

Optical Fiber Types

SINGLE MODE OPTICAL FIBER

Single mode fiber (SMF) is used primarily for intermediate and long distance Outside Plant (OSP) applications that have distances between connections of up to 80 km (50 mi). It is the exceptional information carrying capacity and low-loss properties of this fiber that make it ideal for these demanding applications.

The core, or light-carrying region of the fiber, is approximately 8.3 μm in diameter. This narrows the transmission pathway allowing for only a single path, or mode, for each pulse of light traveling down the core of the fiber. The light transmission technology is laser-based for all single mode communications applications. By combining the extremely high bandwidth properties of SMF with high precision laser-based transceivers, equipment and network systems designers can create networks capable of sending simultaneous voice and data transmission well beyond 10 Gbps over many miles.

Superior Essex offers many types of single mode optical fibers for communications applications. Based on the application, Superior Essex can recommend the following SMF types.

Standard SMF offered by Superior Essex is an excellent choice for patch cords, local area network (LAN), wide area network (WAN) and metropolitan area networks (MAN). This fiber has operating wavelengths centered at 1310 nm and 1550 nm. Refer to the table in Tech Guide 099 for performance information.

Reduced Water Peak (RWP) SMF, which has been designed to have low attenuation at 1383 nm, is becoming the most commonly recommended optical fiber for all types of network applications. Standard optical fiber displays an attenuation increase at or about 1383 nm. This wavelength is known as the water-peak region and is where light is strongly absorbed by naturally occurring water-like end groups in the glass, causing high attenuation or signal loss. Specifically, hydroxyl end groups, which make up half of a water molecule, are always present at some level within the glass core and cause increased attenuation over this wavelength region. Superior Essex RWP SMF reduces this effect and allows all the wavelengths between 1300 nm and 1550 nm to be usable. This optical fiber is therefore, not only an excellent choice for traditional applications, but also for more advanced systems such as coarse wavelength division multiplexing (CWDM) and dense wavelength division multiplexing (DWDM) technologies. RWP SMF is the standard single mode optical fiber for all Superior Essex premises cables. Refer to the table in Tech Guide 099 for performance information.

Zero Water Peak SMF offers further reductions to the attenuation at 1383 nm. Attenuation improvement at 1383 nm is usually 0.03 to 0.04 dB per km. Refer to the table in Tech Guide 099 for performance information.

Non-Zero Dispersion Shifted (NZDS) fiber is used for very high data rates over very long distances (> 30 km). Because of core/cladding modifications, this fiber is more expensive than standard SMF. The advantage of NZDS is that it allows for longer distances between repeaters and therefore lowers the overall system cost for long distance networks. Refer to the table in Tech Guide 099 for performance information.

TeraFlex® bend resistant optical fiber is a SMF that complies with ITU-T G.652.D and G.657.A. The bend sensitivity of this optical fiber has been improved so that it can be coiled into a 20 mm diameter loop with ≤ 0.5 dB incurred loss at 1625 nm and ≤ 0.2 dB incurred loss at 1550 nm - five times better bending performance than leading RWP optical fibers. TeraFlex offers excellent Polarized Mode Dispersion (PMD) of ≤ 0.1 ps/ $\sqrt{\text{km}}$ per individual fiber. TeraFlex is an ideal choice for FTTP applications where small enclosures are normal and space is at a premium.

MULTIMODE OPTICAL FIBER

Multimode fiber (MMF) is identified by the physical size of the core as measured in microns (μm) and the applications for which it is typically used. MMF, the most common types having 62.5/125 μm and 50/125 μm core/cladding dimensions, are used for data communications links with the local area network (LAN). The term "multimode" refers to the way the light travels down the optical fiber. For each pulse of light launched into the optical fiber by light source (transceiver), the light signal energy travels within the optical fiber core along multiple paths, or modes. These modes travel at different speeds, resulting in the pulse of light spreading out. This effect limits the bandwidth and distances that can be supported by MMF. For this reason, MMF is used in short distance LAN applications usually less than 2 km (6,560 ft) between connections. Typical network applications include building-to-building and communications closet-to-closet backbones, intelligent highway systems and fiber-to-the-desk. MMF is the choice for these short distance applications cables because of the large core size, which allows for inexpensive connectivity, greater durability and the use of low-cost light sources.

Typically, a light emitting diode (LED), operating at a nominal wavelength of 850 nm, is used as the light source for MMF cable applications. The use of LED-based transceivers, MMF cables and inexpensive MMF connector systems have provided network designers with a relatively low-cost, high-bandwidth technology for campus-like networks. Recent technology breakthroughs in optical fiber transceiver technology have led to a new light source that extends the distance and increases the signal carrying capacity of MMF. This next-generation light source uses a vertical cavity surface emitting laser, or VCSEL (pronounced "vicSEL").

The use of VCSEL transceivers, when compared to traditional LED-based transmission systems, allows for greater distances for traditional applications such as 100 Mbps and for higher bandwidth applications such as 1 Gigabit Ethernet (1 GbE) and 10 Gigabit Ethernet (10 GbE). The VCSEL source transmits light through the center region of the optical fiber core. This has created the requirement for laser-optimized MMF. One of the most popular emerging applications for VCSEL-based LAN application is 10 GbE. By using laser-optimized optical fibers, network engineers can improve transmission performance over greater distances.

TeraGain® optical fibers are available in 62.5/125 μm and 50/125 μm fiber types. These optical fibers have been designed to provide greater data rate and distance support compared to other manufacturers' optical fiber cables. In particular, the bandwidths of TeraGain optical fibers are greater than the standard MMF offered by other manufacturers and exceed the requirements specified in TIA-568. TeraGain optical fibers can be used with either LED or laser (VCSEL) transmission equipment. Refer to the table in Tech Guide 099 for specific performance information.

TeraGain 10G 50/125 multimode fibers are specifically optimized for 850 nm lasers (or VCSELs) that are the heart of the new 10 GbE systems specified in TIA-568. These optical fibers exceed industry specifications for both bandwidth and for differential modal dispersion. TeraGain 10G optical fibers support 10 GbE applications in three ranges: 150, 300 and 550 meters. These ranges allow engineers to cost effectively design the right optical fiber for their application requirements. Superior Essex offers TeraGain 10G/150 as its standard 50 μm MMF in all its premises optical fiber cables. Refer to the table in Tech Guide 099 for specific performance information.

Like the TeraGain 10G 50/125 multimode fibers, TeraFlex 10G multimode fibers are specifically optimized for 850 nm lasers (or VCSELs) but with the added benefit of Macrobend Resistance. These optical fibers exceed industry specifications for not only bandwidth and differential modal dispersion, but for minimum bend radii allowing use where tight bend radii are encountered. This is especially important for applications, like 40 GbE and 100 GbE, where channel margins are tight. TeraFlex 10G optical fibers support 10 GbE applications in three ranges: 150 (OM2+), 300 (OM3) and 550 (OM4) meters. Refer to the table in Tech Guide 099 for specific performance information.