Laser Diode Packaging Method



Overview

To help dissipate the heat, the conventional method of laser diode packaging is to solder laser bar onto a heatsink, which is made of copper due to its high thermal conductivity, namely, faster heat transfer.

Key Takeaways

Laser diode packaging involves specialized methods to ensure optical alignment, thermal management, and hermetic sealing, with common formats including TO-CAN, Butterfly, and Chip-on-Board (COB) packages. Key Packaging Methods1. TO-CAN Packages TO-CAN (Transistor Outline Can) packages are compact metal housings with a sealed glass window that protects the laser while allowing light transmission.

They are widely used in consumer electronics, laser pointers, and short-distance optical communication. Advantages include low cost, compact size, and good hermeticity, but thermal performance is limited compared to larger packages. 2.

Butterfly Packages Butterfly modules are standard for telecom-grade laser diodes. They integrate additional components such as thermoelectric coolers (TEC), thermistors, optical isolators, and fiber coupling. This design allows precise wavelength stability and active temperature control, making them suitable for DWDM systems, coherent optical communication, and high-power industrial lasers.

3.

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Chip-on-

Board (COB) Packaging COB packaging mounts the laser chip directly onto high-performance substrates without traditional package structures. This method improves thermal dissipation and allows for compact, high-power designs.

CO

B is often used in high-power diode lasers (HPDLs) where heat management is critical, as the active medium generates significant energy that must be efficiently conducted away.

Critical Process Steps

Laser diode packaging requires precise control over contamination, void formation, and thermal stress. Typical steps include: Submount or heatsink preparation: Provides mechanical and thermal support for the laser chip. Die attach: Often uses Au80Sn20 eutectic bonding in a vacuum environment to ensure oxide-free, high-precision attachment.

Active optical alignment: Sub-micron alignment is critical to prevent beam misalignment, wavelength drift, or coupling loss. Wire or ribbon bonding: Provides electrical connections while maintaining mechanical stability. Lens or fiber attachment: Ensures efficient light coupling.

Hermetic sealing: Protects the device from environmental contamination and moisture. Burn-in and optical testing: Verifies performance and reliability before deployment. Thermal Management ConsiderationsHigh-power laser diodes generate substantial heat, which must be dissipated to prevent damage.

Copper and silver are commonly used for submounts due to their high thermal conductivity. Heat is conducted from the active medium to the substrate and then spread to the environment via convection or liquid cooling. Thermoelectric coolers in Butterfly packages further stabilize temperature and wavelength.

Specialized Laser Types

Distributed Feedback (DFB) lasers: Use diffraction gratings in the active region for wavelength stabilization. Fiber Bragg Grating (FBG) lasers: Stabilize wavelength using gratings in the fiber rather than the diode itself. Single-mode and multi-mode pump lasers: Feature thermoelectric coolers, thermal sensors, and fiber-coupled outputs for precise control.

Summary

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Laser diode packaging is a highly specialized process that balances optical precision, thermal management, electrical connectivity, and environmental protection. The choice of packaging method—TO-CAN, Butterfly, or COB—depends on application requirements, power levels, and reliability needs. Advanced techniques like vacuum eutectic bonding, active alignment, and hermetic sealing are essential for high-performance and long-lifetime laser devices.

Article Content

Packaging diode laser arrays. Why and how

ionary approach to laser diode packaging. ClampingTM technology relies (mainly) on a superior surface finish of the copper heat sink, and the establishment of direct thermal and electrical contact with the

Understanding of Laser, Laser diodes, Laser diode packaging and its ...

To help dissipate the heat, the conventional method of laser diode packaging is to solder laser bar onto a heatsink, which is made of copper due to its high thermal conductivity, namely, faster heat transfer.

Laser Diode Packaging for Multi-Emitter Module Assembly

The edge-emitting laser diodes are placed on a submount (heatsink), with the light-emitting facet aligned to the edge of the submount with micrometer precision. A

Design and Research of Laminated Packaging Structure for ...

In this study, a heat sink structure in the form of a laminated DC-mount package was created using Solidworks 2018 in accordance with the semiconductor laser C-mount packaging

Hermetic and reliable packaging of single-emitter laser

Laser diodes manufactured at FBH can usually be operated without being sealed under normal room atmosphere. However, for operation in harsh

Single Mode Laser Diode Packaging

Below we shall discuss current alignment options and potential developments, as well as associated materials, package design, and process alternatives. Emphasizing single mode laser diodes we shall

Laser diode modules

This standardised approach results in no development costs, shortened lead times and reliable laser diode modules in industry standard packages. Our flexible business model allows for customisation

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Laser-based packaging

Since they apply energy locally, laser-based packaging processes help progressively increase the integration density of highly sensitive, functional

Recent Issues in Laser Diode Packaging for High Reliability ...

This presentation provides a brief overview of the various types of common laser diode internal packaging and issues observed during precap and construction analysis across various past and

Advances in High-Power Laser Diode Packaging

In a laser diode package, the heat generated in the laser diode is transferred to the ambient environment by attaching a heat sink or heat spreader onto the laser diode. The laser diode must be attached to

Distributed Feedback (DFB) Single-Frequency Lasers,

Thorlabs'' Distributed Feedback (DFB) Lasers are narrow-linewidth, single-frequency laser diodes that use a corrugated waveguide throughout the active region of the

Leirter 808nm 500mW Laser Diode Module TEC Cooled High Power

2. TO-5.6 standard packaging: Adopting the industry standard TO-5.6 shell packaging, the pin definitions are clear (LD positive/PD reverse), making it easy to quickly replace and integrate with the optical

Laser Diode

Most laser diodes actually house two semiconductor devices in a single package — the laser diode itself and a monitor photodiode for feedback control. The common terminal is connected

Factory High Power 500mW 808nm Infrared Laser Diode Module TO

Factory High Power 500mW 808nm Infrared Laser Diode Module TO-56 Package CW Operation Small-Spot Source Laser Diode No reviews yet $1 - 100 Minimum order quantity: 100 pieces

An Introduction to Laser Diodes

An Introduction to Laser Diodes Learn about the laser diode, including package types, applications, drive circuitry, and some laser diode

(PDF) Advances in High Power Laser Diode Packaging

High-power, packaged diode-laser sources continue to evolve through co-engineering of epitaxial design, beam conditioning and thermal management.

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Advances in High-Power Laser Diode Packaging

1. Introduction Rapid evolution of semiconductor laser technology and its declining cost during the last decades have made the adoption of high-power laser diodes more readily affordable. The continuous

Review of Issues and Solutions in High-Power Semiconductor Laser ...

High power semiconductor laser diode (HPLD) has gradually become an essential core component in a wide range of fields, specifically, the modern laser material processing, laser

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