

Common transmission distances of optical modules



Overview

As 6G and space-air-ground communications evolve, transmission distances will extend further while costs continue to optimize.

Key Takeaways

Optical modules are classified by transmission distance into short-range (up to 300m), medium-range (up to 10km), and long-range (over 30km), with variations depending on fiber type, wavelength, and module design. Short-Distance Modules (SR)

Short-range (SR) optical modules are optimized for high-speed connections within data centers or racks, typically using multimode fiber (MMF). Their transmission distances usually range from 100 meters to 300 meters, depending on the fiber grade (OM3, OM4, or OM5) and data rate. SR modules commonly operate at 850nm using VCSEL lasers, which are cost-effective but more susceptible to modal dispersion, limiting their reach .

Medium-Distance Modules (LR)



Longer-range modules, often labeled as LR (Long Reach), are designed for single-mode fiber (SMF) and can transmit data over up to 10km or 20km. They typically use 1310nm DFB lasers, which reduce attenuation and chromatic dispersion, allowing stable transmission over campus networks, data center interconnects, or metro networks. Some extended LR variants can reach 40km or 80km, depending on the module specification and optical power budget .

Long-Distance Modules (ER/ZR)

Long-distance modules, sometimes called ER (Extended Reach) or ZR (Ultra-Long Reach), are used for telecom or metro networks requiring distances over 30km, with some modules capable of 80km or more. These modules often employ DFB or EML lasers and may include optical amplifiers or advanced modulation techniques to maintain signal integrity over long distances. Single-mode fiber is standard for these modules, and careful consideration of link loss, dispersion, and optical power is essential to achieve maximum reach .

Factors Affecting Transmission Distance

- Fiber Type: MMF limits short-range distances; SMF supports longer distances.
- Wavelength: 850nm for SR, 1310nm for LR, 1550nm for ultra-long distances.
- Laser Type: FP lasers for short distances, DFB/EML for long distances.
- Data Rate: Higher speeds reduce maximum achievable distance due to dispersion.
- Link Loss and Dispersion: Attenuation (dB/km) and chromatic/modal dispersion affect signal quality .

Summary

Optical modules are selected based on distance requirements, fiber type, and network design. Short-range modules are ideal for intra-rack or intra-data center links, medium-range modules suit campus or metro connections, and long-range modules are necessary for inter-city or telecom networks. Matching the module type to the actual link distance ensures cost efficiency and reliable performance .

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

Understanding SR/LR Optical Designations and Distances

The effective transmission distance of optical modules determines how far data can travel while maintaining signal integrity and

A Comprehensive Guide to Optical Transceivers: Speed, Distance,

With a variety of speeds, transmission distances, and form factors, selecting the right optical module is crucial for

SR vs LR vs ER vs ZR: A Complete Guide to Optical Module

As 6G and space-air-ground communications evolve, transmission distances will extend further while costs continue to optimize. The

The Ultimate Guide to Optical Module Transmission Distance

Therefore, engineers have designed optical modules with varying power outputs for different transmission distances.

How Is the Transmission Distance of Optical Modules Determined? —

The transmission distance of optical modules is not a single fixed parameter but the result of multiple influencing

Wavelength and Transmission Distance of Optical Transceiver Modules

The transmission distance of optical transceiver modules is divided into short distance, medium distance, and long distance. Usually,

10G, 25G, 50G and 100G Optical Transceivers and Ethernet Standards

Modern Ethernet speeds from 10G to 100G are supported by optical standards optimized for different fiber types, distances, and

transceiver module transmission distance

Different wavelengths of light are affected differently, leading to the common classification of modules by their

Fiber-optic communication

Another common practice is to bundle many fiber optic strands within long-distance power transmission cable using, for instance, an

Everything You Need to Know About Optical Modules

The transmission distance and speed of optical modules are determined by their modulation technique, which is used to

Exploring the Correlation Between Optical Module Wavelength and ...

This article delves into the correlation between optical module wavelength and transmission distance, shedding light

Optical module transmission distance and related classification

As a photoelectric conversion device, in the optical communication network, the optical module is the most common

Key Standards and Form Factors for Transceivers

With a CFP2-DCO the DSP is located within the optical transceiver. This provides more options as the module can be

How Far Can Fiber Optic Cable Transmit? Fiber Distance Guide

Discover the maximum transmission distance of fiber optic cables and learn how single-mode and multimode fibers

Multi-mode optical fiber

A stripped multi-mode fiber Multi-mode optical fiber is a type of optical fiber mostly used for communication over short distances,

What are the factors that affect the transmission distance of optical ...

The quality of the optical module's conversion of optical and electrical signals depends greatly on its internal light

What is Optical Transceiver: A Beginner Guide (2024)

The Main Parameters of Optical Transceiver • Data Rate: the number of bits transmitted per second. • Transmission

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This document is for preliminary research. Verify specifications against current standards, product documentation and project requirements.

