COETZER OPTICAL SYSTEMS (Pty) Ltd

Single-mode single-optical module

Overview

In fiber-optic communication, a single-mode optical fiber, also known as fundamental- or mono-mode, is an optical fiber designed to carry only a single mode of light - the transverse mode. Modes are the possible solutions of the Helmholtz equation for waves, which is obtained by combining Maxwell''s equations and the boundary conditions. These modes define the way the wave travels through space, i.e. how the wave is distributed in space. Waves can have the same mode but have different frequencies.

Key Takeaways

A single-mode optical module is a hot-swappable device that transmits and receives data over single-mode fiber, optimized for long-distance, high-speed communication.Overview

A single-mode optical module is designed to operate with single-mode fiber (SMF), which has a small core diameter of approximately 8–10 micrometers, allowing only one spatial mode of light to propagate. This design minimizes modal dispersion, enabling high-bandwidth transmission over long distances, often ranging from 10 km to over 80 km depending on the module type and optical power budget . Single-mode modules typically operate at 1310 nm or 1550 nm wavelengths, using laser-based transmission for reliable long-distance communication .

Key Specifications
• Core Size: ~9 µm

• Cladding Diameter: 125 µm

• Wavelengths: 1310 nm or 1550 nm

• Transmission Distance: 10 km to 120 km depending on module type

• Interface: LC connectors are common

• Hot-Swappable: Can be inserted or removed without powering down the device
Applications

Single-mode optical modules are widely used in:

• Data Centers: For high-bandwidth, long-distance interconnects

• Campus Networks: Backbone connections between buildings

• Telecommunications: Long-haul and metro networks requiring minimal signal loss

• Enterprise Networks: Uplink and backbone connections for switches, routers, and servers
Comparison with Multimode ModulesFeatureSingle-Mode (SM)Multimode (MM)Core Diameter~9 µm50–62.5 µmWavelength1310/1550 nm850/1300 nmTransmission Distance10 km to 120 km100 m to 550 mLight SourceLaserLED or VCSELModal DispersionMinimalHigher, limits distanceCostHigherLower, suitable for short distances
Advantages
• Supports long-distance transmission with low attenuation

• Provides high bandwidth for modern network demands

• Ensures signal integrity over continental or metro-scale networks

• Compatible with hot-swappable SFP, SFP+, and QSFP modules for flexible network upgrades
Conclusion

Single-mode optical modules are essential for networks requiring long-range, high-speed, and reliable data transmission. They are ideal for backbone, metro, and telecom applications, offering superior performance compared to multimode modules for extended distances and high-bandwidth requirements .

Article Content

Single-mode optical fiber

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In fiber-optic communication, a single-mode optical fiber, also known as fundamental- or mono-mode, is an optical fiber designed to carry only a single mode of light - the transverse mode. Modes are the possible solutions of the Helmholtz equation for waves, which is obtained by combining Maxwell''s equations and the boundary conditions. These modes define the way the wave travels through space, i.e. how the wave is distributed in space. Waves can have the same mode but have different frequencies. This is the case i

The Difference Between Single-mode and Multi-mode Optical Modules

Definition of Single-mode Optical Modules Single-mode optical modules are designed for long-distance data transmission. They

Single-Mode Vs Multimode Optical Modules: Detailed Differences

Choosing between Single Mode and Multimode Optical Modules will shape cost, reach and upgrade paths. This guide breaks down

Recommendation ITU-T G.652 (08/2024)

This document outlines the specifications for a single-mode optical fiber and cable designed for use around the 1310 nm zero

Gigabit single-mode single-core fiber optic module

Gigabit single-mode single-core optical fiber modules usually have the following specifications: multi-mode 550m, single

Single Mode SFP Transceiver: Complete Guide Explained

A single mode SFP transceiver is a hot-swappable optical module designed to transmit and receive data over single mode fiber

Understanding Single-mode and Multi-mode SFP Optical Modules

Single-mode SFP optical modules are designed for transmitting data over long distances with high precision. SFP transceiver single

How to distinguish whether an optical fiber module is single-mode or ...

Correctly distinguishing single-mode and multi-mode optical modules is critical for matching fiber patch cords, ensuring

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