White Paper

VIAVI Solutions

Staying Within Your Budget

An Introduction to Insertion Loss Measurements

Introduction

In our ever AI-driven world, datacenters, telecommunication providers and photonic systems are requiring lower insertion loss subsystems and components to reduce energy costs and improve signal quality. Insertion loss critically defines the 'transparency' of a subsystem in an optical network.

What is Insertion Loss?

Insertion loss is defined as the ratio of power input to a Device Under Test (DUT) and the power transmitted out of the DUT. Practically, for a DUT like a fiber patch cord or silicon photonic circuit, this is the power lost between input and output terminals. While possible to express this loss-ratio as a percentage, it is the standard to express this loss in the unit of decibels (dB). The equation for measuring this loss in dB then is:

$$\text{IL (dBm)} = 10 \times \log_{10}\left(\frac{P_{in}}{P_{out}}\right)$$

Where P_{in} and P_{out} are powers measured in linear units, like Watts. If the units are measured in dBm as well however, the equation becomes simplified:

$$\text{IL (dBm)} = P_{in\,(dB)} - P_{out\,(dB)}$$

Insertion loss at a practical level is simply the amount of signal lost due to coupling, scattering, mismatched fibers or other loss drivers. When constructing a system design, a loss budget is usually implemented to ensure that enough signal survives the component to be useful at the receiver. This requirement to adhere to the loss budget is the key driver for insertion loss testing.

How Do I Test for Insertion Loss?

The VIAVI Passive Component Tester (PCT) system is an all-in measurement system for insertion loss, return loss and optical length. These measurements are often taken together as the requirements for optical components usually also include a limit on optical return loss, and optical length. In the case where you want to bundle all your testing together, the PCT will guide you through the measurement process with intuitive user interface pictures, no-code process design, and hands-off measurement control sequences. For more information about testing insertion loss using the PCT, read our whitepaper on Fiber Array Unit Optical Testing.

In cases when your insertion loss testing is an exclusive requirement, VIAVI provides all the pieces required to make accurate and fast insertion loss measurements, with a global support network for local service. VIAVI's LightDirect portfolio of optical modules offers both market-leading and cost effective optical sources (lasers, like mSRC), and optical power meters (like mOPM) to create a powerful and flexible solution to meet your exact needs.

If testing over a span of wavelength is required – such as in silicon photonics applications – VIAVI offers the Swept Wavelength System (SWS) as a turnkey solution that gather insertion loss and/or return loss measurements across an entire band of wavelengths within < 3 pm resolution and measurement dynamic ranges exceeding 70 dB.

All-in Optical Testing with VIAVI's PCT

If optical return loss and optical length are requirements of your customers or if there are critical specifications in your integration project, the VIAVI PCT is the best solution to cover your testing needs. VIAVI has longstanding partnerships with manufacturers and integrators of photonic communication technologies to bring the best combination of production efficiency innovations, usability enhancements, and measurement accuracy validation designs to deliver this market defining, comprehensive solution.

Figure 1: Multimode PCT system capable of measuring 24 channels

The PCT does not require a computer – and makes use of a no-code automation space for process enhancements and improvements to operator comfort. It allows test designers to directly connect to printers or interface remotely with computers or servers in the local network, creating efficient interfaces to databases or order management systems (OMS).

Insertion Loss Test with LightDirect Modules

As testing requirements move closer to the chip in many instances, it is critical to have control over your testing setup, making changes as the requirements in your product space change. The LightDirect portfolio of products is designed to meet every test need you have in an ultra-flexible and modular approach. The suite of optical sources allows test designers to leverage Fabry-Perot (FP), Distributed Feedback lasers (DFB), LEDs or SLEDs. Paired with ultra-performance and high-density optical power meters (mOPM and mOPM-C2B), test designers can easily create 7U rack applications for testing insertion loss exceeding 176 channels at a time.

For applications where spectral, attenuation or polarization control are needed, VIAVI offers signal conditioning modules in the same mainframe with a simple user interface and fully remote commands via SCPI over ethernet or GPIB. Additionally, VIAVI offers switches from 1x2 switches up to 1x176 switches, perfect for insertion loss testing of many DUTs.

For large scale testing of insertion loss using a source-switch-power meter architecture, the layout could look like Figure 2 below:

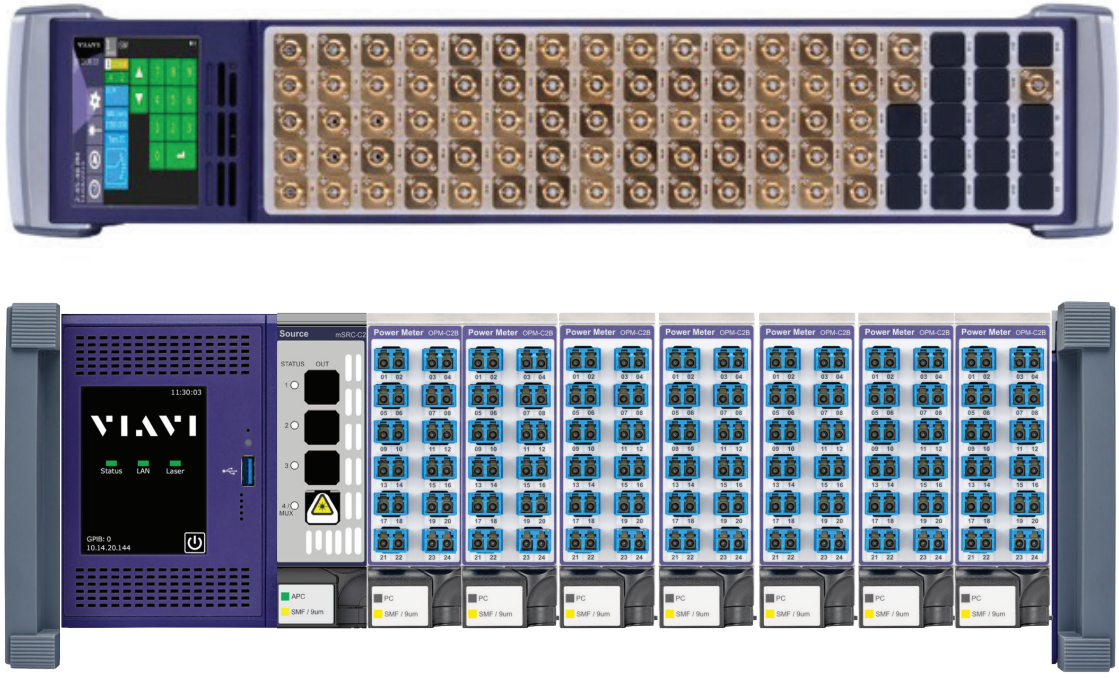

Figure 2: MAP-380 with Optical Source (mSRC) and high density OPMs (mOPM-C2B) with mISW Optical Switch (1x72 shown)

Conclusion: What Now?

VIAVI's market leadership in optical test and measurement, coupled with class-leading modular platform allows you to easily craft custom tests or leverage turnkey solutions to meet your needs. The accuracy and flexibility of your test systems directly contributes to your reputation in the technology landscape. VIAVI will help you create effective spaces to grow your operational capabilities.

Figure 3: Many peripherals can be easily added to the PCT workflow

VIAVI Can Help

As the number of fiber channels and optical components in the world continues to grow year-over-year exponentially, the demand for fast and versatile test systems has never been more critical to relieve process bottlenecks. VIAVI is the market leader for optical test and measurement systems that will lead you into the future of high-volume, high-performance and cost-effective optical manufacturing.

To learn more, contact a product expert in your region or request a demo

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