LDX Optronics Inc.

Specializing in quality high-power diode lasers

Precautions and Tech Notes

General Precautions

1. Special wavelength diodes (especially red diodes) are much, much more susceptible to damage than standard infrared diodes.
2. Think about how you are employing the diodes to make sure you are doing everything possible to get a long lifetime. We want you to be successful using these products.
3. Keep the diodes *clean*. They should not be operated in an environment where dust particles in the air can reach the active region (output facet) of the diode.
4. Keep the output facet (which emits light) *dry*. If you store the unit in a high humidity, the optical coatings can be damaged and render the diode useless.
5. Operating the laser diode at a *temperature lower* than recommended will usually slightly increase the output power (higher efficiency) and improve lifetime.
6. Operating the laser diode at a *temperature higher* than recommended will increase the threshold current and decrease the slope efficiency.
7. Laser diodes need to be operated with an *approved power supply/driver* or they may be damaged and/or destroyed quickly. Off-the-shelf drivers can deliver a high spike of current at turn-on, and they can deliver a very short duration reverse biasing when the unit is turned off. Either of these will damage and/or destroy the diode laser.
8. The power supply/driver should be current-regulated and specifically designed for laser diodes. The power supply should create no surges or spikes, no reverse voltages and should not have any ringing. Many poorly designed power supplies have voltage transients during turn-on, turn-off, or in the case of power failure.
9. Never make the connection to the laser diode with the power supply voltage on. Most laser diode power supplies have provision to disable the supply and short the output to allow for connection of the diode.
10. Laser diodes are very sensitive to damage by electrostatic discharge (ESD), or other voltage transients. The laser should be handled using static-safe procedures when it is taken out of its static-protective shipping container. When the laser is not connected to a power supply, the user should short the anode and cathode together to prevent static damage.
11. Some laser diodes are susceptible to damage from *back reflections* into the device. This is more the case with shorter wavelength material than with longer wavelengths. Thus, if attempting to collimate the output, care must be taken to avoid back reflections.
12. The emission wavelength changes with temperature: the wavelength changes about +1 nm for every 6° C increase in temperature. This value varies by wavelength.

Thermal Management

1. *Heat*: This is the biggest cause of field failures.
2. Some laser diodes are more sensitive than others to the operating temperature. Red laser diodes tend to be more temperature sensitive than the infrared laser diodes.
3. Many customers do not appreciate the importance and/or the complexity of removing waste heat.
4. Because operating temperature has a strong influence on laser lifetime, the heatsinking of the laser package is of tremendous importance and doing it well is not as simple as many assume it is.
5. Waste heat must be removed efficiently and instantaneously, or the laser will heat up and burn out, or, at a minimum, experience an abbreviated lifetime.
6. The laser can be operated at higher temperatures than recommended, but the lifetime of the laser is reduced exponentially as the operating temperature is increased.
7. The diode package should be attached to a heatsink plate at least several millimeters thick.
8. The heatsink must be capable of dissipating the waste heat generated by the laser diode. High power laser diodes are typically 10 – 50% efficient at converting electricity into light. The remainder of the electrical input power is dissipated as heat. Therefore, there may be several watts of waste heat generated by the laser. Because so much heat is generated within the small area, it is critical that the laser is securely connected to an adequate heatsink
9. The best heatsink material is copper, but aluminum is also a fair heat conductor. If aluminum is used, the surface should not be anodized in the region where the laser package makes contact with the heatsink. The aluminum oxide anodized coating makes an effective thermal insulator.
10. The surface of the heatsink should be machined flat and smooth where it will contact the back of the laser package to allow for efficient heat transfer.
11. Thermal compound, or an indium foil washer can be used to reduce the thermal impedance of this interface. Our experience is that indium foil offers negligible improvement over a good copper-to-copper interface. In permanent installations, some improvement of the heatsinking can be achieved using a silver-filled epoxy at this interface. If silver-filled epoxy is used, it should be a “space qualified” low outgassing formulation to avoid contamination of the laser facets (Epoxy Technology H21D, for example)
12. The heatsink may be cooled by air, water, or thermoelectric coolers. Depending on the type of laser, an air-cooled heatsink may provide sufficient cooling, as long as the application does not require stability of the laser wavelength and output power. Most often, active cooling of the heatsink must be used. Active cooling usually is either water-cooling, or thermoelectric coolers (TEC’s).
13. Finally, when testing out a heatsink configuration, it is wise to test the temperature drop between the laser package and the heatsink using a very small thermocouple touched against the base of the package. The temperature drop during laser operation should be only 1-2 ° C.

Free Space Packages

Free space packages can be either a simple open heatsink with an exposed laser chip or a sealed TO-can type package. With open heatsinks, there is no protection for the delicate laser chip. The laser chip is very fragile and must be protected from any mechanical contact. The exposed laser facets (mirror coatings) must not be contaminated with any foreign material. Facet contamination can cause immediate and permanent damage to the laser. You should not blow on the laser, or expose the laser to smoke, dust, oils, or adhesive fumes.

The laser facets are sensitive to accumulation of dust. When the laser is operating, dust particles tend to be attracted to the laser facet. As the dust particles enter the intense optical field at the laser facet, they burn, and the residues accumulate in the laser facet. Unless the laser is operated in a true “class 100” clean-room environment, this dust accumulation will occur, even in a seemingly clean “lab environment. This kind of contamination does not occur very rapidly, but over several hundred hours of operation in a normal room environment, an open heatsink laser will show tiny “specks” on the lasers facet under microscopic examination. These will gradually degrade the laser prematurely. If an open heatsink laser is to be operated outside of a clean-room for more than short periods, it should be packaged within a sealed container to prevent this dust accumulation. This does not require a true hermetic sealing of the laser. An epoxy seal or O-ring seal around the laser assembly is perfectly sufficient.

Tech Notes:

AN-01 C-mount Handling

AN-18 B-mount Handling

AN-19 COS Handling

AN-02 Laser Chip Information

AN-03 Laser Emission and Focusing

AN-04 HHL Package Handling

AN-06 HHL Package Connectors

AN-07 9mm Package Handling

AN-09 TO-3 Package Handling

AN-10 TO-3 Package Connectors

AN-12 Monitor Photodiodes

AN-13 Reverse Protection Diode

AN-14 Laser Damage From Loose Cabling

AN-15 Laser Damage From Optical Feedback

AN-16 Laser Overshoot and Soft Start

Fiber Coupled Packages

Fiber coupled laser diode packages integrate the laser chip with an optical fiber to efficiently deliver the laser output to a specific location or system. These packages typically consist of a laser diode mounted on a heatsink or within a sealed housing, with the emitted light coupled into an optical fiber using precise alignment techniques. The fiber coupling protects the laser facets from direct exposure to environmental contaminants such as dust, smoke, oils, or adhesive fumes, which could otherwise damage the delicate mirror coatings.

The output end of the optical fiber in these packages is sensitive to environmental factors. During operation, dust or particles near the fiber output can scatter the emitted light, reduce beam quality or cause localized heating that may damage the fiber tip. For long-term reliability, the fiber output should be protected with a clean cap or cover when not in use.

Tech Notes:

AN-05 HHL (Fiber) Package Handling

AN-08 9mm SMA Package Guidelines

AN-11 BFC,FCP Fiber Package Connectors

AN-12 Monitor Photodiodes

AN-13 Reverse Protection Diode

AN-14 Laser Damage From Loose Cabling

AN-15 Laser Damage From Optical Feedback

AN-16 Laser Overshoot and Soft Start

Why LDX Optronics?

LDX Optronics Inc.

Your Preferred Source for High-Performance Multimode Laser Diode Products

LDX Optronics is our top choice for high-performance multimode laser diode products. With a wide range of wavelengths and standard packages, along with expertise in packaging and a willingness to customize, they provide optimal solutions for most applications.

More Than 30 Years of Made in the USA Excellence

- All products are proudly manufactured in the USA and shipped from Tennessee, eliminating concerns related to tariffs, international shipping issues, and potential disruptions in supply chains due to global political tensions or trade restrictions.
- Established in 1990, LDX Optronics focuses on high-power multimode laser diodes

Superior Packaging results in Superior Performance

- All products utilize an advanced flux-free & void-free soldering process.
- Customers can choose between hard (AuSn) or soft (In) solder for their products.
- Robust and reliable products that are inherently resistant to shock and vibration.

Proven Quality Process with Unmatched Reliability

- Each wafer design receives extensive qualification and life testing.
- Every device undergoes a thorough burn-in before shipment.
- Each device is individually characterized electrically and optically, with full data supplied with each device.

Customized Laser Diodes for Better Products

- Custom options are available for wavelength, emitter size, and output power. A variety of industry standard laser packages are available, as well as custom package options.
- Additional package options include temperature control (TEC), photodiode, fast axis lensing, or fiber coupling.
- Customers can choose electrically isolated or hermetically sealed options.

Your laser diode partner for your manufacturing business

- Guaranteed supply for the life of your program.
- Extensive selection of wavelengths and package options available from stock, but also open to designing a custom solution for your needs.
- Just-in-time deliveries with buffer stock.

LDX Optronics' management team emphasizes quality and consistency in the semiconductor laser manufacturing processes, with each wafer receiving extensive qualification and life testing, and each device undergoing a thorough burn-in before shipment. Whether you need a custom wafer design or a drop-in replacement that can be integrated into your existing system, LDX Optronics can provide you with a reliable, high-quality product.