IQ-12002

IQ-12002 Optical Calibration System

- High performance: ±0.9% uncertainty
- User-friendly and intuitive Windows™ software with step-by-step procedures
- Flexible: modular and expandable
- Calibration and quality verification
- Complex absolute power and linearity measurement

IQ Optical Calibration System

Fiber-optic test and measurement equipment

Visual IQ

EXFO

IQ Optical Calibration System

System Overview

Verification and Calibration of Fiber-Optic Test Instruments
EXFO offers the IQ-12002 Optical Calibration System for in-house instrument verification. The IQ-12002 OCS puts you in control of all your calibration operations. With this powerful system, you can calibrate your power meters as often as you need. Verify your sources, attenuators, and OTDRs regularly without undergoing downtime and costly shipping. Traceable to NIST standards, the IQ can evolve with your needs. From the most basic setup to the most sophisticated, EXFO's IQ-12002 OCS can be custom-designed to fit your requirements.

The IQ-12002 OCS performs automated, comprehensive tests.

- absolute power calibration and linearity measurement of fiber-optic power meters
- power output, stability, sensitivity to reflections, and central-wavelength measurement of optical light sources
- optical return loss, insertion loss, linearity, and repeatability measurements of optical attenuators
- OTDR attenuation and distance range calibration (manual procedure)

Any benchtop, portable, or handheld instrument can be verified.

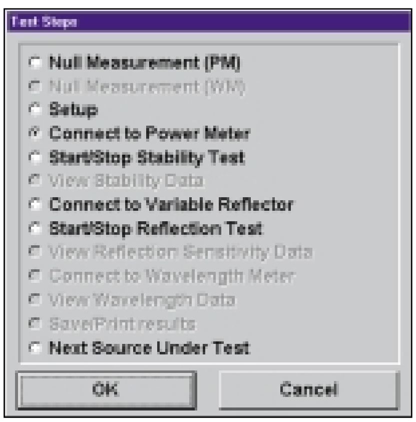
The Visual IQ Software

Integrated Solution

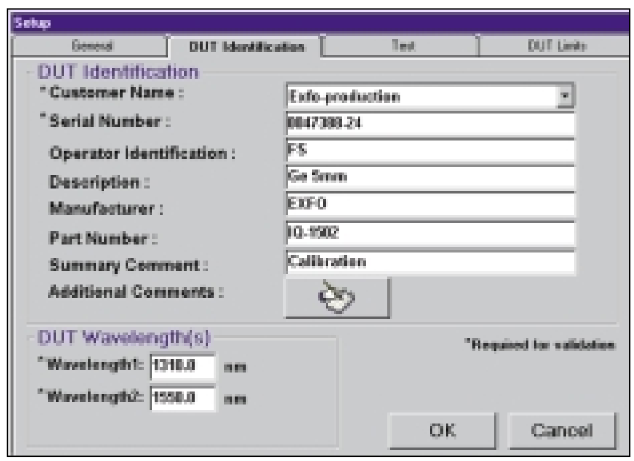
Our calibration system is controlled by one of the Visual IQ applications, the IQ-12002 calibration software. Visual IQ applications integrate the operation of test and measurement instruments and provide an automated turnkey approach to all your testing needs. The IQ-12002 calibration software, like all Visual IQ applications, is efficient and user-friendly. It controls measurement from start to finish according to user-selected parameters. It eliminates the possibility of data-entry and reporting errors while avoiding costly procedural mistakes.

In addition, time-saving features, like Pass/Fail testing and automatic prompting for the next device under test, considerably increase the system's efficiency when compared to traditional test systems.
The built-in flexibility of the IQ-12002 calibration software, combined with the modular design of the IQ-200 Optical Test System, give the user the freedom to quickly reconfigure any tests for different products as well as control module operation. A single software package performs single- or dual-wavelength tests on singlemode fiber.

A convenient step summary indicates the progress of the user-defined test sequence.



Test steps



Detailed information about DUT

Main Features of the IQ-12002 Visual IQ Software

- Step-by-step operating instructions in both graphical and text formats, using an intuitive and flexible software.
- All detailed information about each device under test is saved in a database.
- Generate detailed reports with data tables and graphs that can be printed in summary or detailed format.
- PC-based Windows 95™ environment.

Optical Power Meter Calibration

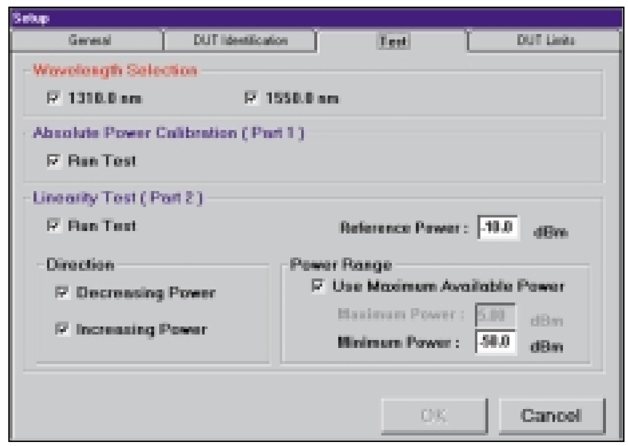
Optical Power Meter Calibration

- Standard system for the Telco industry
- Singlemode, 1310/1550 nm
- Absolute power calibration from –3 to –40 dBm (–10 dBm recommended by NIST)
- Linearity measurements with an uncertainty of ±0.01 dB up to more than +5 dBm
- ±0.9% calibration traceable to NIST

Product calibration and verification of specifications are important steps in ensuring conformance to required quality assurance programs such as ISO-9000. Power meters and other fiber-optic instruments must be periodically verified to guarantee that their optical calibration constants remain the same over a certain period of time. The optical-calibration constants are related to the spectral responsivity curve of the detector (amps per watt versus wavelength).

The two key issues characterizing the calibration and verification of fiber-optic power meters are

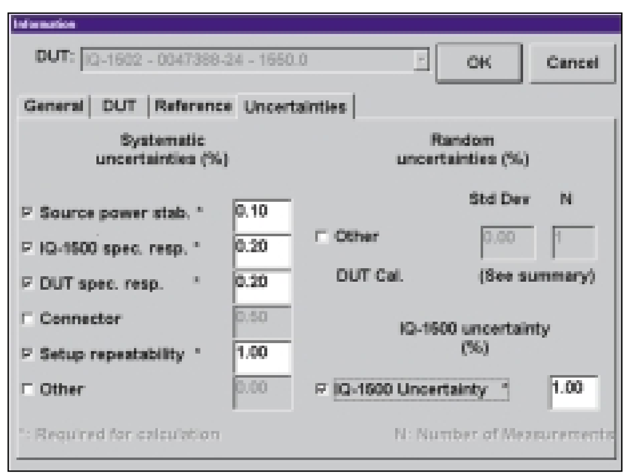
- absolute-response calibration at one or more wavelengths (absolute power calibration)
- response linearity with varying input-power levels (optical linearity measurement)



Typical test for absolute-power calibration and linearity of power meters

Absolute-Power Calibration

The power reading of the device under test, or DUT (power meter), is compared to the power reading of a highly accurate reference power meter (IQ-1500) traceable to a primary reference standard of NIST (USA) at the calibration light source wavelength. The IQ-2400 DFB laser, with its excellent power stability over short periods, is preferred because its central wavelength can be accurately located, and the error due to the spectral width is lesser than that of a Fabry-Perot laser. The calibration software takes into account many system and random sources of error and provides a calibration factor and total uncertainty calculation.

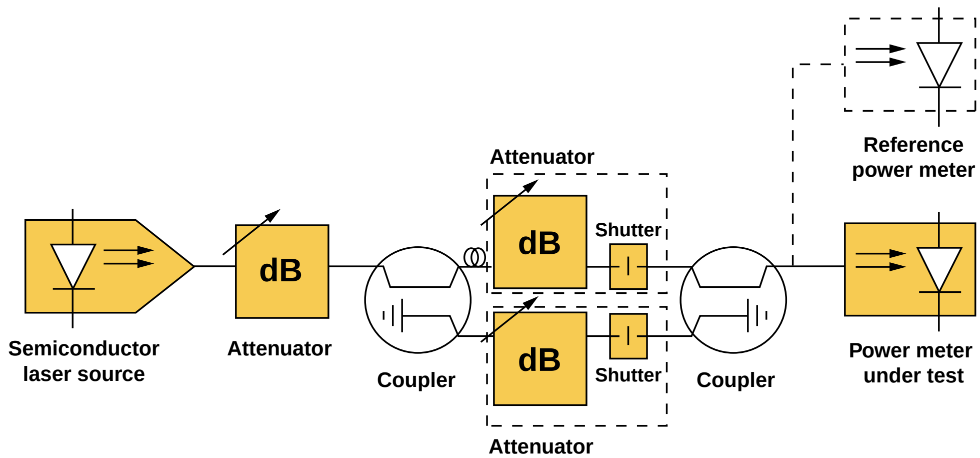


Uncertainty calculations

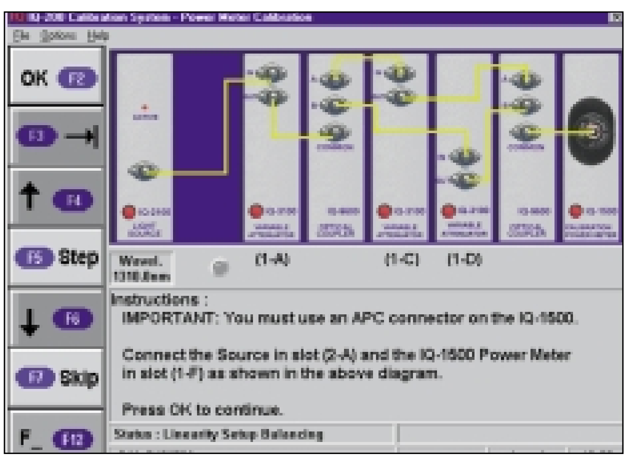
Optical Linearity

The superposition method consists of verifying, as a function of the dynamic power range of the DUT, that the sum of half the power read in each branch of a 1x2 coupler is equal to the total power read by the two branches simultaneously. The software can be configured to test for both increasing and decreasing power.

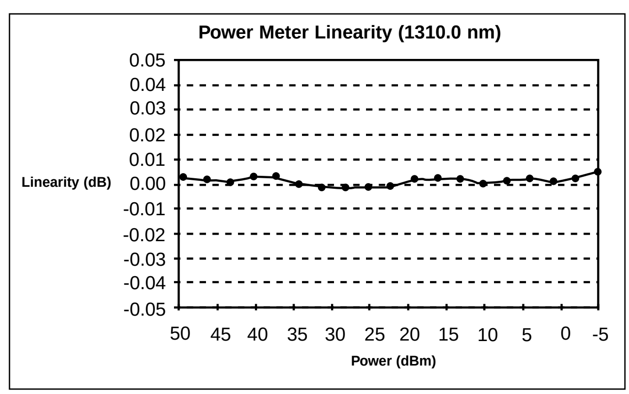
This is more precise than using a direct line attenuator. The setup includes variable attenuators (IQ-3100) and optical couplers (IQ-9600) with low insertion losses. An optical amplifier (IQ-6100) can also be used in conjunction with a variable attenuator to cover the full dynamic range of the DUT.



Typical setup of power-meter linearity test



Typical power-meter linearity test setup



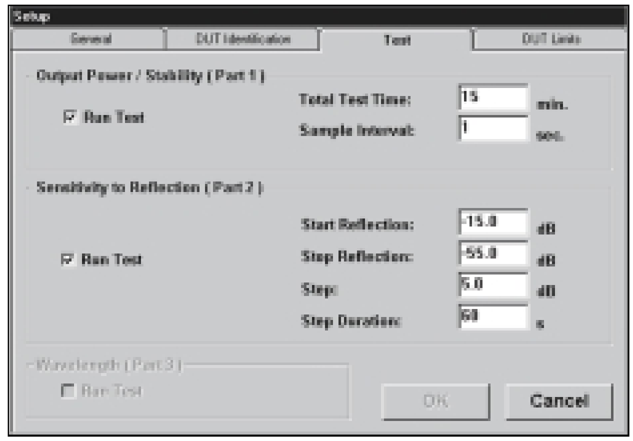
Graphical results of power-meter linearity

Optical Light Source Verification

Optical Light Source Verification

Light sources using semiconductors can only be verified to ensure they meet their stated specifications.
The IQ Optical Calibration System tests all source parameters with a single application.

The verified parameters are
- output power level and stability
- sensitivity to reflections
- central wavelength

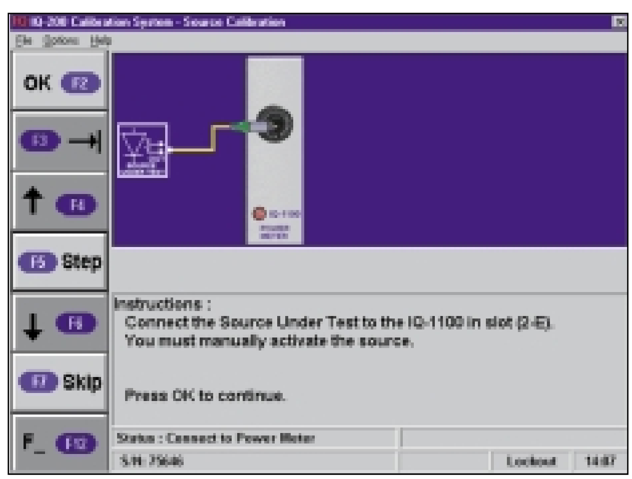


Typical tests performed on a light source

Typical light source power stability vs. time diagram

Output Power Level and Stability

Any source output power fluctuates as a function of time. The source power level and stability must be stated for both the short term (e.g., 15 minutes) and the long term (e.g., over one to eight hours) depending on the applications. To record power stability, the source is connected to a power meter (IQ-1100), and its output power is monitored by the power meter as a function of time.

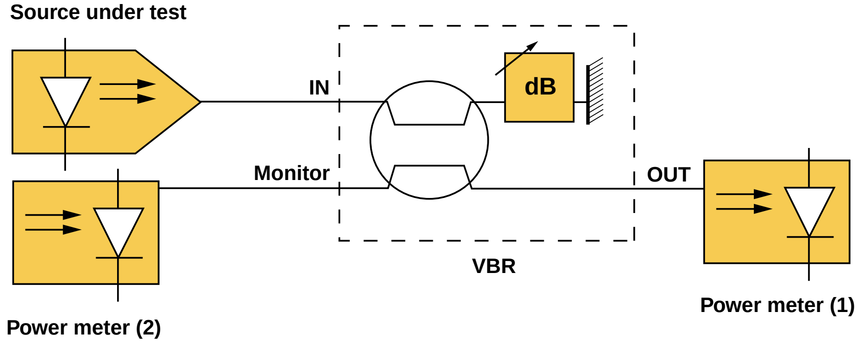


Typical light source verification setup

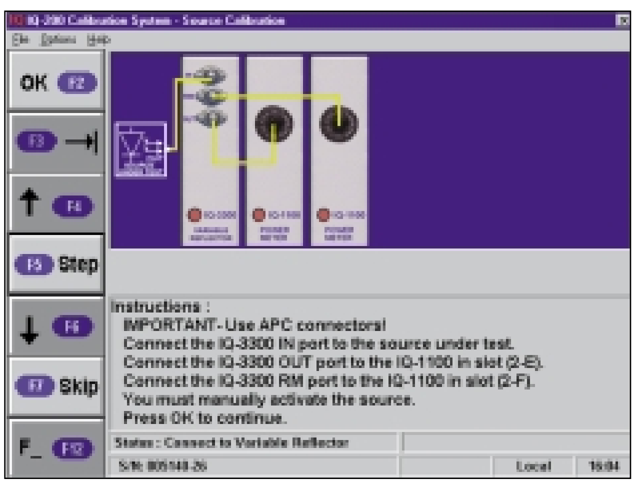
Sensitivity to Reflections

Some light sources, such as lasers, can be very sensitive to reflections, especially because of their coherence length. To test the source's sensitivity to reflections, the source output power is monitored against reflections generated back to the laser under test by the IQ-3300 Variable Backreflector (VBR), which provides sufficient range to test the DUT. Two power meters should be used for this test for better accuracy.

A first power meter (IQ-1100), connected to the OUT port, is properly nulled and automatically set to the source wavelength by the software. It is used to measure source power stability. A second power meter (IQ-1100) is connected to the Monitor port of the VBR to measure reflection, taking into account the OUT port's reflection in addition to the reflection generated by the VBR. The calibration is performed automatically before the measurements.



Test diagram of typical sensivity to reflections



Setup of typical source sensitivity to reflections

Central Wavelength Measurement

The central wavelength uncertainty of fiber-optic light sources must be minimized for some applications. For instance, if the central wavelength of the source cannot be precisely defined, the uncertainty can adversely affect the calibration of a power meter.

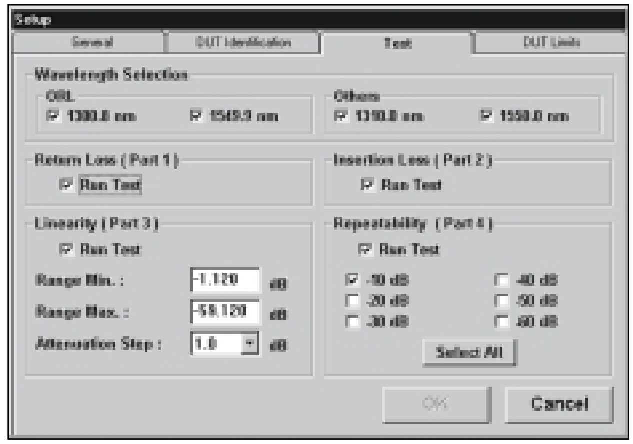
To verify the source central wavelength, the IQ-12002 OCS offers a wavelength meter (IQ-5310) that covers a wide spectral range (600 to 1700 nm) and has a very small wavelength uncertainty (±10 ppm).

Optical Attenuator Verification

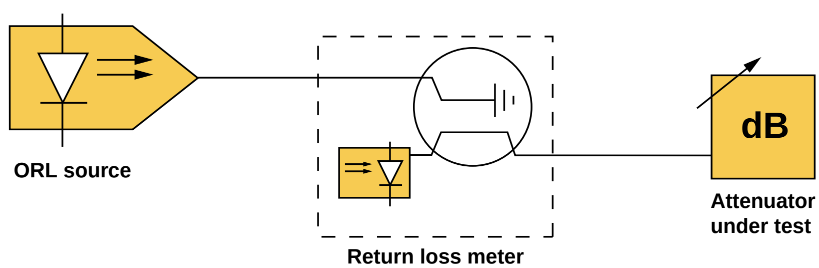
Optical Attenuator Verification

Attenuators can only be verified to ensure that they meet their stated specifications. The following tests are supported by the IQ Calibration System and the integrated IQ-12002 calibration software.

- Optical return loss
- Insertion loss
- Optical linearity
- Repeatability



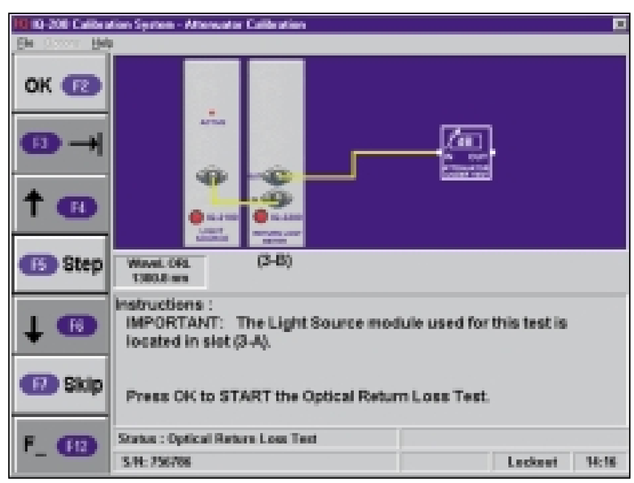
Typical tests performed on an attenuator



Typical return loss test diagram

Optical Return Loss

To measure the optical return loss of the DUT (attenuator), an ORL meter (IQ-3200) is used in conjunction with an ORL source (IQ-2100) to monitor the reflectance of the DUT. The IQ Optical Calibration System performs the return loss measurement in accordance with the EIA-TIA Fiber Optic Test Procedure (FOTP 107).

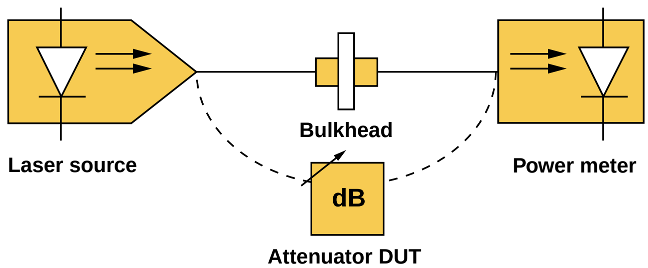


Typical return loss test setup for an attenuator

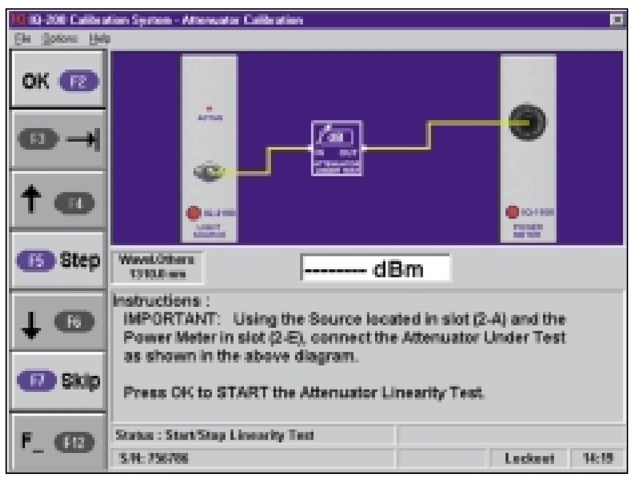
Insertion loss

To test the attenuator's insertion loss, a power reference is first taken with a light source (IQ-2400) connected to a power meter (IQ-1100) using two patchcords connected to a bulkhead adapter.

The bulkhead adapter is then disconnected and replaced by the DUT (attenuator). The DUT is set to the minimum attenuation setting. The source transmits the signal through the DUT, and the power is read by the power meter.



Typical insertion-loss setup



Optical attenuation linearity test setup

Optical Linearity

The optical linearity of the attenuator is tested over the requested attenuation range using a stable DFB source (IQ-2400 BLD) and a highly linear power meter (IQ-1103). The discrepancy between the set attenuation of the DUT and the power-meter reading is equal to the linearity error.

Repeatability

The attenuator must also be tested for repeatability, i.e., when an attenuation is changed from a preset value to a new one, the attenuator will still provide the former when reset to the first value. Repeatability is critical when the change from one value to another, and back, is performed over a wide range of attenuations.

Optical Time Domain Reflectometer Calibration

Optical Time Domain Reflectometer (OTDR) Calibration

The OTDR both locates and characterizes faults such as those caused by broken fiber, connectors, or splices.
The most critical parameters to be verified in an OTDR are attenuation and distance-range accuracy.
When it comes to performance, EXFO understands the need for precision. For this reason, EXFO provides a procedure to ensure that the OTDR performance is within specifications. This procedure is not intended to replace the manufacturer's recommended calibration service where other aspects of OTDR functionality such as mechanical integrity, output connector condition, laser output power, and dynamic range are verified.

The IEC Calibration Procedure was used as a reference to build this procedure, which is performed using calibrated fibers with known attenuation and range length. The fibers are obtained from a well known European calibration laboratory, the National Physical Laboratory (NPL).
EXFO's simplified and cost-effective procedure allows you to perform attenuation and distance-range verification of an OTDR by comparing the readings (attenuation and distance range) of the OTDR DUT with the calibrated values of NPL fibers. Templates are available to guide the user through the steps and calculations for each measurement.

- Two spools of fiber are supplied with typical lengths of 2.2 km and 12.8 km.
- Precise calibration of attenuation uniformity and distance range performed by NPL.
- Attenuation uniformity uncertainty (bidirectional measurement): ±0.006 dB/km.
- Distance range uncertainty: ±0.5 m for 2.2 km, ±0.6m for 12.8 km.

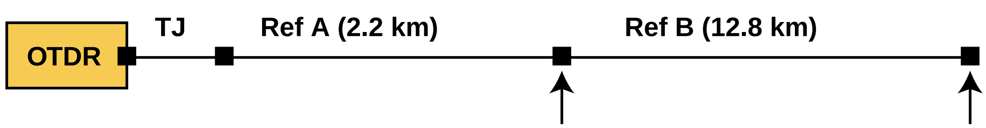
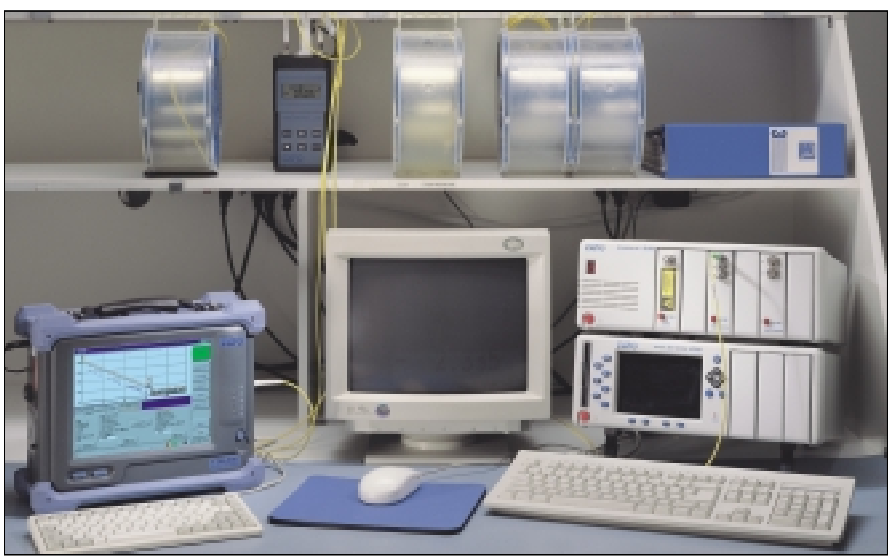


Diagram of attenuation uncertainty



OTDR calibration

SPECIFICATIONS

Power meter calibration			
Wavelength (nm)		1310 ±1	1550 ±1
Absolute power reference uncertainty[1] (%)		±0.9	±0.9
Recommended optical power level for calibration (µW)		100 (–10 dBm)	100 (–10 dBm)
Linearity test power range (dBm)	typical minimum	–7 to –90 –10 to –90	0 to –80 –4 to –70
Uncertainty of the linearity test[2] (dB)		±0.01	±0.01
Light source calibration			
Test		output power/stability	sensitivity to reflections
Wavelength range (nm)		800 to 1700	1200 to 1650
Power range of source (dBm)		+5 to –60	+5 to –40
Reflection range (dB)		-	–15 to –55[3]
Maximum no. of samples		3600	3600
Attenuator calibration			
Wavelength (nm)		1310 ±1	1550 ±1
Attenuation range (dB)		0 to 60	0 to 60
Uncertainty of the linearity test[4] (dB)		±0.04	±0.04
Insertion loss and repeatability test resolution (dB)		0.001	0.001

GENERAL SPECIFICATIONS

Recommended reference conditions		
Temperature	operating storage	23 ±1°C 23 ±5°C
Relative humidity		50 ±10%
Maximum environmental specifications		
Temperature	operating	23 ±5°C
Relative humidity		0 to 80% non-condensing

Fiber type: singlemode
Warm up time: 15 minutes minimum, 1 hour recommended
System connectors: FC/APC, FC/UPC, ST/UPC, SC/APC, SC/UPC
Recommended calibration interval: one year

NOTES

1. ±0.9% with option Q1, ±2% with option Q0.
2. Down to –67 dBm maximum at 1310 nm and 1550 nm if the power meter resolution remains 0.001 dB.
3. The minimum reflection that can be tested is limited by the power of the source; to reach –55 dB, the source should have at least –5 dBm.
4. For an attenuator with resolution of 0.001 dB. ±0.03 dB if the attenuator resolution is 0.01 dB.

STANDARD ACCESSORIES

Instruction manual and IQ-12002 calibration software, IQ-1500 Certificate of Calibration, connection cards

ORDERING INFORMATION

IQ-12002 Calibration Software

IQ-12002S-YY-ZZ-IQ-200-PP-Calibration System*

Wavelength option

02 = IQ-2402BLD-58
03 = IQ-2403BLD-23-P4-M5-58
23 = IQ-2402BLD-P4-58, IQ-2403BLD-23-P4-M5-58

Calibration option

APC-Q1-XX	=	IQ-1502-Q1-B-XX-01, IQ-3100-B58, TJ-B58-58, TJ-B58-XX
APC-Q0-89	=	IQ-1502-Q0-B89-01, IQ-3100-B58, TJ-B58-58, TJ-B58-89
APLC-Q1-XX	=	IQ-1502-Q1-B-XX-01, IQ-9601-03-58-B01, IQ-9601-03-58-B02, IQ-3100-B58 (3x), TJ-B58-58 (6x), TJ-B58-XX
APLC-Q0-89	=	IQ-1502-Q0-B89-01, IQ-9601-03-58-B01, IQ-9601-03-58-B02, IQ-3100-B58,(3X) TJ-B58-58,(6X) TJ-B58-89
SAV-XX	=	IQ-1103-XX, RAC-XX
SAVT-XX	=	IQ-1103-222 (2x), IQ-3300-B58, TJ-B58-58 (2x)
ARL-XX	=	IQ-2123ORL-58, IQ-3200B-58, TJ-B58-XX
CWM	=	IQ-5312-58

Platform and expansion unit

03-01	=	IQ-203, IQ-206
PC-01	=	E2, IQ-206
03-02	=	IQ-203, IQ-206 (2x)
PC-02	=	E2, IQ-206 (2x)
03-03	=	IQ-203, IQ-206 (3x)
PC-03	=	E2, IQ-206 (3x)
03-04	=	IQ-203, IQ-206 (4x)
PC-03	=	E2, IQ-206 (4x)

** YY must be replaced by the required wavelength.*
ZZ must be replaced by the required calibration options, can have more than one.
PP must be replaced by the required IQ-203 (or E2) and IQ-206.

OTDRCAL-50

OTDR calibration

AOP–35 (2.2 km)
AOP–38 (12.8 km)
DC0022A (template)
DC0023A (template)

EXFO is certified ISO 9001 and attests to the quality of its products. These products are accompanied by a 24 month warranty and an excellent after-sales support service. Contact EXFO for prices and availability or to obtain the phone number of your local EXFO distributor.

These devices comply with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) these devices may not cause harmful interference, and (2) these devices must accept any interference received, including interference that may cause undesired operation.

EXFO has made every effort to ensure that the information contained in this brochure is accurate. However, we cannot accept responsibility for any errors or omissions, and we reserve the right to modify design, characteristics, and products at any time without obligation.

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