LASER DIODES IN THE C-MOUNT PACKAGE

• The C-mount package laser is a simple open heatsink, and there is no protection for the delicate laser chip. The Gallium Arsenide laser material is very fragile, and 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 accumulation of dust. When the laser is operating, dust particles tend to be attracted the laser facet. As the dust particles enter the intense optical field at the laser facet, they burn, and the residues accumulate on 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 laser facet under microscopic examination. These will gradually degrade the laser prematurely. If the C-mount 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 true hermetic sealing of the laser. An epoxy seal or O-ring seal around the laser assembly is perfectly sufficient.

• As with all laser diodes, C-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 from a high-quality constant-current driver which is designed for use with 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, the C-mount must be screwed down 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 10 to 50% efficient at converting electricity into light. The remainder of the 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 C-mount package, it is critical that the laser is securely connected to an adequate heatsink.

• Some laser diodes are more sensitive than others to the operating temperature. 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 cooling of the heatsink must be used. Active cooling usually is either water-cooling, or thermoelectric coolers (TEC’s).

• For most efficient heat transfer, the heatsink should be made from copper. For some lower power laser diodes, an aluminum heatsink can be used, as long as the aluminum is not anodized in the mounting area (an anodized layer is a good thermal insulator).

• The C-mount should be attached to the heatsink using a small screw with a #2–56 (english) or M-2 (metric) thread. The C-mount has a shallow counterbore around the mounting hole, for applications which require close mounting of a component in front of the laser. A shallow binding-head screw, or a button-head cap screw can be used in this situation.

• 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**. Thermal grease should not be used with a C-mount laser**. Most thermal greases tend to "creep" and the material will eventually contaminate the laser facets. Some people favor using a piece of thin (.001") Indium foil between the laser and the heatsink, but it is our experience that this offers negligible improvement over a good copper-to-copper interface. The use of thick indium foil (>.001") can do more harm than good. In permanent installations, some improvement of heatsinking can be achieved using a silver-filled epoxy between the C-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 H21D, for example).

• The copper C-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 C-mount. The laser diode cathode (-) terminal is the wire lead attached to the C-block. Connection to this lead can be made either by soldering, or by using 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 if soldering to the cathode wire lead**. The soldering is best done with the C-mount already attached to its heatsink. This will prevent the body of the laser from heating up excessively. The cathode lead itself can withstand high temperatures, but the main part of the laser block must remain at <120 °C. During soldering, the laser can also be damaged by contamination of the laser facets with solder 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 laser chip. The chip and the wire bonds are very fragile, so the foil must be applied carefully, without actually contacting the laser chip.