Main Components of a 400G Optical Module



Overview

A clear, engineer-friendly overview of 400G optical modules, including standards, packaging formats, functions, and market outlook for next-generation data centers.

Key Takeaways

A 400G optical module integrates DSP chips, optical transmitters and receivers, lasers, modulators, photodetectors, and supporting electronics to convert, process, and transmit high-speed optical signals. Digital Signal Processor (DSP) ChipThe DSP chip acts as the central processing unit of the module. On the transmitter side, it converts input electrical signals into multiple 100G electrical lanes using PAM4 modulation, which are then sent to the optical transmitter for conversion into optical signals.

On the receiver side, the DSP samples and quantizes incoming analog signals from the optical receiver, compensates for fiber impairments such as chromatic dispersion and polarization mode dispersion, and performs carrier recovery to restore the original transmitted data. It also manages lane aggregation and clock/data recovery through gearboxes, enabling efficient 400G transmission.

Optical Transmitter Unit

The optical transmitter converts electrical signals from the DSP into optical signals. It typically includes laser chips such as EML (Electro-Absorption Modulated Laser) or silicon photonics-based lasers. These lasers generate the optical carrier, which is modulated by the transmitter to encode data onto the light signal.

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The transmitter may also include modulators like IQ modulators for coherent optics, which encode data onto amplitude and phase of orthogonal polarizations.

Optical Receiver Unit

The optical receiver converts incoming optical signals back into electrical signals. It includes photodetectors (often balanced photodiodes) that detect the optical signal and convert it into electrical currents. In coherent modules, the receiver uses a local oscillator (LO) laser and optical hybrids to extract in-phase (I) and quadrature (Q) components, enabling high-speed coherent detection.

Monitoring Unit

The monitoring unit tracks module performance parameters such as temperature, voltage, optical power, and signal integrity. This ensures reliable operation and allows the system to adjust for optimal performance or trigger alarms if thresholds are exceeded.

PCB Circuit Board

The PC

B provides the electrical interconnections between the DSP, transmitter, receiver, and other supporting electronics. It also houses driver chips for lasers and transimpedance amplifiers (TIAs) for photodetector signals, ensuring proper signal amplification and conditioning.

Housing

The housing protects the internal components, provides thermal management, and ensures mechanical compatibility with network equipment. It also facilitates hot-swapping in pluggable form factors like QSFP-DD and OSFP.

Summary

Each component in a 400G optical module plays a critical role: the DSP handles signal processing and error correction, the transmitter and receiver units perform photoelectric conversion, lasers and modulators encode data onto light, photodetectors recover signals, the PCB and supporting electronics manage signal integrity, and the housing ensures protection and thermal stability. Together, these components enable reliable 400G high-speed optical communication.

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Components of a 400g optical module chip | Weyland

In conclusion, the 400G optical module chip is a complex system-level integration structure composed of optical transmitter chips, receiver chips, modulator chips, and DSP/PHY electrical chips.

What chips are required for a 400g optical module? | Weyland

Overall, 400G optical modules represent a major milestone in modern data center networking. Their architecture is evolving from traditional discrete designs toward silicon photonics

Overview of 400G Optical Modules

What is a 400G Optical Module? A 400G optical module is primarily used for optical-electrical conversion. The electrical signal is converted into an optical signal at the transmitter, which

400G Optical Modules Explained: SR4 Vs. DR4 Vs. FR4 Vs. LR4

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The QSFP-DD 400G optical module has become a key element in the fast-changing field of data transmission technology to improve network

400G optical module

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Key Differences Of 100G, 400G, And 800G Explained

Its core function is to convert electrical signals into optical signals at the transmitting end and convert optical signals back to electrical signals at the

400G Optical Module Block Diagram

Interactive block diagram illustrating multiple Microchip components used in an optical module design

What is a 400G Optical Module?

What is the market value of 400G optical modules? As we all know, 100G technology products have matured, 400G is a hot topic of discussion at present, and the industry is very concerned about the

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400G Coherent Optical Devices: Architecture, Applications & Trends

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400G Coherent Optics is a complex system that integrates key photonic and electronic components to enable high-speed data transmission. These components are often housed within a

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