

Overview:

It is occasionally desirable to connect very short lengths of optical cable between fiber optic transmission modules for specific applications such as high voltage isolation systems, when traversing secure or hazardous environments or for simple bench-testing of equipment. This TECHNIQUE describes steps which should be taken to reduce the chance of transmission problems.

Details:

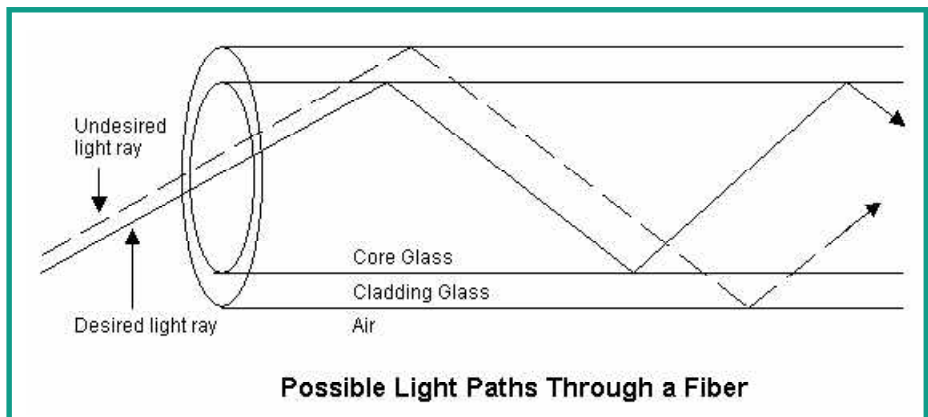
As shown in the diagram, light normally travels through the core of a fiber optic cable by either being reflected from the core/cladding interface of a step-index fiber or by being "bent" by the varying index of refraction of the glass in a graded-index fiber. Attenuation figures (dB/Km) for fiber cable assume that this is the only path, as one would naturally expect. This is not completely true however since there is another path to consider.

Whenever light passes through any transparent media with different refractive indices, it bends. In a step-index fiber the core glass has a higher index of refraction than the cladding glass and the light is reflected back into the core. In the same fiber any light entering the cladding glass will encounter the outside world or air. Air has a refractive index that is equal to 1 (which is less than that of the cladding glass). As a result light will be reflected back into the cladding at the air interface as well and proceed to travel down the fiber as if everything were normal. Light in this second path is quickly

attenuated however since the transmission of the cladding glass is poor. Remember, it's normal function is only to reflect light back into the core from it's surface so it does not have to be very transparent. For very short lengths of fiber however significant light can still travel through this second path.

What does this mean to us? The allowable attenuation range (or loss budget) for most fiber optic transmission systems is normally specified from 0 dB to some maximum. These figures naturally assume only core light, not core + cladding light. If the fiber is very short, a couple of feet for example, more light can pass than expected and the fiber optic receiver "front end circuitry" may actually overload. This will cause distortion in an analog system and intermittent or even complete loss of data in a digital system. Furthermore, since the composition of the cladding glass is not controlled to the degree that the critical core glass is, the amount of cladding light can even vary within the same fiber.

To solve this potential problem the industry has developed what is known as a "0 dB reference fiber". This fiber simply consists of 10 meters (about 33 feet) of standard fiber optic cable wound



Page 2: CONCERNS REGARDING THE USE OF VERY SHORT LENGTHS OF FIBER OPTIC CABLE

around a 1 to 3 inch diameter form. The length is long enough to attenuate any cladding light to the point where it is insignificant and the form serves the function of assuring that the only light propagating through the fiber (at the correct angle of refraction) is core light. A 0 dB reference cable is simple to implement and for most purposes simply securing 10 meters of fiber in a neat three inch diameter "hank" with masking tape is adequate. All normal CSI Fiberlink transmission modules use this type of cable to simulate 0 dB of attenuation.

Suggestions:

If a particular application will require that short lengths of fiber optic cable be used, or if extensive bench-testing of fiber optic transmission modules is anticipated, the user should prepare several 0 dB fibers as described. In this way the potential of front-end overload will be eliminated and the systems may be properly evaluated. If

actual transmission of signals over very short distances is a requirement then the system chosen should be either specifically designed to operate in the presence of higher than normal light levels or a minimum of 10 meters of fiber should be used with the excess neatly coiled.

CSI Products Used in this TECHnique:

All Fiberlink transmission modules

Related TECHniques

- Education Guide: *Introduction to Fiber Optics*
- Educational Guide: *Introduction to Fiber Optic Cables and Connectors*

Key Words

Fiber Optic Cable, loss budget, bench-testing fiber optic systems