

# Small spot size of semiconductor laser diode



## Overview

Laser Spot Size | Edmund Optics Determine spot size of our lasers and laser diode modules from user supplied working distances. Calculator provides circular.

## Key Takeaways

Semiconductor laser diodes can achieve extremely small spot sizes, often below 0.1 mm, depending on wavelength, beam quality, and focusing optics.

## Factors Affecting Spot Size

The spot size of a laser diode is primarily determined by the wavelength of the laser, the beam divergence, and the focusing optics used. Shorter wavelengths allow smaller spot sizes because diffraction limits are reduced, enabling higher resolution for applications like optical storage or precision engraving. The beam quality, often described by the  $TEM_{00}$  mode, also affects how tightly the beam can be focused.

Using high-efficiency lenses with short focal lengths further reduces the spot size.

## Practical Examples

Commercial laser diodes can achieve very small spot sizes. For instance, a 405 nm laser diode can produce a spot size as small as 0.075 mm (0.

003 inches), suitable for high-resolution engraving, precision cutting, or selective laser sintering (SLS) printing. This is possible because shorter wavelengths and multi-transverse mode operation allow better focusing compared to longer-wavelength diodes like 445 nm.

## Calculating Spot Size

Spot size can be estimated using beam waist formulas for Gaussian beams. The minimum beam diameter (spot size) occurs at the beam waist, which depends on the beam diameter at the lens, wavelength, and focal length of the lens. After the waist, the beam diverges, and the depth of field around the waist defines the region where the beam remains tightly focused.

Online calculators, such as those provided by Edmund Optics or Gentec-EO, allow users to input these parameters to determine near-field spot size and far-field divergence.

## Applications

Small spot sizes are critical in applications requiring high precision, including:  
 Microfabrication and engraving  
 Optical data storage (CD, DVD, Blu-ray)  
 Medical procedures requiring focused laser energy  
 High-resolution 3D printing and SLS  
 By selecting the appropriate wavelength, diode type, and focusing optics, semiconductor laser diodes can achieve spot sizes suitable for these demanding applications.

## Article Content

Laser Spot Size | Edmund Optics

Determine spot size of our lasers and laser diode modules from user supplied working distances. Calculator provides circular or elliptical spot size approximations based on  $1/e^2$  beam diameter and

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Plays a key role in both laser cost and how fiber dispersion will limit link bit rate. A measure of how good a single mode laser is. The minimum current required to turn on the laser. Low values are key to

Laser Diode Calculator

The resulting ruggedness and small size allow laser diodes to be used in environments and spaces in which other types of lasers cannot operate.

Semiconductor Laser

The main difference between diode lasers and most of the other bulk solid-state lasers is the small size of the active region in the semiconductor structure, which is close to a p-n junction between the n

Inside the Diode Laser: How Wavelength, Spot Size, and Pulse Width ...

Optimizing diode laser parameters means understanding how wavelength, spot size, and pulse width work together. We look at examples and discuss common issues to ensure the best results.

How small can you make a diode laser spot?

They aren't wrong - high power diodes use a linear array of emitters, so they do produce a rectangular output though the highest power density is usually a small spot in the middle. It's

Semiconductor Laser Diodes

It can be seen that the S.L.D. consists of a laser diode, a photo diode, and connecting leads and pins. All of this is housed in a protective metal casing. A clear screen allows the beam to be emitted. This

Study on laser spot size measurement by scanning-slit method based

It is generated by the laser cutting machine with a spot size of 0.1 mm which is smaller than the spot size of the laser diode module. The slit is oriented perpendicular to the direction of the

Global Laser Printer Market Size, Opportunity Analysis and Forecast ...

Semiconductor lasers were the most used laser technology during 2024 and 2025, dominating commercial laser printer production platforms globally. In October 2025, Brother International

Laser Engraving Machines Market Trends & Forecast, 2026-2033

Global Laser Engraving Machines Market Insights, By Laser Type – Superior Precision and Efficiency are Driving Fiber Laser Engraving Machines Segment Fiber laser engraving machines

How do lasers work? | Who invented the laser?

The small circle on the bottom right is a semiconductor laser diode, while the larger blue circle is the lens that reads the light from the laser after it's bounced off the shiny surface of the disc.

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Laser Rate Equations Define the laser output power  $P(t)$ , the current  $I(t)$ , the active gain volume  $V$ , and the carrier and photon densities  $N(t)$  and  $S(t)$  respectively. The dynamics of carrier and photon

## Modeling of Thermal Phenomena in a High Power Diode Laser Package

Thermal behaviors of, and thermal stresses in, solder interfaces are the major factors affecting the functional and structural performance of high power diode laser packages.

### A 350-nm-band GaN/AlGaIn multiple-quantum-well vertical cavity

As one typical type of semiconductor lasers, vertical cavity surface emitting lasers (VCSELs) are featured with low threshold operation, circular and low-divergence output beam, and

### Study on laser spot size measurement by scanning-slit method based

In this study, a new spot size measurement device based on laser back-injection interferometry was presented. The photodiode integrated with the laser diode was used to collect the

## Lecture 20

Lecture 20 - Laser Diodes 1 - Outline Stimulated emission and optical gain  
Absorption, spontaneous emission, stimulated emission Threshold for optical gain  
Laser diode basics Lasing and conditions at

### Low-coherence semiconductor light sources: devices and ...

Here, we review the development of low-coherence semiconductor light sources, including superluminescent diodes, highly multimode lasers, and random lasers, and the wide range of

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