

High-Temperature Resistant Optical Receivers for Data Centers



Overview

Optical Transceiver | TE Connectivity
Designed for hyperscale data centers, AI/ML, HPC, and telecom applications, our transceivers including 200G, 400G, 800.

Key Takeaways

High-temperature resistant optical receivers and fiber assemblies enable reliable high-speed data transmission in data centers operating under elevated thermal conditions.

Thermal Challenges in Data Centers

Modern data centers, especially those supporting AI workloads, require ultra-high-speed optical transceivers ranging from 100 Gbps to beyond 1.6 Tbps. These transceivers generate significant heat, and maintaining laser stability and receiver performance under high temperatures is critical for reliability and energy efficiency.

Thermoelectric coolers are commonly used to stabilize laser diodes, but high-temperature resistant optical components provide an additional layer of robustness.

High-

Temperature Optical Components



Fiber and receiver assemblies designed for high-temperature environments can operate under extreme conditions: High-temperature fiber arrays: Special coatings on single-mode (SM) and polarization-maintaining (PM) fibers allow solder reflow assembly at 270°C, suitable for silicon photonic integration. Collimators and connectors: High-temperature collimators can operate up to 700-1000°C, enabling optical sensing and interconnection in harsh environments. Sapphire and silica fibers: Sapphire fibers withstand up to 1000°C and provide broad-spectrum transmission, while silica fibers can handle up to 800°C with proper mechanical protection.

Custom assemblies: Hermetic feedthroughs, high-temperature patchcords, and fiber bundles ensure optical integrity in extreme thermal and chemical conditions.

Optical Receiver Technologies

For data center applications, energy-efficient CMOS optical receivers are critical: PAM-4 receivers: Short-reach data center receivers using PAM-4 modulation achieve high sensitivity and low energy per bit, e.g., -5.1 dBm sensitivity at 48 Gb/s with 1.28 pJ/bit efficiency.

Ultra-sensitive receivers: Advanced designs using capacitive transimpedance amplifiers (CTIA) and avalanche photodiodes (APD) can approach the quantum limit, providing high sensitivity while maintaining low power consumption. Thermal management: Receivers often incorporate operating point control and feedback loops to maintain performance under temperature variations. Integration with Silicon Photonics: High-temperature resistant optical components are essential for silicon photonic (SiPh) integration, where fiber arrays must endure solder reflow processes without degradation.

This ensures reliable coupling between fibers and photonic chips, critical for high-speed interconnects in AI and cloud data centers. Summary: High-temperature resistant optical receivers and fiber assemblies combine robust materials, thermal coatings, and advanced receiver architectures to maintain high-speed, reliable data transmission in modern data centers. Key strategies include: Using high-temperature coated SM and PM fibers for solder reflow compatibility.

Employing sapphire or silica fibers for extreme temperature tolerance. Integrating energy-efficient CMOS or ultra-sensitive receivers to maintain performance under thermal stress. Implementing thermal management solutions such as thermoelectric coolers and operating point control.

These technologies collectively ensure that data centers can handle high-speed optical communication even under elevated temperatures, supporting AI workloads and large-scale cloud computing reliably.

Article Content

Optical Transceiver | TE Connectivity

Designed for hyperscale data centers, AI/ML, HPC, and telecom applications, our transceivers including 200G, 400G, 800G and 1.6T solutions, deliver reliable

Optical transceivers can beat the heat in the era of high

The rapid advancement of AI and large language models has created a surge in demand for high-speed optical transceivers, particularly within data centers and

Optical Transceivers Cooling in the Age of AI Cluster Computers and ...

Optical Transceivers: Powering AI Communication er required for AI computations in modern data centers and AI cluster computers. As demand for AI cloud computing and data-driven demand

Optical Transceivers Cooling in the Age of AI Cluster

Explore the challenges of cooling optical transceivers in AI clusters and data centers. Learn how engineered micro TECs ensure optimal

Data Center Optical Transceiver | XtaITQ

An optical transceiver for data centers facilitates ultra-fast data exchange between servers and storage systems. It combines transmitting and receiving capabilities in a single module, ensuring high

Optical Transceivers SFP SFP28 QSFP28 QSFP-DD 1G to 400G Range

100G QSFP28 Transceivers Enterprise-Class Optical Networking Versatile and reliable, perfect for data center and telecom use cases.

Coherent Data Center Links

We discuss alternative designs for coherent receivers, such as DSP-free coherent receivers and Kramers–Kronig (KK) receivers. We com-pare them in terms of receiver sensitivity, power

Optical Transceiver Market: Top 10 Manufacturers Ranked

Optical transceiver market leaders: the top 10 manufacturers powering 400G and 800G modules for hyperscale data centers and AI networking.

SMT Assembly: Mastering Photoelectric Co-Design and Thermal

This article will delve into the core challenges and solutions of SMT assembly for data center optical module PCBs from the perspective of connector and fiber engineers.

Recent advances in optical technologies for data centers: a review

There have been considerable advances in high-bandwidth pluggable optical interconnects for the data center. Large-scale data centers adopted optical transmission technologies during the transition from

Optical transceivers can beat the heat in the era of high

Optical transceivers are the backbone of high-speed communication between servers and network devices, facilitating the data transfer required for AI

Optical Transceivers Cooling in the Age of AI Cluster

Introduction Why temperature control matters Thermal Challenges in Optical Transceivers Laser Diode Performance Laser Diode Cooling Challenges

Optical Fiber Sensors for High-Temperature Monitoring: A Review

High-temperature measurements above 1000 °C are critical in harsh environments such as aerospace, metallurgy, fossil fuel, and power production. Fiber-optic high-temperature sensors are

Optical Transceivers Cooling in the Age of AI Cluster Computers and ...

Optical transceivers enable high-speed communication between servers and network devices and are the critical components that facilitate the high-speed data transfer required for AI computations in

Optical Transceivers in Data Centers: Challenges and Market Trends

In these high-capacity networks, optical transceivers play a critical role. The majority of today's data center networks necessitate high-capacity data transmission. This article addresses the

Supply Chain & Distribution Archives

RISC-V Targets Data Centers, Edge AI, Space "RISC-V is now," said Andrea Gallo, CEO of RISC-V International, during his keynote at this week's

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Optical Transceivers & SFP/QSFP Cages Solutions Complete optical interconnect ecosystem including high-speed transceivers and precision-engineered SFP/QSFP cages for data center and telecom

Optical Transceiver Modules Overcome High Temperatures in the Era

The rapid advancement of artificial intelligence (AI) and large language models has resulted in an unprecedented surge in demand for high-speed optical transceiver modules within

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