



AN-18 LASER DIODES IN THE B-MOUNT PACKAGE

The B-mount package laser uses a simple open heatsink, with no protection for the delicate laser chip. The semiconductor crystal and the wire bonds are very fragile, and the chip 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 dust accumulation. When the laser is operating, dust particles tend to be attracted to the laser facet. As dust particles enter the intense optical field at the laser facet, they burn, leaving residues that accumulate there. Unless the laser is operated in a true “class 100” clean room environment, dust accumulation will occur, even in a seemingly clean “lab” environment. This kind of contamination does not occur rapidly, but over several hundred hours of operation in a normal room environment, an open-heatsink laser will show tiny “specks” on the laser facet under microscopic examination. These will gradually degrade the laser prematurely. If the B-mount laser is to be operated outside a clean room for extended periods, it should be packaged in a sealed container to prevent dust accumulation. This does not require true hermetic sealing of the laser. An epoxy seal or O-ring seal around the laser assembly is perfectly sufficient. The laser could also be operated inside a chamber purged with a low flow of clean, dry air.

As with all laser diodes, B-mount lasers are very sensitive to damage from static electric charges. Laser diodes should always be handled using standard static-avoidance practices. When possible, the laser diode anode and cathode leads can be shorted together for protection when the laser is not connected to a driver. The laser should be operated with a high-quality constant-current driver designed for laser diodes. Such drivers include protection circuitry to prevent damaging spikes, turn-on and turn-off transients, over-limit currents, reverse biases, etc.

To operate properly, the B-mount must be attached securely to a heatsink. The heatsink must be capable of dissipating the waste heat generated by the laser diode. High-power laser diodes are typically only 10-50% efficient at converting electrical energy into light. The remaining electrical input power is dissipated as heat. Thus, there may be several watts of waste heat generated by the laser. Because so much heat is generated within the small space of the B-mount package, it is critical that the laser is securely connected to an adequate heatsink.

Some laser diodes are more sensitive to operating temperature than others. Red laser diodes tend to be more temperature sensitive than infrared laser diodes. 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, the stability of the laser wavelength and output power are important, and active heatsink cooling must be used. Active cooling is usually either water cooling or thermoelectric coolers (TECs).

If the laser is operated below room temperature, moisture can condense onto the bare laser, causing problems. Condensed moisture on the laser facets can lead to permanent damage. If the B-mount must be operated at temperatures below the dew point of its environment, it should be housed in a protective enclosure purged with dry gas (air or nitrogen), or in a sealed enclosure filled with dry gas. Solid desiccant materials can be used to dry the air in a sealed enclosure.

For the most efficient heat transfer, the heatsink should be made from Copper or Aluminum. The Aluminum should not be anodized in the mounting area (an anodized layer is a good thermal insulator). The heatsink surface where it contacts the laser package should be machined flat and smooth to enable efficient heat transfer. **Thermal grease should not be used with a B-mount laser.** Most thermal greases tend to “creep,” and the material will eventually contaminate the laser facets.

Unlike the C-mount, the B-mount has no mounting hole for screw attachment to the heatsink, making proper mounting tricky. Mechanical clamping can be used to press the mount against the heatsink. Attachment to a heatsink can also be achieved using a good thermally-conductive, Silver-filled epoxy between the B-mount and the heatsink. If Silver-filled epoxy is used, it should be a “space-qualified” low-outgassing epoxy, to avoid contamination of the laser facets (Epoxy Technology H20E, for example). Soldering the B-mount to a heatsink is usually impractical. Given the temperature restrictions imposed by the Indium solder chip attachment, solder options are limited and would typically require flux. Flux residues could contaminate the laser facets.

The Copper B-mount is the laser diode anode (+) terminal, so the power supply anode connection is best made to the heatsink. Do not attempt to solder directly to the Copper B-mount. The laser diode cathode (-) terminal is the fly-lead attached to the B-mount. Connection to this lead can be made either by soldering or with a small, high-quality spring contact socket. The best sockets of this type have four contact fingers, and the fingers are Gold-plated (see, for example, parts made by Mill-Max). **Great care must be used when soldering to the cathode wire lead.** The soldering is best done with the B-mount already attached to its heatsink. This will prevent the laser body from overheating. The laser chip is attached to the heatsink with Indium solder, which melts at 157 °C. The cathode fly-lead can withstand high temperatures, but the Copper body of the B-mount should remain below ~120 °C.

During soldering, the laser can also be damaged by contamination of the laser facets with solder flux or flux fumes. Typical rosin-core electronic solder generates a cloud of smoke when it is melted. This smoke will coat the laser facets, and if the laser is then operated, permanent facet damage can occur. If it is necessary to solder near the laser diode, the diode should be covered to prevent this contamination. One method is to use a piece of Aluminum foil to loosely cover or block off the area around the laser chip. The chip and the wire bonds are very fragile, so the foil must be applied carefully, without actually contacting the laser chip.