Transmission distance of data communication optical module

Overview

Explore the ultimate guide to optical modules. Learn types, functions, performance metrics & how to choose the right module for your fiber network.

Key Takeaways

Optical module transmission distance varies from a few meters to over 80 km, depending on fiber type, wavelength, and module design.

Overview of Transmission Distance

The transmission distance of an optical module refers to the maximum length over which it can reliably transmit data without signal amplification or regeneration. Optical modules are generally classified into three categories based on distance: Short-distance modules (SR/short reach): Typically up to 2 km, often used with multimode fiber (MMF) at wavelengths like 850 nm. Medium-distance modules (MR/LR): Usually 10–20 km, often using single-mode fiber (SMF) at 1310 nm.

Long-distance modules (LR/ER/ZR): Exceeding 30 km, with some modules reaching up to 80 km using single-mode fiber and advanced lasers like DFB or EML to reduce dispersion.

Factors Affecting Transmission Distance

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Fiber Type: Multimode fiber (OM3, OM4, OM5): Shorter distances due to modal dispersion; typical 100G modules reach 75–150 m depending on fiber type. Single-mode fiber (OS2): Supports longer distances, up to tens of kilometers, due to lower attenuation and minimal modal dispersion. Wavelength: Shorter wavelengths (850 nm) experience higher attenuation, limiting distance.

Longer wavelengths (1310 nm, 1550 nm) have lower fiber loss, enabling longer transmission distances; 1550 nm is often called the zero-loss window. Laser Technology: VCSELs are common for short-reach multimode modules.

DFB or EM

L lasers are used for long-distance single-mode modules to reduce chromatic dispersion and maintain signal integrity. Power Budget and Receiver Sensitivity: The difference between transmitter output power and receiver sensitivity must exceed total link loss (fiber attenuation + connector loss) to achieve the rated distance. Dispersion: Chromatic and modal dispersion spread optical pulses over distance, limiting high-speed transmission.

Long-distance modules often use single dominant wavelengths to mitigate this effect.

Practical Examples10

G SFP+ SR module: 300 m over OM3 multimode fiber at 850 nm. 25G/100G SR multimode module: 100–150 m over OM4/OM5 fiber. 10G/40G LR single-mode module: 10–40 km at 1310–1550 nm.

Long-distance 40G module with optical amplifiers: Up to 80 km using EML lasers and photodetectors.

Summary

The transmission distance of optical modules is determined by a combination of fiber type, wavelength, laser technology, and module design. Short-reach modules are suitable for data centers, medium-reach for campus or metro networks, and long-reach modules for telecom and long-haul applications. Proper selection ensures reliable, high-speed data communication without signal degradation.

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Article Content

Optical module transmission distance and related classification

According to the different transmission distances of optical modules, they can be divided into three types: short-distance optical module s, medium-distance optical modules, and long

The Most Comprehensive Guide Of Optical Modules

Explore the ultimate guide to optical modules. Learn types, functions, performance metrics & how to choose the right module for your fiber network.

Optical Data Transmission – optical fiber communications, free-space ...

The two main methods are guided transmission using optical fibers, which is common for long distances, and free-space optical communications, which uses light beams transmitted through the air or space,

Exploring the Correlation Between Optical Module Wavelength and ...

The transmission distance of optical modules refers to the distance over which optical signals can be transmitted without the need for relay amplification. It is divided into short, medium,

What are the Key Performance Parameters of Optical Modules?

As core optoelectronic conversion devices in high-speed data communication and optical network systems, the performance of optical modules directly affects the stability and transmission efficiency

Understanding the Transmission Distance of Optical Modules ...

In the complex world of network design, understanding the reach of optical modules is crucial. From ensuring fast, local connections with SR to enabling extensive, long-haul

What are the detailed parameters of the optical module

Transmission distance: Transmission distance refers to the distance that optical signals can be directly transmitted without relay amplification, and the unit is kilometers (also called kilometers, km).

How to Estimate an Optical Module''s Transmission Distance | FiberMall

The transmission distance of optical modules can be estimated by analyzing factors like wavelength, fiber optic cable type, protocols, receiver sensitivity, and required OSNR in an optical

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Fiber-optic communication

The transmission distance of a fiber-optic communication system has traditionally been limited by fiber attenuation and by fiber distortion. By using optoelectronic

Dispersion (optics)

Within optics, dispersion is a property of telecommunication signals along transmission lines (such as microwaves in coaxial cable) or the pulses of light in

How Fibre Optics Transmits Data at Lightning Speeds

Quick Answer: Why Fibre Optics Is So Fast Fibre optic cables send data as laser or LED light pulses through thin strands of ultra-pure glass, travelling at approximately 200,000 kilometres

C-Light Network Communication''s Post

C-LIGHT''s 4G FC 80km SFP optical transceiver is designed to support these demanding SAN environments by offering: Up to 80 km transmission over single-mode fiber Stable 4Gbps Fibre

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Optical networks

An optical transport network is a high-speed communication system that sends light signals over fiber-optic cables to move large amounts of data across long distances.

Cisco 10GBASE SFP+ Modules Data Sheet

Product overview The Cisco® 10GBASE SFP+ modules (Figure 1) give you a wide variety of 10 Gigabit Ethernet connectivity options for data center, enterprise wiring closet, and service provider transport

Optical Transceivers Global Market Report 2023: Growing Adoption of ...

The large market share of this segment is attributed to the growing need for high-speed data transmission and reception of optical signals across a distance of up to 20 km, the rise in high ...

Exploring the Correlation Between Optical Module Wavelength and ...

This article delves into the correlation between optical module wavelength and transmission distance, shedding light on the complexities that impact the efficiency of data transmission.

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The FOA Reference For Fiber Optics

Fiber Optic Transceiver Most systems use a "transceiver" which includes both transmission and receiver in a single module. The transmitter takes an electrical input and converts it to an optical output from a

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