5 Things You Should Know About . . .

Measuring Bandwidth of 10G Laser-optimized Multimode Fiber

❶ *The traditional Overfilled Launch (OFL) method of measuring bandwidth in multimode fiber has been replaced by new, more advanced techniques.*

The advent of 850 nm VCSEL light sources and 10G laser-optimized 50 µm multimode (OM3) fiber has enabled cost-effective 10G transmission for short reach enterprise applications. Unlike LEDs, VCSELs don't light up the entire core of a multimode fiber and their power profile varies from one to another. The traditional OFL bandwidth measurement method used for LED systems cannot ensure the performance of VCSEL-based systems, so a new method called Differential Mode Delay (DMD) was developed and standardized.

❷ *The two techniques – DMD Masks and EMBc – for verifying bandwidth of 10G multimode fiber have significant differences.*

The DMD Mask technique was standardized first. The Calculated Effective Modal Bandwidth (EMBc) method was added later, in an attempt to make 10G bandwidth appear similar to the familiar OFL bandwidth (e.g., "MHz-km"). Either method is allowed by the standards, but both methods require DMD measurement of the fiber. It's how the DMD data is used and interpreted that differs.

The DMD Mask method directly compares DMD test results against a set of specifications (called templates or masks) to see if the fiber has the necessary control of modal dispersion. This is a straightforward approach to make sure the data pulses do not spread excessively beyond the required 10 Gb/s bit period.

While the DMD Mask method is a direct measurement of actual fiber performance, EMBc uses calculations that are based on just a sampling of VCSELs to predict performance.

❸ *The DMD Mask method is more stringent.*

Since EMBc only provides an estimate of performance based on a sampling of VCSEL weighing functions, it does not offer as precise a measurement of fiber quality and performance as the DMD Mask technique.

Furthermore, the EMBc method virtually ignores the center 0 – 5 µm region of a fiber's core because the weighting functions put little emphasis in this area.

OFS' LaserWave 300/550 fiber meets the different specification requirements stipulated for each method. However, it's the DMD Mask method that permits closer scrutiny of fiber performance. This allows OFS to specify LaserWave 300/550 to tighter DMD in the critical center region than is required by standards, providing higher fiber performance and reliability for your networks.

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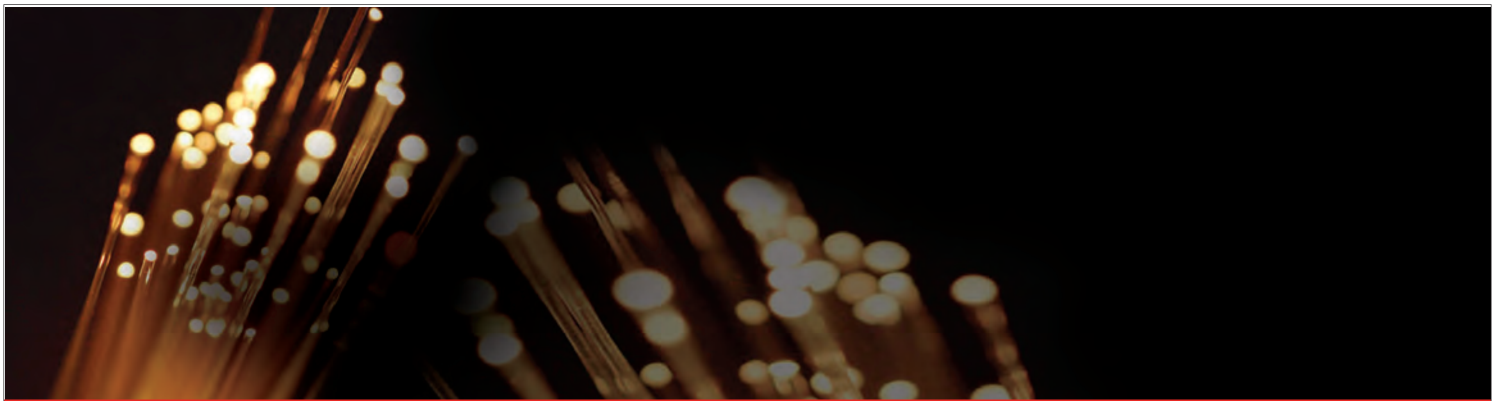

❹ ***Of the two methods, the DMD Mask technique is the more reliable predictor of systems performance.***

The true performance of a fiber not only depends on how well its DMD was controlled during manufacture, but also on how a given VCSEL interacts with the fiber. The DMD Mask method directly scrutinizes the refractive index profile of the fiber; even in regions that EMBc cannot (e.g., the center 0 – 5 µm region), to ensure the utmost performance and reliability with all compliant VCSELs (compared to the sampling of VCSELs used in the EMBc method).

❺ ***The DMD Mask technique is also the best way to ensure the performance of OM4 fiber (extended-length 10G multimode fiber).***

Performance of OM4 fiber, expected to be standardized in 2009, will be verified using the same criteria as OM3, but to tighter specifications. The IEEE 802.3 link model recommends an EMB of 4700 MHz-km for 10G operation to 550 meters. DMD Mask specifications will be tightened proportionately, as will the OFL bandwidth spec. Finally, a 1300 nm OFL bandwidth spec of > 500 MHz-km will be maintained for backward compatibility.

OFS will continue to measure and disposition our LaserWave 300 OM3 and LaserWave 550 OM4 fibers using both the EMBc technique, and the more discriminating DMD Mask method.

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