Fiber Optical PLC Splitter vs Fused Coupler

Part 1. Main differences between PLC splitters and Fused coupler (FBT coupler)

1. Technology of FBT Coupler and PLC splitter.

FBT coupler: Fused Biconical Taper, this is traditional technology to weld several fiber together from side of the fiber.

PLC splitter: Planar waveguide is a micro-optical components products, the use of lithography, the semiconductor substrate in the medium or the formation of optical waveguide, to achieve branch distribution function.

2.Disadvantages and advantages between FBT and PLC.

	PLC splitter	FBT coupler (Fused)
Split Ratio	2*64 splits	2*32splits
Eveness	Can split light evenly	Eveness is not very precise
Size	Compact size	Big size for multi splits

Part 2 Optical Performance

We use fiber optic splitter to distribute or combine optical signals in many applications, we have one question:Shall I use PLC Splitter or Fused Coupler ?

As for FBT is Fused Biconical Tapered Couplers (or splitters), it is a traditional products and it can be one (1310nm or 1550nm), two (1310nm and 1550nm) or three wavelength (1310nm, 1490nm, 1550nm) and different optical ratios (like 85%:5%:5%:5% for 1*4), of course it also can be with same optical ratios (like 1*4:25%:25%:25%:25%).

PLC is Planar Lightwave Circuit Splitter, they are with continual wavelength range like 1250 to 1650 nm, and they always with average optical ratios like 1*4: 25%:25%:25%:25%.

	PLC splitter	FBT coupler (Fused)
Split Ratio	Average	Average or non-average
Wavelength	Continual 1250 to 1650 nm	Separated, one wavelength or two wavelength or three wavelength

Optical Performance

Insertion loss and uniformity vs. wavelength

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The insertion loss plot of a standard 1×8 PLC splitter from 1250 to 1650 nm. You can observe the maximum insertion loss including the water-peak in E-band region (1360 to 1460 nm) and also the excellent uniformity out of this plot. Typical value is 9.8dB for insertion loss and 0.5dB for uniformity.

If you analyze the operating wavelength range from 1250 to 1650 nm as for PLC splitter you will still find an overall good performance level. But if it's a single 1×2 fused coupler, you are not comparing the same devices.

To fabricate a 1×8 fused coupler device each arm have to be manufactured using 3 cascaded (spliced) 1×2 couplers. It means that the "worst" arm could show 10.8dB insertion loss max and the uniformity will be 3dB.

TDL (Temperature Dependent loss)

Due to the manufacturing process and to the sensitivity of the fused region and of the splices integrated in the device, Fused coupler manufacturers have to specify also the TDL value. for a 1×2 Fused coupler, a typical value is +/10.15dB for a temperature range from -5 to +75 centigrade . At the first sight, it could look good, but we have here again to take into account the cascading effect. To make the comparison with 1×8 PLC splitter we have to multiply 0.15 by 3 (3 1×2 for each arm) to finally obtain 0.45dB.

PLC splitter works from -40 to 85 centigrade with a typical TDL of out +/- 0.25dB (-5 to 75 centigrade:+/-0.15dB)

Please note that this TDL effect is already included in the Max. insertion loss specifications available on data sheets.

PDL (Polarization dependent loss)

An Ion-exchange PLC splitter shows a PDL much less than 0.2 dB independently from the split-ratio. A 1×2 fused coupler PDL ranges from 0.1 to 0.15dB.Also in this case, we have to cascade discrete 1*2 Fused coupler to obtain the desired split-ratio, Then also PDL will be increased.

A 1×8 fused coupler will show up to 0.45dB PDL, what is more than the double of a 1×8 PLC splitter.

Reliability

As previously explained, to fabricate a 1×8 fused coupler, you need 7discrete 1×2 couplers and 6 splices. The risk of failure of a device, normally calculated by parameter called FIT(failure in time), is typically low for a single 1×2 fused coupler, but in the case of a 1×8 fuse fused coupler ,it has to be at lease multiplied by 7 and in addition to add the risk

associated to the massive presence of splices in the circuits. As everybody knows, a splice is a potential failure point in a system to be minimized a s much as possible.

At the contrary, a PLC splitter knows only 2 critical points: input and output.

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