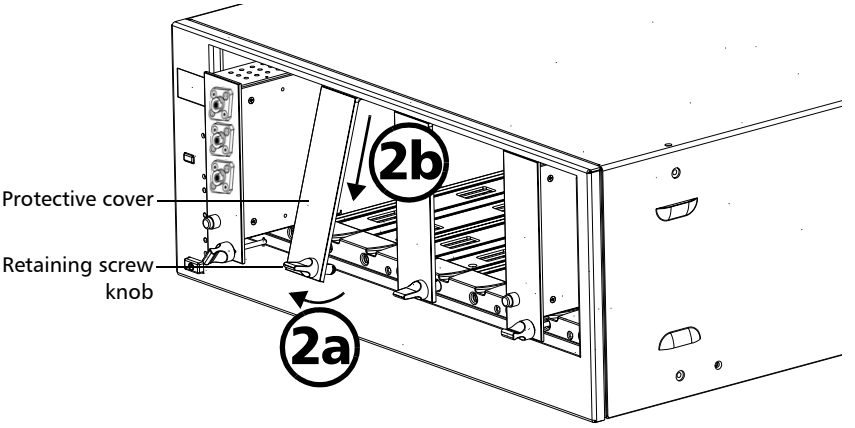
To insert a module into the controller or expansion unit:

1. Exit IQS Manager and turn off all your units.

2. Remove the protective cover from the desired unused module slot.

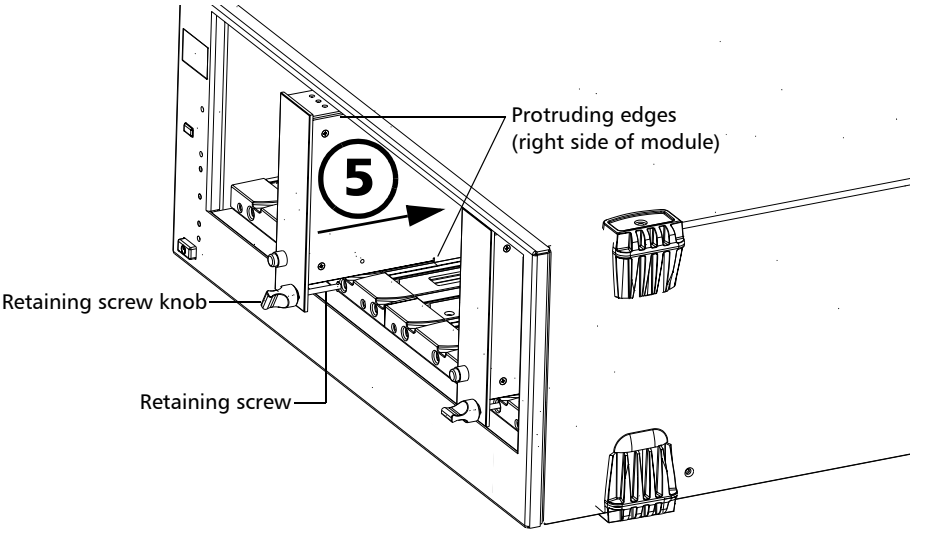
2a. Pull the retaining screw knob firmly towards you and release the bottom of the cover.

2b. Gently pull the top of the protective cover downwards, to remove it from the unit grooves.



3. Position the module so that its front panel is facing you and the top and bottom protruding edges are to your right.

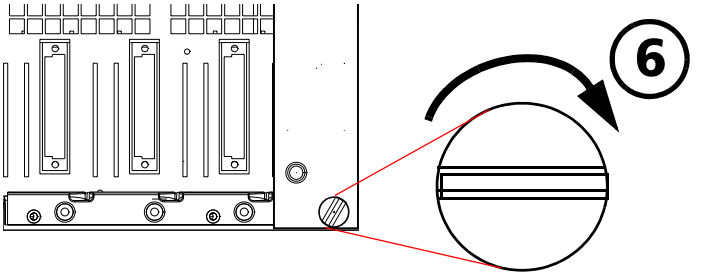
4. Insert the protruding edges of the module into the grooves of the unit's module slot.



5. Push the module all the way to the back of the slot, until the retaining screw makes contact with the unit casing.

6. While applying slight pressure to the module, turn the retaining screw knob (located at the bottom of the panel) clockwise until the knob is horizontal.

This will secure the module into its "seated" position.



The module is correctly inserted when its front panel is flush with the front panel of the controller or expansion unit.

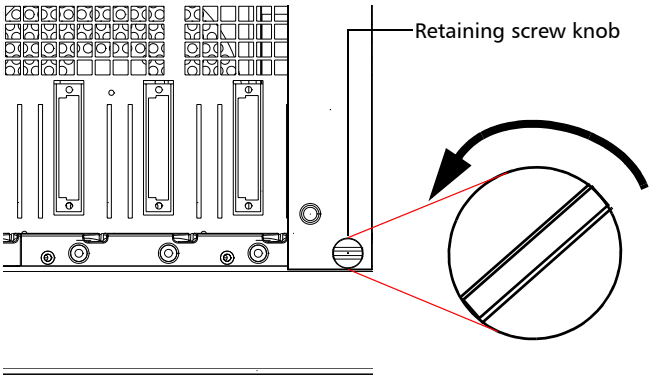
When you turn on the controller unit, the startup sequence will automatically detect your module.

Note: *You can insert IQ modules into your controller or expansion unit; the IQS Manager software will recognize them. However, the IQS-12008 locking mechanism (retaining screw) will not work for IQ modules.*

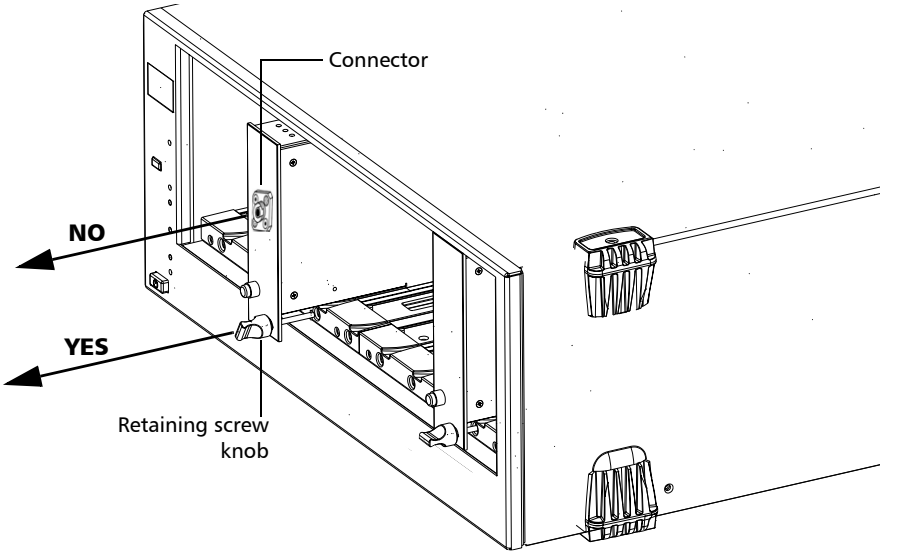
To remove a module from your controller or expansion unit:

1. While pulling gently on the knob, turn it counterclockwise until it stops.

The module will slowly be released from the slot.



2. Place your fingers underneath the module or hold it by the retaining screw knob *(NOT by the connector)* and pull it out.



CAUTION

Pulling out a module by a connector could seriously damage both the module and connector. Always pull out a module by the retaining screw knob.

3. Cover empty slots with the supplied protective covers.

3a. Slide the top of the protective cover into the upper grooves of the unit.

3b. Snap the cover into place by pushing the retaining screw knob.

CAUTION

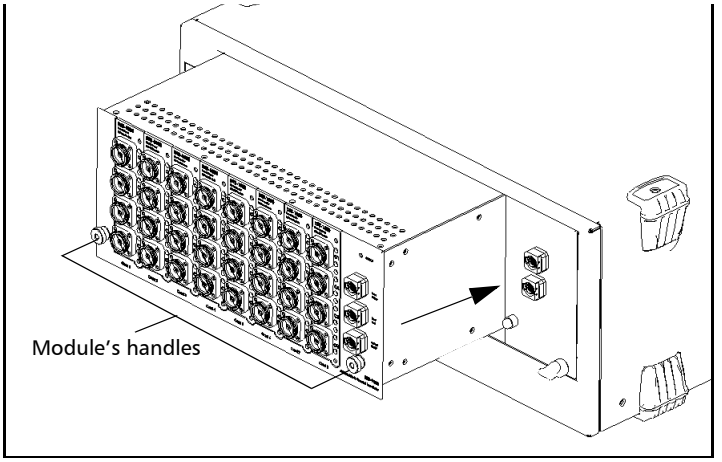
Failure to reinstall protective covers over empty slots will result in ventilation problems.

Inserting and Removing the All-Band Multichannel Loss Meter

You must insert the All-Band Multichannel Loss Meter into the eight first slots of the controller unit. Otherwise, you will not be able to use the provided patchcord.

To insert or remove the All-Band Multichannel Loss Meter:

Follow the instructions given in *Inserting and Removing Test Modules* on page 13. However, since the loss meter does not have retaining screws, push the module or pull it out using its handles instead.You can also use the provided metal tool as a lever to lift the lower right corner.



CAUTION

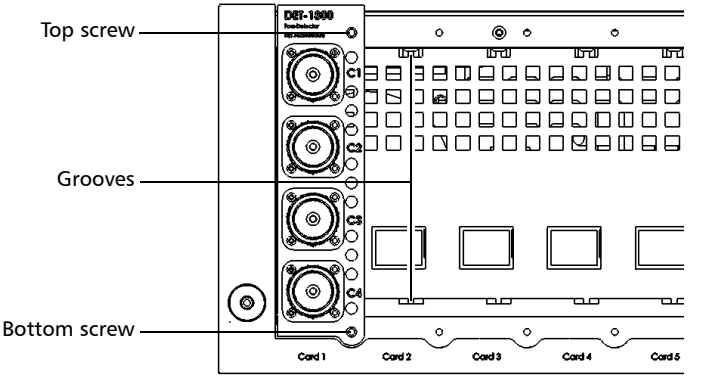
Pulling out the loss meter by its connectors could seriously damage both the module and connectors. Always pull out the loss meter by its handles.

Inserting and Removing Detector Cards

You can insert or remove the DET-1843 Four-Detector IQS Mini-Module detector cards at any time in the system. It is not necessary to turn off the controller or the expansion units.

To insert a detector card:

1. Unscrew and remove the protective cover from the desired unused card slot.
2. Position the card so that its front panel is facing you.
3. Insert the top and bottom edges of the card into the grooves of the module's card slot.



4. Push the card all the way to the back of the slot, until the front panel is flush with the module's front plate.
5. Replace the top and bottom screws to retain the card in place.
6. Exit and restart the application so that the system recognizes the DET-1843 detector card.

To remove a detector card:

1. Remove the top and bottom screws that retain the card in place.
2. Hold the card by the FOAs and pull it out gently.
3. Install a protective cover over the empty slot by replacing top and bottom screws.

CAUTION

Failure to reinstall protective covers over empty slots will result in ventilation problems.

Installing Hardware Components

The All-Band Component Analyzer has been configured and tested at the factory, under normal conditions. The following information is provided in the event that it is necessary to move, transport, or reinstall the system.

Controller and Expansion Units

Please refer to the *IQS-500/600* user guide for detailed information about installing and connecting the controller and expansion unit(s).

All-Band Multichannel Loss Meter and Polarization State Adjuster

The modules must be installed in the same unit. You must insert the All-Band Multichannel Loss Meter to the left of the polarization adjuster. Otherwise, you will not be able to use the provided patchcords.

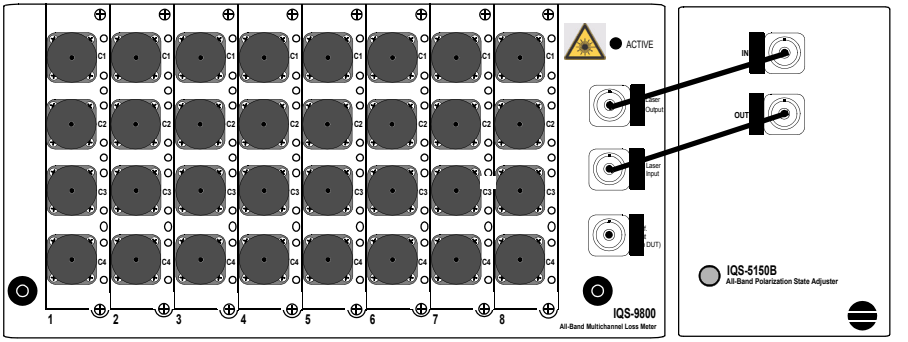
CAUTION

Never insert or remove a module while the controller or expansion unit is turned on. This will result in immediate and irreparable damage to both the module and unit.

➤ Configuration with PDL (IQS-5150B)

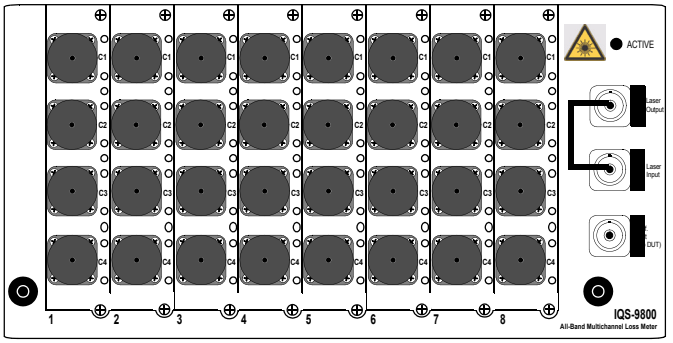
Connect the laser output of the IQS-9800 to the input of the IQS-5150B using the provided polarization-maintaining patchcord.

Connect the output of the IQS-5150B to the input (laser input port) of the IQS-9800 using the semi-rigid patchcord provided with the system.



➤ Configuration without PDL (IQS-5150B)

Connect the laser output of the IQS-9800 to the laser input of the same module with the provided polarization-maintaining patchcord, as illustrated below.



IMPORTANT

To keep the optical ports clean, ensure that protective caps are always installed on detector ports when the mini-modules are not being used.

Installing the IQS-12008 All-Band Component Analyzer Software

For the All-Band Component Analyzer to function properly, IQS Manager must be installed on your IQS platform.

Normally, you would not have to install IQS Manager or the All-Band Component Analyzer application, except in particular circumstances (such as after having reinstalled Microsoft Windows).

For information on installing IQS Manager, refer to the IQS-500/600 user guide.

To install the All-Band Component Analyzer application:

1. Make sure that the IQS Manager software is installed on your unit.
2. Insert the All-Band Component Analyzer CD in the CD-ROM drive.
3. Select **Run** from the Windows **Start** menu.
4. Type *F:\setup.exe* in the **Open** text field.
5. Click **OK** to start the wizard and follow the on-screen instructions.

Starting and Exiting the All-Band Component Analyzer Application

To start the All-Band Component Analyzer application:

➤ On the Windows taskbar, click the **Start** button, select **Programs** > **EXFO** > **IQS-12008** > **IQS-12008 All-Band Component Analyzer**.

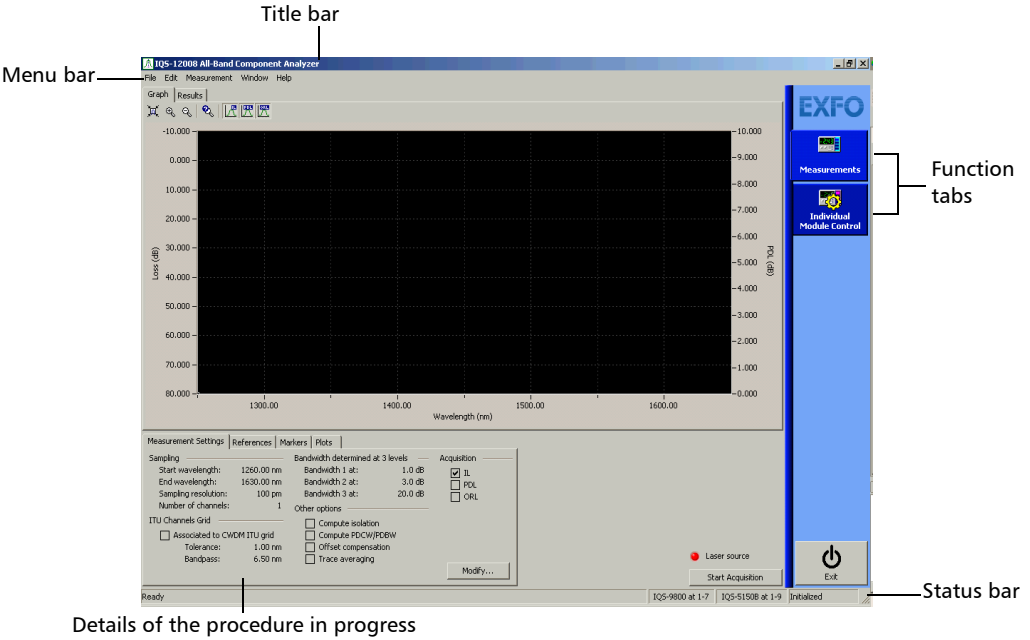
OR

➤ Double-click the **IQS-12008 All-Band Component Analyzer** desktop icon.

To exit the All-Band Component Analyzer application:

Select **Exit** from the **File** menu.

The All-Band Component Analyzer **Measurements** function tab is the central location from where you access all functionalities.



4 Setting Up the All-Band Component Analyzer

Initializing Hardware

The initialization takes a few minutes. It allows the system to test the communication between the modules and to detect which modules are available for the tests.

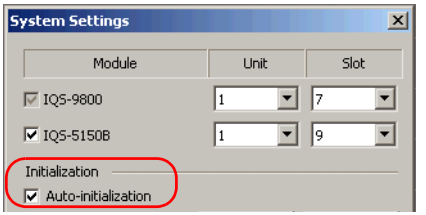
Once the initialization is complete, to ensure stable readings, you should let the system warm up for a minimum of 30 minutes. This will allow all system components, and especially the source, to reach a stable temperature. It is particularly important before performing any calibration, reference, or null measurement.

The initialization can be either automatically performed when the IQS-12008 All-Band Component Analyzer application is started, or performed manually afterwards.

Once the initialization is completed, the laser is positionned at its highest wavelength, where almost no power is emitted.

To set the automatic initialization:

1. On the **Measurement** menu, select **System Settings**.
2. Verify that the modules appear on the **Module** list and that they are located in the indicated slots.
3. In the **System Settings** window, select **Auto-initialization**.

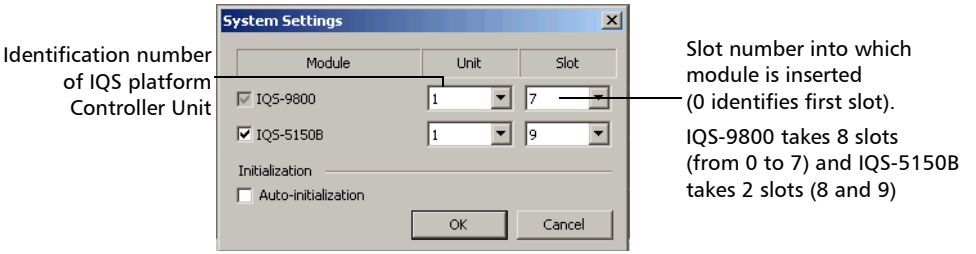


4. Click **OK** to confirm your choice.
5. Let the system warm-up for 30 minutes.

   The system will automatically initialize each time the IQS-12008 application is started.

To initialize the system manually:

1. On the **Measurement** menu, select **System Settings**.
2. Verify that the modules appear on the **Module** list and that they are located in the indicated slots.



3. On the **Measurement** menu, select **Initialize Instruments.**
4. Let the system warm-up for 30 minutes.

Nulling Electrical Offsets

Temperature and humidity variations affect the performance of electronic circuits and optical detectors, which can offset measurement results. To compensate for this offset, the IQS-12008 is equipped with an offset nulling function.

EXFO recommends performing a nulling of the electrical offsets whenever environmental conditions change.

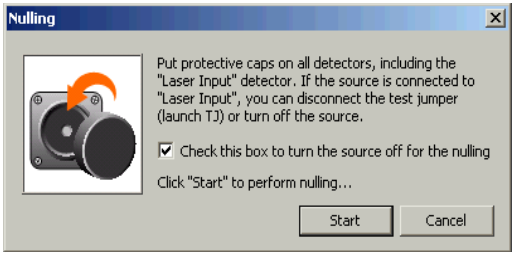
IMPORTANT

Light must not reach any of the detectors during offset nulling.

You must perform a nulling after a warmup period of at least 30 minutes.

To null the detectors:

1. On the menu bar, open the **Measurement** menu.
2. Select **Detectors Nulling**.



3. Put caps on all detectors ensuring that the laser source is not connected to the laser input port (to prevent light from reaching the internal reference detectors).

   To avoid disconnecting test jumpers from the laser input port for the nulling, select the check box.

Note: *You can also perform a nulling without putting caps on detectors if there are connectors on all detectors.*

4. Press **Start** to begin the nulling process.

Calibrating the System

Although the system has been calibrated at the factory, it must be calibrated again upon installation.

Calibration includes:

- *Detector Response* calibration: To correct variations in sensitivity and response of the different detectors.
- *Return Loss* (ORL) calibration (14.7 dB reflection and Zero).

You can optimize the signal-to-noise ratio by selecting the *calibration averaging* option. This way, the application will perform four calibration scans instead of one.

Note: *You must perform calibration before reference measurements because reference is based on certain values obtained during calibration.*

Detector Response Calibration

The detector response calibration is a full-range sweep on each of the detectors. This series of measurements starts with the first channel of the first card and ends with the last channel of the last card of the loss meter. These measurements allow the system software to correct any variation in sensitivity and response of the detectors.

The calibration data is saved to a file and is associated with the detector cards serial numbers. If a new card is added to the system, it will be automatically detected and you will be forced to perform a new calibration.

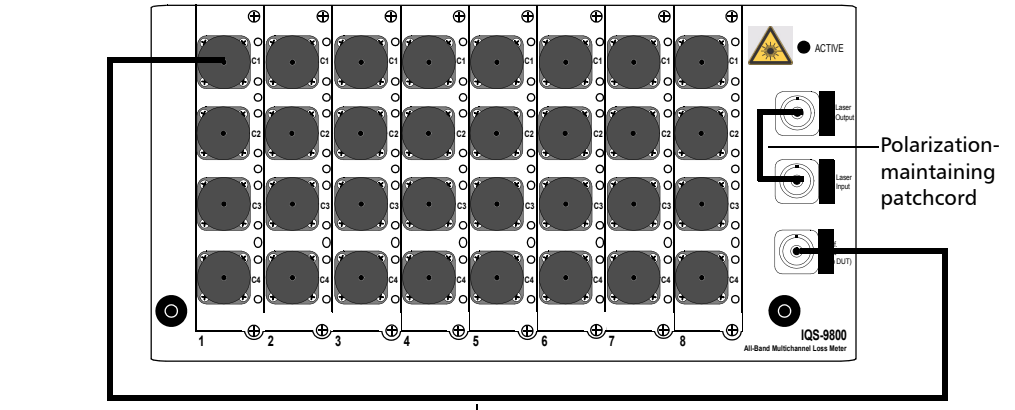
You must perform the entire calibration procedure to obtain a valid calibration.

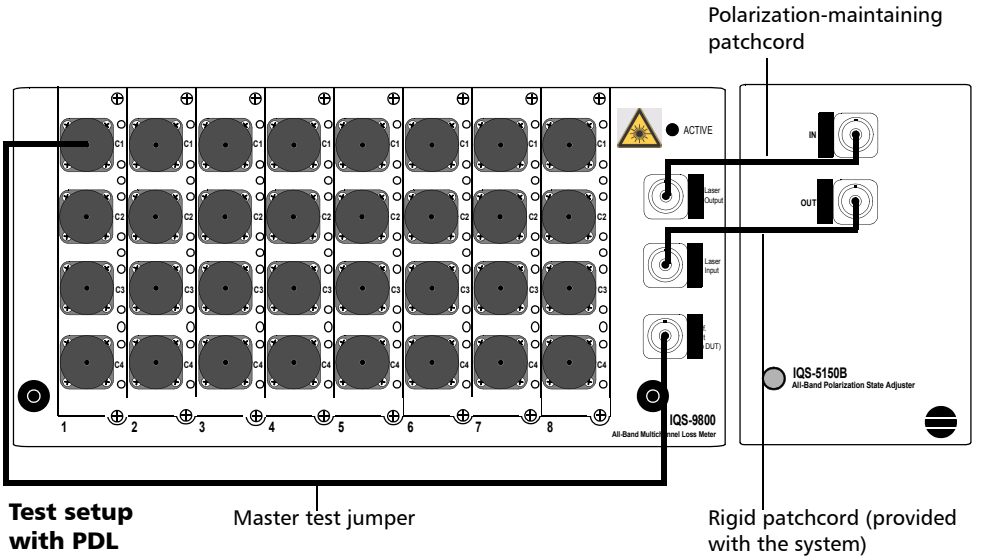
You must perform a detector response calibration in the following cases:

- You replace the loss meter.
- You add detector cards to the system or replace them.
- You replace the IQS-5150B All-Band Polarization State Adjuster (PSA).
- You add a PSA to the system.

To perform the detector response calibration:

1. Connect as shown, depending on the setup you intend to use.



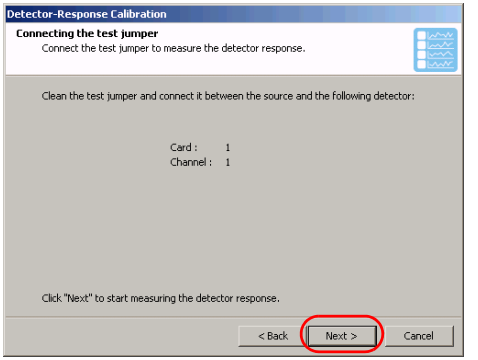


2. For a better signal-to-noise ratio, in the **Measurement** menu, select **Calibration** > **Calibration Averaging**.
3. In the **Measurement** menu, select **Calibration** > **Detector Response**.
4. The laser output has to be connected to:

   the laser input with test jumper if there is no IQS-5150B

   OR

   the IQS-5150B input if you want to measure PDL. The rigid test jumper will redirect the signal going through the IQS-5150B into the laser input port of IQS-9800 module.
5. On the IQS-9800, connect the Ref. Out port to channel 1 of card 1.
6. Click **Next** to perform the measurement and move on to the next detector.



7. On the IQS-9800, connect the Ref. Out port to channel 2 of card 1.
8. Click **Next** to perform the measurement and move on to the next detector.
9. Following the instructions on the screen, connect the output port to all remaining channels in the system.
10. When the detector response measurement is complete, click **Finish** and close the wizard.

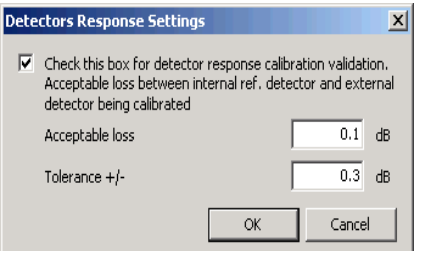
Validating Calibration Measurement Quality

When validating the calibration during the process, the system compares, for each detector, the average value measured on the internal reference detector with the average value measured on the detector being calibrated. The averaged difference should not be greater than a set value within a determined tolerance.

The detector response can be configured prior to calibrating the IQS-12008 All-Band Component Analyzer.

To change the detector response settings:

1. From the main window, select the **Measurement** menu, then **Calibration > Detectors response settings**.
2. Select **Acceptable loss** to enable the validation of the calibration process and the other boxes.
3. If needed, change the value and tolerance.



4. Click **OK** to enter the changes. They will be saved in the measurement configuration file.

Return Loss Calibration

The return loss calibration is performed to compensate for internal parasitic reflections and parasitic reflections from the connection between the IQS-9800 and the output fiber.

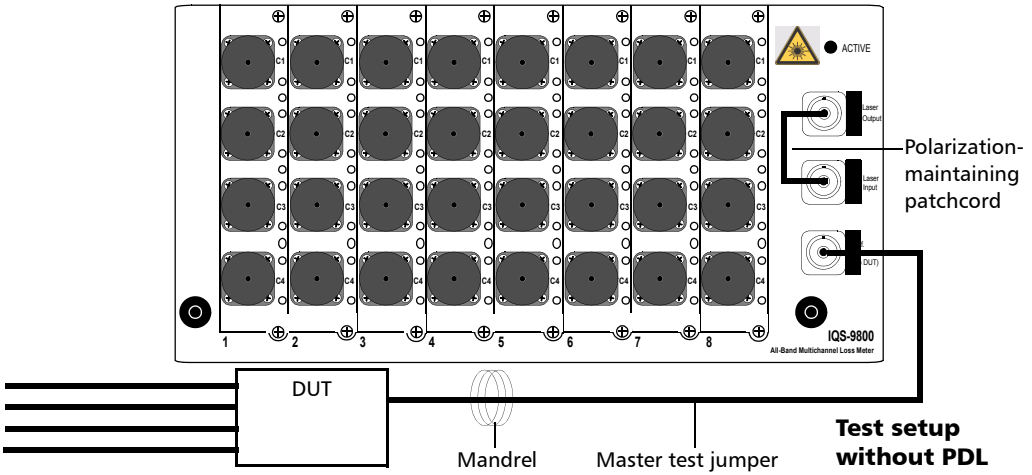
The return loss calibration is performed in two steps using a reflection reference jumper supplied with the system. This reflection reference jumper provides a known optical reflection (UPC connector interface with air).

During the first step, the system will measure the reflection of the reference test jumper across the full tuning range. The second step of the ORL calibration is a zero reflection scan. Based on the two scans, the ORL calibration factors are calculated and stored into a system calibration file.

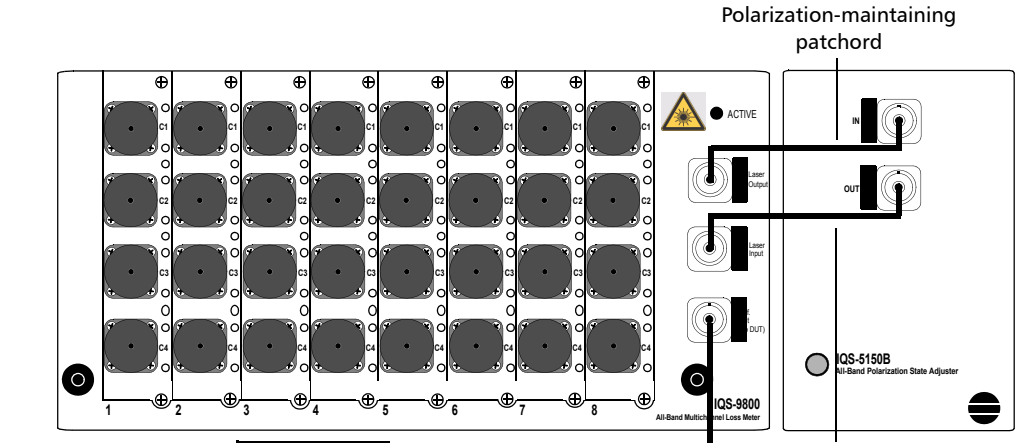
It will be necessary to repeat the return loss calibration if any of the modules are replaced. One way of verifying the ORL measurement is to measure the ORL of the reflection reference test jumper at 1550 nm. The result should be 14.7 dB ± the uncertainty indicated in the specification sheet.

To perform the return loss calibration:

1. Connect as shown, depending on the setup you intend to use.



Test setup without PDL



Test setup with PDL

2. For a better signal-to-noise ratio, in the **Measurement** menu, select **Calibration** > **Calibration Averaging**.
3. In the **Measurement** menu, select **Calibration** > **Return Loss**.
4. The laser output has to be connected to:

   the laser input with test jumper if there is no IQS-5150B

   OR

   the IQS-5150B input if you want to measure PDL. The rigid test jumper will redirect the signal going through the IQS-5150B into the laser input port of IQS-9800 module.
5. Connect the reflection reference jumper to the Ref. Out connector of the IQS-9800.
6. Click **Next** to start the measurement.
7. Then, for the zero calibration, mandrel wrap the reflection reference jumper, giving the fiber 10 turns around the mandrel tool.
8. Hold the fiber on the mandrel and click **Next** to proceed.
9. Click **Finish** when the return loss calibration has been done.

Referencing the System

System referencing comprises:

- Insertion loss (IL) reference
- IL/PDL reference
- Return loss (ORL) reference

EXFO recommends that you perform reference measurements in the following cases:

- Every time you turn the system on.
- When you remove or replace the master test jumper.
- When the system is used for long periods of time.
- When there are important changes in environmental conditions.
- When you remove or replace any module.

Insertion Loss Reference Measurement

This reference measurement compensates for any loss or spectral non-uniformity of the master test jumper connection to the output port. You may select to perform an IL reference with or without averaging. Averaging the IL reference measurement takes more time as the system makes four scans to optimize the signal-to-noise-ratio.

You can perform an IL reference measurement with or without the IQS-5150B All-Band Polarization State Adjuster (PSA). If you do not use the PSA, the polarization state will be unknown. Polarization state stability is assured if you use a polarization-maintaining fiber (PMF) and it is properly connected. When using the PSA, you may select the polarization state manually or use the default polarization state, which is linear positive diagonal.

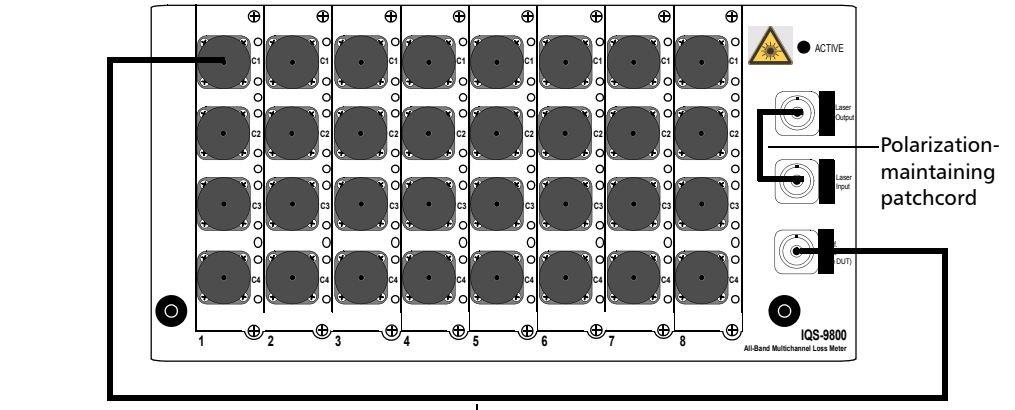
Performing an IL reference measurement without the IQS-5150B has the advantage of adding 3 to 8 dB, depending on the polarization state, to the dynamic range of the system. This may be useful if you want to perform high-isolation measurements.

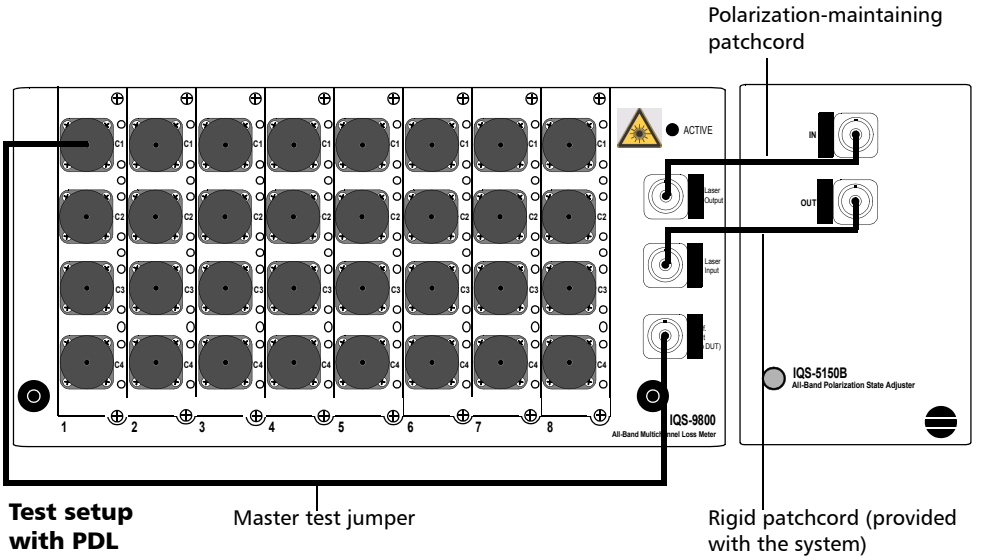
IMPORTANT

Before performing any reference measurement, ensure that all the connectors and fiber-optic adapters (FOAs) are clean, and that the warmup period (at least 30 minutes) is over.

To perform an insertion loss reference measurement:

1. Connect as shown, depending on the setup you intend to use.





2. If your setup includes PDL, if desired, select the polarization state manually as follows:

2a. Click the **Individual Module Control** function tab.

2b. Select the desired polarization state.

IMPORTANT

If you do not perform the reference with the default polarization state (linear positive diagonal), ensure that you will use the same polarization state for your measurements. Otherwise, your results will not be accurate.

3. If you want to perform reference averaging (for a better signal-to-noise ratio):

➤ On the menu bar, select **Measurement** > **Reference** > **Reference Averaging**

OR

➤ From the **References** tab, select the **Reference Averaging** box.

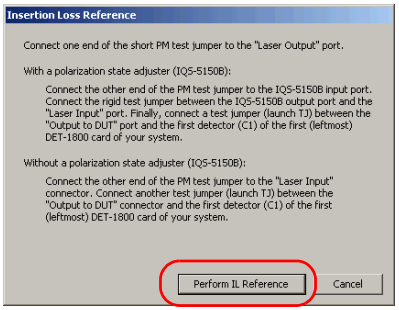
4. Start the insertion loss reference procedure:

➤ On the menu bar, select **Measurements** > **Reference** > **Insertion Loss**

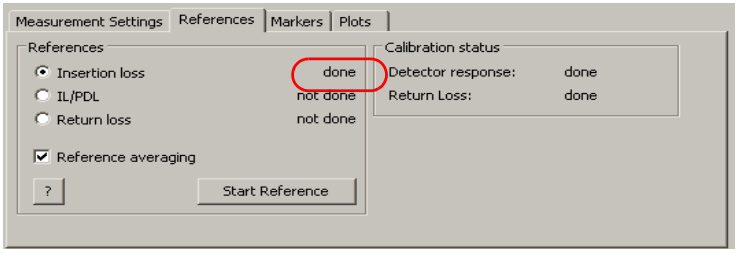
OR

➤ From the **References** tab, select **Insertion Loss** and click the **Start Reference** button.

5. At the bottom of the wizard screen, click **Perform IL Reference** to proceed or **Cancel** to stop.



When the IL reference measurement scan is over, the word **Done** will appear to the right of the **Insertion Loss** reference option in the **References** tab, indicating that the reference has been successfully completed.



The indicator **Done** means that the system has access to a reference file. If the environmental conditions change or if you use a different master test jumper, the reference values might not be valid for the tests to perform.

IMPORTANT

Before performing any reference measurement, ensure that all the connectors and fiber-optic adapters (FOAs) are clean, and that the warmup period (at least 30 minutes) is over.

IL/PDL Reference Measurement

This reference measurement compensates for any loss or spectral non-uniformity of the master test jumper connection to the output port.

The IL reference measurement performed through the IL/PDL reference procedure differs from the insertion loss reference measurement explained previously. The IL reference measurement in IL/PDL reference is the average of all insertion losses calculated at the four polarization states used for the PDL measurement:

- Linear horizontal
- Linear vertical
- Linear positive diagonal
- Right circular

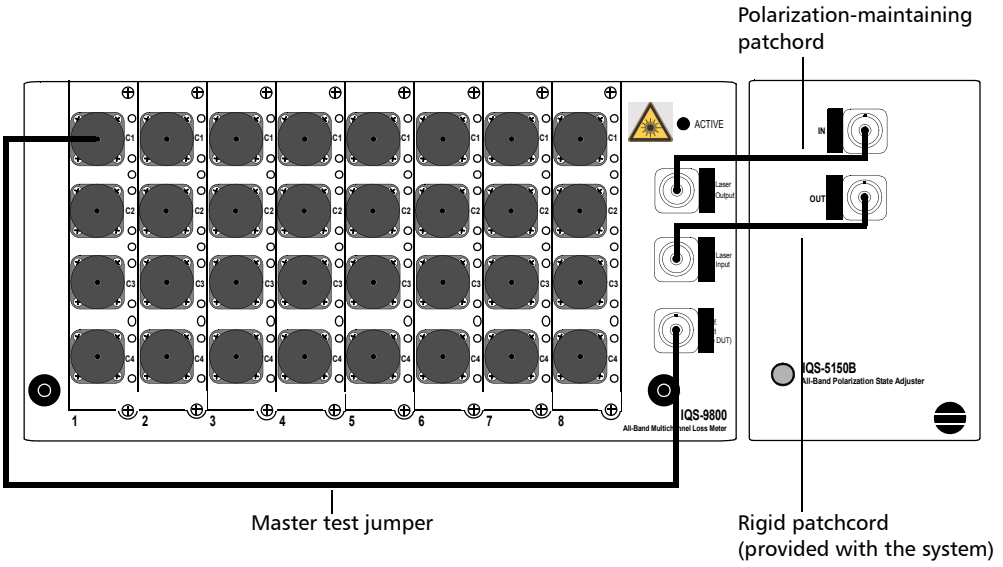
Any divergence between this reference measurement and the one obtained through the IL reference procedure is normal, especially if the DUT is very sensitive to polarization state changes.

IMPORTANT

Before performing any reference measurement, ensure that all the connectors and fiber-optic adapters (FOAs) are clean, and that the warmup period (at least 30 minutes) is over.

To perform the IL/PDL reference measurement:

1. Connect as shown.



2. If you want to perform reference averaging (for a better signal-to-noise ratio):

➤ On the menu bar, select **Measurement** > **Reference** > **Reference Averaging**

OR

➤ From the **References** tab, select the **Reference Averaging** box.

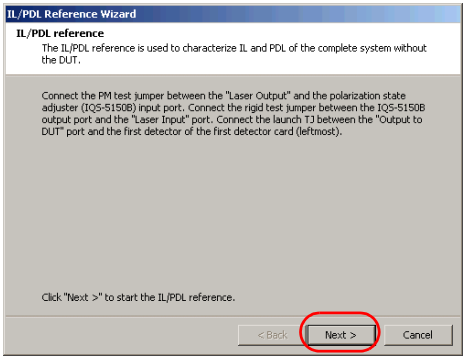
3. Start the IL/PDL reference procedure:

➤ On the menu bar, select **Measurements** > **Reference** > **IL/PDL**.

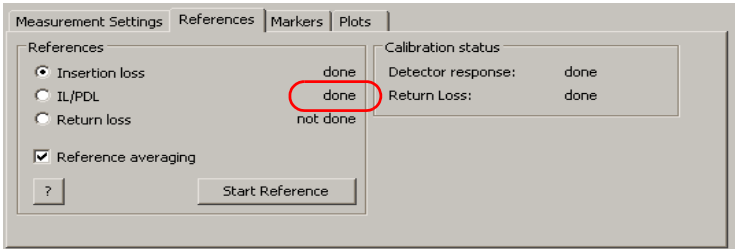
OR

➤ From the **References** tab, select **IL/PDL** and click the **Start Reference** button.

4. At the bottom of the wizard screen, click **Next >** to proceed or **Cancel** to stop.



When the IL/PDL reference scan is over, the word **Done** will appear to the right of the **IL/PDL** reference option in the **References** tab.



The indicator **Done** means that the system has access to a reference file. If the environmental conditions change or if you use a different master test jumper, the reference values might not be valid for the tests to perform.

Return Loss Reference

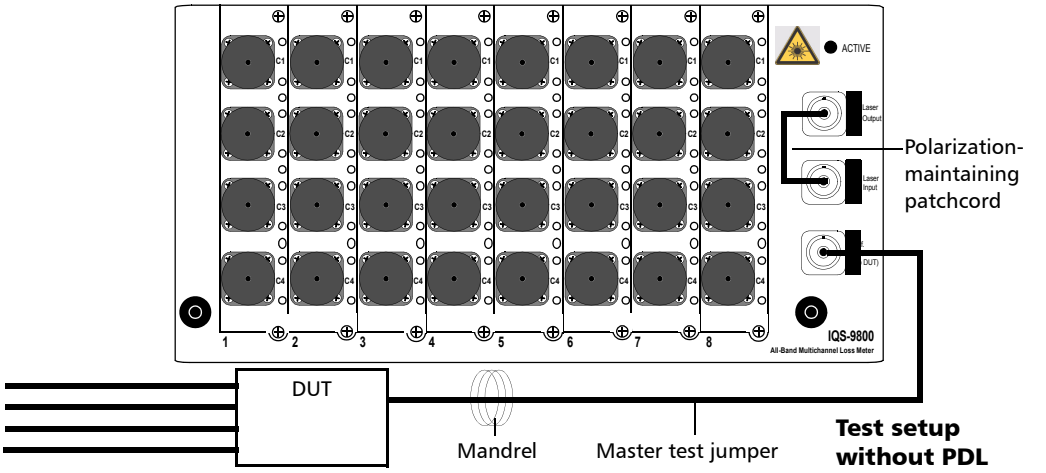
This reference provides a zero-reflection reference to the detector. The reference will be used to compensate for internal detector parasitic reflections and those coming from the connection with the master test jumper used for ORL measurement.

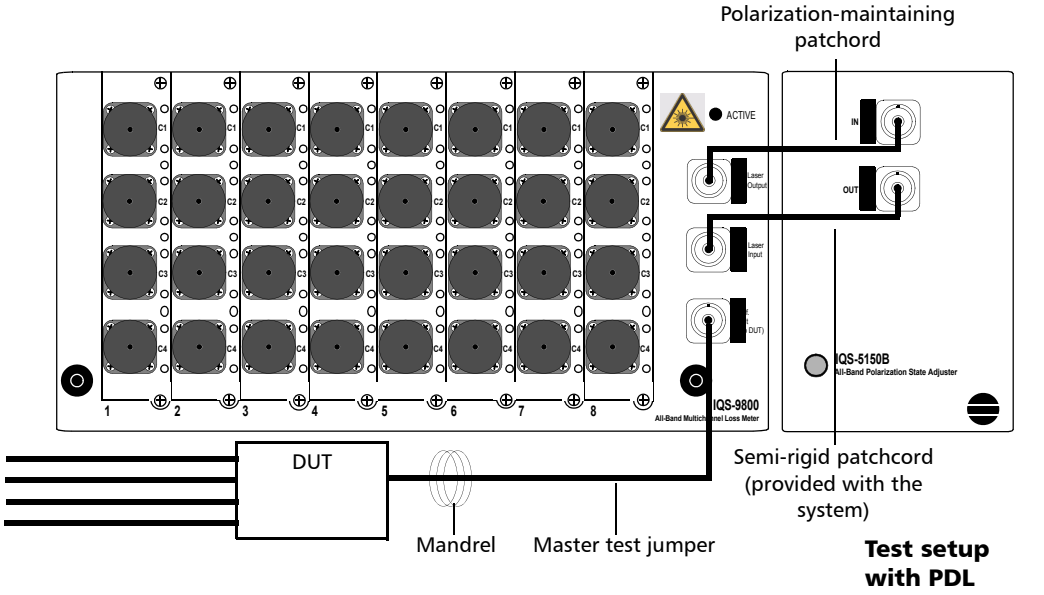
IMPORTANT

Before performing any reference measurement, ensure that all the connectors and fiber-optic adapters (FOAs) are clean, and that the warmup period (at least 30 minutes) is over.

To perform a return loss reference:

1. Connect as shown, depending on the setup you intend to use.





2. If you want to perform reference averaging (for a better signal-to-noise ratio):

   ➤ On the menu bar, select **Measurement** > **Reference** > **Reference Averaging**

   OR

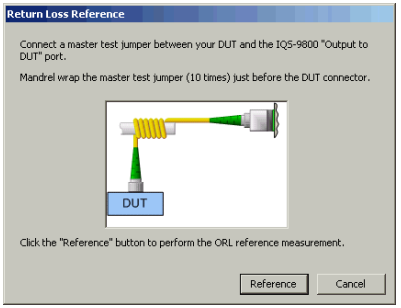
   ➤ From the **References** tab, select the **Reference Averaging** box.

3. Start the return loss reference procedure:

   ➤ On the menu bar, select **Measurements** > **Reference** > **Return Loss**.

   OR

   ➤ From the **References** tab, select **Return Loss**, and click the **Start Reference** button.

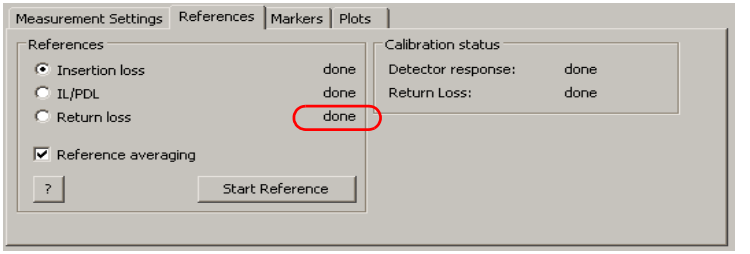


4. Mandrel wrap the master test jumper before the DUT connector (10 turns).

5. At the bottom of the wizard screen, click **Next >** to proceed or **Cancel** to stop.

6. When the ORL reference has been completed, straighten the master test jumper.

When the return loss reference scan is over, the word **Done** will appear to the right of the **Return Loss** reference option in the **References** tab.



The indicator **Done** means that the system has access to a reference file. If the environmental conditions change or if you use a different master test jumper, the reference values might not be valid for the tests to perform.

Configuring Test Parameters

Before performing a test, you must specify the analysis parameters and the pass-fail criteria for the device under test (DUT).

Configuring Analysis Parameters

The **Sampling** group contains all the parameters relative to the scanning properties of the system.

- **Channels**: Channels to be tested. To reduce testing time, select only the channels you intend to use. You must select at least one channel to enable the start button.
- **Start wavelength** and **End wavelength**: Test wavelength range (in nm) corresponding to the full range of the source. Defining a smaller range optimizes the test results and may reduce testing time. The software allows to scan from 1250 to 1650 nm while the source emission is guaranteed on a slightly smaller range.

- **Sampling resolution**: Scan resolution (in pm).
- **Offset compensation**: Relationship between the motor position and the signal wavelength used in calculations to take into account any possible drift. Offset compensation is done using the internal wavelength referencing elements (Fabry-Perot etalon and acetylene cell).

  You should perform an offset compensation at the beginning of each test session. If you select the check box, the application will calculate the offset and adjust the calibration table during the measurement.

  This value will remain valid until you turn off the unit. You can then clear the check box for the rest of the test session, after the first measurement.

  If you clear the check box, the application will use the last offset compensation performed during the current test session. If no compensation has been performed, factory settings will be used.
- **Trace averaging**: Selected to optimize the signal-to-noise ratio of the test scan.You can select the number of scans the application will perform during the tests. The application will then average the results. If you select **None**, only one scan will be performed.

The **Analysis parameters** group allows you to determine the spectral analysis that will be provided after the scan, for bandpass devices.

Note: *The bandpass analysis will be performed only if the first channel is a bandpass.*

- **Bandwidth determined at 3 levels**: The DUT will be spectrally analyzed and the bandwidth for each channel will be provided at three different, user-defined, attenuation levels. Default values are 1 dB, 3 dB, and 20 dB.

- **Associate with CWDM ITU channels grid (Insertion Loss or PDL acquisition required)**: Results will be compared against the ITU grid wavelengths. When you select this option, you must determine how the wavelength will be correlated to the ITU grid:
  - **Tolerance**: Central wavelength for each channel will be compared to the closest ITU channel central wavelength and a positive correlation will be made if the DUT's channel is within the user-specified wavelength tolerance.
  - **Bandpass**: Wavelength range around the ITU central wavelength, where IL, PDL, ORL and isolation calculations will be performed.
  - **Compute Isolation**: Isolation is calculated on the ITU channels defined above. It corresponds to the maximum insertion loss in the ITU bandwidth under analysis, minus the minimum insertion loss in the ITU bandwidth of any adjacent or non-adjacent channel. Isolation is calculated using a 1-nm integrated resolution; therefore you may notice differences between the graph and the results table.
  - **Compute PDCW/PDBW (PDL acquisition required)**: When testing for PDL, you may select to analyze the polarization-dependent central wavelength and the polarization-dependent bandwidth. For a definition of these parameters, refer to *Bandpass Filters* on page 112.

The application allows you to indicate the test selection in the **Acquisition** group.

IMPORTANT

To ensure the best possible results, you should not perform ORL measurement at the same time than IL or PDL measurements when the DUT's output ports are either terminated or mandrel-wrapped.

- **Insertion Loss (IL):** Measurement is performed at unknown state of polarization (SOP) without IQS-5150B, at default SOP or at the SOP you selected. In the latter case, ensure that the reference has been performed using the same SOP.
- **PDL and average IL**:
  - IL measurement corresponds to average IL, as calculated using Mueller Matrix.
  - For PDL, calculations, based on the Mueller Matrix four-state method, take into account the optical retardation of the All-Band Polarization State Adjuster (IQS-5150B).
- **Return Loss:** Measurement is performed at default SOP or at the SOP you selected. In the latter case, ensure that the reference has been performed using the same SOP.

  During the measurement, you should mandrel all the outputs of the DUT, in order to avoid any reflection from the output connectors to interfere with the measurement.

To configure the analysis parameters:

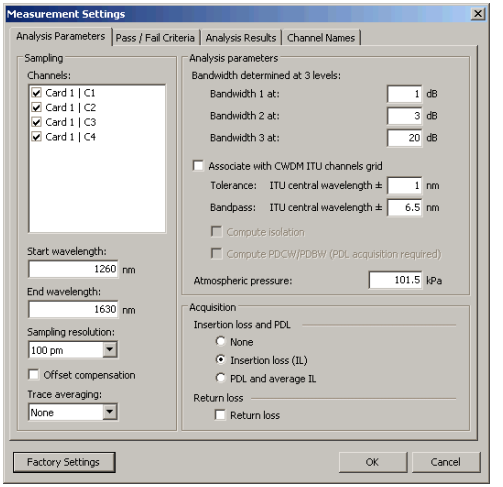
1. On the menu bar, select **Measurements > Modify Measurement Settings**.

   OR

   On the **Measurement Settings** tab, click the **Modify** button.

2. From the **Analysis Parameters** tab, enter the desired values in the corresponding boxes. Those values will be kept until you click **Factory Settings** to reset them.

Note: *You can save the measurements settings (**File Menu > Save**) for further use (**File Menu > Recall**).*



Defining Pass/Fail Criteria for Bandpass DUTs

You can specify pass/fail criteria for the DUT to determine whether or not the DUT is within specifications.

The pass/fail criteria are divided into two groups:

- **Bandpass Criteria**: The bandpass criteria is always taken into account when testing a bandpass filter.
- **ITU Comparison Criteria**: The ITU comparison criteria is only taken into account when **Associate to CWDM ITU Channels Grid** has been selected in the **Analysis Parameters** tab.

After each acquisition scan, the values that do not comply with the defined pass/fail criteria will appear in red in the results table.

The bandpass criteria for pass/fail results include:

- **Maximum insertion loss at center wavelength**: Center wavelength is the midpoint between the lower and upper wavelengths of the BW1 interval. The insertion loss is determined as the acceptable attenuation at this wavelength. The default value is 3 dB.
- **Minimum bandwidth [BW1]**: Bandwidth is determined as the minimum acceptable wavelength interval at a specified loss level calculated from the peak power. The default value is 13 nm.
- **Maximum insertion loss at BW1**: Maximum insertion loss is determined as the maximum acceptable attenuation within the BW1 interval. The default value is 3 dB.
- **Maximum polarization dependent loss at BW1**: Maximum acceptable PDL over the range defined by BW1. The default value is 0.2 dB.
- **Maximum return loss at BW1**: Strongest acceptable reflection (lowest acceptable ORL) value within BW1. The default value is 50 B

The ITU comparison criteria for pass/fail results are:

- **Maximum center wavelength [CW] deviation**: Difference, in nm, between the ITU center wavelength and the detected channel center wavelength. For this correlation to be made, the tolerance condition specified in the **Analysis Parameters** tab must be respected. The default value is 1 nm.
- **Maximum insertion loss at ITU CW ± bandpass**: Maximum acceptable insertion loss of the detected channel will be determined at the wavelength corresponding to the ITU channel central wavelength. The default value is 3 dB.
- **Maximum polarization dependent loss at ITU CW ± bandpass**: Maximum acceptable PDL of the detected channel will be calculated at the central wavelength of the corresponding ITU channel. The default value is 0.2 dB.
- **Maximum return loss at ITU CW ± bandpass:** Maximum acceptable reflection (lowest acceptable ORL) value at the corresponding ITU center wavelength. The default value is 50 dB.
- **Maximum ripple at ITU CW ± bandpass**: Ripple is the IL variation over the ITU defined bandpass interval of the channel. The default value is 0.5 dB.

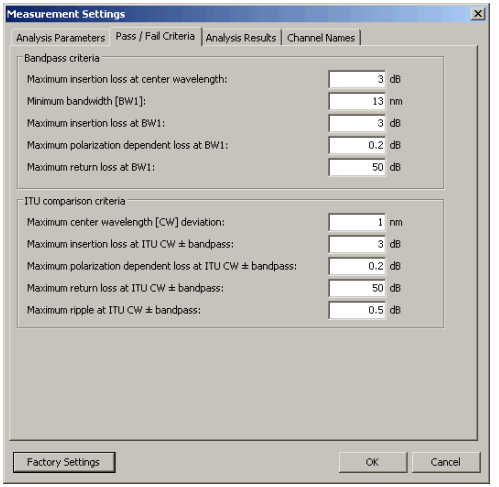
To define the pass/fail criteria:

1. On the menu bar, select **Measurements** > **Modify Measurement Settings**.

OR

On the **Measurement Settings** tab, click the **Modify** button.

2. Select the **Pass/Fail Criteria** tab.



3. Enter the desired values in the corresponding boxes.

Setting up the Wavelength Ranges

You can set up to three wavelength ranges for the analysis.

These ranges can:

- ➤ all be different (1260-1360 nm, 1370-1390 nm, 1450-1490 nm, 1510-1610 nm)
- ➤ overlap (1260-1630 nm, 1290-1310 nm, 1400-1600 nm, 1500-1550 nm)
- ➤ be limited to one number (1590-1590 nm)

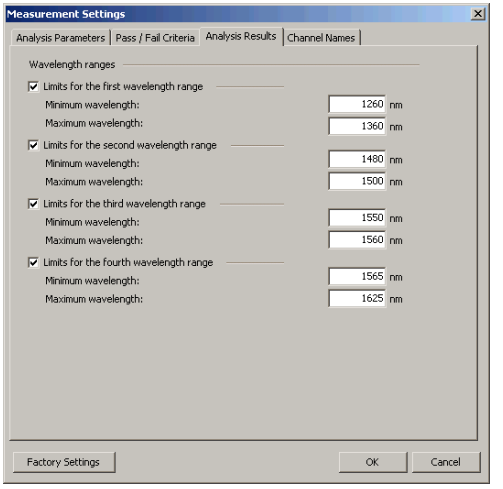
To set the wavelength ranges:

1. On the menu bar, select **Measurements** > **Modify Measurement Settings**.

   OR

   On the **Measurement Settings** tab, click the **Modify** button.

2. Select the **Analysis Results** tab.



3. Select which ranges you want to enable by checking the corresponding boxes.
4. Enter the minimum and maximum values for the selected wavelength ranges.

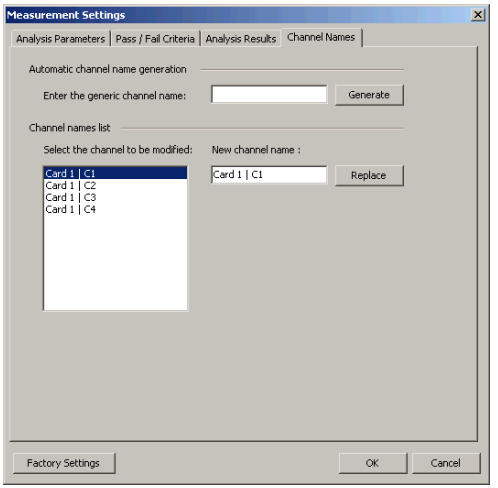
   If you enter the same value for maximum and minimum, only one measurement will be taken at that one wavelength instead of a range.
5. Click **OK** to use the new wavelength ranges, or click **Factory Settings** to revert to the original values.

Customizing Channel Names

The channels can be named using a generic name, followed by a number to differenciate them amongst themselves, or you can enter individual names to help you locate your test results quicker.

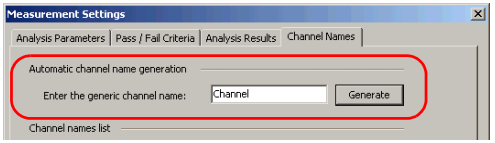
To change the channel names:

1. On the menu bar, select **Measurements** > **Modify Measurement Settings**.
2. Select the **Chanel Names** tab.

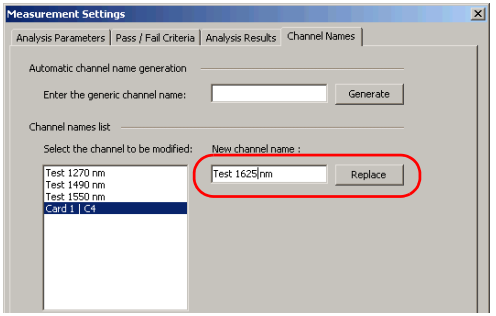


3. Name the channels.

➤ To use the automatic naming feature, enter a generic name in the corresponding box, then click **Generate**. If you leave the box empty, the channels will only be identified by their numbers.



➤ To name channels manually, select one from the list to the left, type in the name you want under **New channel name**, then click **Replace**.



4. Click **OK** to apply the changes everywhere in the application, or click **Factory Settings** to revert to the original names.

Changing Atmospheric Pressure Value Manually

You might want to change the atmospheric pressure value to ensure the best wavelength accuracy possible. The system will then automatically adjust the wavelength calibration table to compensate for the local atmospheric pressure. An internal temperature probe completes the information needed for wavelength adjustment.

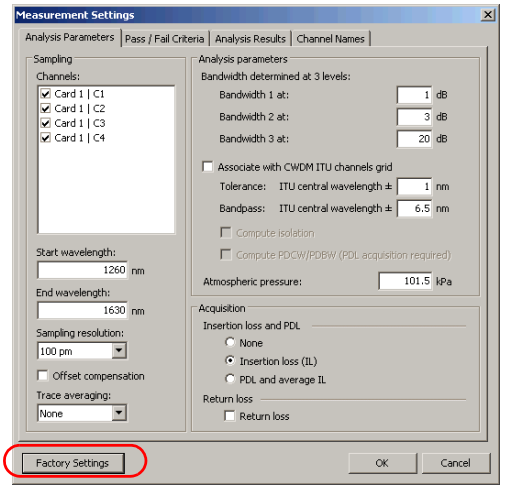
To change the atmospheric pressure value:

1. On the menu bar, select **Measurements** > **Modify Measurement Settings**.

   OR

   On the **Measurement Settings** tab, click the **Modify** button.

2. From the **Analysis Parameters** tab, change the atmospheric pressure value in the correspondig box. This value will be kept until you click **Factory Settings** to reset them.



3. Click **OK** to confirm your change.

Saving and Retrieving Measurement Settings

Once all measurement settings have been configured, you can save them for future use, especially if these parameters will be used often.

To save the measurement settings:

1. On the menu bar, open the **File** menu
2. Select **Save Measurement Settings As**.
3. Enter the desired file name and select a location to save the file. The format of this file is *.cfg12008.
4. Click **Save**.

To retrieve the measurement settings:

1. On the menu bar, open the **File** menu
2. Select **Open Measurement Settings**.
3. If necessary, select the location where the measurement settings file is saved.
4. Select the desired file (file format is *.cfg12008) and click **Open**.

Configuring Advanced Application Parameters

Further customization of the following application parameters is possible through the application configuration file:

- ITU grid baseline: An ITU grid wavelength offset is also possible through the configuration file. The default wavelength is the first wavelength of the scan range. An offset can be applied to this wavelength and it will be applied to all the wavelengths in the ITU grid. The minimum value, and the start value as well, is 1251 nm (or can be manually changed to 1250 nm). The ITU grid is generated by adding steps of 20 nm to the start value.

All of the minimum and maximum limits, as well as the checked states are saved in the configuration file under the Measurement Settings part for any modification concerning them.

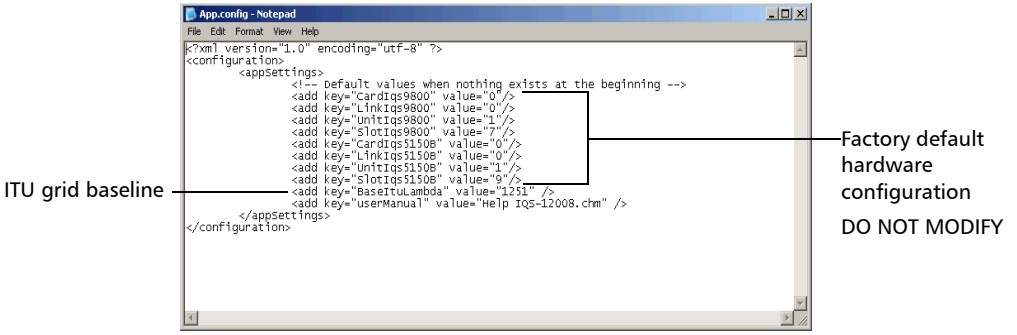
To modify the configuration file:

1. Close the IQS-12008 application.
2. Go to C:\Program Files\EXFO\ IQS12008\Application12008.exe.config.

IMPORTANT

Before modifying the configuration file, EXFO suggests that you make a copy of the *Application12008.exe.config* file. In case of problems, you could use this copy as a backup.

3. Open the file with a text editor.



IMPORTANT

For your system to function properly,

- **Do not modify the lines that correspond to the factory default hardware configuration.**
- **Modify only the BaseItuLambda value.**

4. If needed, modify the BaseItuLambda value from 1270 to 1271; such a change will reflect automatically on the result display wavelengths, which will be changed to fit the new ITU grid baseline value.

5. Save the file and close the text editor.

The changes will apply the next time you open the IQS-12008 All-Band Component Analyzer application.

Optimizing Performance

This section gives you important information on how to get optimum performance from your All-Band Component Analyzer.

Spectral Errors

The IQS-12008 All-Band Component Analyzer uses a Fabry-Perot interferometer and a high-precision absolute wavelength reference gas cell to ensure wavelength accuracy of the spectral measurements. To ensure that the system is operating to its published specifications, it is important to respect the recommended 30-minute warmup period and the specified operating environment (see *Technical Specifications* on page 109).

The system is calibrated at EXFO and verified with a NIST SRM 2519 HCN absorption cell.

You can use the offset compensation function to optimize test results. See *Configuring Test Parameters* on page 48.

IL/PDL Errors

There are numerous possible sources of errors for the IL measurement. Some of them are inherent to system and test procedures, while others are related to operation and fiber handling. Understanding these sources of error will help you to optimize the accuracy of your loss measurements.

- *Environmental stability*

  To ensure optimum results, it is important to respect the recommended 30-minute warmup period before performing any calibration, reference, or null measurement.

- *Connector repeatability*

  It is well known that connector repeatability is a significant source of error when testing the IL of any connectorized component. There is no practical way of completely eliminating these errors. However, if all connectors are of good quality and adequately cleaned, if you perform reference measurements after changing master test jumpers, the errors are minimized. Where it is important to measure the IL of the device alone, you should use fusion splices on the start side of the DUT.

- *Different connector types*

  To test components with different connector types, you will have to change the master test jumper, use a hybrid patchcord or change the EUI on the Ref. Out connector. It implies that You will have to perform a new reference measurement.

  You will also have to change the fiber-optic adapters (FOAs) on the IQS mini-modules' detectors. In this case, you will need to perform a new detector response calibration and to repeat the reference measurement for optimum results. Different FOAs have slightly different alignment characteristics (within manufacturing tolerances), which increase measurement uncertainty.

Return Loss Errors

Most of the factors affecting IL and PDL also affect return loss accuracy. There are, however, some additional factors that should be considered.

➤ *Power budget*

When measuring return loss, the detectors read a very small amount of power. To obtain optimum accuracy with weak reflections, it is important to optimize the system's dynamic range. One way of improving the ORL sensitivity is to bypass the optional IQS-5150B All-Band Polarization State Adjuster. This will give an additional 3 to 8 dB sensitivity as well as better accuracy and resolution.

➤ *Calibration reference*

The calibration reference test jumper supplied with the system is used as an absolute reflection reference based on the glass-to-air interface reflection of ≈4% (–14.7 dB at 1550 nm). When performing measurements, you use a different master test jumper. The IL of the output connector/master test jumper connector will not be exactly the same as the IL of the output connector or of the reference test jumper connector. This difference contributes directly to the ORL measurement error. For this reason, it is important to use a master test jumper with a good quality connector.

5 Testing DUTs with the All-Band Component Analyzer

Cleaning and Connecting Optical Fibers

IMPORTANT

To ensure maximum power and to avoid erroneous readings:

- **Always clean fiber ends as explained below before inserting them into the port. EXFO is not responsible for damage or errors caused by bad fiber cleaning or handling.**
- **Ensure that your patchcord has appropriate connectors. Joining mismatched connectors will damage the ferrules.**

To connect the fiber-optic cable to the port:

1. Clean the fiber ends as follows:

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

   1b. Use compressed air to dry completely.

   1c. Visually inspect the fiber end to ensure its cleanliness.

2. Carefully align the connector and port to prevent the fiber end from touching the outside of the port or rubbing against other surfaces.

   If your connector features a key, ensure that it is fully fitted into the port's corresponding notch.

3. Push the connector in so that the fiber-optic cable is firmly in place, thus ensuring adequate contact.

   If your connector features a screwsleeve, tighten the connector enough to firmly maintain the fiber in place. Do not overtighten, as this will damage the fiber and the port.

Note: *If your fiber-optic cable is not properly aligned and/or connected, you will notice heavy loss and reflection.*

Performing Test Scans

Once the calibration and reference have been completed and the test parameters have been defined, you may proceed with a test scan. A test scan includes the number of sweeps necessary to provide information for all the selected tests.

IMPORTANT

For accurate results:

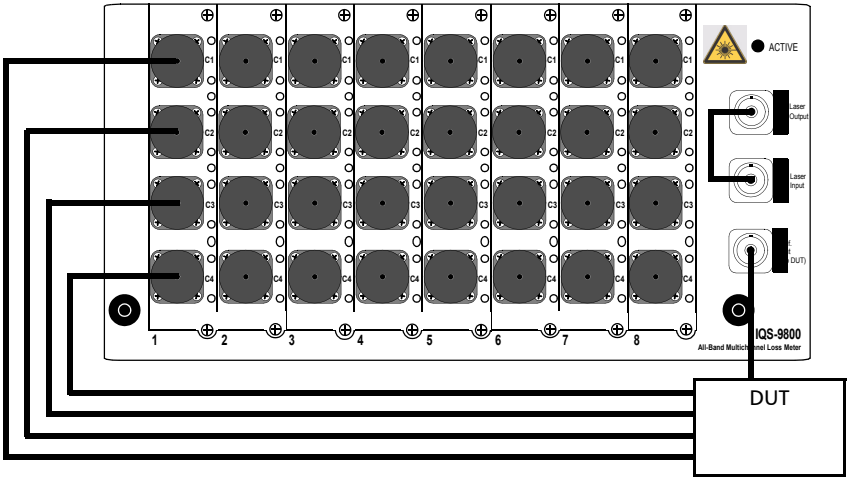
- **Before performing any measurement, ensure that all the connectors and fiber-optic adapters (FOAs) are clean, and that the warmup period (at least 30 minutes) is over.**
- **The test types you select must correspond to the reference measurements you performed (e.g., an IL/PDL reference will only allow an IL/PDL measurement).**
- **If you did not perform the reference with the default polarization state (linear positive diagonal), you should use the same polarization state for your measurements.**
- **You should not perform ORL measurement at the same time than IL or PDL measurements when the DUT's output ports are either terminated or mandrel-wrapped.**

The system will sweep the source, transfer the data, analyze the acquisition points, and display the results in accordance with the parameters displayed in the **Analysis Parameters** and **Pass/Fail Criteria** tabs. To configure these settings, see *Configuring Test Parameters* on page 48.

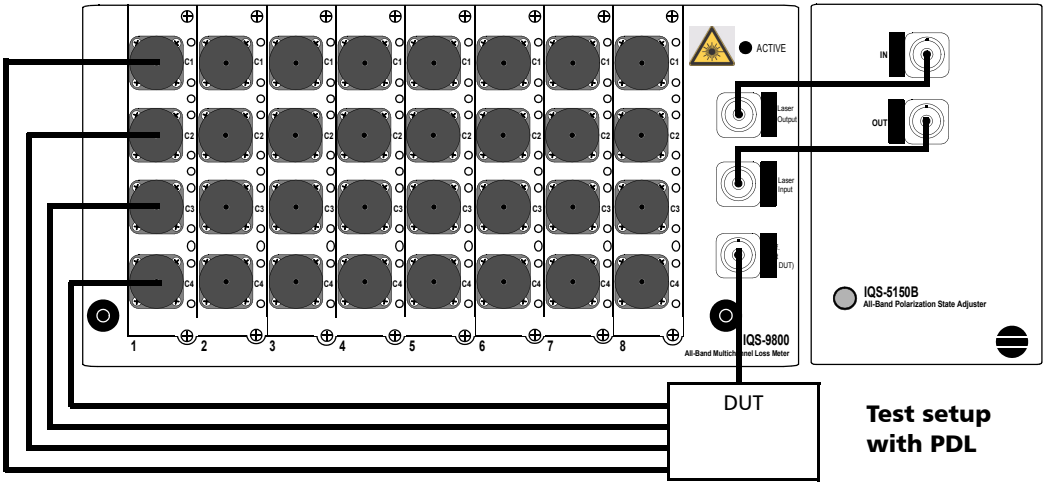
To perform a test scan:

1. From the **Measurement Settings** tab, select the desired tests.

2. Connect the DUT as shown, depending on the setup you intend to use.



Test setup without PDL



Test setup with PDL

3. Click **Start Acquisition**, at the bottom right corner of the application main window.

Note: *You can stop the acquistion at any time by clicking* ***Stop Acquisition****.*

Controlling Modules Individually

The All-Band Component Analyzer allows you to manually turn the source on or off and set it to a specific wavelength, modify the polarization state of the IQS-5150B All-Band Polarization State Adjuster. You can also control certain features of the IQS-9800 All-Band Multichannel Loss Meter.

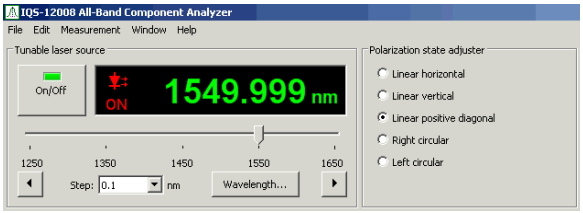
To read the power on each detector:

1. Select the **Individual Module Control** function tab, then **Dectectors** tab.
2. Select the detectors you wish to monitor by clicking the **Select Detectors** button and selecting the desired channels on the dialog box. Click **OK** to confirm and close the window.

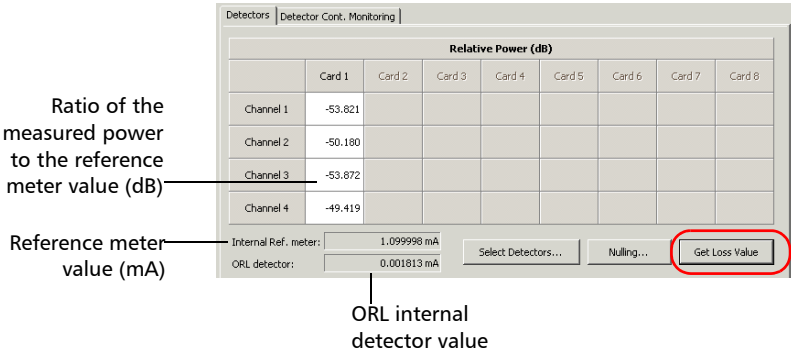
3. In the **Tunable Laser Source** group, you may set the laser source to a specific wavelength in three different ways:

- ➤ By sliding the cursor underneath the wavelength display.
- ➤ By clicking **Wavelength** and entering the desired wavelength.
- ➤ By clicking the left and right arrows located on each side of the wavelength cursor line. The wavelength steps are selected in the **Step** drop-down menu.

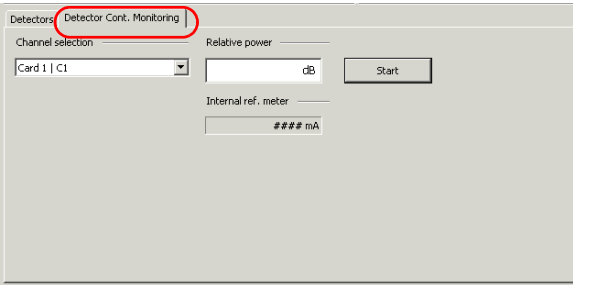
Note: *At the end of a complete scan, the source automatically sets itself at 1650 nm where almost no light is emitted. Make sure to set the source at a different wavelength to start measuring the loss on individual detectors.*



4. If necessary, select a polarization state.
5. In the **Detectors** tab, click **Get Loss Value** to display the power reading for the selected detector(s).



6. To view a continuous monitoring of a precise channel, click the **Detector Cont. Monitoring** tab.



7. Select the channel you want to view in the drop-down list.
8. Click **Start**. The **Relative power** and **Internal ref. meter** values are updated twice every second.
9. Click **Stop** once you are done.

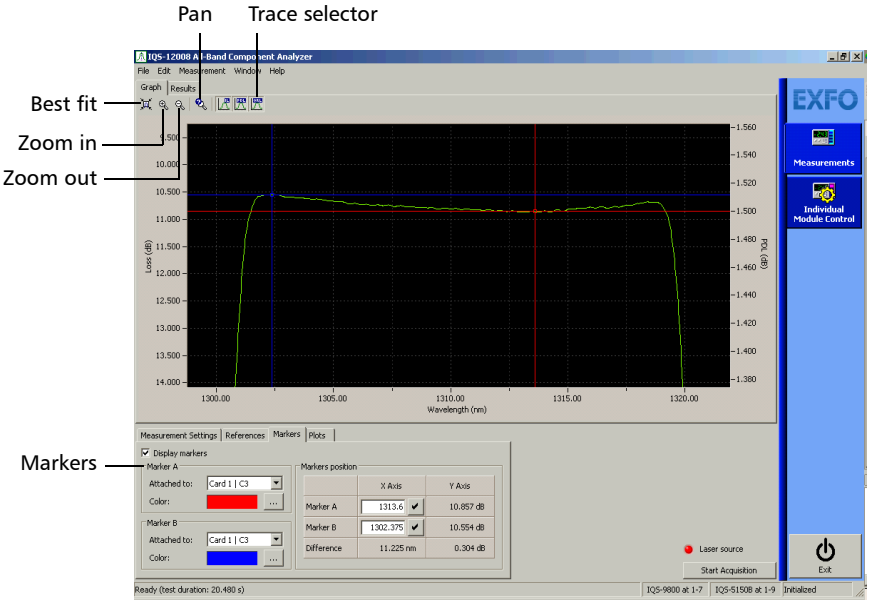
Note: *If the continuous monitoring feature is enabled, the values in the **Detectors** tab will be disabled.*

6 Viewing the All-Band Component Analyzer Results

Test results are available in two formats: a graph and a data table. The results can be viewed and analyzed on-screen or saved to a file for further analysis and printing. The following sections will present how to use the on-screen tools for results analysis and how to treat the data file for analysis using a spreadsheet application.

Viewing the Results Graph

The results of the tested device appear as soon as the analysis ends. To further analyze the graph, you dispose of different graphic tools:



The graph displays the IL, PDL, and ORL traces. You can independently select the trace you want to view by clicking the corresponding button (trace selector).

Note: *IL and ORL are displayed using the same scale (left), and PDL is displayed on a separate scale (right).*

Best Fit

The best fit button reduces or enlarges the graph to optimize the graphical display area. The plot will occupy the maximum area while displaying the whole acquisition trace.

Zoom and Pan

To enlarge a specific area of the results trace you may zoom in or out of the graph. You may also pan the graph in any direction to keep the same zoom level as you view different sections of the trace.

To enlarge or reduce the desired area:

1. Click once in the plot area.
2. Hold down the SHIFT key.
3. Click and hold the left mouse button to indicate the top left corner of the area to enlarge.
4. Drag the mouse pointer to select the graph area you wish to enlarge.
5. Release both the mouse button and the SHIFT key. The area should be enlarged on the screen.
6. Repeat this procedure for further zoom levels.
7. Zoom out by clicking the zoom out or the best fit buttons.

To return to the previous zoom level:

1. Click once in the plot area.
2. Hold down the CTRL or the SHIFT key.
3. Click the right mouse button.

To pan the graph:

1. Click once in the plot area.
2. Hold down the CTRL key.
3. Click and hold the left mouse button.
4. Drag the cursor to pan the graph.

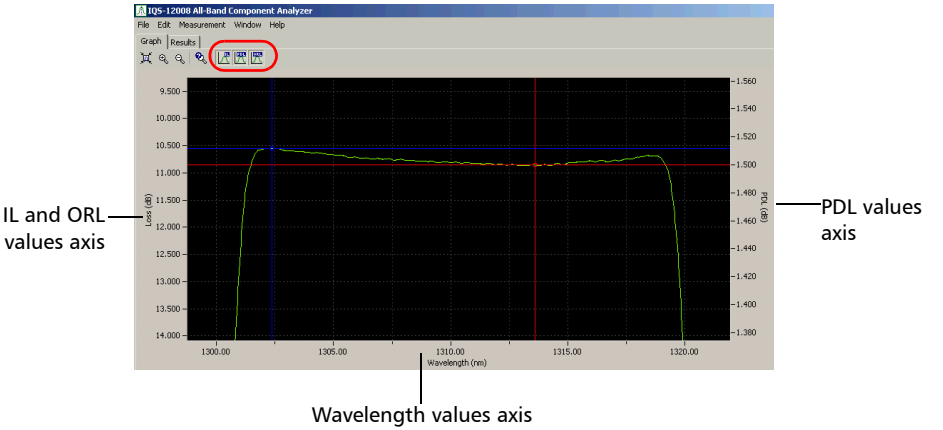
You will notice that the scale axis will change according to the zoom level and the plot area on screen.

Trace Selector

You can display IL, IL/PDL, and ORL traces individually or all at the same time on the graph.

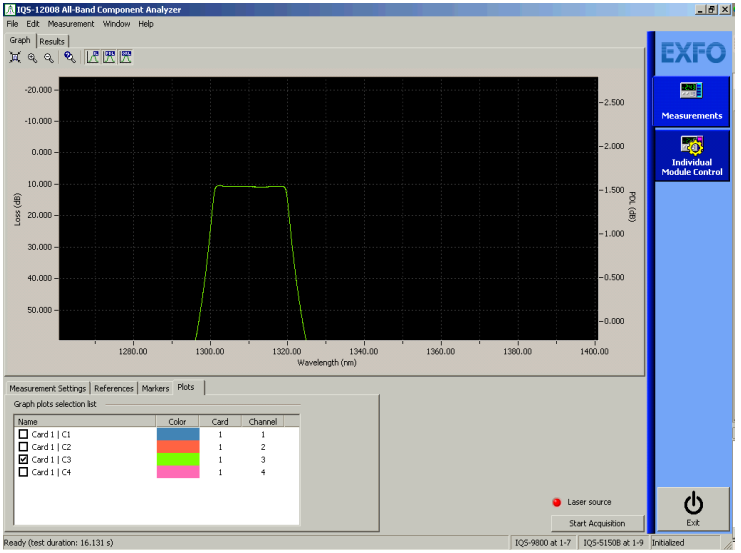
To show or hide a trace:

Click the button corresponding to the desired trace.



To select which traces to display by default:

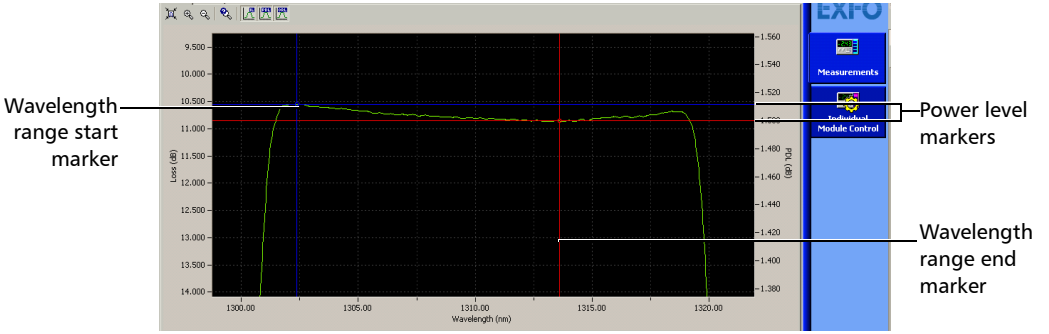
1. Select the **Plots** tab.



2. Select the channel or channels to display. Additional information is provided as to the channel's name, the color used to display the graph, as well as the channel's associated number and card.

Insertion Loss Trace Markers

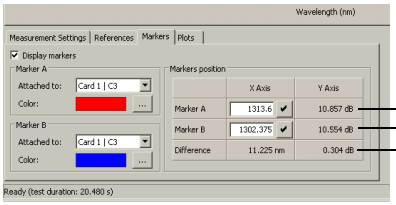
You can perform a point-by-point analysis on a specific wavelength interval by using the **Markers** tab.



The markers are crossbars that travel along the IL trace. The vertical bars travel along the wavelength axis, while the horizontal bars select automatically the power level at the intersection between the two bars.

To view markers on the graph:

1. Select the **Markers** tab to access markers functions.
2. Select the **Display Markers** box.
3. Attach markers A and B to a detector from the **Attach to** box.
4. Select a color for each marker.
5. Move the markers on the graph with your mouse, or enter precise wavelength values in the **Marker A** and **Marker B** boxes, in the **Markers Position** table.



Loss values at marker positions and loss variation between the markers are shown for the selected channel. The difference in wavelength and power is also displayed in the **Markers Position** table.

Note: *Since the graph resolution is lower than the scan resolution, sliding the markers along the wavelength axis may not go to the exact wavelength you wish to analyze. To reach a specific wavelength, you may have to zoom in to increase the number of data points between two wavelengths.*

Viewing the Results Tables

You can view all the data analysis based on the test measurement settings. The summary of the scan results is presented in three different tables:

- Main Analysis
- ITU Analysis
- Isolation

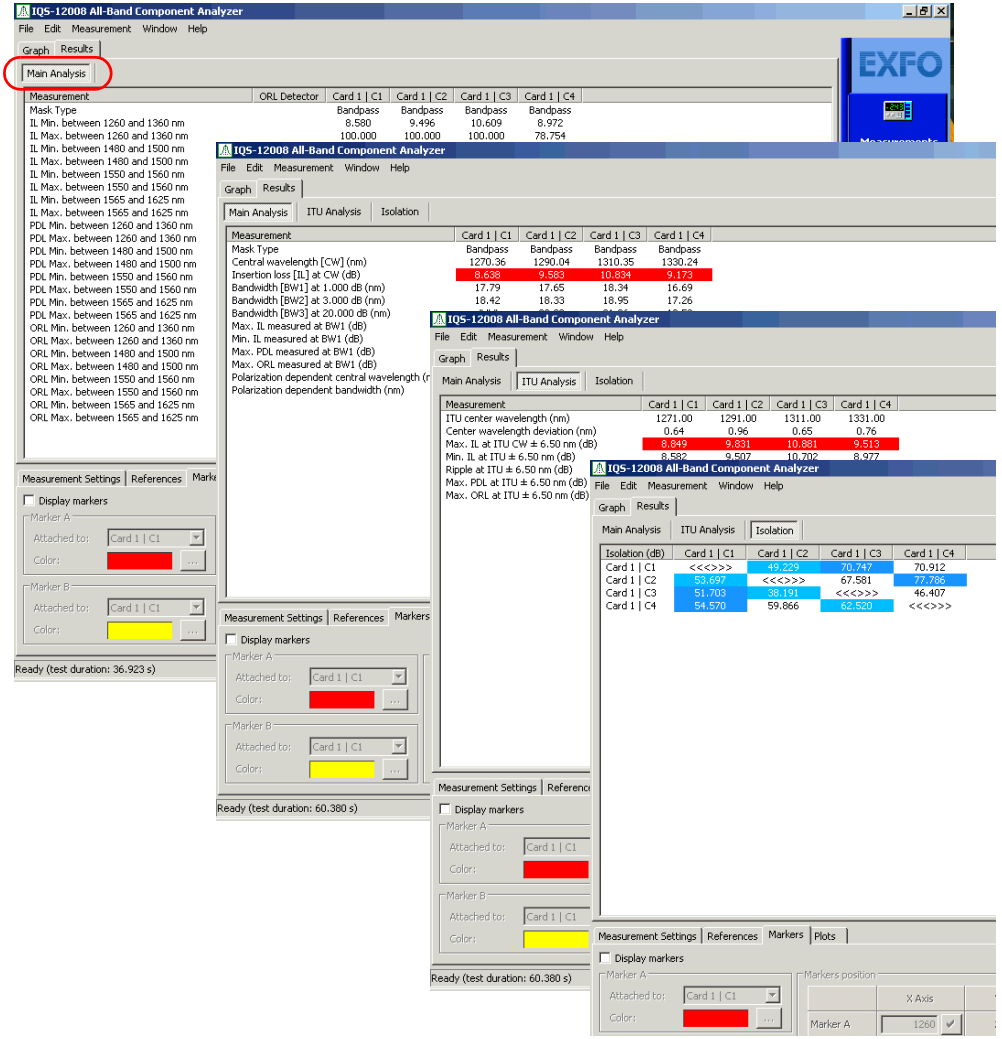
Should there be ORL results for the data analysis, you will notice an **ORL Detector** column in the table. Otherwise, you will only see the channel columns.

In the isolation table, the channels with the worst isolation values compared to the base channel with the <<<>>> will be displayed with a blue background. This will happen for the adjacent value (directly before or after the channel) and non-adjacent value (not directly before or after the channel).

The data presented in these tables is calculated in accordance with the definitions presented in *Definitions and Calculation Methods* on page 111.

To view the results tables:

1. From the **Measurements** function tab, select the **Results** tab.
2. Select the desired pane.



Exporting Data

You can build your own reports by exporting results table, IL, ORL and PDL data points, and graph.

- You can export results table and data points to a .txt (tab-separated) or a .csv (comma-separated) format.
- You can export the graph to different formats: .emf, .bmp, .jpg, .png.

You can use the exported data with a word processor or a spreadsheet of your choice.

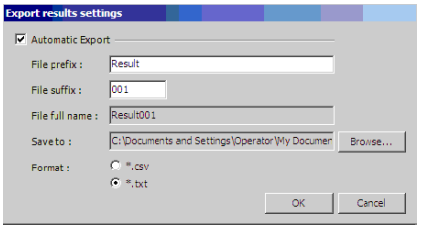
To export the results graph:

1. In the **File** menu, select **Export Graph**.
2. In the **Export Graph** window, enter the desired file name.
3. Select the desired file name format.
4. Click **Save**. By default, the file will be saved to the *My Documents* folder.

Open an image editor or import the graph into a word processor to view the file.

To set up the automatic exportation settings:

1. In the **Edit** menu, select **Export Results Settings**.
2. In the **Export results settings** dialog box, check the Automatic Export box.

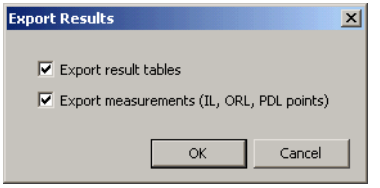


- ➤ The prefix is the part of the name that will not change. It will accept up to 30 characters
- ➤ The suffix is made of three digits from 00 to 999. This suffix will be automatically incremented as the exportations are performed.
- ➤ The box **Installs to** allows you to select where those files will be saved. Use the **Browse** button to select the location.
- ➤ The format can be either a .csv (comma-separated) or a .txt (tab-separated).

3. Click **OK** to confirm the parameters.

To export results table and/or data points:

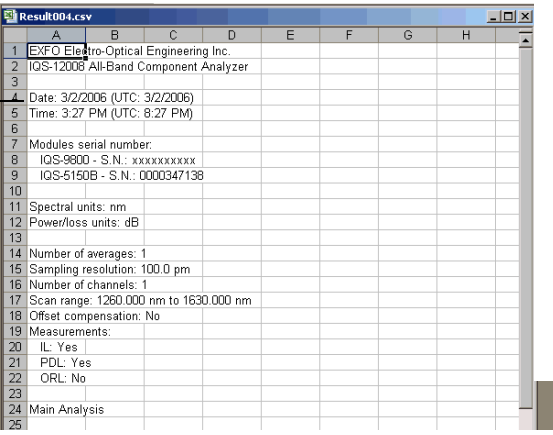
1. In the **File** menu, select **Export Results**.
2. In the **Export Results** dialog box, select the type of data you wish to export.



   Click **OK**.

3. In the **Export Results** dialog box, enter the desired file name. By default, the file has a .txt (tab-separated) format.
4. Click **Save**. By default, the file will be saved to the *My Documents* folder.
5. Open a spreadsheet, text editor or word processor to view the file. The columns (fields) are separated using a tab or a comma.

Tab-separated text file



7 Maintenance

To help ensure long, trouble-free operation:

- Always clean fiber-optic connectors before using them.
- Keep the unit free of dust.
- Clean the unit casing and front panel with a cloth 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.
- Avoid unnecessary shocks and vibrations.
- If any liquids are spilled on or into the unit, turn off the power immediately and let the unit dry completely.

WARNING

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

Cleaning EUI Connectors

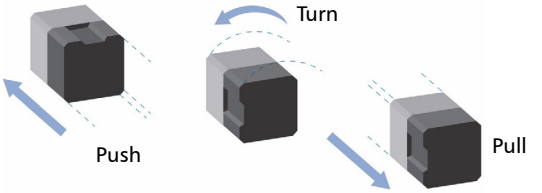
Regular cleaning of EUI connectors will help maintain optimum performance. There is no need to disassemble the unit.

IMPORTANT

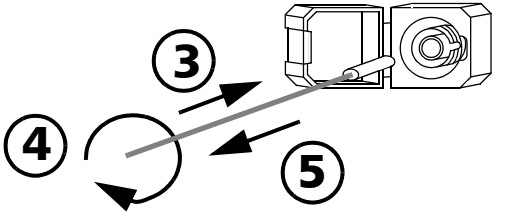
If any damage occurs to internal connectors, the module casing will have to be opened and a new calibration will be required.

To clean EUI connectors:

1. Remove the EUI from the instrument to expose the connector baseplate and ferrule.



2. Moisten a 2.5 mm cleaning tip with *one drop* of isopropyl alcohol (alcohol may leave traces if used abundantly).
3. Slowly insert the cleaning tip into the EUI 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, then continue to turn as you withdraw it.

5. Repeat steps 3 to 4 with a dry cleaning tip.

Note: *Make sure you don't touch the soft end of the cleaning tip.*

6. Clean the ferrule in the connector port as follows:

6a. Deposit *one drop* of isopropyl alcohol on a lint-free wiping cloth.

IMPORTANT

Isopropyl alcohol may leave residues if used abundantly or left to evaporate (about 10 seconds).

Avoid contact between the tip of the bottle and the wiping cloth, and dry the surface quickly.

6b. Gently wipe the connector and ferrule.

6c. With a dry lint-free wiping cloth, gently wipe the same surfaces to ensure that the connector and ferrule are perfectly dry.

6d. Verify connector surface with a portable fiber-optic microscope (for example, EXFO's FOMS) or inspection probe (for example, EXFO's FIP).

WARNING

Verifying the surface of the connector WHILE THE UNIT IS ACTIVE WILL result in permanent eye damage.

7. Put the EUI back onto the instrument (push and turn clockwise).

8. Throw out cleaning tips and wiping cloths after one use.

Cleaning Detector Ports

Regular cleaning of detectors will help maintain measurement accuracy.

IMPORTANT

Always cover detectors with protective caps when unit is not in use.

To clean detector ports:

1. Remove the protective cap and adapter (FOA) from the detector.
2. If the detector is dusty, blow dry with compressed air.
3. Being careful not to touch the soft end of the swab, moisten a cleaning tip with *only one drop* of isopropyl alcohol.

IMPORTANT

Alcohol may leave traces if used abundantly. Do not use bottles that distribute too much alcohol at a time.

4. While applying light pressure (to avoid breaking the detector window), gently rotate the cleaning tip on the detector window.
5. Repeat step 4 with a dry cleaning tip or blow dry with compressed air.
6. Discard the cleaning tips after one use.

Recalibrating the Unit

Manufacturing and service center calibrations are based on the ISO/IEC 17025 Standard, which states that calibration documents must not contain a recommended calibration interval, unless this has been previously agreed upon with the customer.

Validity of specifications depends on operating conditions. For example, the calibration validity period can be longer or shorter depending on the intensity of use, environmental conditions and unit maintenance. You should determine the adequate calibration interval for your unit according to your accuracy requirements.

Under normal use, EXFO recommends calibrating your unit every three years.

Recycling and Disposal (Applies to European Union Only)

Recycle or dispose of your product (including electric and electronic accessories) properly, in accordance with local regulations. Do not dispose of it in ordinary garbage receptacles.

This equipment was sold after August 13, 2005 (as identified by the black rectangle).

- Unless otherwise noted in a separate agreement between EXFO and a customer, distributor or commercial partner, EXFO will cover costs related to the collection, treatment, recovery and disposal of end-of-lifecycle waste generated by electronic equipment introduced after August 13, 2005 to an European Union member state with legislation regarding Directive 2002/96/EC.
- Except for reasons of safety or environmental benefit, equipment manufactured by EXFO, under its brand name, is generally designed to facilitate dismantling and reclamation.

For complete recycling/disposal procedures and contact information, visit the EXFO Web site at www.exfo.com/recycle.

8 Troubleshooting

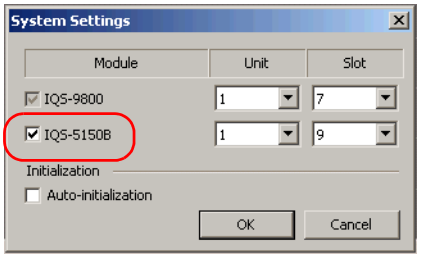
Ensuring Proper Hardware Operation

You can verify that the system gives the best possible IL, PDL and ORL results.

To ensure that all the hardware functions properly:

1. If it is not already done, insert the IQS-9800 Loss Meter into the IQS-500/600 Controller Unit so that it takes slots 0 to 7 inclusively. If you want to measure PDL, insert the IQS-5150B All-Band Polarization State Analyzer (PSA). For more information, see *Getting Started with Your All-Band Component Analyzer* on page 13.
2. Turn on the IQS-510P/IQS-610P Controller Unit.
3. Go to C:\Documents and Setting\All Users\Application Data\EXFO\IQS-12008 and delete the *Reference.cfg* and *Calibration.cfg* files.
4. Start the IQS-12008 All-Band Component Analyzer application.
5. From the **Measurement** menu, select **System Settings**.

   Depending on if your test setup includes PDL or not, select or clear the **IQS-5150B** box.

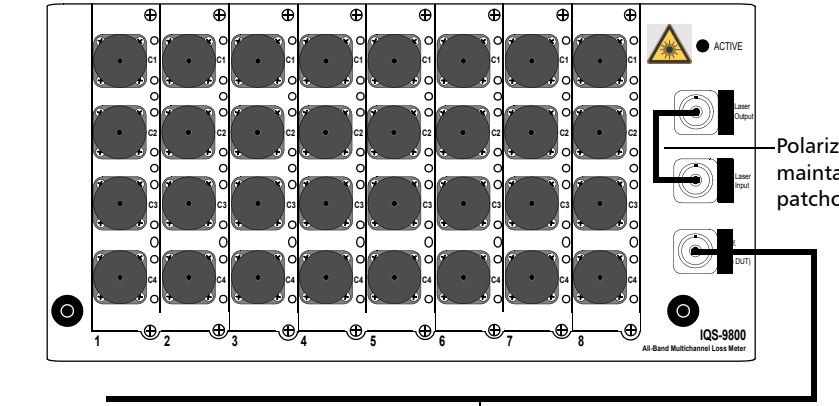


   Click **OK**.
6. From the **Measurement** menu, select **Initialize Hardware**.
7. Let the system warm up for 30 minutes.

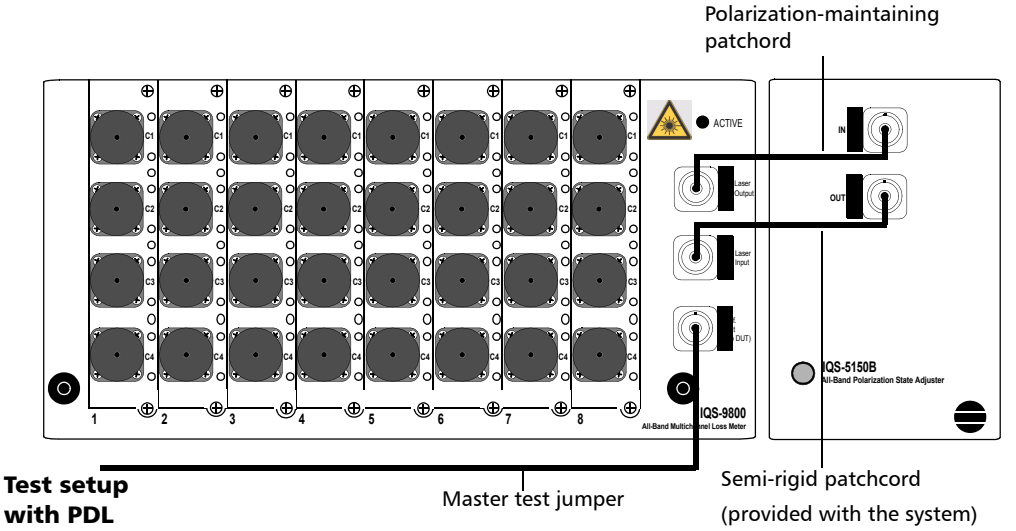
8. If no fiber is connected to the detectors, put protective caps on all detectors. Disconnect the polarization-maintaining test jumper from the Laser Output port.

9. From the **Measurement** menu, select **Detectors Nulling**.

10. When nulling is complete, connect as shown, depending on the setup you intend to use.



Test setup without PDL

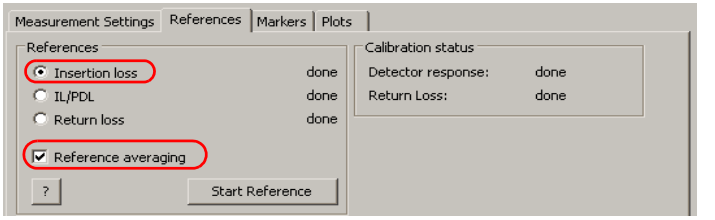


11. On the menu bar, select **Measurement >Calibration> Calibration Averaging**.

12. On the menu bar, select **Measurement >Calibration > Detector Response** and follow the instructions on-screen. For more information, see *Calibrating the System* on page 29.

13. Start the insertion loss (IL) reference as follows:

13a. On the **References** tab, select the **Reference averaging** box.

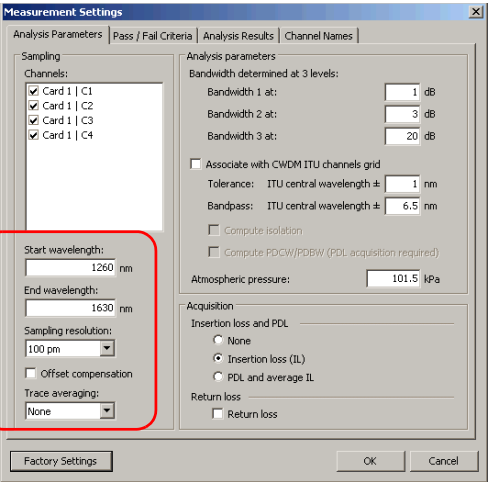


13b. Select **Insertion Loss** then click the **Start Reference** button and follow the instructions on-screen. For more information, see *Referencing the System* on page 37.

14. Set the analysis parameters as follows:

14a. On the menu bar, select **Measurement** > **Modify Measurement Settings**.

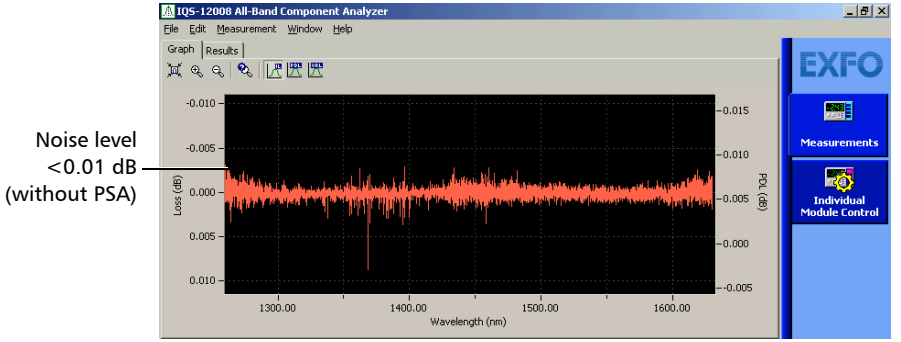
14b. From the **Analysis Parameters** tab, enter the values in the corresponding boxes, as shown:



14c. Click **OK** to confirm.

15. If your test setup includes a PSA, go directly to step 16.
If you are testing without a PSA, perform an IL measurement by connecting, the master test jumper to each detector, one at a time. Click **Start Acquisition** to start the measurement.

All the resulting curves must be centered around 0 dB ±0.005 for the 1260 to 1550 nm range and ±0.01 for the 1550 to 1630 nm range. The noise level is typically of less than 0.01 dB over the 1260 to 1630 nm range.



Note: *If the curves are not as expected, refer to the following table:*

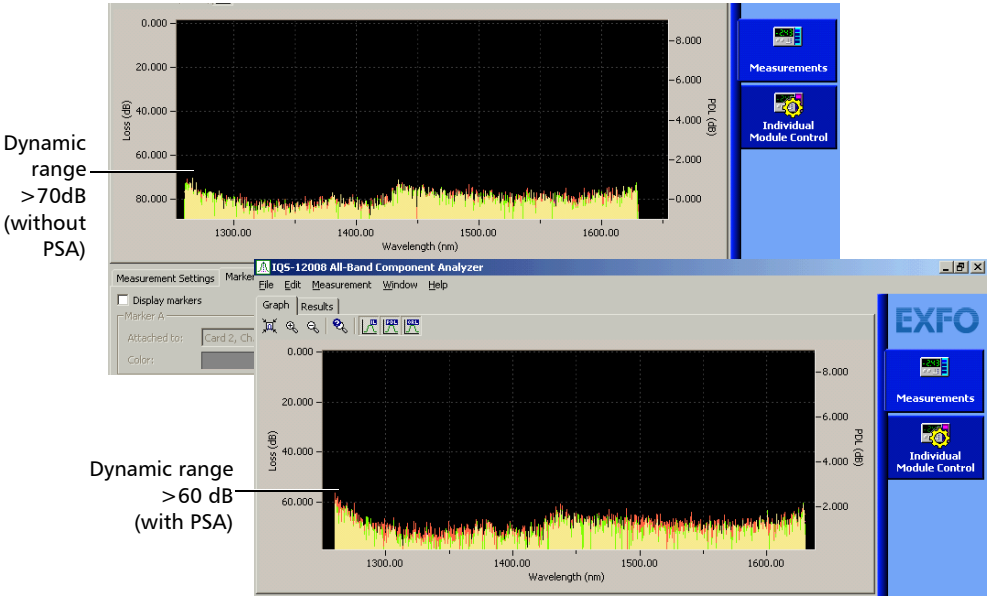
Problem	Possible cause
Most curves are not centered around 0 dB or noise level is too high on most curves	You did not use a polarization-maintaining patchcord between the Laser Out port and the PSA input port.
	Master test jumper is defective.
	Selected state of polarization was not Linear Positive Diagonal for reference and measurement.
	Master test jumper was not properly connected to the Ref. Out port during reference.
	FOA installed on the first channel of the leftmost DET-1843 card is dirty.
	All FOAs are dirty.
	Equipment is defective.
Some curves and noise levels are correct and some others are not	Master test jumper is defective.
	During detector response or IL measurement, patchcord was not properly connected to the FOA of the channels having incorrect curves or noise level.
	Bad nulling (light reached detectors) or nulling was performed too long ago.
	FOAs installed on the channels having incorrect curves or noise level are dirty.
	Equipment is defective.

16. Measure the IL dynamic range as follows:

16a. Put protective caps on all detectors.

16b. Perform an IL measurement on all channels (select **IL** option and not **IL/PDL**) with the averaging option selected. For more information, see *Configuring Test Parameters* on page 48 and *Performing Test Scans* on page 68.

The displayed curve shows the IL dynamic range of all channels. The dynamic range is typically of more than 70 dB (without PSA) and 60 dB (with PSA) on the 1260 to 1630 nm range.



Note: *If the IL dynamic range is not as expected, refer to the following table:*

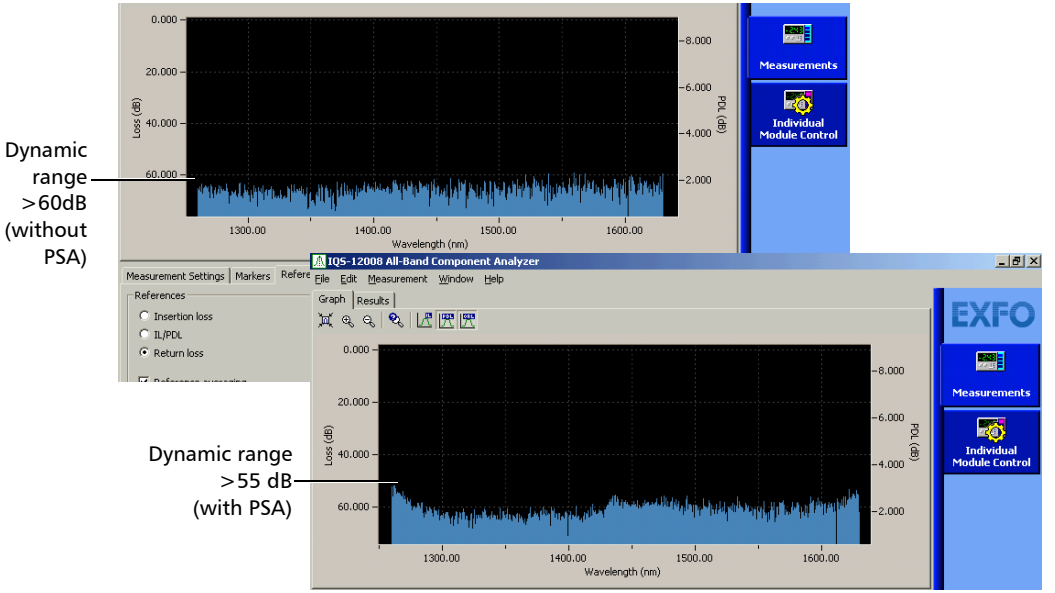
Problem	Possible cause
Dynamic range is too low on most channels	You did not use a polarization-maintaining patchcord between the Laser Out port and the PSA input port.
	Connectors of the polarization-maintaining patchcord, master test jumper or semi-rigid patchcord are dirty.
	Laser Out, Laser In or Ref. Out ports are dirty.
	One or more patchcord is defective.
	Bad nulling (light reached detectors) or nulling was performed too long ago.
	Selected state of polarization was not Linear Positive Diagonal.
	Master test jumper was not properly connected to the Ref. Out port during reference.
	FOA installed on the first channel of the leftmost DET-1843 card is dirty.
	All FOAs are dirty.
	Equipment is defective.
Dynamic range is correct on some channels and too low on others	Master test jumper is defective.
	Bad nulling (light reached detectors) or nulling was performed too long ago.
	During detector response, patchcord was not properly connected to the FOA of the channels having a low dynamic range.
	FOAs installed on the channels having a low dynamic range are dirty.
	Equipment is defective.

17. On the menu bar, select **Measurement** > **Calibration** > **Return Loss** to perform a return loss calibration. Ensure that the averaging option is selected. For more information, see *Return Loss Calibration* on page 34.

To ensure a better accuracy, keep the fiber mandrel-wrapped between calibration and reference steps.

18. On the menu bar, select **Measurements** > **Reference** > **Return Loss** to perform a return loss reference. Ensure that the averaging option is selected. For more information, see *Return Loss Reference* on page 45.

19. Perform an ORL measurement with a mandrel-wrapped fiber (minimum of 10 turns) to measure ORL dynamic range. For more information, see *Performing Test Scans* on page 68.
The noise floor is typically of at least 60 dB (without PSA) and of 55 dB (with PSA) on the entire range.



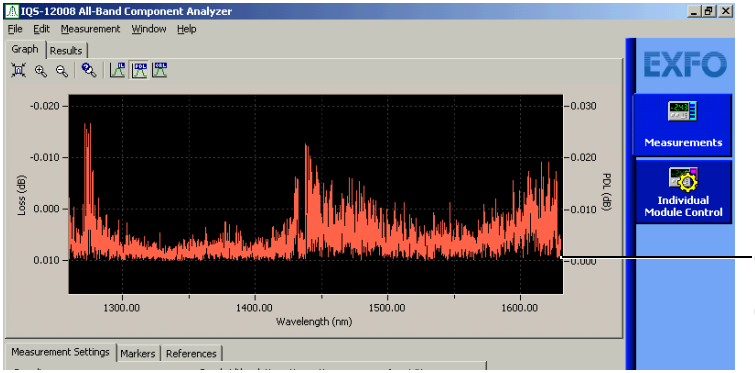
Note: *If the ORL dynamic range is not as expected, refer to the following table:*

Problem	Possible cause
Noise floor is too low	You did not use a polarization-maintaining patchcord between the Laser Out port and the PSA input port.
	Selected state of polarization was not Linear Positive Diagonal for reference and measurement.
	Connectors of the polarization-maintaining patchcord, master test jumper or semi-rigid patchcord are dirty.
	Laser Out, Laser In or Ref. Out ports are dirty.
	Patchcords were not correctly mandrel wrapped during return loss calibration or reference. At least 10 turns are necessary, especially for wavelengths of less than 1310 nm.
	Master test jumper was not properly connected to the Ref. Out port during ORL calibration or reference.
	Master test jumper is defective.
	Equipment is defective.

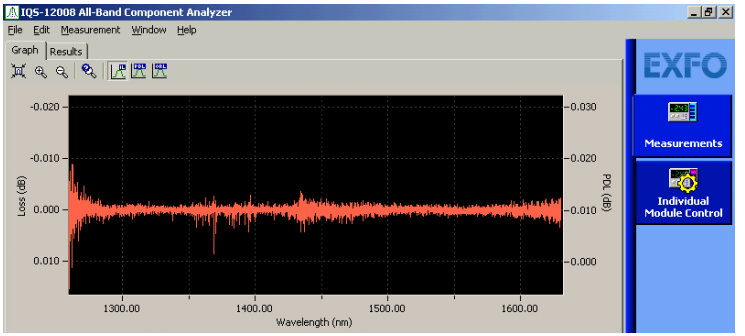
20. If your test setup includes a PSA, on the menu bar, select **Measurements** > **Reference** > **IL/PDL** to perform a PDL reference. Ensure that the averaging option is selected.

21. If your test setup includes a PSA, perform an IL/PDL measurement on all channels. For more information, see *Performing Test Scans* on page 68.

The bottom of the resulting PDL curves must be at 0 dB with a typical noise of +0.025.



The resulting IL curves must be centered around 0 dB ±0.005 for the 1260 to 1550 nm range and ±0.01 for the 1550 to 1630 nm range. The noise level is typically of less than 0.01 dB over the 1260 to 1630 nm range.



Note: *If the curves are not as expected, refer to the following table:*

Problem	Possible cause
Most curves are not centered around 0 dB	You did not use a polarization-maintaining patchcord between the Laser Out port and the PSA input port.
	You did not use a semi-rigid patchcord between the Laser In port and the PSA output port.
	Master test jumper is defective.
	Master test jumper was not properly connected to the Ref. Out port during reference.
	FOA installed on the first channel of the leftmost DET-1843 card is dirty.
	All FOAs are dirty.
	Equipment is defective.

From the **Help** menu, select **IQS-12008 All-Band Component Analyzer Help**.

Contacting the Technical Support Group

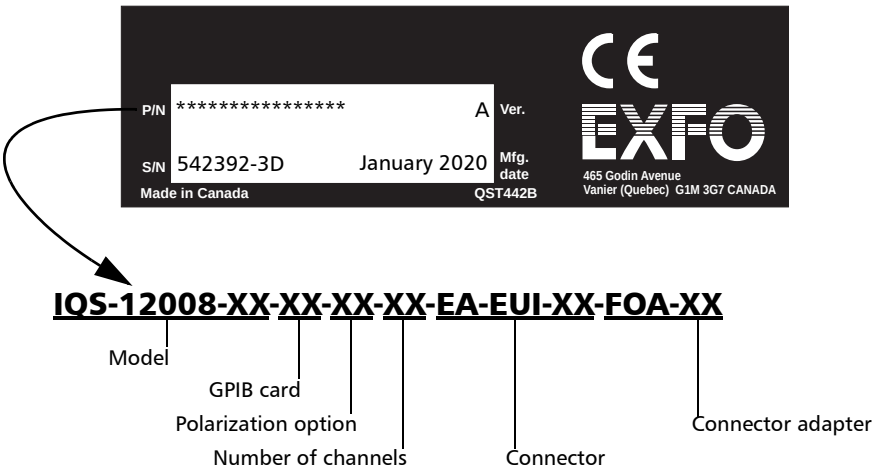
To obtain after-sales service or technical support for this product, contact EXFO at one of the following numbers. The Technical Support Group is available to take your calls from Monday to Friday, 8:00 a.m. to 7:00 p.m. (Eastern Time in North America).

For detailed information about technical support, visit the EXFO Web site at www.exfo.com.

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

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

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



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 its original packing material when shipping.
- Avoid high humidity or large temperature fluctuations.
- Keep the unit out of direct sunlight.
- Avoid unnecessary shocks and vibrations.

9 Warranty

General Information

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

During the warranty period, EXFO will, at its discretion, repair, replace, or issue credit for any defective product, as well as verify and adjust the product free of charge should the equipment need to be repaired or if the original calibration is erroneous. If the equipment is sent back for verification of calibration during the warranty period and found to meet all published specifications, EXFO will charge standard calibration fees.

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.

Liability

EXFO shall not be liable for damages resulting from the use of the product, nor shall be responsible for any failure in the performance of other items to which the product is connected or the operation of any system of which the 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, batteries and universal interfaces (EUI) used with EXFO products are not covered by this warranty.

This warranty excludes failure resulting from: improper use or installation, normal wear and tear, accident, abuse, neglect, fire, water, lightning or other acts of nature, causes external to the product or other factors beyond EXFO's control.

Certification

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

Service and Repairs

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

To send any equipment for service or repair:

1. Call one of EXFO's authorized service centers (see *EXFO Service Centers Worldwide* on page 108). Support personnel will determine if the equipment requires service, repair, or calibration.
2. If equipment must be returned to EXFO or an authorized service center, support personnel will issue a Return Merchandise Authorization (RMA) number and provide an address for return.
3. If possible, back up your data before sending the unit for repair.
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 to you by support personnel. Be sure to write the RMA number on the shipping slip. *EXFO will refuse and return any package that does not bear an RMAnumber.*

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, you will be invoiced for the cost appearing on this report. EXFO will pay return-to-customer shipping costs for equipment under warranty. Shipping insurance is at your expense.

Routine recalibration is not included in any of the warranty plans. Since calibrations/verifications are not covered by the basic or extended warranties, you may elect to purchase FlexCare Calibration/Verification Packages for a definite period of time. Contact an authorized service center (see *EXFO Service Centers Worldwide* on page 108).

EXFO Service Centers Worldwide

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

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

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

EXFO Europe Service Center
Omega Enterprise Park, Electron Way
Chandlers Ford, Hampshire S053 4SE
ENGLAND

Tel.: +44 2380 246810
Fax: +44 2380 246801
europe.service@exfo.com

EXFO China Service Center/
Beijing OSIC
Beijing New Century Hotel
Office Tower, Room 1754-1755
No. 6 Southern Capital Gym Road
Beijing 100044
P. R. CHINA

Tel.: +86 (10) 6849 2738
Fax: +86 (10) 6849 2662
beijing.service@exfo.com

A Technical Specifications

IMPORTANT

The following technical specifications can change without notice. The information presented in this section is provided as a reference only. To obtain this product's most recent technical specifications, visit the EXFO Web site at *www.exfo.com*.

Source	Value
Wavelength range (nm)[2]	1260 – 1630
Wavelength uncertainty, sweep mode (pm)[3]	±22
Wavelength uncertainty static, typ. (pm)[3]	±22
Wavelength resolution, stepped mode (pm)	5
Wavelength repeatability, sweep mode, typ. (pm)	±6.5
Wavelength stability (pm/hour)	3
Linewidth FWHM, typ. (pm)	45
Output power (dBm)	At laser output connector: $0 < P_{max} < 9$ After referencing elements (before DUT): $-4 < P_{max} < 3$
Sweeping speed, typ. (nm/s)	220
Detectors	
Maximum input power (dBm)	3
System	
Insertion loss measurement range (dB), 1 scan	72 typ., 60 guaranteed
IL uncertainty (dB), typ.[4]	±0.02
IL uncertainty (dB)[4]	±0.05
IL repeatability (dB)[4]	±0.02
PDL uncertainty (dB), typ., for PDL < 0.5 dB; 1300 nm - 1630 nm[5]	±0.02
PDL uncertainty (dB), for PDL < 5 dB; 1300 nm - 1630 nm[5]	±(0.05 + 5 % of DUT's PDL)
PDL repeatability (dB), for PDL < 0.5 dB; 1300 nm - 1630 nm[5]	±0.009
ORL uncertainty (dB)[6]	±1
ORL range, typ. (dB)	63.5
Minimum wavelength sampling resolution (pm)	25
Measurement time, typ., IL only, 8 channels, 1260 - 1630 nm (s)	8
Measurement time, typ., IL & PDL, 8 channels, 1260 - 1630 nm (s)	40
Measurement time, typ., IL & PDL, 32 channels, 1260 - 1630 nm (s)	70
Maximum number of channels	32
Recommended calibration interval	3 years

Technical Specifications

IQS-9800 module		
Size (H x W x D)	125 mm x 303 mm x 282 mm	4 15/16 in x 11 15/16 in x 11 1/8 in
Weight	4.7 kg	10.3 lb
IQS-5150B module		
Size (H x W x D)	125 mm x 74 mm x 282 mm	4 15/16 in x 2 15/16 in x 11 1/8 in
Weight	2.0 kg	4.4 lb
DET-1843 mini-module		
Size (H x W x D)	116 mm x 30 mm x 131 mm	4 9/16 in x 1 3/16 in x 5 3/16 in
Weight	0.12 kg	0.26 lb
IQS-12008 system		
Temperature		
operating	10 °C to 40 °C	50 °F to 104 °F
storage	−20 °C to 50 °C	−4 °F to 122 °F
Relative humidity (%)	80 % maximum (non-condensing) at 40 °C	

Standard Accessories

User guide, interconnecting patchcords (one polarization maintaining patchcord, one ORL reference test jumper; when optional IQS-5150B module is selected, one rigid test jumper is provided).

Notes

1. Specifications are valid at 23 °C ± 1 °C, for resolution set to 50 pm, after a warm-up time of 1 hour, and for a wavelength range of 1260 nm to 1630 nm, unless specifically noted otherwise.
2. Some measurements may be possible on the 1250 nm to 1650 nm range.
3. After wavelength self-calibration with atmospheric pressure entered by user in the measurement settings. For "02" option, which does not include acetylene gaz cell, the wavelength uncertainty in sweep mode is ±42 pm; in static mode, wavelength uncertainty is typically ±22 pm.
4. For IL < 20 dB, including repeatability of FOA, not including connector uncertainty.
5. With four-scan averaging on detector response and reference trace.
6. For ORL values between 10 dB and 48 dB.

B Definitions and Calculation Methods

The IQS-12008 All-Band Component Analyzer performs measurements and uses them in automated calculations. The definitions and calculation methods used are explained in this chapter.

The All-Band Component Analyzer recognizes the following DUT types:

Bandpass or Periodical Bandpass	Notch	Undefined
		

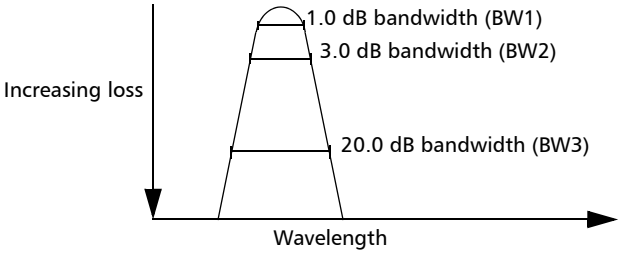
Bandpass Filters

The following table summarizes the analysis made with bandpass filters.

Bandpass Filters	
Central wavelength (CW)	*X*-dB center, where *X* is the dB level at which BW1 is measured (see *Central Wavelength (nm)* on page 115).
Center wavelength deviation	Difference between the defined wavelength and the measured central wavelength.
IL at CW	IL value at the defined central wavelength.
Min./Max. IL at BW1	Minimum/maximum IL value over operating wavelength range (BW1) (see *Insertion Loss (dB)* on page 115).
Min./Max. IL at ITU ±*x* nm	Minimum/maximum IL value over the ITU bandpass.
Max. PDL at BW1	Maximum PDL value over the operating wavelength range defined by BW1.
Max. PDL at ITU ±*x* nm	Maximum PDL value over the ITU bandpass.
Max. ORL at BW1	Lowest ORL value (strongest reflection) within BW1.
Max. ORL at ITU ±*x* nm	Lowest ORL value (strongest reflection) over the ITU bandpass.
BW1, BW2, BW3	The bandwidth at X-dB level relative to the peak transmission (see *Bandwidth (nm)* on page 113).
Ripple at ITU ±*x* nm	Maximum IL variations across bandpass defined as ITU CW ±x nm (see *Ripple (dB)* on page 116).
Isolation	Smallest difference between in-band (BW1) loss and other channel band (BW1) loss (see *Channel Isolation (dB)* on page 117).

Bandwidth (nm)

Bandwidth is the spectral width over which the attenuation of the device exceeds some stated loss value. The system can measure bandwidth at three different attenuation levels, called BW1, BW2, and BW3, relative to the minimum attenuation level, as illustrated in the following diagram.



You can configure these levels, but they are given the default values of 1.0 dB, 3.0 dB, and 20.0 dB.

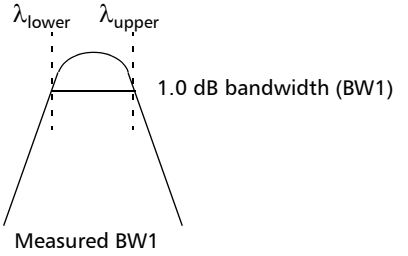
- A BW1 bandpass filter (at 1.0 dB or 0.5 dB) is commonly referred to as the bandpass or operating wavelength range of the device.
- BW2 (at 3 dB) is the half-power bandwidth.
- BW3 (at 20 dB or higher) is often used to describe the rejection or isolation band. The BW1/BW3 ratio can be used as an indicator of the filter shape.

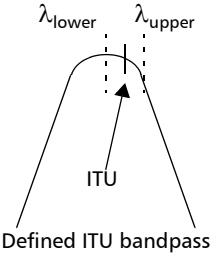
IMPORTANT

The application uses BW1 for IL and PDL calculations. The results appearing in the *Main Analysis* results table will depend on the selected method (BW1 or defined ITU bandpass).

Measured BW1

In this method, BW1 is calculated based on measurement data. For example, if you select a 1.0 dB bandwidth, the software will calculate the wavelength range corresponding to the measured BW1. As shown in the diagram, λ_{lower} and λ_{upper} correspond to the 1.0 dB cutoff wavelengths, and this wavelength range will be used for the IL and PDL measurements. These values are presented in the *Main Analysis* results table.





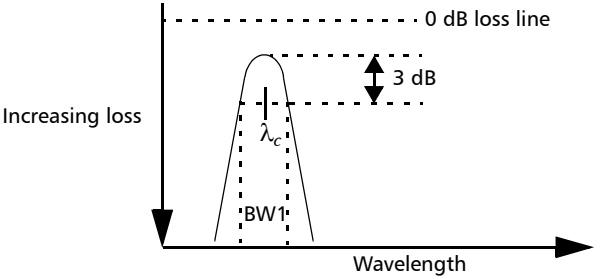
Defined ITU Bandpass

In this method, you specify the wavelength range to use for the evaluation. You will have to provide a span range centered around the ITU CWDM central wavelength.

As shown in the diagrams, the wavelength range for BW1 and ITU bandpass is different and the resulting calculations will be different.

Central Wavelength (nm)

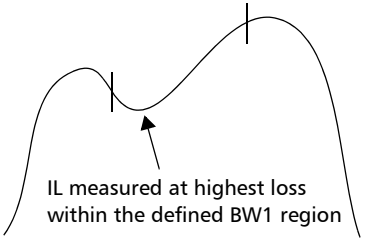
The central wavelength is the wavelength at the midpoint between the lower and upper wavelengths at BW1 dB level from the peak. Note that the central wavelength is not necessarily the peak wavelength.



Insertion Loss (dB)

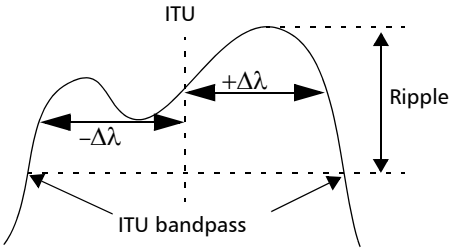
The insertion loss (IL) of a filter or multiplexer channel can be described in many different ways. The All-Band Component Analyzer uses the *Maximum attenuation within the BW1 interval* method to determine the insertion loss.

The BW1 value you specified will be used as an interval on which the highest loss will be taken. This is illustrated below:

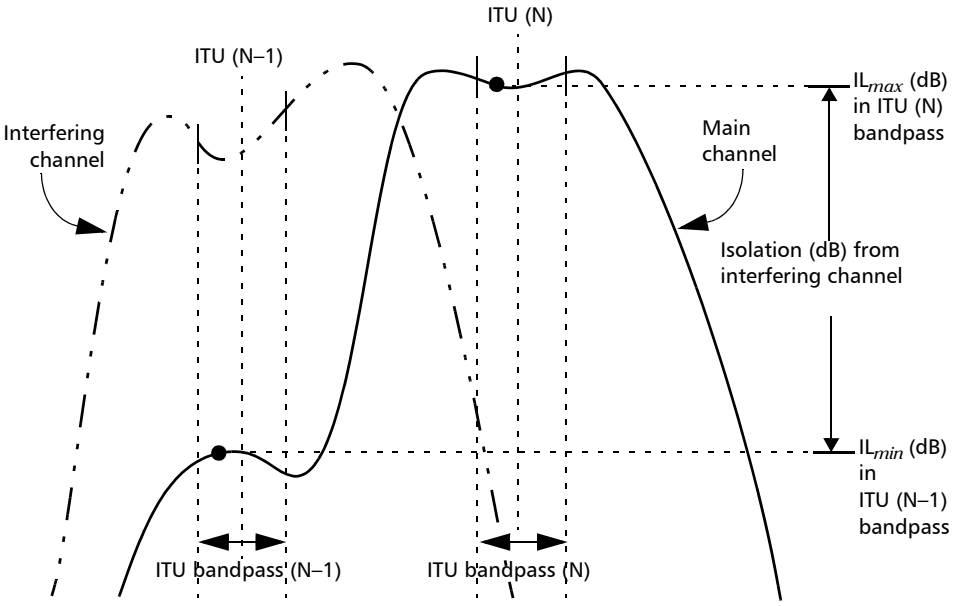


Ripple (dB)

The ripple is the IL variation over the ITU defined bandpass of each channel.



Channel Isolation (dB)



The application calculates the worst-case isolation, which is the smallest difference in IL between two intervals on the main channel curve ($BW1_{main}$ and $BW1_{interf}$).

- IL_{max} is the highest loss on the main channel curve in the $BW1_{main}$ interval.
- IL_{min} is the lowest loss on the main channel curve in the $BW1_{interf}$ interval.

Note: *Measurements are taken between all bandpass channels, not only adjacent channels.*

Notch Filters

IL, PDL and ORL values are given at 1310 nm, 1490 nm, 1550 nm and 1625 nm.

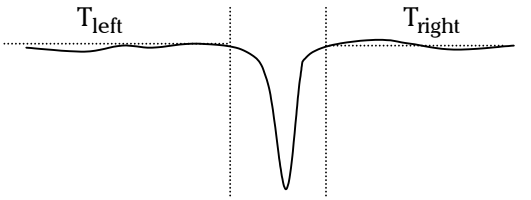
Notch Filters	
IL	Maximum attenuation over the entire range.
PDL	Maximum PDL based on the entire analysis range.
ORL	ORL value representing the strongest reflection.

Transmission Portion of Notch

The attenuation data is divided into three regions:

- transmission left (T_{left})
- transmission right (T_{right})
- notch

The transmission portion is the total range of T_{left} and T_{right}.



The wavelengths that segregate these regions are determined in a function that will find the nominal attenuation for each of the left and right shoulders. This is a statistical calculation and can be different for the right and left shoulders.

Undefined Filters

IL, PDL and ORL values are given at 1310 nm, 1490 nm, 1550 nm and 1625 nm.

Undefined Filters	
IL	Maximum attenuation over the entire range.
PDL	Maximum PDL based on the entire analysis range.
ORL	ORL value representing the strongest reflection.

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