faq

ofs
A Furukawa Company

Measuring OM4/OM3 Fiber Bandwidth

With the introduction of advanced OM4 and OM3 multimode fibers for high-speed LANs and data center networks, it's more critical than ever to select fiber that has the bandwidth it needs to do the job. Unfortunately, there's a lot of misinformation out there about the best way to measure bandwidth. We try to make things clear in this FAQ.

Why don't we just use the old overfilled bandwidth method to measure bandwidth of OM4 and OM3 fibers?

The traditional Overfilled Launch (OFL) bandwidth measurement method that is used with LED light sources doesn't work with VCSEL-based (laser) systems. That's why a new method called Differential Mode Delay (DMD) was developed and standardized to verify the Effective Modal Bandwidth (also called laser bandwidth) of OM4/OM3 fibers. DMD measurement is written into the standards as the only reliable method for verifying bandwidth required for 10 Gb/s performance and beyond.

What is DMD testing?

In DMD testing, high-powered laser pulses are transmitted through the fiber in tiny steps across the entire core of the fiber. Only a few modes are excited at each step, and their arrival times are recorded. The DMD of the fiber is the difference between the earliest and the latest arrival times of all modes at all steps.

The standards allow two ways to use DMD test results to verify laser bandwidth: the DMD Mask Method, and the EMBc Method. Both methods require DMD testing -- the difference lies in how the data is used and interpreted. OFS strongly endorses the DMD Mask Method.

What are the advantages of the DMD Mask Method?

Simply stated, the DMD Mask Method is a straightforward process that directly compares DMD test results against a set of specifications (called *templates* or *masks*) to see if the fiber has the necessary performance. It's a direct approach - if the fiber passes these DMD specs, then you are ensured it complies with the standards.

How does that compare to the EMBc method?

The EMBc Method is much more complex and open to interpretation. It takes the DMD results and matches them against a set of theoretical "weighting functions" that are intended to represent the launch distributions of all compliant VCSELs. The DMD results are combined mathematically with each of the 10 weighting functions. This produces 10 different EMBc values, the lowest of which (called minEMBc) is then multiplied by a factor of 1.13 to obtain the fiber's EMB value. If this EMB value is $\geq$ 2000 MHz-km, the fiber is deemed compliant with OM3 requirements and should support 300 meters at 10 Gb/s.

What are the shortcomings of the EMBc method?

There are several:

- it does not provide the same scrutiny of fiber performance as the DMD Mask technique
- it requires complex calculations that don't cover all the potential laser launch conditions allowed by application standards
- the "weighting functions" only represent a sampling of the launch characteristics of the various VCSELs that could actually be used in a real system
- it virtually ignores the center 0 – 5 µm (radial) region of a fiber's core where the light signal could well travel

So which method does OFS use to certify its fiber bandwidth?

OFS uses both methods to ensure that the bandwidth of our LaserWave® Fiber meets and exceeds the specification requirements of both the EMBc and the more discriminating DMD mask methods for verifying Effective Modal Bandwidth to help us provide the highest performance and reliability.

More questions? Please contact:

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