MAP-200-Based Insertion Loss/Return Loss Testing Solution

mORL/mIL with PCT Application Environment

Key Benefits

- Increases production yield by a factor of 4
- Requires only 25% of the space of other solutions
- Enables expansion into new high-growth, high-performance applications such as 40/100 G data center markets
- Modular platform can scale as needs arise and budget allows
- Port mapping verifies multifiber MPO cassette continuity and polarity in less than 15 seconds
- Fully supports high-growth MPO and MTP multifiber connectors

Applications

- Testing IL/RL/length of optical connectors and cable assemblies, structured-cabling solutions, and optical splitters
- Automated testing of multifiber assemblies such as MPO
- Solutions for both single-mode and multimode fiber-based devices
- Verifying continuity and polarity of large multifiber assemblies
- Measuring RL of line cards and receptacle-based transponders

Safety Features

MAP mORL-A1 and MAP mIL-A2 modules installed in a MAP-200 chassis comply with CE, CSA/UL/IEC61010-1, and LXI Class C requirements

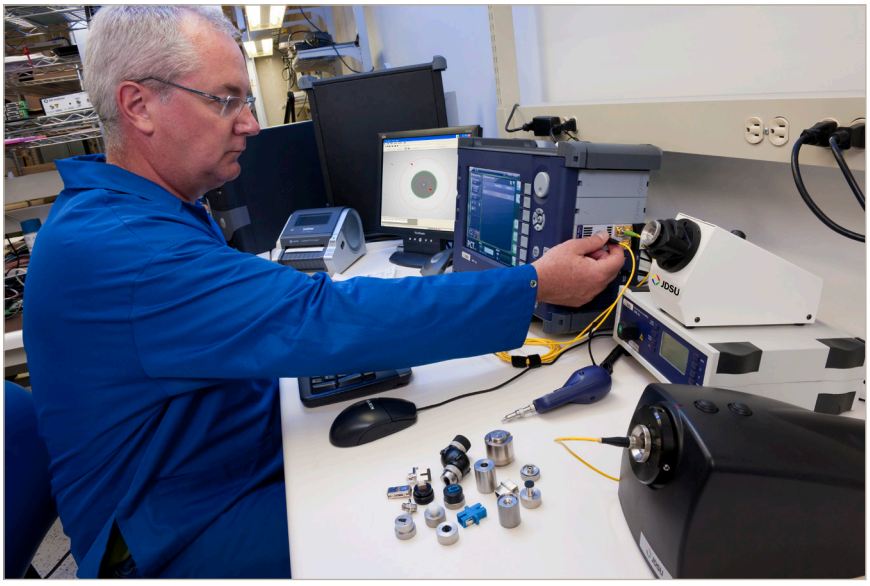
Optical connectivity solutions (optical connectors, structured cabling, splitters, and the enclosures that house them) are central to connection-intensive central office, data center, and optical-distribution networks. Outside of telecom, datacom, wireless backhaul, and FTTx, new supercomputing applications are emerging and naval, avionic, and military applications continue to multiply. All of these markets are driven by the demand for more bandwidth. Out of necessity, new connector formats are coming to market, driven by the need to lower installation costs and speed deployments.

However, the quality and optical performance of these connection points is often overlooked. Poor insertion and return loss (IL and RL) can have far-reaching impact on network performance. Poor performance can directly affect reach and reliability, and can even block the path to technology upgrades. Simultaneously, economic factors require manufacturers to lower costs, speed production, and accelerate time-to-market.

The JDSU passive component/connector test solution (PCT) consists of a powerful family of modules, software, and peripherals for testing IL, RL, physical length, and polarity of optical connectivity products. Leveraging the modularity and connectivity of the JDSU MAP-200 platform, the PCT can be configured for R&D, production, or qualification test environments and can address all key fiber types from single-mode through OM1 and OM4.

The sections that follow will review:

- Core measurement modules (for both single-mode and multimode)
- The software and application framework
- Configuring for MPO and multifiber test
- Key peripherals and accessories



A typical connector test bench would include the JDSU solutions for IL and RL plus connector inspection

Core Measurement Modules

Single-mode fiber mORL-A1 with mBID Bidirectional option

mORL-A1 Single-Mode IL and RL

One single-slot module contains up to four sources (1310, 1490, 1550, 1625 nm), and integrated power meter, and an optional 2x2 optical switch for automated bidirectional testing.

RL measurements are based on time-domain technology and are often referred to as "mandrel-free." Mandrel-free technology dramatically reduces test time by eliminating the need to make slow, difficult, manual terminations during both setup and execution of RL measurements. It also measures length further eliminating the need for extra steps to verify quality. Leveraging decades of OTDR technology, the JDSU mORL-A1 delivers 80 dB of RL dynamic range and can measure jumpers as short as 70 cm in as quickly as 6 seconds per two wavelengths.

IL is measured using the power meter method. Precise launch power monitoring and depolarization technology provides true 0.001 dB resolution. IL measurements are completed in parallel using the same optical stimulus, requiring less time overall.

Multimode fiber mORL-A2, 50 µm with mBID Bidirectional options and a dual-fiber version of the module

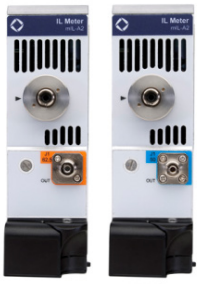
mORL-A1 Multimode IL and RL

Multimode modules are based on the same basic technology and architecture as the single-mode module described above. A standard dual-wavelength version is available (850, 1300 nm) for multimode applications with an integrated power meter and optional 2x2 optical switches for automated bidirectional testing.

The multimode module requires the selection of fiber type. After years of fighting to balance test capacity investments between 50 µm (OM2, 3, 4) and 62.5 µm (OM1), JDSU released a first-of-its-kind module that tests both fiber types. The dual-fiber option can test 50 µm or 62.5 µm from the same module. Similar to the single-mode version, an optional bidirectional test is available which can also test hybrid assemblies.

Measurements for RL from 15 to 60 dB are possible and can be achieved during concurrent IL measurements in less than 2 s per wavelength.

IL performance meets IEC 61280-4-1 recommendations for mode fill. For high-throughput testing, the mORL module uses the same laser sources for IL and RL. The multimode module includes a standard set of low-power LED sources from which to select for extra precision. The low-power LED sources offer lower coherence without polarization, removing instability from speckle effects on the power meter surface. Like the single-mode module, launch powers are monitored to achieve an IL stability of ±0.02 dB.



mIL-A2 modules: One for 50 µm fiber (OM3) and another for 62.5 µm fiber (OM1)

mIL-A2 Multimode IL

The final measurement module in the PCT family is the multimode insertion loss meter (mIL-A2) which is a powerful, stable, and compact IL-only solution. One single-slot module contains two LED sources (850 nm and 1300 nm), and an integrated power meter for manual or automated testing. It is an ideal lower-cost option for applications that do not require RL measurements.

Its excellent source stability and launch monitoring minimizes reference frequency requirements. The mIL-A2 uses the same lower-power, incoherent, and depolarized LED sources as the mORL described earlier. It also meets the latest IEC launch-condition standard and is available in either an OM1 (62.5 µm) or OM3 (50 µm) version.

Like the mORL modules, the mIL-A2 module works within the standard MAP-200-based PCT application framework and shares the same graphical user interface (GUI) and features, simplifying training and reducing operator transition time.

Serviceability — Keeping Units in the Field

For manufacturing applications, maintaining equipment with minimum downtime is critical to profitability. The mORL-A1, mIL-A2 module, and the MAP-200 were designed with this critical need in mind. An industry-unique feature for modular platforms is the access the mORL/mIL provides to optical connectors. As the figure below shows, removing only one screw provides full access to the bulkhead connector.

Step-by-step example of opening the front panel door to maintain the launch connectors

Simplify Workflows with the Bidirectional Test

The mBID code option adds an internal 2x2 switch to the mORL modules (not available on mIL). When coupled with the time-domain RL measurement it dramatically reduces test times because it measures optical RL on both connectors with one connection using the multiple programmable window function. This eliminates the need to measure the jumper in the other direction, effectively cutting test times in half.

PCT solution with mORL modules that cover all three fiber types

Modular Compact Form Factor saves Workspace

The MAP-200 offers industry-unique levels of integration. The compact size of the modules lets you develop a universal fiber test solution within a single three-slot chassis. Accessibility from the front, rear, or side minimizes the working space required to manage and properly condition test cables.

PCT Application Framework

The PCT application environment for the mORL-A1 and mIL-A21 module family is considered a MAP-200 super-application because it drives the core measurement module as well as several adjacent modules and peripherals (for example, optical switches, barcode reader, and USB printers) for a total application solution. Maintenance utilities can assist users in the field while login rights ensure that only authorized personnel can change the key set-up parameters.

The PCT software has three main operation modes: instrument mode, script mode, and port mapping. A full complement of SCPI-compliant remote commands is available as well.

Instrument Mode

Instrument mode lets users quickly and easily access all the key setup parameters in a simple easy-to-use intuitive GUI, which is ideal for R&D and qualification labs. This feature gives users maximum control in a rapidly changing environment. Users have constant access to interactive windows showing current connections and measurement setups. Quick-save features let users save test results to text files and window settings to simplify recall.

Example screen shots from the PCT application framework. Simple results views and real time connection views simplify use.

Script Mode

Script mode fully automates tests with user-programmed test sequences and provides an SQL-light database to store results in a password-protected environment. Serial numbers may be generated locally or entered using a USB barcode reader. User-defined scripts ensure that production procedures are followed strictly while a full HTML editor can be used to embed instructions and photos for operators to follow. Users can print reports and labels or export data from the database for analysis. A database query engine lets users extract results based on criteria such as device type, connector type, or customer.

Screen shots from the onboard script mode for production testing

Data can be saved locally to the internal flash disk and then exported over USB or the network FTP server. Alternatively, users can store individual test files directly to a mapped network drive. When using the remote network drive, the PCT application can locally cache files, in case the connection to the remote drive is lost, and will re-sync automatically once the connection is restored.

Remote Commands

Integrating the PCT application with external automation environments, such as LabView and Visual Basic, leverages the full power of the MAP-200 platform. Its full set of standard commands for programmable instruments (SCPI)-based commands are accessible through the local area network (LAN) or over the legacy general-purpose interface bus (GPIB) interface. The simple, robust, remote interface is a core requirement of the application. The MAP-200 Linux-based operating system eliminates the maintenance requirements of legacy Windows-based platforms and IT department efforts on viruses and network access. A simple Excel-based example is available and may be all that is required for programmers to get started.

For debugging purposes, users can remotely login to the unit over VNC, which is extremely useful when interacting with remote manufacturing locations.

Leverage the power of optical switches to convert the mORL into a fully featured MPO test solution

MPO and Multifiber Test Accessories

Multiple-fiber push-on/pull-off (MPO) connectors are one of the fastest growing segments in the connectivity market. The MAP-200 PCT can be flexibly adapted to create high-throughput solutions for cables, breakouts, and modules. As volumes change, users can adapt the MAP-200 on site to convert single-fiber test solutions to multifiber. Manufacturers are future-proofed against changing requirements and markets. The PCT MPO solutions set consists of three key components.

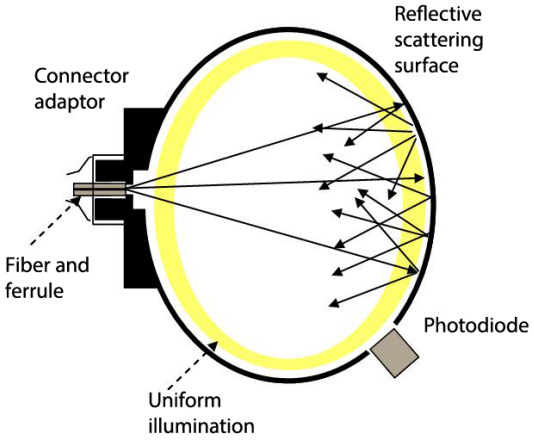
Optical Switches

Pairing the mORL or mIL with the industry-leading MAP Optical Switch Count (mOSW-C1) switch family can expand a single fiber output to 8, 12, or 24 outputs. Switches are used to speed workflow and to connect multiple master test jumpers (MTJ) to the system simultaneously. If 24 channels are insufficient, external JDSU switches can be used and controlled via USB to sequentially test up to 96 fibers hands-free.

The JDSU mOSW-C1 and external optical switches are the industry leaders in loss and repeatability and provide more than 100 M+ switch cycles without specification degradation. The repeatability and stability of the switch directly impacts the measurement repeatability for IL. Up to two switches can be associated with the application at any one time, but unique architectures can be implemented where switches are selected based on the fiber type required.

Integrating Sphere

An optional integrating sphere attachment is available to measure ribbon connectors and bare fiber. The integrating sphere scatters the input light for uniform illumination of its inner surface. A small opening at the photodiode allows for integrated power level measurements. The innovative JDSU design allows for removal of the integrating sphere for simplex connector work or maintenance when not in use. The input aperture is large enough to accommodate 72-fiber MT ferrules when used with the correct detector adaptor.

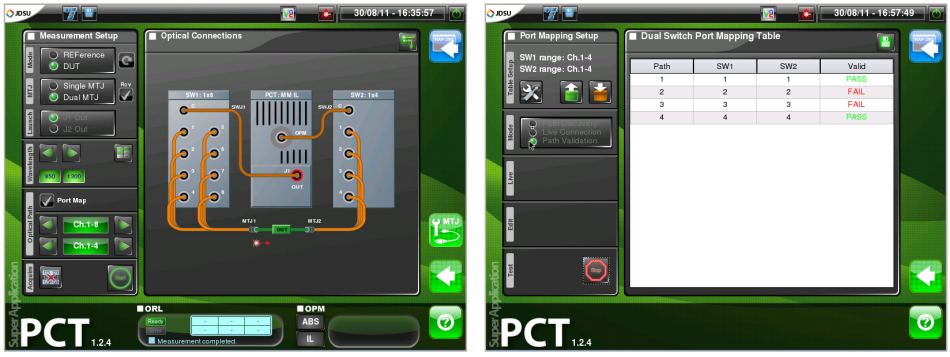


Schematic example of the JDSU AC990 integrating sphere

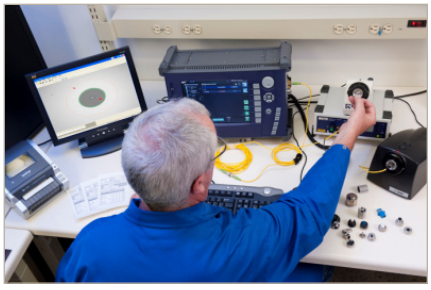
The JDSU AC990 attached to the front panel of an mORL module with an MPO power meter adaptor

Port-Mapping Application

Port mapping is an additional software application (mSUP-PCTMAPPING) that unlocks the power of two optical switches inside the PCT framework to let users pre-program connectivity or polarity templates and to quickly verify whether the DUT complies before executing IL or IL/RL tests. Leveraging the speed and unique capabilities of JDSU optical switches, this testing can be accomplished in less than a quarter of the time it takes to fully characterize the assembly. The port-mapping application also has a discover mode that is particularly powerful for breakout cable assemblies. Using the discover mode eliminates the need to pre-select outputs or match DUT outputs to switch outputs. Users can simply connect it as quickly as possible and allow the application to find the ports prior to test. Field trials indicate that this can cut connection times in half. Once the port maps are established, the information seamlessly feeds back into the instrument and test script modes.



Port mapping (also called continuity or polarity testing) is enabled with two optical switches



Operator leveraging the IL/ORL test solution alongside connector inspections

Key Peripherals and Accessories

Connector Inspection

While the MAP-200 is not a PC, its Linux controller can support a wide range of USB-based devices, including connector inspection tools. Manufacturers commonly know that contaminated master test jumpers are a major source of test failure if left uncontrolled. The fiber inspection and test application (mSUP-FIT) is a super application that runs parallel to the PCT. A toggle button ensures that the operator is never more than one-button-press away from inspection of the master-test jumper.

Power Meter Connector Adaptors

JDSU is committed to providing the latest power-meter adaptor interfaces. As connector formats change, new power-meter adaptors are required. JDSU can provide mechanical specifications and drawings for specialized formats so that manufacturers can develop their own interface, as required.

Third-Party Accessories

To simplify workflow, several standard third-party accessories can be used including a standard mouse, keyboard and ASCII text-entry-based barcode readers. The unit directly supports two label printers; see the ordering information for specific models. It also supports network printing on postscript-enabled printers. Contact the JDSU technical assistance center for concerns or questions regarding supported devices.

Examples of the range of accessories available for use with the PCT

Specifications

mORL-A1 Single-Mode Insertion Loss and Return Loss Module

Parameter	*Specification*
Source	
2-wavelength version	1310, 1550 nm
4-wavelength version	1310, 1490, 1550, 1625 nm
Measurement Time	
Initialization time	< 4 s
Averaging options per wavelength	2, 5, 10 s
Insertion Loss	
Display resolution	0.001 dB
Total IL uncertainty[1]	±0.02 dB
Additional uncertainties	
Due to 1xN switching (if mOSW-C1 added)	±0.01 dB
Additional uncertainties	
Due to fiber position in the integrating sphere[2]	±0.03 dB
Return Loss	
Display resolution	0.01 dB
DUT length	
DUT reflections (both ends) < 40 dB	>170 cm
DUT reflections (both ends) > 40 dB	>70 cm
Return Loss Repeatability[3,4]	
–30 to 65 dB	±0.1 dB
–65 to 70 dB	±0.2 dB
–70 to 75 dB	±0.4 dB
–75 to 80 dB	±1.5 dB
Return Loss Accuracy[3]	
–30 to 70 dB	±1.0 dB
–70 to 75 dB	±1.7 dB
– 75 to 80 dB	±3.0 dB
Recalibration Period	1 year

1. After valid zero loss, total expanded uncertainty (2σ), and reconnecting the same connector and OPM adaptor, temperature ±1°C, using internal source.
2. 24-channel ribbon fiber
3. All measurement specifications provided at 5 s averaging time and 200 m range, unless otherwise stated.
4. 10 measurements with a stable connection of a 3 m patch cord.

mIL-A2 Multimode Insertion Loss Module

Parameter	*Specification*
Source	
Source type	Dual LED
Wavelength	850 nm, 1300 nm, or both
Measurement Time	
Single wavelength	0.8 s
Dual wavelength	1.3 s
Insertion Loss	
Display resolution	0.001 dB
IL dynamic range[1]	>25 dB for both 850/1300 nm
IL linearity[2]	±0.010 dB ±10 pW (1300 nm)
IL stability – 15 min[3]	±0.01 dB
IL long-term stability – typical[4]	±0.05 dB
Fiber Type	50 or 62.5 µm
Recalibration Period	1 year

1. With standard AC101 FC adaptor.
2. Temperature ±3°C within 20 to 30°C
3. After 1 minute in repeat mode and at constant temperature with a stable 1 m patch cord connection.
4. Over 20 hours at a temperature within ±3°C from 20 to 30°C and with a stable 1 m patch cord connection.

mORL-A1 Multimode Insertion Loss and Return Loss Module

Parameter	*Specification*
Source	
2-wavelength version (LED or laser mode)	850, 1300 nm
Fiber Types	
Single fiber	50 µm (OM3)
Dual fiber	50 µm (OM3) and 62.5 µm (OM1) (software selectable)
Measurement Time	
Initialization time	<4 s
Averaging options per wavelength	2, 5, 10 s
Insertion Loss	
Modes	LED or laser (software selectable)
Display resolution	0.001 dB
Total IL uncertainty[1,2]	±0.05 dB
Additional uncertainties[2]	
Due to 1xN switching (if mOSW-C1 added)	±0.01 dB
Additional uncertainties[2]	
Due to fiber position in integrating sphere[3]	±0.03 dB
Return Loss	
Display resolution	0.01 dB
DUT length	
DUT reflections (both ends) < 30 dB	>170 cm
DUT reflections (both ends) > 30 dB	>70 cm
Return Loss Repeatability[4, 5]	
–15 to 60 dB	±0.2 dB
–60 to 70 dB	±0.5 dB
Return Loss Accuracy[4]	
–15 to 20 dB	±1.8 dB
–20 to 60 dB	±1.3 dB
Recalibration Period	1 year

1. For LED mode, after valid zero loss, total expanded uncertainty (2σ), and reconnecting the same connector and OPM adaptor, temperature ±1°C, using internal source.
2. IL uncertainty from launching condition is not included.
3. 24-channel ribbon fiber.
4. All measurement specifications provided at 5 s averaging time and 200 m range, unless otherwise stated.
5. 10-measurements with a stable connection of a 3 m patch cord.

General Environmental Specifications (module only, not in MAP-200 chassis)

Parameter	*Specification*
Environmental	
Warm-up time	20 min
Operating temperature, humidity	25 ±5°C non-condensing humidity
Storage temperature	–30 to +60°C
Physical	
Size (W x H x D)	4.06 x 13.26 x 37.03 cm (1.6 x 5.22 x 14.58 in)
Weight (approximate)	1.2 kg (2.65 lb)

For additional specifications, see the MAP-200 data sheet.

Ordering Information

mORL-A1 Single-Mode Insertion Loss and Return Loss Module

Product Code	*Description*
MORL-A13500-MSTD	IL/RL meter, standard dual wavelength (1310, 1550 nm)
MORL-A13500-MBID	IL/RL meter, integrated bidirectional, dual wavelength (1310, 1550 nm)
MORL-A13456-MSTD	IL/RL meter, standard quad wavelength (1310, 1490, 1550, 1625 nm)
MORL-A13456-MBID	IL/RL meter, integrated bidirectional, quad wavelength (1310, 1490, 1550, 1625 nm)

Fiber Type Options (required)

M100	9/125 fiber type

Connector Options (required)

MFA	FC/APC connector type

mORL-A1 Multimode Insertion Loss and Return Loss Module (fiber type codes are embedded directly)

Product Code	*Description*
MORL-A11308-MSTD-M101	IL/RL meter, standard dual wavelength (850, 1300 nm), 50 µm (OM3) fiber
MORL-A11308-MBID-M101	IL/RL meter, integrated bidirectional, dual wavelength (850, 1300 nm), 50 µm (OM3) fiber
MORL-A11308-MSTD-M112	IL/RL meter, standard dual wavelength (850, 1300 nm), 50um (OM3) and 62.5 µm (OM1) fiber
MORL-A11308-MBID-M112	IL/RL meter, integrated bidirectional, dual wavelength (850, 1300 nm), 50 µm (OM3) and 62.5 µm (OM1) fiber

Connector Options (required)

MFA	FC/APC connector type

mIL-A2 Multimode Insertion Loss Module

Product Code	*Description*
mIL-A21308	IL meter, dual wavelength 850, 1300, LED based

Fiber Type Options (1 selection required)

M101	50/125 fiber
M102	62.5/125 fiber

Connector Options (required)

MFP	FC/PC

Popular optical switches (additional versions available, consult separate switch data sheets)

MAP-200-Based Switch Modules

Product Code	*Description*
MOSW-C111C004B(S)(M)*	Single 1 x 4 switch, bulkheads
MOSW-C111C008B(S)(M)*	Single 1 x 8 switch, bulkheads
MOSW-C111C012B(S)(M)*	Single 1 x 12 switch, bulkheads (dual width)
MOSW-C111C024B(S)(M)*	Single 1 x 24 switch, bulkheads (dual width)

Fiber type Options (required)

M100	9/125 fiber type
M101	50/125 fiber (OM3)
M102	62.5/125 fiber (OM1)

Connector Options (required)

MFA	FC/APC connector type
MFP	FC/PC

100 µm Fiber Receive Switch (for use in front of power meter only)

MOSW-C11RX012BX	Single 1x12 switch, 100 µm fiber, FC/APC connector
MOSW-C11RX024BX	Single 1x24 switch, 100 µm fiber, FC/APC connector

Software Options

Product Code	*Description*
MSUP-FIT	Visual inspection application license
MSUP-PCTMAPPING	PCT mapping applications license
MSUP-SBSC	SB/SC series external optical switches driver license (requires MAP-200A15)

*Select (S) for single-mode or (M) for multimode

Fiber Connector Inspection Probes (connector interfaces options on request)

Product Code	*Description*
FBP-P5000	P5000 digital probe microscope
FVD-2200	200X digital bench-top microscope
FVD-2400	400X digital bench-top microscope
FVD-2400-L	400X digital bench-top microscope — long working distance (recommended for MPO or connector with guide pins)

Third-Party Supported Accessories

Control and Data-Entry Devices

Standard USB HID-compliant single-function keyboard
Standard USB HID-compliant Mouse
USB barcode reader with HID/keyboard emulation

Direct-Connect Printers (part numbers change frequently, please check with JDSU for the current list)

Brother QL-1060N (direct connection via USB or Ethernet)
Dymo Label Writer 93089 (direction connection via USB)

Network Printer Support

PostScript®-compatible network printer
Common power meter interfaces (Consult with JDSU for additional options, if required.)

Blanking and Dark-Current Caps

Product Code	*Description*
AC100	Protective dust cap (Comes with one, standard, with each module)
AC900	Magnetic quick-attach adaptor for dark-level measurements
AC990	72-Fiber integrating sphere, locking style

Common Connector Adaptors (all adaptors accommodate PC, UPC, and APC interfaces.)

Product Code	*Description*
AC901	FC adaptor, locking style (also available in AC101 non-locking)
AC102	ST adaptor
AC903	SC adaptor, locking style (also available in AC103 non-locking)
AC112	MT ferrule holder
AC114	MU adaptor
AC917	MPO adaptor, locking style (requires AC990)
AC918	LC adaptor, locking style
AC918D	LC duplex adaptor, locking style

Ferrule Adaptors

Product Code	*Description*
AC116	Universal 2.5 mm ferrule holder
AC116L	Universal 2.5 mm ferrule with LC-centering feature
AC123	Universal 1.25 mm ferrule holder

Bare-Fiber Holder

Product Code	*Description*
AC120	Barrel adaptor for bare-fiber holder
AC121	Single-fiber bare-fiber adaptor (requires AC120)

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