INTRODUCTORY INFORMATION

LASER DIODE PRINCIPLES & DIODE CONFIGURATIONS

Basic Diode Principles

- Diode specifications typically change from one diode manufacturing lot to another
- Changes in temperature translate into changes in wavelength & optical power
- Diodes become more single-mode as you approach their rated power
- Raw diode power is always greater than the output power of a laser module

A number of questions and misconceptions surround the laser diode. Are all laser diode specifications identical? Do single-mode diodes always operate as single-mode? What effect does temperature change have on wavelength and optical power? The following paragraphs explore these and other common diode questions and principles.

Are all laser diodes with the same model number identical?

Individual diode specifications generally vary from one diode manufacturing lot to another. These variances, typically minor and insignificant, may appear as changes in wavelength or in divergence angles or ratios. During diode manufacturing, variations in materials and layer thickness often account for differences in center wavelength and operating current. To denote potential changes from one diode to another, laser diode manufacturers—like most other manufacturers—allow for tolerances in their specifications. For example, diode manufacturers typically report most visible diode specifications at a center wavelength ±10nm. If a specific wavelength is required, we at Power Technology, Inc. offer wavelength selection at a minimal cost.

What effect does temperature change have on wavelength & optical power?

Maintaining an optimum operating temperature for a laser diode can be extremely important. Changes in temperature translate into changes in wavelength and optical power. Unlike gas laser wavelengths—which are determined by atomic transitions—laser diode wavelengths are inherently unstable. The wavelength of a typical Fabry-Perot laser diode typically changes 0.3nm per degree Centigrade. Therefore, for every 3 degrees' change, the wavelength of the laser diode can change nearly 1nm. If operated in constant current mode, diode output power tends to decrease as temperature increases, and diode power can exceed its maximum rating with a decrease in temperature. For this reason, we recommend choosing the automatic power control mode of operation, or using a laser module with active temperature control for constant current mode of operation.

What spectral changes can occur from diode to diode?

One misconception about single-mode diodes is that they are always single-mode. Most single-mode laser diodes operate as such only when driven at or near their recommended operating current. When operated at a lower-than-recommended operating power, a single-mode laser diode can function as if it were multi-mode. For this reason, if single mode output is desired, users should employ a neutral density filter to decrease the intensity of the beam without changing the spectral distribution of the energy.

Does raw diode power equal module output power?

When purchasing a laser diode module, keep in mind that the output power of the module will be less than the maximum rated power of the laser diode. This result can be attributed to several factors: optical loss, CDRH safety margins, and general derating of laser modules due to PTI's knowledge and experience regarding certain diodes. Always ask your sales engineer what output power your laser module will have with a particular laser diode installed.

Diode configurations—

The following are the common diode configurations that may be driven in automatic power control mode.

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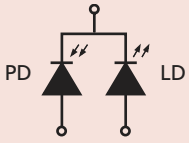

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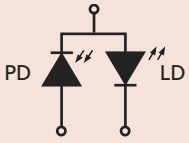

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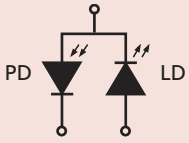

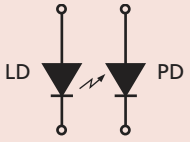

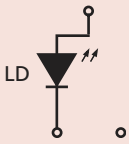

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