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Common Models and Quantities of Optical Modules



Overview

Many different forms of optical modulation and multiplexing have been employed in optical modules. The most common modulation technique historically has been on-off keying or NRZ. Pulse-amplitude modulation (PAM-4) has also been extensively used. In the 2010s, coherent optical modulation has been used. Techniques include Dual Polarization Quadrature Phase Shift Keying (DP-QPSK) and QAM-16.

Key Takeaways

Optical modules come in various models such as SFP, SFP+, QSFP, and CFP, each supporting different data rates, distances, and network applications.Common Models of Optical Modules

• SFP (Small Form-factor Pluggable)
• Supports data rates up to 4.25 Gbps

• Widely used in enterprise networks for 1 Gbps connections

• Suitable for short to medium distances over single-mode or multi-mode fiber

• SFP+ (Enhanced SFP)
• Supports up to 10 Gbps

• Common in data centers and high-speed networks

• Compatible with 10G Ethernet and Fibre Channel

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• QSFP (Quad Small Form-factor Pluggable)
• Supports 40 Gbps (QSFP+) and 100 Gbps (QSFP28)

• Used in high-performance computing and network aggregation layers

• QSFP-DD supports 400 Gbps for ultra-high-speed applications

• CFP (C Form-factor Pluggable)
• Designed for 100 Gbps and higher speeds

• Often used in core network infrastructures and long-haul optical links

• Other Advanced Modules
• XFP, X2, XENPAK, and CFP2-ACO for coherent optics and flexible bandwidth applications

• Support high-speed modulation formats like DP-QPSK and QAM-16

Key Quantities and Classifications

Optical modules are classified based on several factors:

• Data Rate: 100 Mbps, 1 Gbps, 10 Gbps, 25/40/100 Gbps, 200/400 Gbps

• Form Factor: Determines physical size and interface compatibility with switches, routers, or servers

• Transmission Distance: Short-range (SR), long-range (LR), extended-range (ER), and ultra-long-range (ZR)

• Fiber Type: Single-mode or multi-mode

• Wavelength Division Multiplexing: CWDM (coarse) and DWDM (dense) for multiple signals over a single fiber
Practical Deployment Quantities
• Enterprise Networks: Typically use SFP or SFP+ modules, with quantities depending on the number of switches and uplinks.

• Data Centers: QSFP and SFP28 modules are common, often deployed in hundreds to thousands for high-throughput aggregation and spine-leaf architectures.

• Telecom/Core Networks: CFP and CFP2 modules are used in smaller quantities but for high-capacity backbone links.
Summary

Choosing the right optical module depends on network speed, distance, fiber type, and cost considerations. SFP and SFP+ dominate enterprise and data center deployments, while QSFP and CFP modules are essential for high-speed and long-haul networks. Proper selection ensures efficient data transmission, compatibility, and scalability in modern optical communication systems .

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Article Content

Optical module

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