

Using OSRAM OS High Power Laser Diodes in TO 220 Package (SPL 2FXX, SPL 2YXX)

Application Note

Introduction

OSRAM Opto Semiconductors high power laser diodes in TO220 package are efficient radiation source for cw and pulsed operation.

Through the new optimized strained quantum-well structure reliability has been improved, low threshold current and higher efficiency has been reached.

Small TO-220 package provides efficient thermal coupling. Included thermistor allows wavelength control by temperature.

This article gives some proposals for using OSRAM high power laser diodes in metal package.

Safety Instructions

Products incorporating these laser diodes will normally be classified as **class 4 laser products** according to IEC 60825-1 in a normal operation mode. Direct exposure of the human eye with laser radiation is therefore hazardous and must be strictly avoided.

Testing and maintenance of these products shall be performed only by personnel who are trained in laser safety. For details please refer to relevant local safety regulations and to the manufacturers requirements according to IEC 60825-1.

Persons working with high power diode lasers must wear suitable laser protection glasses.

Storage and Shipping

Storage and shipping of diode lasers must be done in a clean and dry atmosphere in a temperature range of 0°C up to 60°C.

Unpacking and Handling

The high power diode lasers are shipped in a conductive plastic shipping container, that is packed in dry nitrogen filled sealed plastic bag.

Before opening the plastic bag, diode lasers should be kept at least 4 hours in the rooms where the bag will be opened to achieve thermal equilibrium. The protective bag may be opened only in a clean environment and non-humid atmosphere.

Diode lasers are electrostatic sensitive devices. Thus, their handling requires strict precautions against electrostatic charges. Every person and each tool that might get into contact with the diode laser must be continuously ESD protected. Therefore the devices should only be handled in ESD protected areas (EN 100 015 former CECC 000 15).

Solvents, plastics, glues and heat conductive paste are not allowed near the diode lasers, because solvents could emerge and deposit on the facets. The semiconductor crystal and its coatings are very sensitive to any kind of solvents and liquids. There is no way to clean the front facets neither by solvents nor by mechanical tools. Especially, the diode laser front facet is extremely sensitive and must be kept free of dust, water and any other kind of contamination. Any contact to the laser front facet will lead to irreversible damage and

failure of the diode laser, even if there is no sudden failure.

Pay special attention not to scratch the bottom surface of diode lasers. Scratches will increase the thermal resistance of the mounted device and reduces the heat dissipating capacity, which might result in reduced efficiency and thermal overload of the diode laser.

Mounting

In general, appropriate cooling of the diode lasers is necessary. To achieve appropriate cooling the laser device can either be screwed or clamped onto a flat submount surface. The submount must be kept at constant temperature (typically 25°C) even under thermal load.

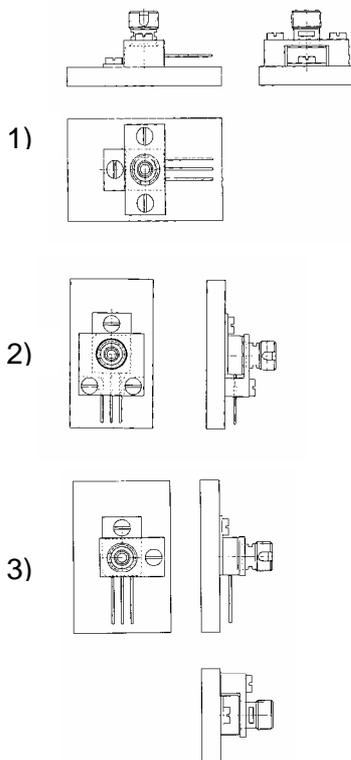


Figure 1 shows three possible mounting configurations of the TO220 package

Screwing: The diode laser must be tightly screwed to the submount surface through the center mounting hole with an appropriate

screw. The submount surface should be finely milled or lapped (flatness: 0.5 µm, roughness: 0.5 µm), clean and free of scratches to guarantee good thermal contact.

Clamping: Any deformation of the heat sink by clamping must be avoided. A thin metal foil (e.g. Indium) can reduce the thermal resistance, but may even contaminate the surfaces and prevent a further use.

Diode laser degradation accelerates with increased temperature. Therefore, housing or heatsink temperature should be minimized where possible. Lowering the diode laser temperature below 15°C is only suitable in a closed housing with dry inert atmosphere (e.g. nitrogen). Condensation of water or other liquids irreversibly damages the diode lasers.

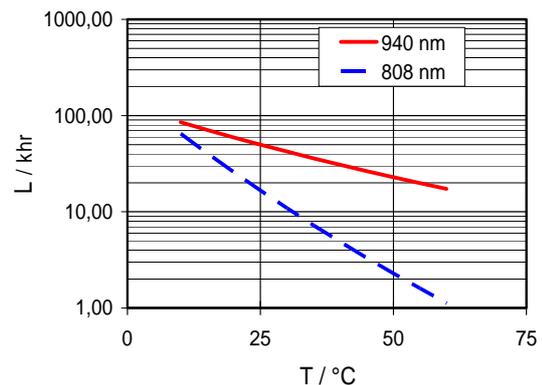


Figure 2 shows the typical dependence of median lifetime L (end of life criteria -20% P_{op}) on the ambient temperature T at nominal output power P_{op} for 808nm and 940 nm.

Check the emission wavelength at the specified current. A much longer wavelength than specified indicates bad thermal contact and thermal overload of the diode laser. Then the thermal contact has to be improved before continuing laser operation. (The emission wavelength shifts with 0.3 nm/K.)

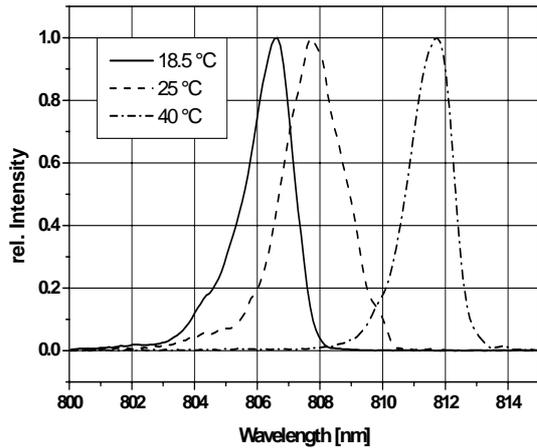


Figure 3 shows the temperature dependence of the emission spectrum

The heat sink temperature and therefore the emission wavelength can be controlled by using the integrated thermistor.

$$R_T = f(T_A)$$

$$R_T = R_0 \cdot \exp(B \cdot (1/T - 1/T_0))$$

$$R_0 = 10 \text{ k} \quad 3 \%, \quad T_0 = 25 \text{ }^\circ\text{C} = 298 \text{ K},$$

$$B = 3730 \text{ K}$$

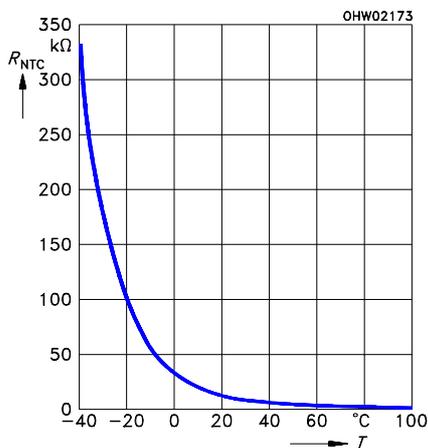


Figure 4 shows the resistance of the integrated thermistors vs. heat sink temperature

If the diode laser has to be electrically insulated from the mounting surface, insulation may only be achieved by a thin flat

ceramic plate of high thermal conductivity. Plastic insulation foil (e.g. Kapton) will effect laser lifetime because of an increased thermal resistance and possible solvent emerging that might damage the semiconductor crystal.

Diode lasers should be operated only in dust free environment. High electrical fields near the active region attract dust particles, which cause irreversible damage of the facets during operation.

Operating Conditions

Diode lasers should be operated only in dust free environment. High electrical fields near the active region attract dust particles, which cause irreversible damage of the facets during operation.

Diode lasers must be operated with a suitable power supply (0 – 3 A, n x 2.5 V with n = number of diode lasers connected in series) in regulated current mode only, as even very short current or voltage spikes may destroy them.

Precautions against spiking during switching on or off the power supply must be assured.

Correct polarity of the power supply must be assured, because even small reverse voltages can cause irreversible damage of the diode laser.

Assure that all connectors in the electrical circuit guarantee a good contact. Electrical cables should be arranged in a low-inductance constellation to avoid any tendency towards current oscillations.

Before switching on the power supply assure that the current preset is set to zero. Then, switch on the power supply and increase the current slowly.

Do not exceed the maximum operating current according to the supplied data sheet.

<i>Series / type</i>	<i>Performance</i>	<i>Manufacturer</i>
LDC 3565	< 6 A, 5 V	ILX Lightwave
06 DLD 205	< 3 A, 5 V	Melles Griot
500, 5000	< 6 A, 5 V	Newport
LDC 300	< 10 A, 5 V	Profile

Table 1 lists a selection of conventional laser diode drivers for the laboratory use

Using the laser in quasi continuous wave (qcw) mode, the max. peak power is increased and depends on pulse width and duty cycle. The following de-rating diagrams describe the correlation.

High frequency modulation of SPL 2Y94 has been tested up to 700 Mhz without reaching the cut-off frequency.

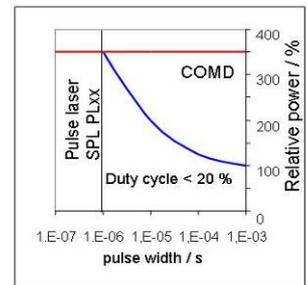
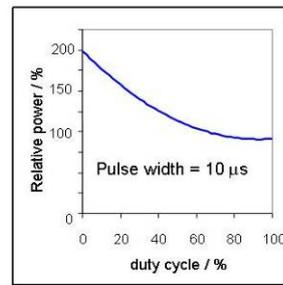


Figure 4 shows the maximum optical peak power in quasi continuous wave mode vs. duty cycle at a pulse width of 10 μs and vs. pulse width at a duty cycle of 20 %. 100 % relative power refer to the operating power P_{op} specified in the data sheet

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About Osram Opto Semiconductors

Osram Opto Semiconductors GmbH, Regensburg, is a wholly owned subsidiary of Osram GmbH, one of the world's three largest lamp manufacturers, and offers its customers a range of solutions based on semiconductor technology for lighting, sensor and visualisation applications. The company operates facilities in Regensburg (Germany), San José (USA) and Penang (Malaysia). Further information is available at www.osram-os.com.

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