FAQs: OM4 Fiber

The explosion in demand for bandwidth in enterprise networks is driving an urgent need for higher Ethernet network speeds. Several factors are contributing to this, including broadband penetration fueled by video-rich content, Data Center demands, and exponential growth in supercomputer and R&D computing activities.

Laser-optimized multimode fiber is recognized as the medium of choice to support these high-speed data networks. With next-generation 40 and 100 Gigabit Ethernet speeds on the horizon, the industry has developed a new type of multimode fiber, called OM4, which offers a minimum effective modal bandwidth of 4700 MHz-km at 850 nm, compared with 2000 MHz-km for OM3.

What is "OM4" fiber?

OM4 fiber is a 50 µm laser-optimized fiber with extended bandwidth. It is designed to enhance the system cost benefits enabled by 850 nm VCSELs for existing 1 and 10 Gb/s applications as well as future 40 and 100 Gb/s systems.

OM4 fiber supports Ethernet, Fibre Channel, and OIF applications, allowing extended reach upwards of 550 meters at 10 Gb/s for ultra long building backbones and medium length campus backbones. With an Effective Modal Bandwidth (EMB, also known as laser bandwidth) of 4700 MHz-km (more than double the IEEE requirement for 10 Gb/s 300 meter support), OM4 fiber is also suited for shorter reach data center and high performance computing applications.

Why is it called OM4?

Multimode fibers are identified by the OM ("optical multimode") designation as outlined in the ISO/IEC 11801 standard:

- OM1, for fiber with 200/500 MHz-km overfilled launch (OFL) bandwidth at 850/1300 nm (typically 62.5/125 µm fiber) - ***Berk-Tek "CB" fiber***

- OM2, for fiber with 500/500 MHz-km OFL band width at 850/1300 nm (typically 50/125 µm fiber) - ***Berk-Tek "LB" fiber (exceeds OM2 requirements)***

- OM3, for laser-optimized 50 µm fiber having 2000 MHz-km effective modal bandwidth (laser bandwidth), designed for 10 Gb/s transmission - ***Berk-Tek "EB" fiber***

Today, this evolution continues with the development of OM4 fiber as the industry prepares itself for speeds of 40 and 100 Gb/s.

Is OM4 fiber available today?

Yes, Berk-Tek's "FB" fiber optic cable, which has been available for more than five years, meets or exceeds the OM4 standards.

Also available is Berk-Tek's premium "XB" fiber, which surpasses the OM4 specification to provide additional headroom.

What are the standards that define the use of OM4 fiber?

There are a number of standards that define the use of OM4 fiber for high-speed transmission. Within the TIA, TIA-492AAAD, approved in August 2009, contains the OM4 fiber performance specifications. Similarly, IEC is working in parallel to adopt equivalent specs that will be documented in the international fiber standard IEC 60793-2-10 as fiber type A1a.3.

What role will OM4 fiber play in next-generation speeds?

IEEE continues to work on standards for next-generation speeds, where OM4 fiber is likely to play a large role. For short reach 40 Gb/s and 100 Gb/s applications on multimode fiber, it appears the IEEE 802.3ba Task Force has defined a Physical Medium Dependent (PMD) solution involving already-proven parallel optics technology. This will help preserve the low-cost advantage of today's 850 nm VCSELs.

These parallel systems will transmit one 10 Gb/s signal on each of 4 or 10 fibers (for 40 Gb/s and 100 Gb/s, respectively). Each 10 Gb/s signal will be aggregated in an arrayed transceiver containing 4, or 10, VCSELs and detectors.

For these parallel systems, IEEE set an objective of a minimum reach of 100 meters (m), specifically on OM3 fiber (OM1 and OM2 fibers will not be supported in the 40 Gb/s and 100 Gb/s standard).

Because the 100 m distance is expected to cover only about 85 percent of data center links, the task force subsequently adopted OM4, capable of reaching 125 m. Although the additional 25 m may not seem significant, it will support the majority of the remaining access-to-distribution and distribution-to-core links in large data centers.

What bandwidth does the standard specify for OM4 fiber?

OM4 has a significantly higher bandwidth (EMB of 4700 MHz-km with VCSEL launch at 850 nm) than OM3. It also is backward compatible with applications calling for OFL bandwidth of at least 500 MHz-km at 1300 nm (e.g. FDDI, IEEE 100BASE-FX, 1000BASE-LX, 10GBASE-LX4, and 10GBASE-LRM).

There was some discussion and debate within the standards groups about a minimum OFL bandwidth requirement at 850 nm. Although current applications primarily use 850 nm VCSEL lasers with fibers that are specified to a minimum EMB, the group also established a minimum 850 nm OFL bandwidth specification, and for good reason.

It has been shown that fibers with higher OFL bandwidth perform better with VCSELs that launch more power into outer modes. That is why the OM3 fiber standards require a minimum 1500 MHz-km OFL bandwidth at 850 nm.

For OM4, Berk-Tek and others in the standard group strongly recommended at least 3500 MHz-km OFL bandwidth in order to ensure the utmost performance and reliability. Consensus within the group was reached, and the OM4 standard includes this requirement.

How do you measure bandwidth in OM4 fiber?

It is important that the performance characteristics of enhanced multimode fiber are carefully measured and controlled. Performance of OM4 fiber is verified using the same criteria as OM3, but to tighter specifications.

The IEEE 802.3 10GbE link model recommends an EMB of 4700 MHz-km for 10 Gb/s operation to 550 meters. Differential Mode Delay (DMD) mask specifications will be tightened proportionately and, as previously mentioned, so should the 850 nm OFL bandwidth spec.

There has been much discussion about the use of DMD, calculated EMB (EMBc), and OFL bandwidth measurement methods. It's important to remember that these parameters exist for one reason - to determine whether a link will operate when inserted into a system.

Which method - DMD Mask or EMBc - provides the most stringent measurement?

The results of a recent study conducted by OFS show that the DMD masks provide the most rigorous screening of high performance multimode fiber. For this study, commercially available OM4 fibers and cables from various vendors were tested to determine their ability to support claims of extended link distances for 10 Gb/s transmission. The fibers were measured using the DMD mask technique as well as the EMBc method, and they were then subjected to BER systems testing.

Results of the study indicated that the DMD mask method showed excellent correlation with system performance, and reliably identified poor performing and even failing fibers when matched up with marginal transceivers.The EMBc technique does not always find such fibers. Some fibers that failed the DMD masks - yet passed EMBc requirements - showed significantly poorer performance, and in several cases actually failed system testing.

It should also be noted that fibers with relatively low OFL bandwidth tended to perform poorly in systems testing when matched with a transceiver that launches higher power into outer modes. Similarly, fibers with good control of inner modes (as evidenced by low DMD in the center region of the fiber) performed better with transceivers that launched more power into this region. The EMBc method does not probe the center portion of a fiber, thus allowing marginal fibers to be deployed.

The standards allow either the DMD mask method or the EMBc method for verifying OM3 and OM4 performance. We have been a strong proponent of the more stringent DMD mask method. In order to provide the utmost in performance and reliability, however, we ensure that our OM3/OM4 fiber optic cable meets and exceeds the requirements of both the EMBc method and the more discriminating DMD mask method.

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