Optical Module Packaging Method



Overview

Achieving high performance in the module requires not only the chip design, but also requires the package design, which includes optical, electrical, mechanical, and thermal designs.

Key Takeaways

Optical module packaging methods include COB, BOX, TO-CAN, and butterfly types, each designed to balance cost, reliability, heat dissipation, and environmental suitability. Hermetic vs Non-Hermetic PackagingHermetic packaging involves sealing optical components in a protective enclosure, often filled with inert gas, to prevent moisture and dust ingress. This ensures high reliability and stable performance in harsh environments, such as outdoor telecom networks or industrial applications.

Common hermetic packages include TO-CAN, BOX, and butterfly packages. Hermetic designs often incorporate thermoelectric coolers (TECs) for temperature-sensitive laser diodes, maintaining wavelength stability and device longevity. Non-hermetic packaging reduces cost and complexity by directly attaching optical chips to the PCB and sealing them with epoxy or adhesives.

This approach, exemplified by Chip-on-Board (COB) packaging, is widely used in data centers and short-distance applications where environmental conditions are controlled. Common Packaging Methods1.

© 2026 EXF OPTICAL NETWORKS - All rights reserved

Chip-on-

Board (COB)Description: The laser or photodiode chip is mounted directly on the PCB. Advantages: Miniaturization, lightweight, lower cost, and shorter interconnection paths for improved performance. Applications: Data centers, high-performance computing, campus networks, and short-distance optical links.

Limitations: Sensitive to environmental instability; not ideal for industrial or outdoor temperature extremes. 2.

BOX Packaging

Description: Optical components are enclosed in a metal box, often hermetically sealed with inert gas. Advantages: High reliability, stable optical and electrical performance, effective heat dissipation, and easier maintenance. Applications: Carrier-grade telecom modules, 100G optical transceivers, data centers, and high-performance computing networks.

Characteristics: Suitable for harsh environments with large temperature and humidity fluctuations. 3. TO-CAN PackagingDescription: The laser is mounted on a small heat sink and enclosed in a metal can with a sealed window.

Advantages: Compact, cost-effective, and provides basic hermetic protection. Limitations: Limited volume restricts heat dissipation; not suitable for high-power or long-distance applications. Applications: Short to medium-distance telecom links, such as 10 km 10G/25G fronthaul and home broadband.

4.

Butterfly Packaging

Description: A specialized hermetic package often used for multi-channel transceivers. Advantages: Integrates multiple lasers in a single package, suitable for high-density, multi-channel applications. Applications: High-speed telecom and data center modules requiring precise temperature control and reliability.

Evolution and Trends

Optical module packaging has evolved from bulky GBIC modules to compact SFP, QSFP, QSFP-DD, and co-packaged optics (CPO). Miniaturization improves port density, reduces cost, and enhances performance for high-bandwidth applications like 5G, AI computing, and cloud storage. Modern packaging emphasizes integration, thermal management, and cost efficiency while maintaining optical alignment and reliability.

Key Considerations

© 2026 EXF OPTICAL NETWORKS - All rights reserved

Environmental conditions: Hermetic packages for outdoor/industrial use; non-hermetic for controlled environments. Heat dissipation: BOX and TO-CAN packages often include heat sinks or thermal pads. Cost vs performance: COB reduces cost but may compromise environmental robustness; hermetic packages increase reliability at higher cost.

Application distance: VCSEL chips in COB for short reach; DFB or EML chips in hermetic packages for medium to long distances. In summary, selecting an optical module packaging method requires balancing cost, reliability, thermal management, and environmental suitability, with COB, BOX, TO-CAN, and butterfly packages serving distinct roles across data center, telecom, and industrial applications.

Article Content

Optical Packaging/Module Technologies: Design Methodologies

Achieving high performance in the module requires not only the chip design, but also requires the package design, which includes optical, electrical, mechanical, and thermal designs. The chapter

Optical Transceiver: Packaging Methods & Optical Chip Types

This article analyzes the requirements of optical transceivers and discusses packaging methods and optical chip types to help readers better understand their design and manufacturing...

Introduction To Hermetic And Non-Hermetic Packaging Of Optical

For higher reliability and environmental adaptability, hermetically packaged optical modules are generally preferred. For cost-sensitive applications deployed inside equipment rooms,

CPO optical module packaging structure and wafer level packaging

The invention provides a wafer level packaging method of a CPO optical module packaging structure and the CPO optical module packaging structure, which solve the problem that an...

Advanced optical packaging – how much do you know ?

Optical transceiver modules can be classified into three levels: optical chip, optical device, and optical module. They are used in telecom and data

Optical Module: A Comprehensive Analysis from Source to Terminal

© 2026 EXF OPTICAL NETWORKS - All rights reserved

In the optical module design process, we have already chosen an appropriate packaging form based on the operating environment, and selected the suitable laser type according to the

Understanding COB, BOX, and TO-CAN Packaging for

When it comes to optical devices, the right packaging technology can make all the difference. COB, BOX, and TO-CAN packaging each offer

Electronic Chip Package and Co-Packaged Optics (CPO) Technology

This paper discusses the evolution of both conventional and advanced packaging technologies and outlines future directions for design, fabrication, and packaging using glass

Four Optical Packaging Processes

The packaging of high-speed optical modules puts higher requirements on parallel optical design, high-rate electromagnetic interference, volume reduction, and heat dissipation under

Everything You Need to Know About 800G/1.6T Optical Transceiver

Technical Architecture of 800G/1.6T Modules Key Components: DSP, LPO Technology, and Co-Package Design The architecture of 800G/1.6T optical modules hinges on three transformative

KB: Creating protection for Hyper-V VMs on Windows Server 2012

First published on TECHNET on Oct 11, 2012 Here''s a new Knowledge Base article we published. This one talks about an issue where using DPM 2012 SP1 to create a protection group for

GlobalFoundries accelerates adoption of co-packaged optics for

SCALE CPO solution is the industry''s first OCI MSA capable platform and built with GF''s proven silicon photonics technology MALTA, N.Y., May 4, 2026 – GlobalFoundries (Nasdaq: GFS)

Optical Packaging/Module Technologies: Design Methodologies

This chapter reviews the design methodologies required for optical package design for photonic components. Achieving high performance in the module re

Materials Science & Chemical Manufacturing | Dow Inc.

Dow is a materials science company that offers a wide range of products and services, including agricultural films, construction materials, and medical

WORLD WIDE WEB JOURNAL Home

© 2026 EXF OPTICAL NETWORKS - All rights reserved

By clicking download, will open to start the export process. The process may take but once it finishes a file will be downloadable from your browser. You may continue to browse the DL while the export

Progress in Research on Co-Packaged Optics

In the 5G era, the demand for high-bandwidth computing, transmission, and storage has led to the development of optoelectronic interconnect technology. This technology has evolved from

Advanced Optical Integration Processes for

First, we discuss the basic optical connection methods of PIC chips at the optical component level. Next, we introduce photonic chip packaging

Design Guidelines for Photonic Integrated Circuit Packaging

Design Guidelines for Photonic Integrated Circuit Packaging PHIX is a one-stop-shop for the manufacturing of modules powered by photonic integrated circuits (PICs), from design to volume

Related Video Reference

This video was associated with the source search result. Verify technical details against current product documentation and project requirements.

Contact Us

Continue your research online:

Website: https://explosivefunctions.co.za
Technical inquiry: https://explosivefunctions.co.za/contact.html
EU project coordination: Parque das Nações, Lisbon, Portugal

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

© 2026 EXF OPTICAL NETWORKS - All rights reserved