

Article Overview

The optical power of a laser diode increases with drive current above the threshold, and the intensity decreases with distance due to beam divergence and spreading.

Laser Diode Current and Optical Output

A laser diode emits light when a forward current is applied across its p-n junction. Below a certain threshold current, the diode behaves like a standard LED, producing incoherent light. Once the current exceeds the threshold, stimulated emission dominates, and coherent laser light is generated. The optical power output, P_o , increases approximately linearly with current above the threshold, as shown in the I-L (current-light) curve. For example, a diode may require 30 mA to produce 5 mW at 25°C, but higher currents are needed at elevated temperatures due to reduced efficiency. It is important to stay below the maximum rated current to prevent damage from overheating or excessive optical power. Temperature control and proper drive circuitry are critical for stable operation.

Effect of Distance on Laser Intensity

The intensity of a laser beam decreases with distance primarily due to beam divergence. Even highly collimated laser diodes spread slightly over distance, following the inverse-square law for far-field propagation if the beam is approximated as a point source. For a Gaussian beam, the beam radius increases with distance, reducing the power density at the target. The received optical power at a distance d can be estimated as:

$$P(d) = P_o \cdot \frac{A_{\text{receiver}}}{w(d)^2}$$

where $w(d)$ is the beam radius at distance d and A_{receiver} is the area of the detector. Collimating optics can reduce divergence, maintaining higher intensity over longer distances.

Practical Considerations

- o Threshold and slope efficiency: Ensure the current is above threshold but within safe limits to achieve desired output power.
 - o Temperature effects: Higher temperatures require higher currents for the same optical output.
 - o Beam alignment: Small misalignments can significantly reduce received power at long distances.
 - o Safety: Laser diodes can cause eye damage; always follow safety guidelines for the class of laser used.
- In summary, increasing the drive current above threshold increases optical power, while distance reduces intensity due to divergence, and careful design of current, optics, and thermal management is essential for efficient and safe operation.

Laser Diode Current and Distance

Laser diodes are semiconductor lasers with a current-carrying p-n junction as the gain medium. They are

0 current density and the external differential quantum efficiency of the device increase less rapidly with increasing temperatures, i.e.

A Electron Current Diode made from a direct bandgap semiconductor. Note: These devices may not be a simple p-n type diode, but

Optical power-current characteristics of a laser diode obtained for a constant bias voltage of 3.5 V and a 670 nm emission line. For

A laser diode (LD, also injection laser diode or ILD or semiconductor laser or diode laser) is a semiconductor device similar to a light

Pulse laser diodes are LDs that produce high optical output power with short current application time (pulse width). In recent years,

The purpose of this laser diode tutorial is to provide the information necessary to create a long lifetime, stable laser diode system.

The laser diode rate equations can be formulated with more or less complexity to model different aspects of laser diode behavior with

A laser diode is a small semiconductor gadget that produces strong and precise light

Laser diodes are highly susceptible to damage from forward and reverse voltage surges and transients, and they

To assess the quality, performance, and characteristics of laser diodes, manufacturers often perform

Contains specifications of several commercial lasers and allows the user to calculate far field divergence

Laser diodes are enjoying ever greater popularity in sensor engineering and measurement technology thanks to their

An Introduction to Laser Diodes Learn about the laser diode, including package types,

What is a laser diode driver? In the most ideal form, it is a constant current source, linear, noiseless, and accurate, that delivers



Laser Diode Current and Distance

Driving circuit examples of laser diodes May. 21, 2020 Optical module Business Unit Photonics Div. Product Development Dept. 1

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