White Paper

VIAVI Solutions

Novel Insertion Loss Measurements VIAVI PCT Enhanced TDR

Introduction

As the AI world continues to grow, the demand for optical connectors for hyperscale applications is exploding at unprecedented rates. As a critical partner for many hyperscalers, VIAVI understands the importance of meeting deadlines, scaling quickly, and maintaining close relationships with these key customers. VIAVI testing platforms enable users to get to the measurements that matter and drive growth, while leveraging decades of industry-leading experience to help customers optimize their production environments, even beyond the test and measurement area of their space.

Meet the world-leading VIAVI Multiple Application Platform (MAP) architecture. With over 1200+ MAP systems ordered every month, VIAVI has led the production test market for over 15 years and constantly innovates to keep production environments fast, small and cost-effective. The MAP system is the top tier production tool for manufacturers and labs that want to have access to market-leading modules, open automation tools and cost-effective scaling as they grow.

The MAP-300 Mainframe Family

Within the MAP, VIAVI offers the most advanced and flexible Passive Component Tester (PCT) that allows a wide range of optical production environments to measure insertion loss, return loss and length, all while scaling to as many as 1000 channels in a single test. The PCT integrates data control with SQL databasing and process controls to make sure that the operator experience is simple, easy and fast at every step.

VIAVI has now released the Enhanced TDR feature that allows PCT users to go even further – measuring insertion loss without connecting the far end of their device under test (DUT). This revolutionary process allows manufacturers to skip costly process steps on fiber systems where the far end of the DUT is going to be shipped as bare fiber or otherwise not connectorized.

Market Assessment: AI Infrastructure

As Artificial Intelligence continues to grow and require larger datasets, the superhighways that connect data centers together have grown exponentially as well. These superhighways are being built in two dimensions at the same time – speed and size. While the evolution of faster signal encoding and decoding continues to march forward, the Shannon limit will soon require that larger datacenters will consume more lanes on the superhighway to achieve more throughput, which means more and higher density fiber systems. Quantities of fiber connectors shipped have continued to grow over the last two decades, but multi-ferrule and multi-fiber connectors have seen the total count of fibers produced grow exponentially, well beyond many hundreds of millions of fibers per year.

As multi-fiber connector types have increased in popularity, VIAVI has been closely monitoring new connector types and requirements to deliver over 100 adapters for the MAP system and for the PCT - including multi-fiber adapters, outdoor cabling adapters, and even bare fiber adapters to enable every measurement that could be desired by your customers. VIAVI also has an ongoing program to support new custom connector adapters, so if you need an adapter for your application that we don't have right now, let us know. We partner with many consumers on a quarterly basis to innovate and drive test enablement together.

The AC Adapter Series' Most Common Adapters

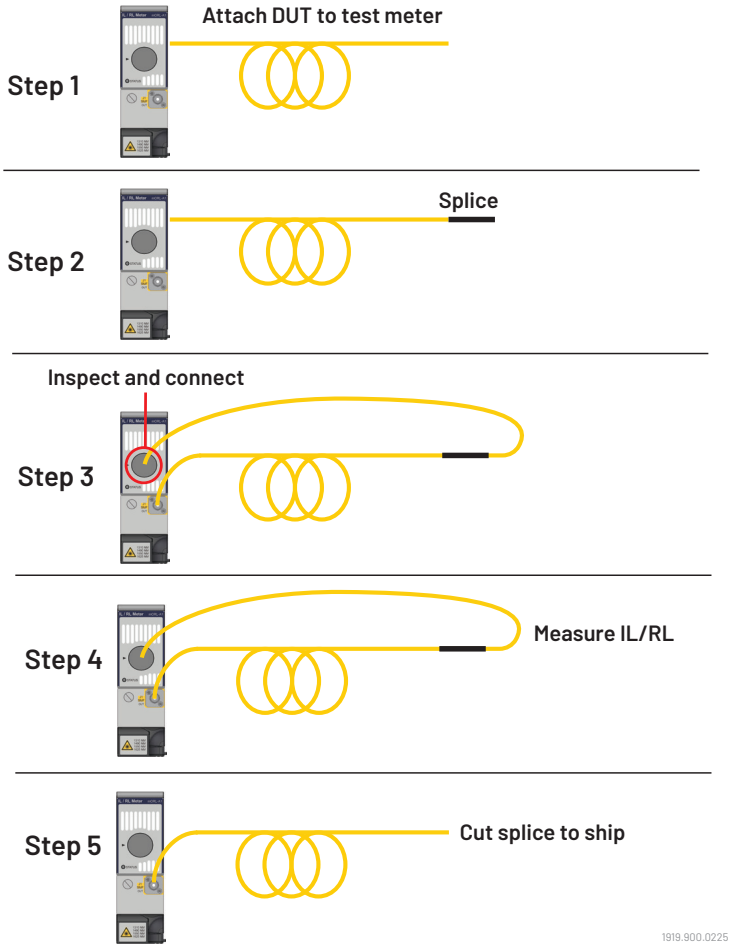
On top of multi-fiber connectors, demand from hyperscalers continues to stress the operational excellence of production environments and push manufacturers to measure faster by reducing every addressable bottleneck. To this end, the PCT can be easily customized to meet your exact needs to reduce test times and increase operational throughput. Critically, VIAVI has the experience you can rely on for expert advice on test setups, automation, or how to layout a patch panel to make testing more comfortable for your operators.

Enhanced TDR: Same Measurement – Innovative Approach

Committed to leading the test world into the AI data center reality, VIAVI has added several key improvements and features to the PCT component of its MAP platform. The focus in this discussion is the Enhanced TDR feature, which is a software addition to the PCT infrastructure which customers across the globe have already integrated. The outcome of Enhanced TDR is simple: measure the insertion loss and return loss of your DUT without connecting to a power meter, improving test throughput by reducing a procedural bottleneck.

Traditional insertion loss will always have its place in ultra-performance environments where the PCT's performance has an uncertainty specified at ±0.02dB, and in ultra-high speed environments where the only metric of interest is measurement speed. While FastIL within PCT can achieve insertion loss measurements in under 0.5 seconds per channel, it is important to have a view of measurement time and cost across the entire process.

Power Meter Method with Involved Cutback Procedure



In the Enhanced TDR world, this process is not needed and can easily be replaced by the following workflow:

Simplified Testing using Enhanced TDR

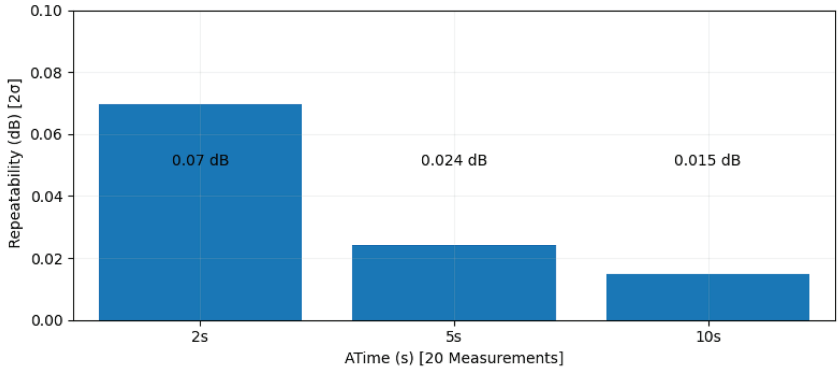
This new workflow, while requiring more time to execute the test itself, dramatically saves on material cost and total time, significantly increasing the overall throughput of your process - a groundbreaking leap forward in testing technology.

The Enhanced TDR works by performing a measure of the backscatter from your fiber system, before and after the connector, the user wants to measure. This means there needs to be a span of fiber before the connector under test and after this connector to make a backscatter measurement from. The minimum DUT length for this measurement to be performed with a high degree of effectiveness is 5 meters. The test lead to the DUT likewise needs to be at least 5 meters, but should be longer when possible, up to 50 meters.

Performance Qualities: Technical Understandings

The Enhanced TDR has trade-offs that should be noted from the traditional power meter method of measuring insertion loss. The primary two trade-offs are in speed and dynamic range.

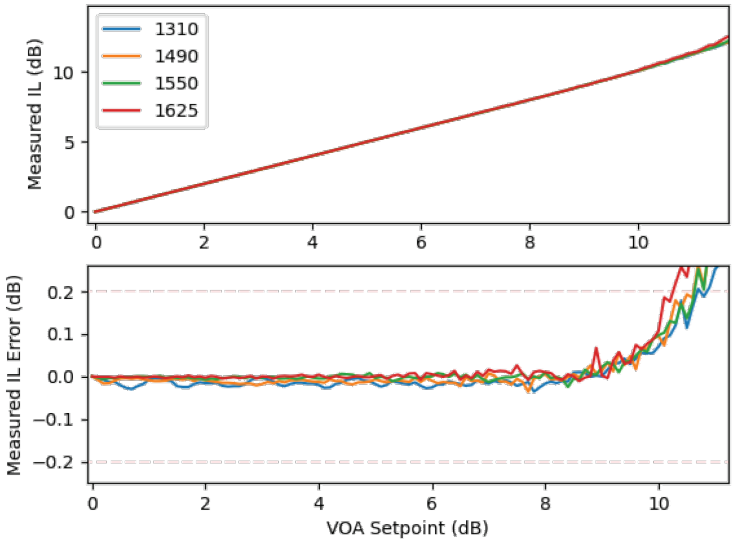
The speed of the Enhanced TDR can be controlled by a test engineer to an exact specification, understanding the following graphic:



Repeatability of TDR Feature Over ATime

To see the same accuracy performance as the traditional insertion loss measurement, a setting of 5 seconds averaging time is required (and is the default value). This means that compared to the normal 2 seconds averaging time of the power meter method in PCT, Enhanced TDR is about twice as slow, only for the test time.

The dynamic range of the Enhanced TDR is likewise greatly impacted by the measurement philosophy. Since Enhanced TDR leverages a whole OTDR engine to make measurements, the effective range of the measurement is much smaller, but still appropriate for the measurement of passive components like cables or jumpers. The effective range of the traditional measurement can exceed even 70 dB, whereas Enhanced TDR can reach about 9 dB before the linearity error begins to impact the measurement as shown in the graphics below:

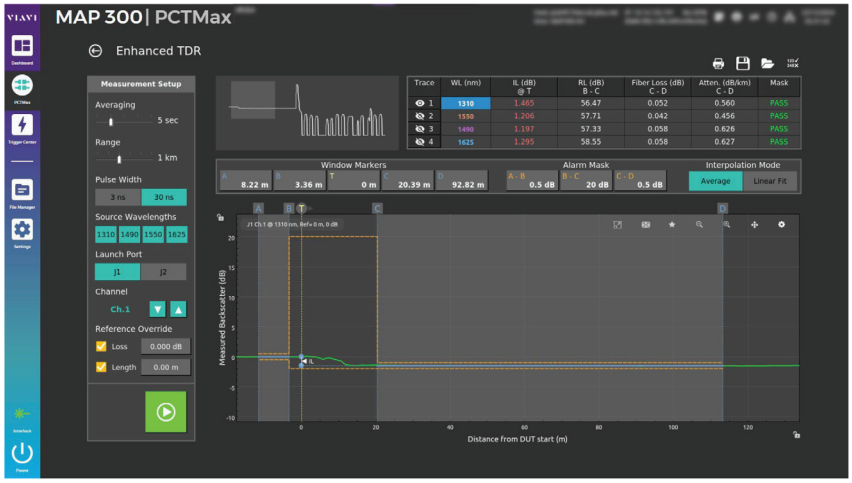


Measurement Performance of the Enhanced TDR for an Example Measurement

Process Control: Operationalized Enhanced TDR

As a part of the MAP framework, Enhanced TDR is automation-oriented and every function of the feature is fully replicated from remote SCPI commands, which can be automated in any programming language or model. Additionally, all results can be queried from remote commands in the same manner.

A critical aspect to the feature is the process control tool, data masks - the dashed orange lines which show up on the graphical user interface (GUI):



Future Releases: Looking Forward

PCT will soon incorporate Enhanced TDR as a troubleshooting tool within Instrument mode, allowing users to launch an Enhanced TDR measurement only on channels where a traditional IL/RL measurement was made and failed. This allows operators to assess the cause of the failure, and production facilities to intelligently track the leading causes of failures to reduce process losses.

Many Peripherals can be Easily Added to the PCT Workflow

Enhanced TDR will also be included in the PCT's onboard test scripting mode, where operators can work through a tightly controlled list of actions to execute the testing of the DUT, and have results automatically pushed onto a database and sent to a printer. This mode also allows for the use of other peripherals like a foot pedal to start a measurement, or a barcode scanner to read the serial number of the DUT from its packaging.

Conclusion: What Now?

The Enhanced TDR function within the PCT architecture provides unparalleled access for testers to know about their DUT and test IL and RL without connecting to a power meter – reducing material costs and steps in the process, and increasing overall throughput efficiency - all without requiring advanced training for operators. Remote commands and scripting with the MAP-300 system enables easy automation for users wishing to design their own workflows.

VIAVI Can Help

As the number of fiber channels 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.

viavisolutions.com

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