Engineering Standards and Technology

Optical Splitter Product Notes

Optical Splitters are used in PON (Passive Optical Network) architectures.

PON (Passive Optical Networks)

There are two common types of systems that make up fiber networks: Active Optical Networks and Passive Optical Networks. Each offer ways to separate data and route it to multiple locations, and each have advantages and disadvantages as compared to the other. An active optical system uses electrically powered switching equipment, such as routers or switch aggregators, to manage signal distribution and direct signals to specific locations. A passive optical network, on the other hand, does not include electrically powered switching equipment and instead uses optical splitters to separate and collect optical signals as they move through the network. A passive optical network shares fiber optic strands for portions of the network and are then split to feed the signal to multiple locations. Powered equipment is required only at the source and receiving ends of the signal.

A Passive Optical Network (PON) is a point-to-multi-point fiber to the premise network architecture. This type of network uses unpowered Optical Splitters along with WDM/CWDM/DWDM to enable a single optical fiber to be split into many separate fibers to serve multiple locations. A PON consists of an optical line terminal (OLT) at the service provider's central office and optical network units (ONUs) near or at the end users location. A PON reduces the amount of fibers and central office equipment required in the network, especially when compared to typical point-to-point architecture. A passive optical network is one form of a fiber-optic access network.

Passive optical networks or PONs have some distinct advantages. They are efficient in that each fiber optic strand can be split many times and can serve many users. The majority of the existing networks are splitting the signal 32 times, while newer systems have gone even further by splitting 64 times. There are even some networks pushing the envelope even further by splitting a signal 128 times. PONs have a low building cost relative to active optical networks along with lower maintenance costs. Because there are few moving or electrical parts, there's simply less that can go wrong in a PON.

Splitters play an important role in Fiber to the Home (FTTH) networks by allowing a single PON network interface to be shared among many subscribers. They are the network element that put the passive in Passive Optical Network. In some cases, FTTH systems may combine elements of both passive and active architectures to form a hybrid system.

Technologies used to fabricate splitters and couplers.

Planar Lightwave Circuit (PLC or Planar)

PLC splitters are used to separate or combine optical signals. A PLC is a micro-optical component based on planar lightwave circuit technology and provides a low cost light distribution solution with small form factor and high reliability. PLCs are manufactured using silica glass waveguide circuits that are aligned with a V-groove fiber array chip that uses ribbon fiber. Once everything is aligned and bonded, it is then packaged inside a miniature housing. PLC Splitters have high quality performance, such as low insertion loss, low PDL, high return loss and excellent uniformity over a wide wavelength range from 1,260 nm to 1,620 nm and have an operating temperature -40ºC to 85ºC. Clearfield® products meet or exceed Telcordia GR-1209 and GR-1221 certifications.

FBT Splitter Specifications

FBT is the traditional technology in which two fibers are placed closely together, typically twisted around each other and fused together by applying heat while the assembly is being elongated and tapered. A signal source controls the desired coupling ratio. The fused fibers are protected by a glass substrate and then protected by a stainless steel tube, typically 3 mm diameter by 54 mm long. As this technology has developed over time, the quality of FBT splitters has improved and they can be deployed in a cost-effective manner. FBT splitters are widely accepted and used in passive optical networks, especially for instances where the split configuration is not more than 1x4. The slight drawback of this technology is when larger split configurations such as 1x16, 1x32 and 1x64 are needed. FBT technology is limited to the number of splits that can be achieved with one coupling. If more than four splits are required, multiple FBT splitters can be spliced together in concatenation to multiply the amount of splits available. This is also known as a tree splitter or coupler. When using this design, the package size increases due to multiple FBT splitters and splices needed to concatenate. The insertion loss also increases with the additional splitters and splices used. When high split counts are needed and small package size and low insertion loss is critical, a PLC splitter is more ideal.

Planar Lightwave Circuit (PLC) Optical Splitter Specifications

Type	IL	RL	PDL	Uniformity	Directivity	Operating-Temp	Storage-Temp
1 x 32	< 16.8 dB	> 50 dB	< 0.3 dB	< 1.7 dB	> 55 dB	-40°C to 85°C	-40°C to 85°C
2 x 32	< 17.8 dB	> 50 dB	< 0.3 dB	< 1.8 dB	> 55 dB	-40°C to 85°C	-40°C to 85°C
1 x 16	< 13.8 dB	> 50 dB	< 0.3 dB	< 1.2 dB	> 55 dB	-40°C to 85°C	-40°C to 85°C
1 x 8	< 10.8 dB	> 50 dB	< 0.3 dB	< 0.8 dB	> 55 dB	-40°C to 85°C	-40°C to 85°C
1 x 4	< 7.5 dB	> 50 dB	< 0.3 dB	< 0.6 dB	> 55 dB	-40°C to 85°C	-40°C to 85°C

Fused Biconic Taper (FBT) Dual Window - Wavelength Flattened (Terminated Specifications)

	1 x 2	1 x 4	1 x 8	1 x 16	1 x 32
Maximum Insertion Loss (dB)	3.6	7.2	10.7	14.0	17.6
Maximum Uniformity (dB)	0.8	1.0	1.3	1.6	1.9
Maximum PDL (dB)	0.2	0.3	0.4	0.5	0.6
Center Wavelengths (nm)	1,310 and 1,550	1,310 and 1,550	1,310 and 1,550	1,310 and 1,550	1,310 and 1,550