The Viavi Solutions Fiber Characterization Service

Independent Verification of High Speed Fiber Links

About the Viavi Fiber Characterization Service

Anyone turning up, qualifying, speeding up, or otherwise modifying a fiber optic network must understand—precisely and without guesswork—the quality of their infrastructure. Can the fiber handle the tighter tolerances of 10G or 40G dense wavelength division multiplexing (DWDM)? How are connectors and other inline components holding up? Can the existing fiber plant be upgraded? Will a new installation perform to service level agreements (SLAs)?

Accurately evaluating the quality of fiber spans requires a very high level of expertise and complex test equipment. For most network service providers, equipment manufacturers, and contractors, it makes sense to outsource periodic fiber characterization to specialists who can get the job done quickly and correctly.

The Viavi Fiber Characterization Service independently verifies the quality and integrity of new or existing optical fibers to determine their suitability for today's high-speed applications. Our expert field engineers perform comprehensive testing using the latest, award-winning fiber optic measurement instruments that are meticulously maintained and calibrated. With comprehensive reports that detail results and give clear analyses and recommendations, they can eliminate uncertainty and identify infrastructure and cross-carrier issues before deployment—avoiding the costs of troubleshooting and rework.

Network service providers, equipment manufacturers, and contractors all use the Viavi Fiber Characterization Service to assure top quality work, cost-effectively allocate resources, and efficiently meet the strictest deadlines:

- benchmark accurate fiber test data from a trusted, independent third party
- ensure that transmission characteristics meet performance standards for 10G, 40G, and DWDM
- enable optimal network planning and engineering
- meet the most aggressive deadlines with a team that masters complex, multi-carrier projects
- avoid acquiring and maintaining equipment and personnel for a function with only sporadic demand.

New service options evaluate the most complex fiber-span components, including:

- submarine fiber
- ROADMs
- Raman amplifiers
- EDFAs.

The Technical Challenges of Higher Performance

As optical networking migrates to 10 Gbps and faster speeds, the need for higher-quality fiber increases dramatically. Above 2.5 Gbps, the increased effects of dispersion, reductions in optical power budget, and the introduction of complex new technologies such as DWDM, ROADM, erbium-doped fiber amplifiers (EDFA), and Raman amplifiers create much greater sensitivity to impairments. For example, the use of ROADMs enables on-demand wavelength route changes and eliminates many costly optical-electrical-optical (OEO) conversions. However, CD and PMD on fiber links can cascade out of control and must be fully quantified prior to a successful service turn-up. For these reasons, engineering new and faster networks for optimal cost and performance requires precise and comprehensive fiber characterization performed by highly trained, experienced personnel.

Fiber Characterization—Standard Tests

Every fiber deployment is unique and every characterization starts with a detailed Statement of Work that specifies tests and deliverables, lead times, pricing, and project details. Typically, the following tests are standard for any characterization:

Pre-Test Inspection and Cleaning

Prior to testing, we inspect each fiber with a Viavi video microscope probe to identify scratches, pits, or other blemishes of the core and cladding that could cause optical insertion or return loss. We remove dirt and residue to ensure the best possible performance of every connector.

Optical Insertion Loss

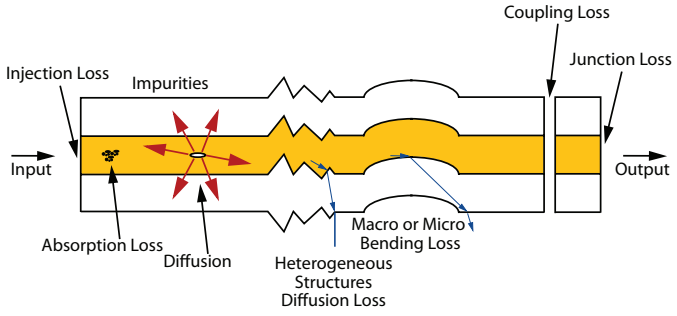
Optical insertion loss (OIL) measurement provides optical power loss results at various wavelengths as well as transmission delay and fiber length. Excessive loss may dictate the addition of optical amplifiers or regenerators.

Optical Return Loss

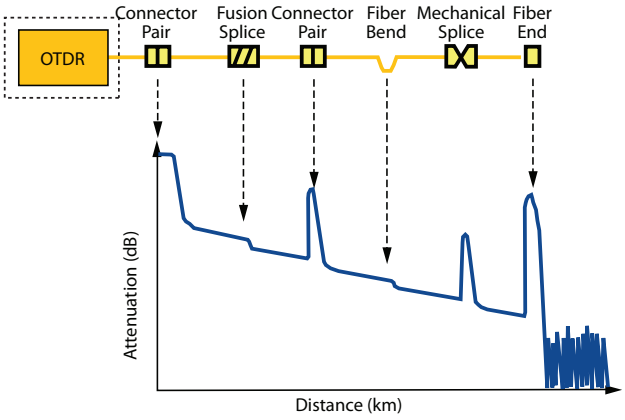
Optical return loss (ORL) measurement indicates the cumulative reflection offered by the optical link as a result of connector reflectance and inherent fiber reflectance. It provides a pass/fail result for the entire link and determines the suitability of a link for WDM applications. Failed ORL results are usually corrected by careful cleaning of the fiber connectors or, in worst-case scenarios, by re-termination of the fiber connectors.

Optical Time Domain Reflectometry

An optical time domain reflectometer (OTDR) trace provides an overall view of the fiber span. It identifies high-loss splices, bends, and connectors as well as individual reflective events from connectors and mechanical splices. This test requires a very experienced operator who can correctly judge instrument settings to locate a problem accurately.



Sources of Loss



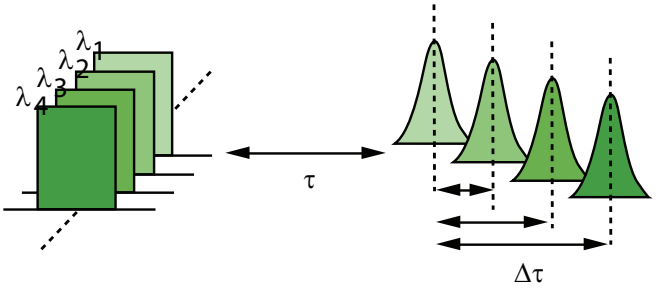
Optical Time Domain Reflectometry

Chromatic Dispersion

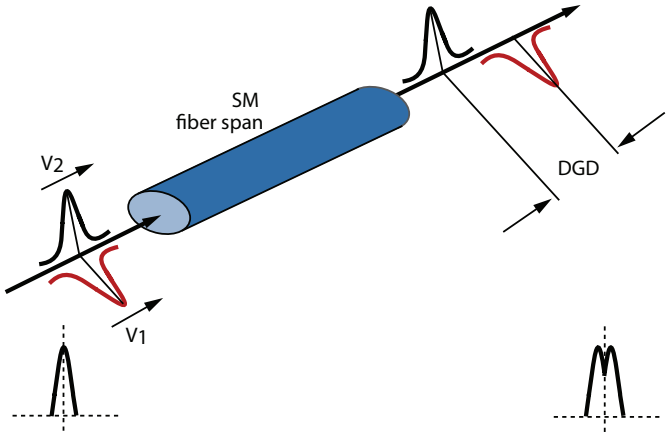
Chromatic dispersion (CD) measurement indicates the amount of dispersion, or pulse spreading, over a wavelength. CD results also indicate the type of fiber used through the analysis of zero dispersion wavelength and slope characteristics. Transmission systems engineers rely on this data to design the proper compensation scheme for CD, a vital task to ensure top-level reconfigurable optical add-drop multiplexer (ROADM) performance.

Polarization Mode Dispersion

Polarization mode dispersion (PMD) results typically determine the suitability of a fiber itself for high-bit-rate applications. Two different polarizations of light may travel at different speeds in a fiber due to fiber imperfections and asymmetries, causing pulses to spread and overlap. Technicians cannot economically compensate for PMD; and, temperature variations, the condition of the installed fiber, and inherent fiber geometry affects these results.



Chromatic Dispersion



Polarization Mode Dispersion

Fiber Characterization—Specialized Tests

In addition to standard fiber characterization tests, Viavi offers a number of application-specific evaluations.

Fiber Characterization for Submarine Fiber System Upgrades

Leveraging our global fiber characterization capabilities and expertise in logistics management, the Viavi team offers a suite of tests specifically designed to provide critical data necessary for link engineering of submarine system upgrades. The suite consists of residual CD, PMD, spectral gain profile, and one-channel optical signal-to-noise ratio (OSNR) tests.

Fiber Characterization for Distributed Raman Amplifiers

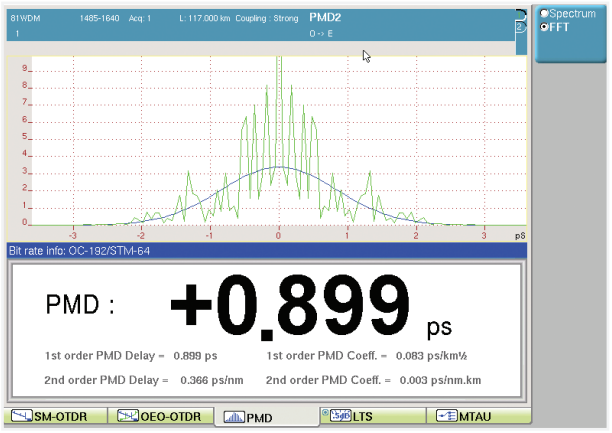
Due to the very high power (>27 dBm) used to pump distributed Raman amplifiers, the quality and cleanliness of all connectors at and near the fiber ends are critical. In addition to the standard fiber characterization tests, Viavi uses short-range, high-resolution OTDR traces to inspect each individual connector event in great detail.

Spectral Attenuation Profile

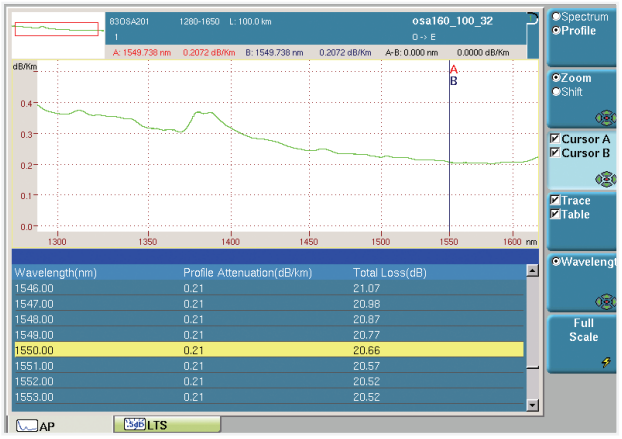
The spectral attenuation profile (SAP) measurement shows how the insertion loss of the fiber under test changes with wavelength. This test may be useful when faced with unknown fiber types and is especially important for coarse wavelength division multiplexing (CWDM) and ultra-long-haul spans (such as submarine systems) with multiple amplifiers.

First Connector Loss and Reflectance Characterization

Sometimes it is important to accurately characterize the loss and reflectance at the terminating connectors of a fiber. This is a useful metric for judging the quality of workmanship, but it is a complex test to perform, requiring unique test setups and meticulously maintained equipment.



PMD Test Results



Attenuation Profile Measurements

Related Services

Program Management

For large-scale fiber characterization projects involving high fiber counts or multi-national, multi-carrier coordination, Viavi can manage an entire program with an experienced Viavi project manager working as an extension of your team.

Optical Network Qualification Service

Optical Network Qualification (ONQ) is a set of engineering and field measure-ment services designed to help network operators characterize and qualify advanced optical network designs and deployments such as those using DWDM, submarine cables, 40G/100G, ROADMs, and amplifiers. Viavi ONQ services proactively qualify and characterize next-generation optical networks and network elements in both the lab and field environment to ensure compliance with necessary standards and functional, scalability, reliability, and resiliency requirements.

Network Planning and Optimization Practice

The Viavi Network Planning and Optimization (NPO) Practice works with network operators to design, plan, and optimize their next-generation optical, Internet protocol/multiprotocol label switching (IP/MPLS), and synchronization network infrastructure. Our teams apply their industry-leading expertise and design/modeling tools to help network operators reduce time to market; smoothly roll out new converged networks; and, provide high-quality, reliable services at an optimal cost.

Broadband and IPTV Network Assessment

Viavi Broadband and IPTV Network Assessment offers a range of professional and consulting services that address the specific challenges of deploying and maintaining IP-based video technologies. We adopt a phased program to let operators ensure the right infrastructure is in place for the cost-effective delivery of high-quality IP television/digital video (IPTV) services.

Specifications—Tests and Deliverables

Viavi conducts all testing according to a detailed Statement of Work that is unique for each customer and test environment. Standard tests include:

- bidirectional OIL at 1550 and 1625 nm
- bidirectional ORL at 1550 and 1625 nm
- bidirectional OTDR traces at 1550 and 1625 nm
- CD in the S, C, and L bands
- PMD over S, C, and L bands.

Once work begins, Viavi sends a daily summary of test results within 24 hours of testing. Upon completion, a comprehensive, final report includes:

- test plan and procedures
- results including pass/fail analyses and OTDR and CD trace printouts
- Viavi OFS-110 Fiber Trace Viewer software
- digital pictures of selected fiber end faces
- recommended actions.

Conclusion

Whether you are installing new fiber runs, deploying 10G/40G, rolling out DWDM, or troubleshooting service issues, you must verify your fiber plant. It is usually not feasible or economical for organizations to acquire and maintain the skills and equipment necessary to accurately characterize fiber. This is why network service providers, equipment manufacturers, and contractors outsource these measurements to a trusted, independent advisor—Viavi.

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