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. More recently, it is being used in massive data centers where port density and space are an issue.

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. Wavelength division multiplexing is a method used to increase bandwidth where multiple wavelengths are transmitted simultaneously within a fiber. 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 hundreds of gigabits per second 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.

Reduced Water Peak (RWP) 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 from 1310 nm to 1550 nm.

RWP SMF is designed to have low attenuation at 1383 nm and is becoming the most commonly recommended optical fiber for all types of network applications. Legacy SMF displays an attenuation increase at around 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 has no water peak 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 on page X-4 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 on page X-4 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 on page X-4 for performance information.

TeraFlex® bend resistant optical fiber is a SMF that complies with ITU-T G.652.D and G.657.A1, A2 or B3. The bend sensitivity of the A1 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/√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 Data Centers, building-to-building and communications closet-to-closet backbones, 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.

Formerly, light emitting diodes (LED), operating at a nominal wavelength of 850 nm, were used as the light source for MMF cable applications. The use of these LED-based transceivers, MMF cables and inexpensive MMF connector systems provided network designers with a relatively low-cost, high-bandwidth technology for campus-like networks. Today vertical cavity surface emitting lasers, or VCSELs (pronounced "vicsels") are used since LEDs are unable to be modulated (turned off and on) at speeds greater than 1 Gb/s.

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 from 1 Gigabit Ethernet (1 GbE) up to 400 Gigabit Ethernet (400 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 100 GbE. By using laser-optimized optical fibers, network engineers can improve transmission performance over greater distances.

TeraGain® optical fibers is available in the 62.5/125 µm type. This optical fiber has been designed to provide greater data rate and distance support compared to other manufacturers' optical fiber cables. In particular, the bandwidths of 62.5 µm TeraGain optical fiber is greater than the standard 62.5 µm 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 on page X-5 for specific performance information.

TeraFlex 10G 50/125 OM3, OM4 and OM5 bend-resistant 50 µm MMFs are optimized for 850 nm lasers (or VCSELs) and, in the case of OM5 MMF, lasers that operate between 850 nm and 950 nm. These optical fibers exceed industry specifications for both bandwidth and for differential modal dispersion. TeraFlex 10G multimode fibers also have the added benefit of macrobend resistance. These optical fibers exceed industry specifications for minimum bend radii allowing use where tight bend radii are encountered, for example, in Data Centers. This is especially important for applications, like 40, 100, 200 and 400 GbE, where channel margins are tight. These ranges allow engineers to cost effectively design the right optical fiber for their application requirements. Superior Essex offers TeraFlex all three grades: OM3, OM4 and OM5. Refer to the table on page X-5 for specific performance information.