Polymer Optical Fiber (POF)

Application Note 5596

Table of Contents

This application note describes the main mechanical and optical features of POF and is divided into two sections.

Part 1, **POF overview**, is a general outline of the basic concepts of fiber optics. As such, concepts like numerical aperture (NA), total internal reflection (TIR), attenuation or dispersion, among others, are deeply explained.

Part 2, **Avago POF cables**, focuses on the different POF cables that Avago has currently in the market. In this part, mechanical and optical characteristics of these cables will be presented along with results of qualification tests.

Part I. POF Overview

Introduction

Plastic optical fibers (POFs) are used to guide light, which, in most of the cases, carries data. This transmission medium offers many important advantages over traditional copper wire. Among these advantages, the following ones may be remarked:

- Electrical isolation at the input/output
- Immunity to electromagnetic interference (EMI) along the path of the optical fiber
- Relatively broad bandwidth over distances of several tens of meters
- Low-price, low-weight, small-diameter cables

The electrical isolation at the input and output and the immunity to EMI are due to the fact that the optical fiber transports photons instead of electrons. These two features make a very appropriate transmission medium for electrically noisy environments out of the optical fiber. Therefore, optical fibers are particularly interesting not only for telecommunications, where their use allow fully avoiding the interference between adjacent lines due to cross talk, but also for industrial applications, where hostile electrical environments are very common.

Another major advantage of optical fibers over copper wire is that the bandwidth of an optical fiber is relatively high in comparison to other transmission media. Current Avago products are able to achieve an error-free channel for data-rate of 1Gbps transmitted over an up to 50-meter-long POF link.

On the other hand, features like low-weight and small-diameter, along with the low price, mean that POF is an easy-handling and cost-effective transmission medium, which enormously contributes to its expansion.

Finally, it is important to mention that POF is much more robust than silica fibers in terms of mechanical stress (i.e., when silica fibers and POF are subjected to the same mechanical stress, silica fibers get damaged more easily than POF). This feature, together with the ones already mentioned, make a very suitable transmission medium for harsh environments out of POF.

Principle of operation

Numerical Aperture

As already introduced, POFs (and optical fibers in general) are used to guide light. The guidance of light is based on the application of the Snell's law under some specific conditions.

Snell's law states that a ray of light which reaches the interface between two media gets refracted as described in figure 1 and equation 1.

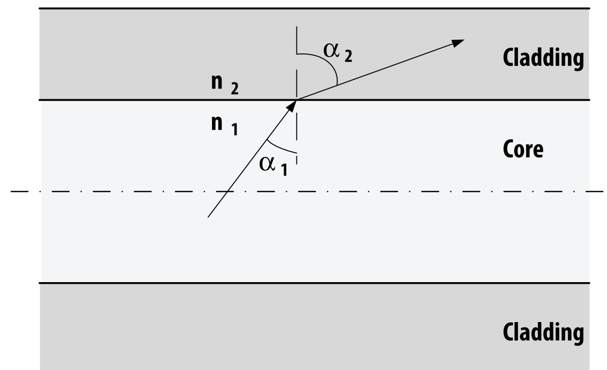

Figure 1. Snell's law

According to the Snell's law, the behavior of the rays of light shown in figure 1 would be as stated below:

$$n_1 \cdot sin\alpha_1 = n_2 \cdot sin\alpha_2 \qquad \text{(Eq. 1)}$$

From equation 1, the condition for total internal reflection (TIR) can be easily obtained:

$$\alpha_2 = 90° =>$$

$$=> sin\alpha_1 = \frac{n_2}{n_1}, \text{ where } n_1 > n_2 \qquad \text{(Eq. 2)}$$

In other words, if the angle α1 fulfills the condition

$$\alpha_1 \geq arcsin\left(\frac{n_2}{n_1}\right) \qquad \text{(Eq. 3)}$$

the light that reaches the interface between the core and the cladding of the optical fiber is fully reflected on this interface and it is, therefore, guided through the core from one end to the other end of the optical fiber.

The application of the Snell's law one more time leads to the calculation of the so-called numerical aperture (NA), which is a parameter of the optical fiber related to the acceptance angle of light (i.e., any ray of light which reaches an end of the fiber with an angle lower or equal to the angle given by the NA is guided inside the core of said fiber).

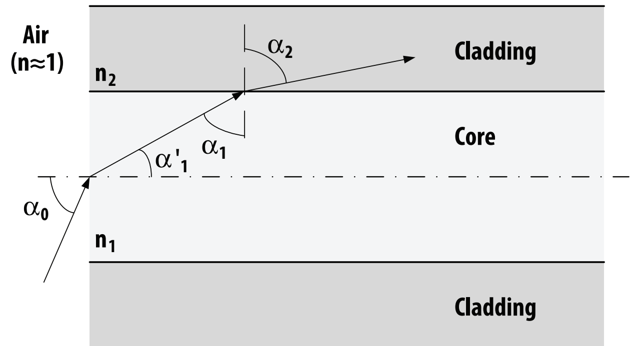

Figure 2. Numerical aperture (NA) calculation

According to figure 2 and equation 2, the angle α_0 would be:

$$\alpha_2 = 90° \Rightarrow$$

$$\Rightarrow sin\alpha_1 = \frac{n_2}{n_1}$$

$$sin\alpha_1' = sin(90 - \alpha_1) = cos\alpha_1 =$$

$$= \sqrt{1 - (sin\alpha_1)^2} = \sqrt{1 - \frac{n_2^2}{n_1^2}} \qquad \text{(Eq. 4)}$$

finally:

$$sin\alpha_0 = n_1 \cdot sin\alpha_1' =$$

$$= n_1 \cdot \sqrt{1 - \frac{n_2^2}{n_1^2}} = \sqrt{n_1^2 - n_2^2} \Rightarrow$$

$$\Rightarrow \alpha_0 = arcsin\left(\sqrt{n_1^2 - n_2^2}\right) \qquad \text{(Eq. 5)}$$

The NA of the fiber is defined as the sine of the angle α0, as follows:

$$NA = \sqrt{n_1^2 - n_2^2} \qquad \text{(Eq. 6)}$$

Any ray of light which reaches an end of the optical fiber and is within the acceptance cone defined by the AN will be guided inside the optical fiber.

In the case of POF, a typical value for the refractive index of the core is n_1=1.49, while the refractive index of the cladding has a typical value of either n_2=1.46, leading to NA=0.3 (α_0=17.5°), or n_2=1.40, leading to NA=0.5 (α_0=30°), being the NA=0.5 the most common case for regular applications.

Modes

Given the boundary conditions fixed by the geometry of an optical fiber, a guided mode is each one of the solutions to the Maxwell's equations which fulfills said boundary conditions. On the other hand, an unguided mode is any electromagnetic field which is not a solution to the Maxwell's equations for the boundary conditions imposed by the geometry of the optical fiber.

If there is only one solution to the Maxwell's equations which fulfills the boundary conditions imposed by the geometry of a given optical fiber, then there is only one guided mode for that given fiber and the particular fiber receives the name of mono-mode fiber or single-mode fiber. The opposite case, when there is more than one guided mode for a given optical fiber, the fiber receives the name of multi-mode fiber.

Applying ray theory instead of wave theory to the propagation of light within an optical fiber, a guided mode may be understood as a ray of light travelling along the optical fiber following a specific path. This path is different from that followed by the ray of light associated to a different mode.

The high frequency of the light waves along with the geometry of the optical fiber makes it possible to analyze the propagation of light through the optical fiber by means of the so-called ray theory, which considerably simplifies the analysis. However, it is important to remark that ray theory is not as accurate as wave theory, as the first is based on geometry rules while the latter is based on the application of the Maxwell's equations. Wave theory is used, for example, to determine the distribution of the energy of a given mode between the core and the cladding of the optical fiber.

Attenuation

Attenuation is the phenomenon which makes optical pulses to lose power as they travel within an optical fiber, as shown in figure 3.

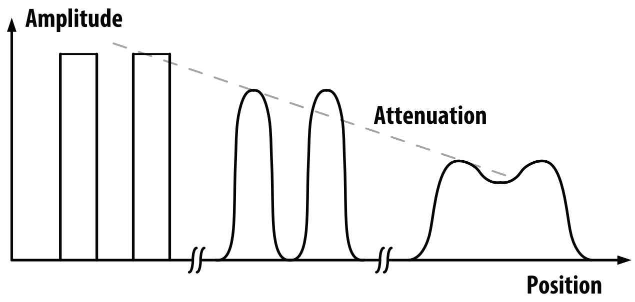

Figure 3. Evolution of optical pulses inside an optical fiber

Figure 3 depicts the evolution undergone by optical pulses as they travel through an optical fiber. As may be seen, not only the amplitude of the pulses changes as they are propagated inside the optical fiber, but also their width. The first effect is due to attenuation, while the second one is due to dispersion, which will be studied in the next section of this application note.

Depending on the type of optical fiber, attenuation is measured either in terms of dB/km (pure glass fiber and plastic-clad silica fiber, or PCS) or in terms of dB/m (POF).

There are three main sources of attenuation in an optical fiber: Rayleigh scattering, absorption and bending.

Rayleigh scattering

The interface between the core and the cladding of an optical fiber is not homogeneous, but it has microscopic variations which make any incident ray of light to be scattered in many directions. The rays scattered in some of these directions no longer fulfill the requirements for TIR (see equation 3). Therefore, a fraction of the optical energy is lost.

Absorption

Absorption is due to impurities in the core and cladding of the optical fiber. These impurities absorb photons and generate phonons (heat). The ions of water are the main reason that light energy is absorbed in POF.

Bending

Bending is divided into two categories: micro-bending and macro-bending. Micro-bending consists of microscopic imperfections in the optical fiber geometry, such as rotational asymmetry, variations of the core diameter, and harsh interface between the core and the cladding caused by pressure, tension and twist. On the other hand, macro-bending consists of curving the optical fiber around diameters of about one centimeter making some of the modes not to fulfill the condition for TIR anymore.

Figure 4 shows the influence of macro-bending on the optical power carried by a fiber.

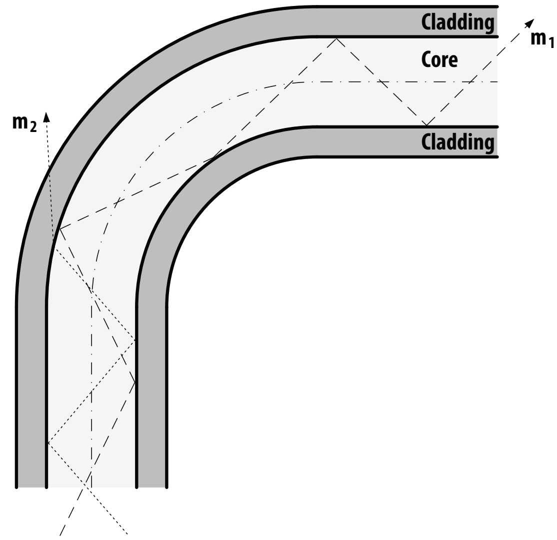

Figure 4. Influence of macro-bending on the optical power carried by a fiber

As depicted in figure 4, mode m_1 successfully passes the bent section of the fiber. Within this section, the different angles of incidence of mode m_1 with the interface between the core and the cladding of the fiber always fulfill the condition for TIR (see equation 3). However, when it comes to mode m_2, the angle of incidence of this mode with said surface at the beginning of the bent section of the fiber does not fulfill the condition for TIR; therefore, mode m_2 escapes from the core of the fiber and it is no longer guided.

In the case of POF, if the bending radius is larger than 5cm, approximately, the loss due to bending is normally unnoticeable.

Other factors

Other major factor that may cause an important loss of the power carried by POFs is a poor finishing of the optical fiber ends, which would result in a portion of the light to be scattered.

Figure 5 shows the attenuation curve of POF. Rayleigh scattering and absorption are the main contributors to this curve.

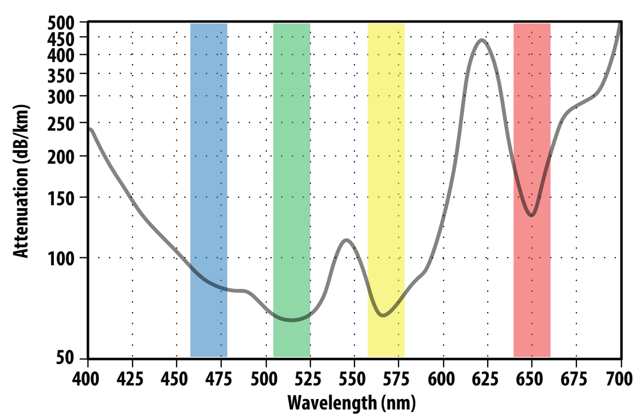

Figure 5. POF attenuation vs. wavelength

According to figure 5, the minimum attenuation occurs at wavelengths lower than 650nm; however, there are a few reasons which have made 650nm the preferred wavelength for applications over POF:

- In the early years of POF, the technology required for building light sources at wavelengths below 650nm had not been fully developed yet, whereas the light sources working at 650nm were quite well deployed in the market.
- The light sources that operate at wavelengths below 650nm usually require a supply voltage higher than 3.3V, which is not compatible with the CMOS technology commonly used nowadays. This fact makes it necessary to implement extra circuitry to adapt the supply voltage between different parts of a given transmission system, which increases the overall cost of such a system.
- On the side of the receiver, the sensitivity of the photodiode commonly decreases as the wavelength of the incoming light is lowered, as shown in figure 6.

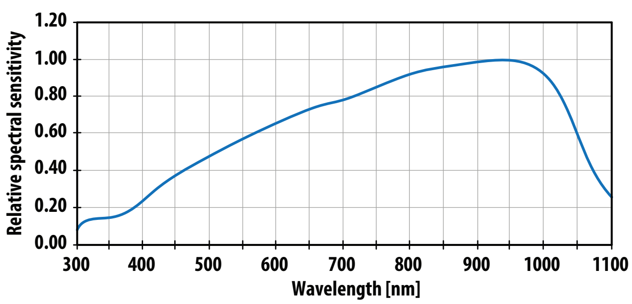

Figure 6. Relative spectral responsivity of a silicon photodiode

A positive side effect obtained from operating the fiber at 650nm is the visibility of the light. While transceivers designed to operate over silica fibers usually operate in the infrared spectrum, most of POF applications work in the visible spectrum, commonly at 650nm, which increases the ease of use.

Dispersion

Dispersion is the phenomenon which makes the optical pulses travelling inside an optical fiber to widen as they are propagated. Figure 3 depicts this phenomenon.

There are three different types of dispersion: chromatic dispersion, modal dispersion and waveguide dispersion.

Chromatic dispersion

Chromatic dispersion results from the spectral width of the light travelling inside the optical fiber. The wider the spectrum of the light is, the more wavelengths it comprises. As the refractive index of a particular material is a function of the wavelength of the electromagnetic field which travels through the material, electromagnetic fields with different wavelengths will have different refractive indexes associated to them, as given by equation 7:

$$n = n(\lambda) \qquad \text{(Eq. 7)}$$

Additionally, the speed at which an electromagnetic field travels inside a particular material is given by equation 8:

$$v = \frac{c}{n} \qquad \text{(Eq. 8)}$$

where c is the speed of light in vacuum and n is the refractive index of the material.

From equation 7 and equation 8 it is easily derived that the different wavelengths that travel inside the optical fiber do it at different speeds, distorting the optical pulses, as shown in figure 3.

Modal dispersion

The optical pulses which carry data inside a given optical fiber are transported by the different guided modes associated to that optical fiber. On the other hand, distinct guided modes follow distinct paths within an optical fiber, as previously mentioned. This is shown in figure 7. Due to the distinct paths followed by the distinct guided modes, these modes will reach the optical receiver at different instants, causing dispersion in the optical pulses they transport (in the example shown in figure 7, mode m_1 goes through a longer path than mode m_2, which generates dispersion in the received optical pulses).

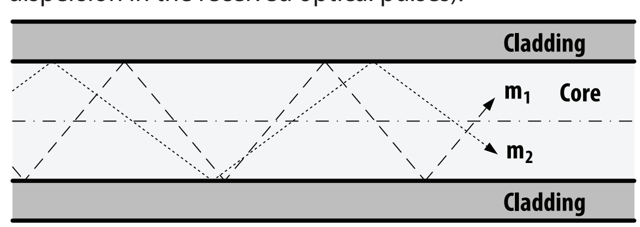

Figure 7. Guided modes within an optical fiber

The effect of modal dispersion can be lowered by making use of the so-called graded-index fibers. In contrast to step-index fibers, where the refractive index of the core remains constant independently of the distance to the center of the fiber, graded-index fibers have a core whose refractive index changes gradually as the distance to the center of the fiber varies, as shown in figure 8.

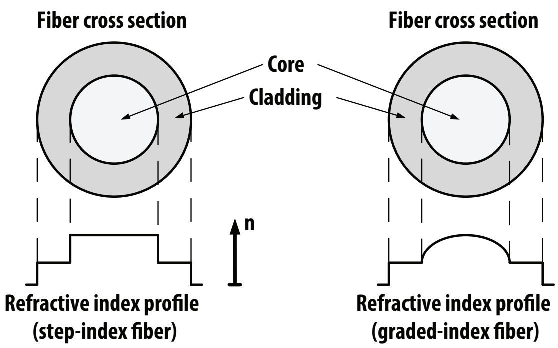

Figure 8. Step-index fiber vs. graded-index fiber

The graded-index profile makes guided modes to curve their paths, reducing the difference in the distances that the different modes go through and, therefore, mitigating the effect of dispersion. Figure 9 depicts the curved paths followed by guided modes in graded-index fibers. Comparing figure 7 to figure 9, it may be seen that the difference in the lengths of the paths followed by mode m_1 and mode m_2 is lower in the case shown in figure 9, which leads to a lower modal dispersion in graded-index fibers than in step-index fibers.

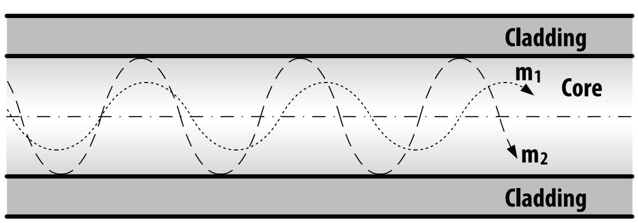

Figure 9. Guided modes within a graded-index optical fiber

Modal dispersion can be completely eliminated by substituting multi-mode fibers with single-mode fibers, although this type of fibers is out of the scope of this application note, as POF is always multimode due to the radius of its core.

Waveguide dispersion

When applying wave theory to the propagation of light within an optical fiber, it may be demonstrated that the optical power carried by each mode is distributed between the core and the cladding of the optical fiber. Since core and cladding have different refractive indexes, the speed at which a given mode travels in the core of the optical fiber is different from the speed at which that mode travels in the cladding of said optical fiber, which results in certain distortion in the optical pulses carried by that mode due to dispersion.

Modal dispersion is the major contributor to the total dispersion in POF. This is due to the geometry of this type of optical fiber. On one side, due to the radius of the core of the fiber, the length difference between the shortest optical path (i.e., the optical path associated to mode that enters the fiber with an angle α_0=0°. This angle is defined in figure 2) and the longest optical path (i.e., the optical path associated to the mode that enters the fiber with an angle α_0=arcsin(NA). NA is defined in equation 6, leads to a modal dispersion contribution which widely exceeds the contribution due to chromatic dispersion. On the other hand, due to the fact that the radius of the core of the fiber is much greater than the radius of the cladding of the fiber, the contribution of modal dispersion is much higher than the contribution of waveguide dispersion. For specific values of the radius of the core and the cladding of Avago POF cables, see **Part 2, Mechanical characteristics, Core, cladding and jacket diameter**, in this application note.

Bandwidth-length product

The capacity of an optical fiber to transport data is usually measured in terms of the bandwidth-length product of the optical fiber, as MHz·km.

The concrete value of the bandwidth-length product is mainly related to the dispersion introduced by a specific optical fiber and, therefore, it depends on the characteristics of that optical fiber.

Figure 10 shows a typical distance versus data-rate plot of an optical fiber.

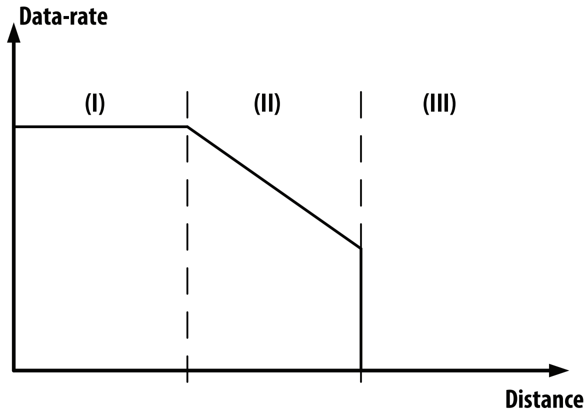

Figure 10. Data-rate vs. distance in an optical fiber.

In section I of figure 10, the fiber does not have any limiting effect over the data-rate of the link. This means that the optical receiver can handle the dispersion added to the optical pulses due to the length of the link and, also, that the attenuation introduced by the length of the link is not high enough as to distort the reception of the data due to a poor signal-to-noise ratio (SNR). On the other hand, section II of figure 10 depicts the range of link lengths for which the data-rate of the transmitter must be lowered in order to keep the quality of the received signal above the threshold which makes the communication possible. The factors which force the data-rate to be decreased are a high dispersion and/or a low SNR. Finally, beyond a certain distance, the communication is no longer possible due to an excessive dispersion and/or attenuation. This case is depicted in section III of figure 10

In the case of POF, typical values for the bandwidth-length product depend of the specific type of optical fiber, as shown in Table 1.

Table 1. Bandwidth-length product vs. POF type.

POF type	NA	BW-length product (MHz x km)
Step Index POF	0.5	4
Step Index POF	0.3	10

Applications

POF dates from early 80s of past century, when their use was limited to illumination applications, such as decoration of hotels, public buildings or apartments.

In mid/late 80s, as the amount of data traffic within industrial environments increases and the need for reliable communication systems becomes a major topic, POF begins to be used as a transmission medium for data communication (advantages of optical fibers over copper wire for data transmission are detailed in section Introduction of this application note). Applications based on the SERCOS standard are a good example of the use of POF which dates back from those days.

In mid 90s, consumer electronics applications requiring audio and video transmission begin to be held over POF.

Later, in the beginning of the first decade of the 21st century, POF finds a new field of application: it becomes the transmission medium for in-vehicle infotainment systems supported by the MOST standard. This standard, based on the OSI layer model, is widely used nowadays and defines a communication system which involves all the information and entertainment devices available in a vehicle, such as GPS navigation system, CD/DVD/Blu-ray disc player, radio receiver or portable telephone, among many others.

Finally, another application area for POF has recently emerged: home networking. The evolution of the technology of the optical transceivers and the encoding/decoding hardware has led to an important increase in the data-rates of the communications held over POF. The data-rates currently reachable over this transmission medium are high enough as to satisfy the requirements of home networks. Existing Avago products allow transmissions of 1Gbps over an up to 50-meter-long POF link.

Figure 11 shows the development of different POF applications over time. The initial illumination applications represent nowadays less than 30% of the total number of applications held over this type of optical fiber.

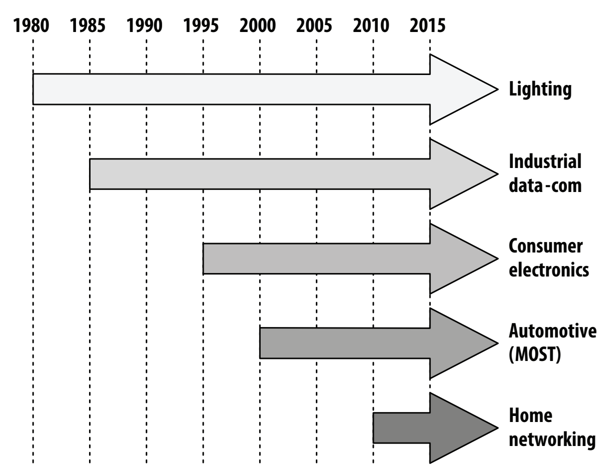

Figure 11. Different POF applications over time.

Part 2. Avago POF cables

The current Avago POF cable portfolio mainly includes the following POF cables:

- HFBR-EXXYYYZ series
- AFBR-HXXYYYZ series

These two items are compliant with the standard EN 60793-2-40 A4a.2, which defines POF cables.

Both HFBR-EXXYYYZ and AFBR-HXXYYYZ are extra low loss cables with similar features. The main difference between them is that AFBR-HXXYYYZ is halogen-free, while HFBR-EXXYYYZ is not. Due to the wide range of features shown by the two cable series currently offered by Avago, customers can find a suitable solution for any need they may have.

Mechanical characteristic

Core, cladding and jacket diameter

Figure 12 shows the layer structure of a POF cable.

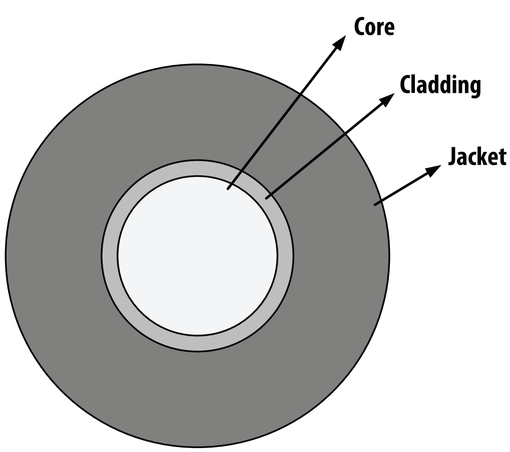

Figure 12. POF cable structure

Table 2 shows the values of the diameter of the core plus the cladding of the fiber and, also, the diameter of the jacket for HFBR-EXXYYYZ cable series and AFBR-HXXYYYZ cable series.

Table 2. Diameter, in mm, of the different layers of the cross section of HFBR-EXXYYYZ and AFBR-HXXYYYZ cable series

Layer	Min.	Typ.	Max.
Core + cladding	0.94	1.00	1.06
Jacket	2.13	2.20	2.27

Core and cladding refractive indexes and numerical aperture

HFBR-EXXYYYZ cable series and AFBR-HXXYYYZ cable series are step-index fibers (see figure 8), with a typical refractive index in the core n_1=1.49 and a typical refractive index in the cladding n_2=1.41, leading both values to a numerical aperture NA=0.5.

Optical characteristics

Attenuation

Figure 13 shows the typical attenuation curve, at 25°C, of HFBR-EXXYYYZ and AFBR-HXXYYYZ cable series.

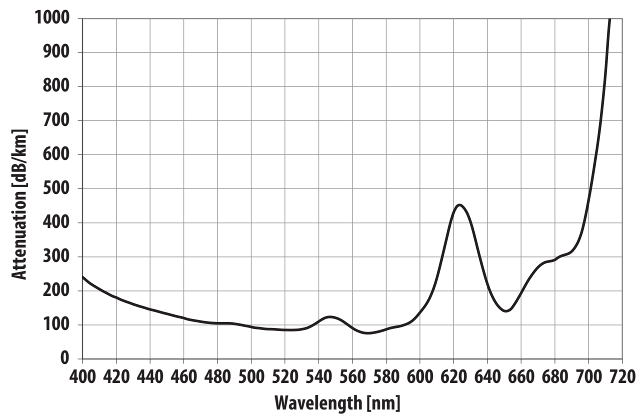

Figure 13. Typical attenuation curve, at 25°C, of HFBR-EXXYYYZ cable series and AFBR-HXXYYYZ cable series

The attenuation curve shown in figure 13 has been calculated according to VDE/VDI 5570 standard. Based on this standard, the calculation of the spectral attenuation of a POF cable is made by means of the so-called cut-back method. Very briefly, the method consists of the following steps:

- Measuring the optical power at the end of a 52-meter-long (or 102-meter-long) fiber cable.
- Cutting a 2-meter-long piece out of the 52-meter-long (or 102-meter-long) cable and measuring the power at the end of this 2-meter-long piece.
- Computing the spectral attenuation of the POF cable through the values measured in the previous steps.

For the two measurements detailed before (optical power measurement at the end of the 52-meter-long fiber cable and optical power measurement at the end of the 2-meter-long fiber piece), the optical power launched by the light source involved in the measurements remains unchanged. Figure 14 shows a schematic of the cut-back method referred in the VDE/VDI 5570 standard.

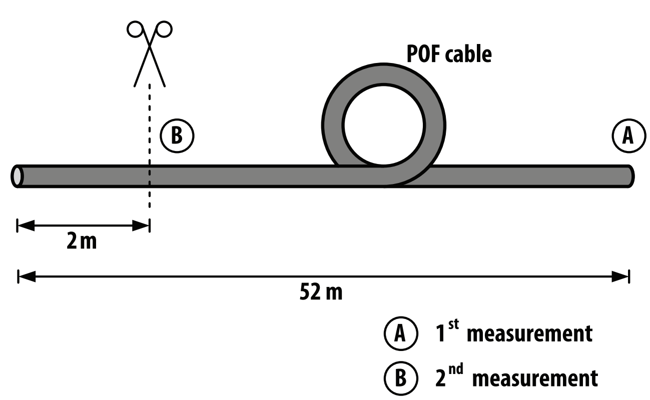

Figure 14. Schematic of the cut-back method referred in the VDE/VDI 5570 standard

Propagation delay constant

This parameter refers to the propagation speed of light within the POF cable and it is defined as the reciprocal of the group velocity of the electromagnetic wave associated to said light.

Since the group velocity is given by equation 8, and since the refractive index of the core of HFBR-EXXYYYZ and AFBR-HXXYYYZ cables is n_1=1.49, as detailed in section Mechanical characteristics, the propagation delay constant for these two POF cables is 5ns/m.

Flammability

In order to avoid the propagation of flames in case of fire, which could damage installations or, even, injure people, both HFBR-EXXYYYZ and AFBR-HXXYYYZ are compliant with UL 1581 (VW-1 flame test) standard. VW-1 is the standard most demanded by professionals to certify fire safety compliance of wires.

Qualification results

In pursuance of guaranteeing the best possible performance under the full range of allowed operating conditions, Avago POF cables are subjected to the most demanding qualification processes.

This section contains the results of different qualification tests to which HFBR-EXXYYYZ cable series and AFBR-HXXYYYZ cable series have been subjected. Due to the similarity of the results shown by both cable series, only one curve has been represented in each of the graphs included in this section.

The aim of the different qualification tests is to check how the attenuation of the cable samples increases after the implementation of the test. Therefore, the launched optical power (LOP) measured at one end of the cable samples has been evaluated for each performed test, at least, in two different moments: 0 hours (non-stressed samples) and after test completion.

Figure 15 shows a schematic of the setup used for the LOP measurements mentioned previously.

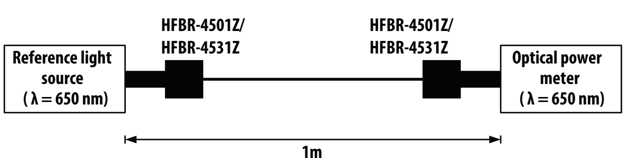

Figure 15. Schematic of the setup used for qualification LOP readouts

Temperature cycling (TMCL)

The TMCL test consists of placing the POF cable samples inside a chamber whose temperature varies between -40°C and +95°C. The transition from -40°C to +95°C, and vice versa, lasts for 10 minutes. Once the temperature inside the chamber has reached the target temperature, it remains constant for other 10 minutes. Figure 17 shows the profile of the temperature in the chamber.

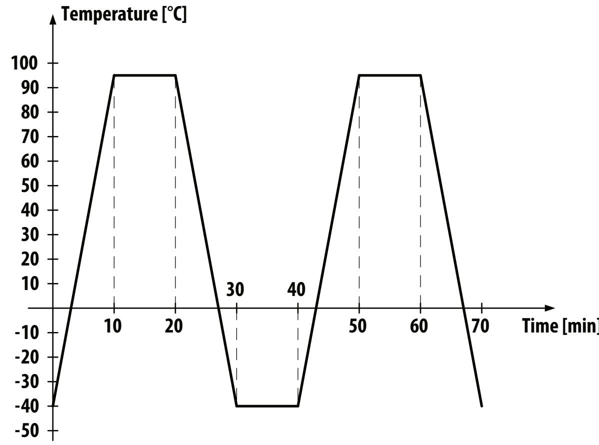

Figure 17. Temperature profile of the TMCL test

Figure 18 shows the results of the TMCL test performed over HFBR-EXXYYYZ and AFBR-HXXYYYZ cable samples.

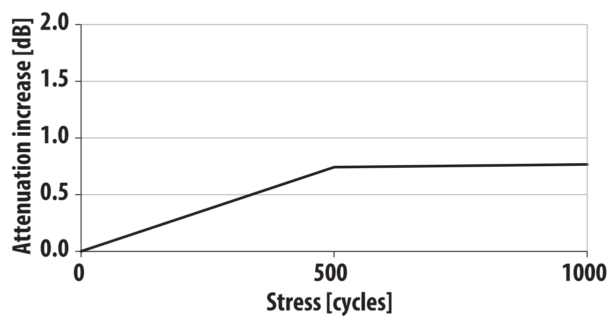

Figure 18. Results of TMCL test

Corrosive atmosphere (CA)

The CA test consists of placing the POF cable samples inside a chamber whose inner atmosphere has the following additives: H_2S (10ppb), NO_2 (200ppb), CL_2 (10ppb) and SO_2 (200ppb). The temperature inside the chamber is 25°C, while the relative humidity is 75%. The POF cable samples remain immersed in this environment for 14 days.

Figure 19 shows the results of the CA test performed over HFBR-EXXYYYZ and AFBR-HXXYYYZ cable samples.

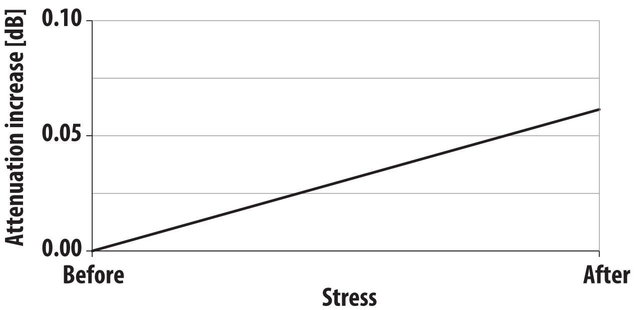

Figure 19. Results of CA test

Chemical resistance (CR)

The CR test consists of submerging the POF cable samples in four different chemical substances: penetrating oil, anti-freeze, cold cleaner and ethanol. The samples remain immersed in the chemical agent for 5 minutes before they get dried for 48 hours at 50°C.

Figure 20 shows the results of the CR test performed over HFBR-EXXYYYZ and AFBR-HXXYYYZ cable samples when the chemical agent is penetrating oil.

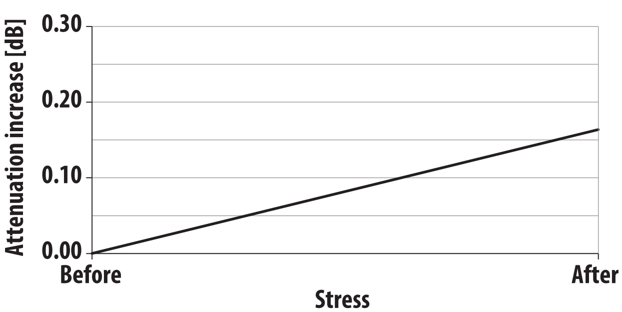

Figure 20. Results of CR test - Penetrating oil

Figure 21 shows the results of the CR test performed over HFBR-EXXYYYZ and AFBR-HXXYYYZ cable samples when the chemical agent is anti-freeze.

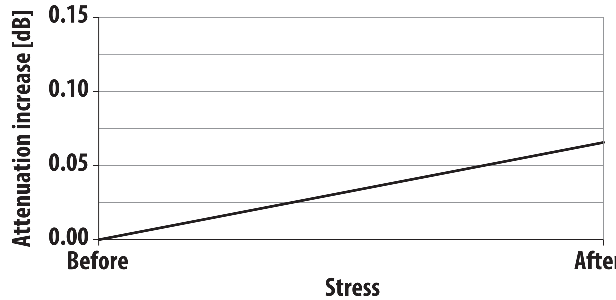

Figure 21. Results of CR test - Anti-freeze

Figure 22 shows the results of the CR test performed over HFBR-EXXYYYZ and AFBR-HXXYYYZ cable samples when the chemical agent is cold cleaner.

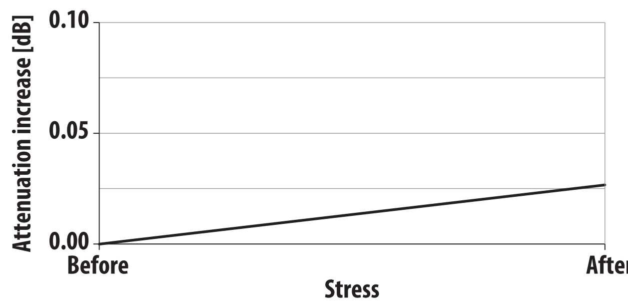

Figure 22. Results of CR test - Cold cleaner

Figure 23 shows the results of the CR test performed over HFBR-EXXYYYZ and AFBR-HXXYYYZ cable samples when the chemical agent is ethanol.

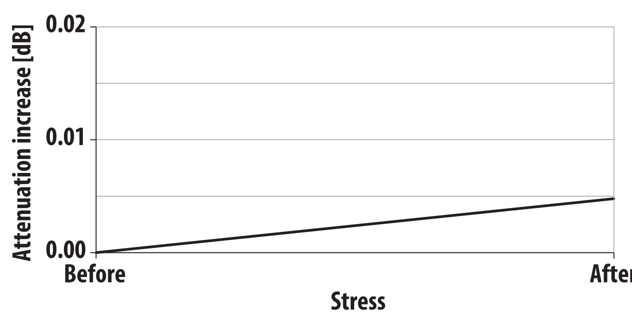

Figure 23. Results of CR test - Ethanol

Bending

There are two types of bending which are applicable to POF: static bending and dynamic bending.

Static bending

Some scenarios require the POF cable to be bent in order to get it connected to another cable though a bulkhead or to reach the optical receiver. As explained in **Part 1, Bending**, of this application note, when bending a fiber, a number of modes can be lost if the bending radius is smaller than a given threshold, which is translated into certain increase of the attenuation of the fiber cable.

Figure 24 shows the increase of the attenuation of the POF cable as the bending radius is increased. Both HFBR-EXXYYYZ and AFBR-HXXYYYZ have been tested at 660nm and 25°C and for a bending angle of 90°.

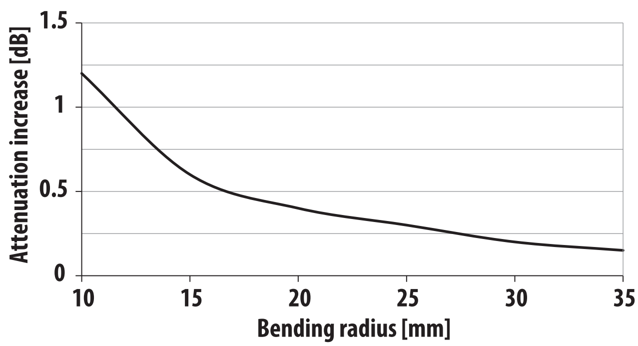

Figure 24. Results of static bending test

Dynamic bending

There are scenarios in which the fiber cable is repeatedly bent, such as robotic arms, which are very common in industrial applications. Since the quality of the data transmission must be assured for these applications as well, both HFBR-EXXYYYZ and AFBR-HXXYYYZ cables have been tested in terms of bending cycles.

Figure 25 shows a schematic of the setup used for the dynamic bending testing of the fiber cables.

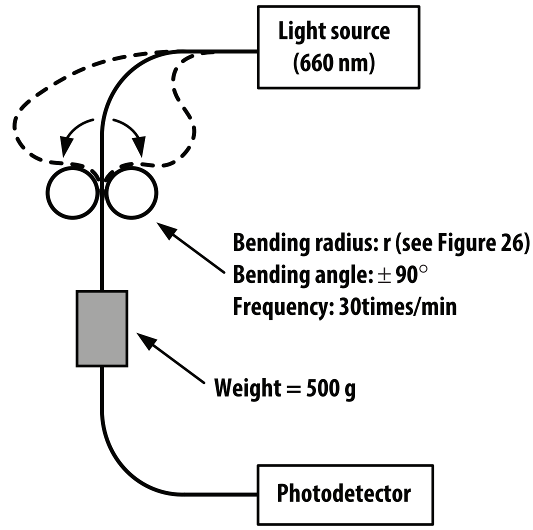

Figure 25. Dynamic bending test setup

Figure 26 shows the increase of the attenuation of the POF cable as the number of bending cycles is incremented. Both HFBR-EXXYYYZ and AFBR-HXXYYYZ have been tested at 25°C.

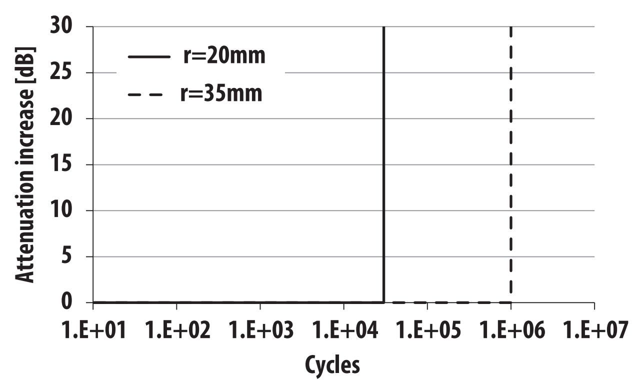

Figure 26. Results of dynamic bending test

Vibrations

Because of the diversity of industrial environments to which POF may be exposed, it may happen that the cables are subjected to vibrations. For example, this is the case of automotive applications. To ensure the correct performance of HFBR-EXXYYZ and AFBR-HXXYYYZ cable series under vibration stress, those cables have been tested according to the methods described in the specifications IEC 60068-2-6 and MIL-STD-883G (2007.3). Even under the most severe conditions defined in said specifications (displacement = 0.75mm; acceleration = 20g; frequency = 2KHz), the communication channel has been proved to be error-free. The tests have been conducted with AFBR-16X4Z transmitters, AFBR-26X4Z receivers and the HFBR-45XXZ Versatile Link connector family.

Additional information

The document AV02-0730EN (Application Note 1035), by Avago, contains very useful information on ordering, connectorizing, polishing and some other topics which might be interesting for users of the Avago POF cables.

Conclusion

As deeply discussed in this application note, POF is a very robust and reliable transmission media for countless applications, being appropriate for those cases which demand low data-rate communication over short links as well as for scenarios which require transmissions at 1Gbps over distances up to 50 meter. POF is also highly suitable for a wide set of environments, ranging from the harsh atmosphere proper from industrial or automotive surroundings to the friendly ambient found in home networking.

Avago HFBR-EXXYYYZ and AFBR-HXXYYYZ cable series have been subjected to the most demanding qualification tests in order to guarantee the best performance under the most critical conditions. These cables are ready to meet the needs of present and future applications that require a highly reliable transmission media for low or medium data-rates (up to 1Gbps, nowadays) over short or intermediate distances (up to 50 meters, currently).

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