

# Measurement of the thermal resistance of VCSEL devices

*Thursday 23 September 2010 16:00 (2 hours)*

Future high energy physics experiments will operate at energies much higher than the present ones. To read out even the innermost detectors electronics and optical components must be developed to survive the harsh conditions during the lifetime of the experiments. It has been found that for VCSEL the irradiation hardness is connected to the temperature behavior of the device and that an increase of temperature above a certain value causes a loss of light power. A test stand to qualify the effect of heat in the device and the adoption of the heat sink has been realized. Measurements to show the effect of heat and measure the thermal resistance of laser devices are presented.

## Summary

The junction temperature inside a VCSEL is a crucial factor to determine the light output of a VCSEL. Since a direct measurement is not possible one needs to adopt a measurement to qualify the capability of heat transfer from the VCSEL to the cooling. This can be quantified in a parameter, the thermal resistance.

The thermal resistance of a VCSEL device is a measure for the heat coupling and the capability of the cooling. To measure this parameter a test stand containing a temperature control and a system to operate the laser has been developed.

Measured is the wavelength spectrum depending on the temperature inside the VCSEL controlled through either the environmental temperature or the driving current of the device.

The spectrum of the VCSEL shifts with temperature. Therefore the change in wavelength of a given peak can be connected to the change in temperature or power. Using the same change in wavelength the ratio between power change and temperature change can be derived, which forms the thermal resistance.

By optimizing the thermal resistance of the package, the heat introduced by irradiation can be reduced. This in turn enables the laser to withstand higher irradiation damage and still provide light output.

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**Session Classification:** POSTERS Session

**Track Classification:** Optoelectronics and Links