



T-BERD[®]/MTS-8000 I-PMD[™]

In-Service PMD Test Solution for DWDM/ROADM Networks



The innovative Viavi Solutions in-service PMD test solution (I-PMD) for the T-BERD/MTS-8000 V2 uses dense wavelength division multiplexing (DWDM) traffic wavelengths to efficiently measure polarization mode dispersion (PMD) (using effective DGD) without inserting a test signal.

Based on the coherent detection technique, the I-PMD provides high-resolution optical channel analysis (for power level and frequency) and in-band optical signal-to-noise ratio (OSNR) testing capability, enabling long-term monitoring for signal variations.

The I-PMD is the industry's first solution dedicated for network maintenance and troubleshooting of high-speed DWDM and reconfigurable optical add-drop multiplexers (ROADMs).

Key Benefits

- Qualifies link PMD, without turning off DWDM transmission, and monitors PMD fluctuations on DWDM channels using remote access for long-term analysis
- Prequalifies running 2.5 or 10 G DWDM systems with upgradability to 10 or 40 G
- Identifies PMD or spectral issues on faulty DWDM channels from any test access point
- Offers simultaneous in-band OSNR measurements for advanced analysis

Key Features

- Single-ended test solution combines three instruments into one (PMD, OSA, and I-OSNR)
- Use traffic wavelength to test 2.5/10/40 G, regardless of single polarity or modulation format
- Out-of-service PMD measurements when combined with a polarized broadband source at the far end
- Automated, in-service I-OSNR for any single polarization format from 2.5 to 40 G
- In-service I-OSNR measurements on 40 G PM NRZ-QPSK signals in ROADM DWDM networks
- Measures out-of-band OSNR on pol-mux signals using Viavi ON/OFF method

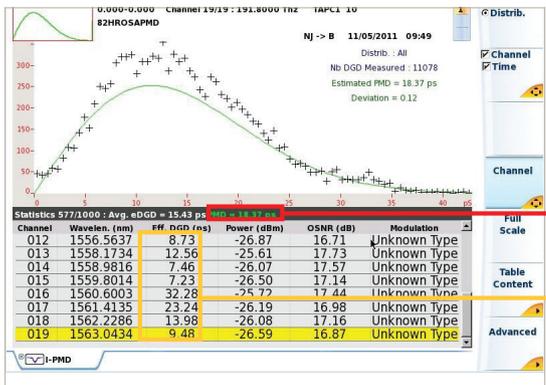
Applications

- Test for in-service PMD on DWDM and ROADM networks
- Monitor live DWDM channels for PMD
- Troubleshoot high-speed DWDM networks
- Perform live characterization for future upgrade paths from 2.5 to 40 G

Measuring PMD In-Service on Live Traffic

DWDM channels running at 2.5, 10, and 40 G are used as test signals to measure effective DGD and link PMD. Technicians can now qualify link PMD for live DWDM traffic.

- Perform measurements on a live DWDM system with fixed or ROADM network configurations
- Use high sensitivity to enable testing from any access point in the network
- Repeat effective DGD measurements to obtain PMD link values for a given test point
- Identify live channels or define channel test grid per ITU-T G.693
- Map DGDEff variations over time channel per channel to determine fluctuations in link PMD



Total PMD value

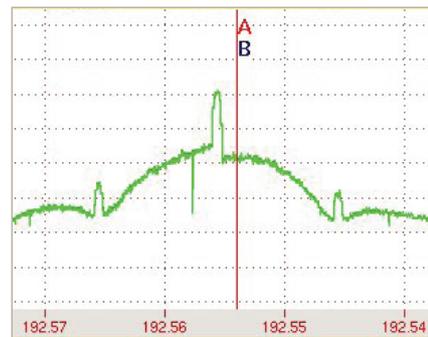
Instantaneous effective DGD for each channel

Effective DGD and PMD measurement of 10 G DWDM channels

Analyzing Live Transmission Signals

The Viavi I-PMD is much more than an in-service PMD analyzer. It can precisely characterize and pinpoint all detailed spectral information for optical signals.

- Precisely characterize laser frequencies and power levels
- Identify laser (incorrect tuning, chirp) or ROADM component (bandpass window) failures
- Analyze 2.5/10/40 G and next-generation modulation format signals
- Compare the passband shape against the ITU grid (using dedicated probe signal)

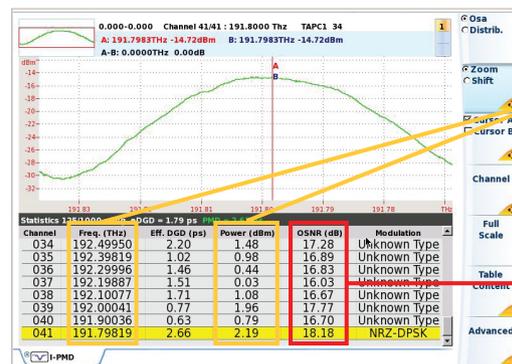


Laser chirp identification with I-PMD high-resolution spectrum analysis

Qualify DWDM with In-Band OSNR Testing

OSNR measurements complete full DWDM system qualification. The Viavi optical polarization splitting (OPS) method suppresses the transmission signal to access the noise value inside the optical channel. The I-PMD is the only viable test solution for any scenario regardless of the filter type, data rate, or direct modulation format.

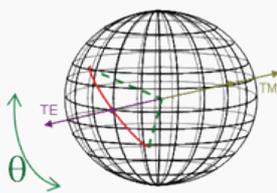
- Perform I-OSNR tests simultaneously with PMD and spectral analysis
- Measure PMD and I-OSNR to correlate with BER to identify the root causes of failures
- Perform long-term I-OSNR analysis



Optical spectrum analysis with frequency and power level

In-band OSNR measured for each individual channel

Spectrum analysis of a 40 G channel



$$DGD_{Effective}(v) = \frac{\Delta\theta(v)}{2\pi\Delta v}$$

What is Effective DGD?

Effective DGD $[\Delta Eff]$ is a quantity that represents the perturbation a channel undergoes due to PMD. Mathematically, it is defined as:

$\Delta Eff = \Delta \sin \theta$, where Δ is the instantaneous DGD in the channel, and θ is the angle (in Stokes space) between the actual signal polarization state and the principal polarization states in the WDM channel.

For intermediate polarization states, effective DGD may be any intermediate value, following a Rayleigh distribution. Therefore, the effective DGD always represents the impact of PMD on the channel.

Specifications

| In-Band DWDM Spectral Analyzer Module | |
|---|---|
| Optical Interfaces | |
| Applicable fiber | SMF 9/125 μm |
| Interchangeable optical connectors | FC, SC, DIN, LC |
| General | |
| Weight | 600 g (1.2 lb) |
| Dimensions (w × h × d) | 213 x 124 x 32 mm (8.38 x 4.88 x 1.26 in) |
| Operating temperature range | 0°C to +40°C (32°F to 104°F) |
| Storage temperature range | -20°C to +60°C (-4°F to 140°F) |
| Humidity | 95% without condensing |
| Frequency | |
| Optical frequency (wavelength) range | 196.05–191.35 THz (1529.16–1566.72 nm) |
| Absolute uncertainty of frequency (wavelength) ¹ | ± 370 MHz (± 3 pm) |
| Frequency (wavelength) resolution | 300 MHz (2.4 pm) |
| Minimum signal separation | 2 GHz (16 pm) |
| Power level | |
| Input power range (in 300 MHz bandwidth) ² | -60 dBm to +10 dBm |
| Max. safe total input power ³ | +17 dBm |
| Absolute uncertainty ⁴ | ± 0.5 dB |
| linearity ⁵ | ± 0.4 dB |
| Polarization dependence | ± 0.2 dB |
| PMD | |
| Test conditions | 2.5/10/40 G DWDM channel |
| DWDM channel spacing | Min. 50 GHz as per ITU-T G.694.1 |
| Input power level ⁶ | -45 dBm to +10 dBm |
| Measurement range | 0 to 50 ps |
| Uncertainty ⁷ | 200 fs $\pm 2\%$ x PMD |
| Acquisition time ⁸ | <5 s |
| I-OSNR | |
| Test conditions | Up to 40 G (single-polarization signal) |
| Test Method | Polarization nulling |
| Measurement range ⁹ | 5 to 35 dB |
| Absolute uncertainty ¹⁰ | ± 0.5 dB |

1. Over entire frequency range.

2. Power of unmodulated single-frequency laser or peak power of modulated signal in 300 MHz optical bandwidth.

3. Total power of all input signals.

4. At -20 dBm input power.

5. For input powers between -10 and -40 dBm.

6. Per DWDM channel.

7. From 1 to 20 ps PMD with strong coupling. Power level from -35 to -10 dBm. Averaging over 1000 independent effective DGD values. 10 G NRZ signal. OSNR >15dB.

8. Effective differential group delay, power level, frequency, and I-OSNR measurements per channel performed simultaneously.

9. Optical noise level > -55 dBm in 0.1 nm bandwidth.

10. At 1550 nm from 10 to 25 dB OSNR with PMD <50 ps.

Ordering Information

| Description | Part Number |
|---|-----------------|
| In-service PMD test solution with instantaneous effective DGD measurement, long-term PMD monitoring, high-resolution spectrum analysis, and in-band OSNR measurement. Contains a T-BERD 8000 V2 mainframe with I-PMD and polarization scrambler modules, accessories, and a transport case. | TB8000-IBDT-P1 |
| In-service PMD analyzer with instantaneous effective DGD measurement, long-term PMD monitoring, high-resolution spectrum analysis, and in-band OSNR measurement. Contains an MTS 8000 V2 mainframe with I-PMD and polarization scrambler modules, accessories, and a transport case. | MTS8000-IBDT-P1 |



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