

Making an optical coupler

Article Overview

Optical couplers are made by bringing fiber cores into close proximity to enable evanescent wave coupling, typically using fused biconical taper (FBT) or planar lightwave circuit (PLC) techniques.

Operating Principle

An optical coupler is a passive device that splits or combines light between fibers without external power. Its operation relies on evanescent coupling, where a small portion of the light field extends beyond the fiber core into the cladding. When two fiber cores are brought within a few micrometers, the evanescent waves overlap, allowing light to transfer from one fiber to another. The splitting ratio--the percentage of light directed to each output--is controlled by the interaction length and core separation, while insertion loss quantifies the total light loss during coupling .

Fused Biconical Taper (FBT) Method

The traditional FBT method involves:

- o Stripping and cleaning fibers to expose the cores.
- o Twisting or aligning fibers in close contact.
- o Heating the fibers until the glass softens.
- o Stretching the fibers to taper the cladding, bringing the cores into sufficient proximity for evanescent coupling.
- o Monitoring the splitting ratio in real time and stopping the process when the desired ratio (e.g., 50/50, 70/30) is achieved. This method allows flexibility for custom ratios and is suitable for low-port-count couplers. However, the process is sensitive to small variations in elongation, requiring careful measurement and adjustment to achieve the intended performance .

Planar Lightwave Circuit (PLC) Method

PLC couplers are fabricated using photolithographic etching on a silicon substrate:

- o Waveguides are etched to form precise Y-branch structures.
- o Fibers are coupled to the input and output ports.
- o The device is thermally stabilized to ensure uniform performance across all channels. PLC technology is preferred for high-port-count splitters (e.g., 1x32) due to its high uniformity, thermal stability, and scalability. Unlike FBT, PLC devices are highly reproducible and suitable for mass production .

Performance Considerations

Key metrics in coupler fabrication include:

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- o Splitting ratio: Determines how light is distributed among outputs.
- o Insertion loss: Total light loss, including coupling and excess loss.
- o Directivity: Fraction of input light lost internally.
- o Polarization-dependent loss (PDL): Variation in transmission due to polarization states. These parameters are measured during and after fabrication to ensure the coupler meets design specifications .

Summary

The process of making an optical coupler combines precise physical alignment, controlled heating, and stretching (FBT) or microfabrication techniques (PLC) to achieve efficient light transfer between fibers. The choice of method depends on the number of ports, desired splitting ratio, and production scale, with FBT suited for small-scale, customizable couplers and PLC ideal for high-volume, multiport applications .

Fiber optic couplers are optical devices that connect three or more fiber ends, dividing one input between two or more outputs, or

Fiber optic couplers are used to split or combine optical signals in optical fiber systems. It contains various types like

I Introduction This article focuses on the electronic component known as the Optocoupler.

An optocoupler is a coupling device used to couple optical signals. It's primarily employed to combine and split signals in optical

Understand the physics of light division (evanescent coupling) and the manufacturing methods (FBT, PLC) that power

Fiber optic connections also permit fiber optic systems to be more than just point-to-point data communication links. In fact, fiber

Fiber joints are permanent or removable connections between multimode or single-mode fiber ends.

What is an optoisolator (optical coupler or optocoupler)? An optoisolator (also known as an optical coupler,

Simply described, an optocoupler device is a sealed, self-contained unit that houses independently-powered optical (light) Tx and Rx

Connecting Fibers to LEDs and Sensors Optical fiber couplers for various LEDs and light

Making an optical coupler

A method of making an optical fiber coupler from at least a pair of optical fibers, comprising; (a) selecting the optical fibers having a

Understand what an optocoupler is and how it works at our electronics workshop at Jameco Electronics. Explore tutorials on how

An opto-isolator contains a source (emitter) of light, almost always a near infrared light-emitting diode (LED), that converts electrical

Within the resonator of a fiber laser, a dichroic fiber coupler can be used to inject pump light, and another

This optical coupling allows the input and output circuits to remain electrically isolated from each other, protecting

How measured fiber parameters help to choose the best coupling and collimation optics.

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