Test procedure for Princeton Optronics High Power VCSEL array

1. Scope of the document

The purpose of this document is to establish the guidelines for safe and correct measurements of Optical Power and Wall Plug efficiency of High Power VCSEL arrays developed at Princeton Optronics. This document describes the test setup, equipment requirements, main steps of test procedure, and handling precautions. Following the given procedure will avoid unwanted device stressing or damaging during the testing and handling.

2. General overview

The DUT is the 5mm x 5mm VCSEL array chip soldered on a 8mm x 12mm CVD diamond heat spreader mounted on a copper micro-channel cooler. For the electrical connection the device has two copper strip connectors and for the water line connection it has two copper tubes, as indicated in Figure 1.
The device is electro-static sensitive and requires ESD precautions during handling and testing.
The top surface of the device is the output surface of the laser array. In order to avoid dust contamination and unwanted surface contacts that could cause damaging, the device should be extracted from container and exposed to the air just for the period of testing.
To reduce possible dust contamination and for safety reason during testing, the device should be mounted in a vertical configuration, as illustrated in Figure 2 (the normal to the chip surface should be horizontal).
To remove unwanted contaminations from the chip surface only very weak airflow can be used. Using different solvents and swabbing can damage the device.
When the device is not in use, the terminals should be connected together (shorted) to avoid ESD-induced damage.

3. Equipment

The following is a list of equipment needed for testing:

- Constant current source ("CCS"; with upper current limit set at 130A) designed for laser diode operation
- Optical Power Meter, detector (Silicon or Germanium based preferred) and Optical Integrating Sphere (with >200W power limit), or high-power thermopile detector (with >200W power limit). Note that the integrating sphere or thermopile detector may also require water-cooling via a separate chiller (refer to manufacturer's operating procedure for the particular integrating sphere or thermopile detector used).
- Multi-meter or Voltmeter.
- Water chiller & filter.

4. Main Steps

4.1. Assembling and mounting

Connect DUT to chiller. Set chiller temperature to 21 deg C (or other desired testing temperature in the range 10-35 deg C). Start chiller. Make sure that the coolant is flowing properly, without excessive air bubbles. Also check that there are no leaks.

4.2. Electrical connection

Make sure that the terminals of the device are not connected together. Bolt on the negative output of the CCS to the "LDK" connector and the positive output of the CCS to the "LDA" connector of the device. Make sure the device is not reversed biased.

4.3. Turn ON device.

Before turning on the CCS make sure that micro-cooler works properly, and that no water leakage is observed.
Set output of CCS to 0A.
Turn output of CCS ON.
Set 10mA current and check the voltage reading to make sure the DUT is not shorted or open circuit.

4.4. Current adjustment

To avoid device damaging and for better performance all current changing should be made slowly and continuously, without current hopping.
Caution: When you reduce current avoid device cooling below the room temperature. It can initiate water condensation and short the device.

4.5. Optical Power measurements

The dimensions of the light-emitting surface are limited by 5mm x 5mm square chip. The far-field laser beam divergence is expected to be in the 20 to 30 degree range (full 1/e^2 width). The integrating sphere should have a >25mm input port and be placed no further than 10mm from DUT (also, please refer to the manufacturer's operating procedure). If using a thermopile detector, please refer to manufacturer's operating procedure.

4.6. Turning the device "OFF"

Slowly reduce the current to 0A (following precautions described in 4.4.)
Turn output of CCS "OFF"
Disconnect device from CCS
Short the device's electrical connectors.

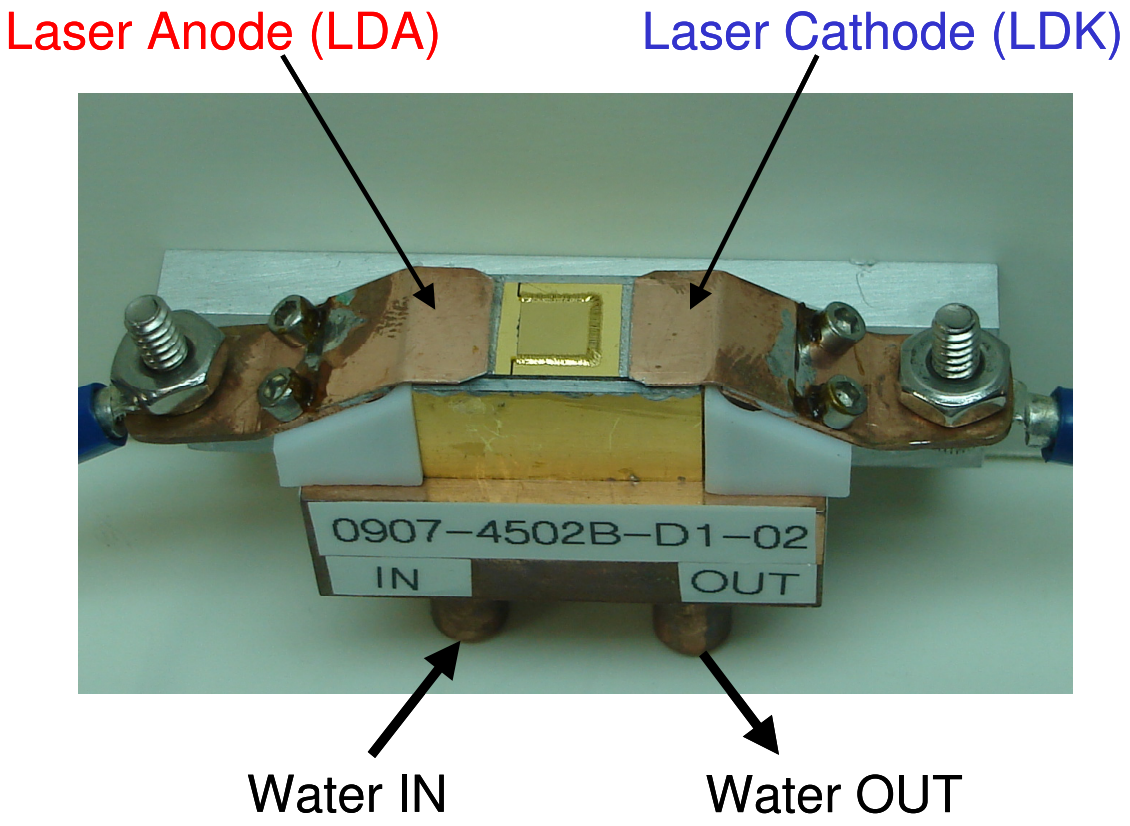

Figure 1 Picture of a high-power VCSEL array mounted on a micro-channel cooler. The polarity and water flow direction are indicated.

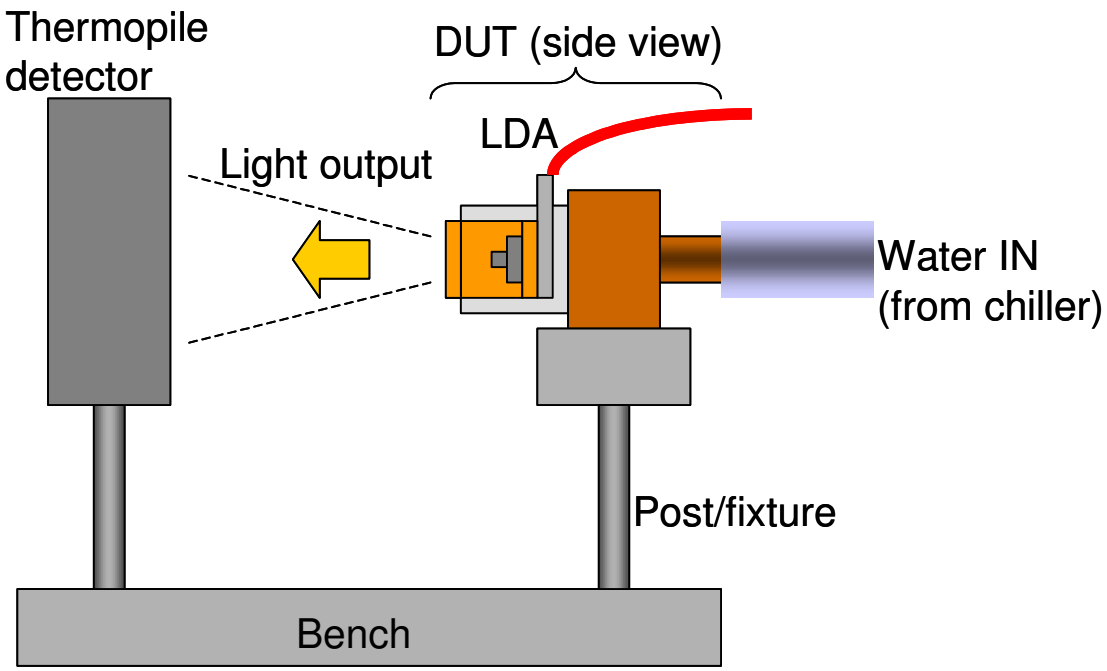

Figure 2 Schematic of suggested test set-up for high-power VCSEL array.