CommScope®

Are you Confident that Your Optical Fiber Infrastructure Can Support High Data Rate Applications?

White Paper — July 2010

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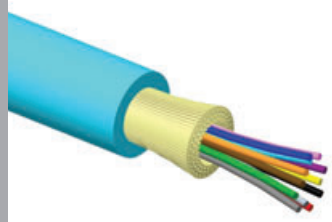
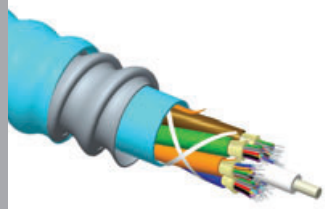
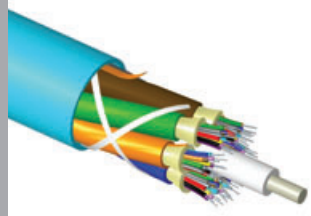




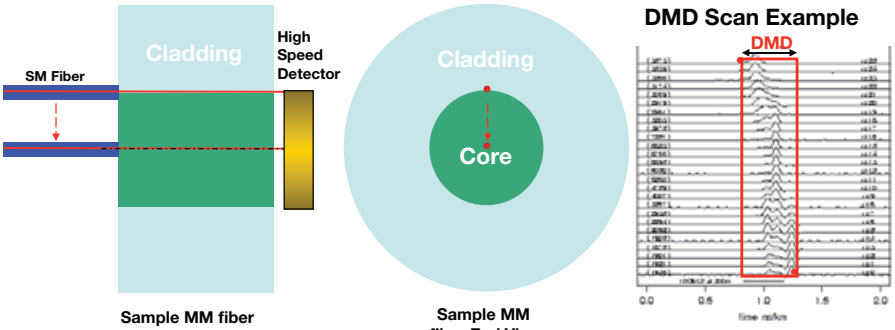


In 2009, TIA 492-AAAD was finalized, making OM4 laser-optimized fiber a standards recognized solution that offered a new high bandwidth multimode fiber option to the industry. Following close behind, new high data rate 40 and 100 Gigabit Ethernet technologies were standardized in June 2010 by IEEE, referencing OM4 media and complementing work in other high data rate protocols, such as 16 gigabit Fibre Channel and Infiniband. This exciting combination of events has expanded the data rate capability that structured cabling solutions are now being designed for. It is very important to be confident that the cabling products you are specifying and purchasing can actually meet the bandwidth claims of the manufacturer. So how can you and the manufacturer be confident that a cabling solution meets or exceeds the bandwidth performance needed to achieve high data rates?

Manufacturers of optical fiber cable must be able to test bandwidth themselves, even if the raw fiber was 100% tested. Optical fiber can be placed under stress during the manufacturing process, as fiber may be twisted, pulled, and covered with coatings during the stranding process. Even if the fiber started out with a high bandwidth, stress during manufacturing may negatively affect the performance. Cable manufacturers that can perform qualification as well as periodic evaluations of their cabling process will be able to verify that a standard's compliant cable is provided to the customer.

The solution to ensure that a fiber optic cable has the capacity to handle today's emerging high data rates is to be able to quantify Differential Mode Delay (DMD). Companies without a DMD testing facility are not able to fully evaluate multimode cable product for bandwidth. Many provide a "pass-through" value for bandwidth, trusting (i.e. hoping) that the manufacturing process to produce a cable does not adversely affect the performance of the optical fiber bandwidth. Although most cablers test for attenuation, or power loss, this does not provide feedback on the bandwidth of the finished product. Even companies that manufacture optical fiber as well as fiber cable may not be set up to measure bandwidth on a cabled product; DMD testing capability may be limited to their optical fiber manufacturing facility.

Let's see how DMD testing works. A single-mode optical fiber is used to insert laser light into the core of the multimode fiber, starting at the edge of the fiber core, close to the cladding. After the first pulse of light enters into the multimode fiber, the single-mode fiber is stepped closer to the core, and another pulse is sent out. Each pulse of light is measured for time – how long does it take for the light to reach the receiver at the end of the fiber. Perfection would be for all pulses to take the exactly the same amount of time. In reality, the pulses arrive at different times, and if the difference is too great, a receiver would not be able to properly decode the signal. So DMD measures the spreading of light as it travels down the fiber.



The original DMD testing standard procedures, outlined in TIA FOTP 455-203, were set up for evaluating an OM3 or 300 meter rated fiber for 10G Ethernet. This Fiber Optic Test Procedure (FOTP), released in June 2001, may not provide the resolution needed to evaluate an optical fiber for today's more demanding applications. We now have OM4 fiber, which is rated for 550 meters at the same data rate, or almost double the distance of an OM3 fiber. Additionally we have higher data rate applications coming soon, which will push your network to its limits.

CommScope utilizes a "high resolution" DMD test method that goes above and beyond the standard requirements in such ways as:

	CommScope	Standard	Effect
Probe step	1 micron	2 microns	CommScope evaluates twice as many measurements of the fiber for superior spatial resolution
Scan coverage	4 quadrants	1 quadrant	CommScope evaluates all four quadrants rather than just one to reveal degradations due to asymmetrical cores
Pulse duration	5 ps	Not stated, commonly 100 ps	CommScope's shorter pulses provide superior temporal resolution allowing more accurate assessment of DMD magnitude, critical for proper selection of OM4 fibers
Evaluation length	550 meters	Not stated, commonly a spool of fiber (~8 km)	CommScope requires that samples from both ends of a longer spool must pass specification, eliminating the effects of averaging over a long length that can hide areas of poor performance

As you can see, High Resolution DMD (HRDMD) testing method is really steps ahead of the minimum required by the standard. Using a traditional "low-resolution" DMD test method, defined before OM4 fiber or 100 gigabit Ethernet were available, would not allow you to be confident that your network can be designed for longer distances, higher margins, and/or higher data rate networks. This is true whether you are using the DMD mask or the miniEMBc methods; both will require high resolution DMD values to best evaluate the capabilities of the optical fiber tested.

CommScope is continuing to work within the industry to develop better bandwidth testing standards. For example, TIA's OM4 requirements reflected CommScope's conservative specifications for LazrSPEED 550, including:

1) a minimum 4700 MHz•km Effective Modal Bandwidth (EMB) bolstered by a minimum 3500 MHz•km overfilled modal bandwidth at 850 nm to ensure that the entire fiber core is evaluated, making it more likely that OM4 will maintain its value for new, as yet undefined, applications.

2) a minimum 500 MHz•km overfilled modal bandwidth at 1300 nm to maintain its compatibility with legacy applications and be 100% compliant to OM2 and OM3 specifications that allow it to be a drop-in replacement for any previous standard 50 µm fiber.

The standards are moving towards a new method for determining 850 nm overfilled modal bandwidth thru the use of the DMD data. CommScope proposed theoretically correct weight factors that convert DMD to overfilled bandwidth. These were accepted by IEC in a revision of the bandwidth test method now approved. This approach provides a more reliable and repeatable means of assessing the overfilled bandwidth compared to the traditional method of attempting the difficult task of producing a true overfilled launch while measuring the bandwidth with conventional instruments that are pushed to their limits by the 3500 MHz*km minimum requirement set by the OM4 standard. Thus while the 850 nm overfilled bandwidth value is the same for OM4 as it is for LazrSPEED 550, we have pushed the state of the art in measurements to a new height for even greater performance assurance.

Testing DMD requires sophisticated and precise measurements using expensive test gear. CommScope has spent over half a million dollars on DMD testing, creating one of the most advanced DMD testing facilities in the world. The CommScope Richardson, Texas DMD testing facility was the first DMD lab to be qualified by Underwriter's Laboratories (UL) in 2003. This bench supported development of LazrSPEED 550, the first commercially available OM4-grade fiber released in 2003.[1] In addition, any time that the fiber or cable manufacturing process changes, CommScope is able to re-qualify the fiber, after cabling, to ensure that the product going to the customer still meets our bandwidth performance.

For greenfield installations and system upgrades, you can choose CommScope fiber solutions like LazrSPEED 550 or 300 fiber with the confidence that they meet or exceed the performance specified. For those already using our solutions, relax and let your network work for you.

[1] CommScope LazrSPEED 300 and 550 fibers were released before a standard was created. LazrSPEED 300 (OM3) and LazrSPEED 550 (OM4) met the TIA standards requirements, once they were available, without a specification change.

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