

PURPOSE

The LDM-4872 Quantum Cascade Laser Mount is designed to meet the unique requirements of quantum cascade lasers, including stable, low temperature operation and vacuum or nitrogen environments. The specified temperature control range of the LDM-4872 is -30°C to 30°C with 10°C circulating water and a 10W heat load. Actual control range will vary with device load and water temperature. This technical note describes temperature control range and stability of the LDM-4872.

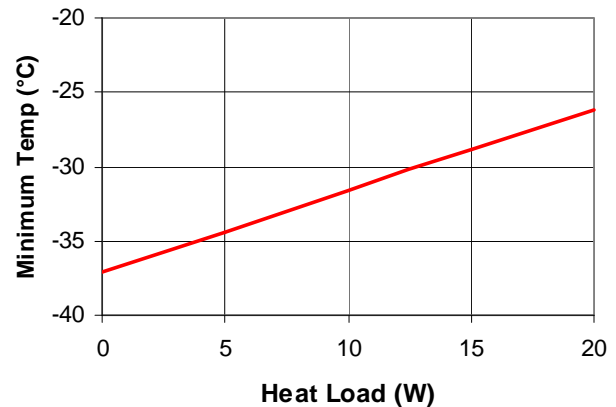
MEASUREMENT SETUP

The mount was connected to circulating water from an ILX Lightwave LDT-53540 chiller. Water temperature was set to 10.0°C. Flow rate through the mount was 1.8±0.1 L/min. A special laser plate was installed into the mount that included a 1.0 ohm resistor as a thermal dummy load. A bench top power supply was used to power the resistor. Voltage drop across the resistor was monitored with an external voltmeter and current was measured with an inline ammeter. An LDT-5980 was used to control temperature and TEC current. A vacuum pump and gauge were connected to the mount, and the pressure was reduced to 100 mTorr for all tests.

TEMPERATURE RANGE

To measure minimum temperature at each power level, the temperature controller was set to control TEC current. The current was set to 9.5A (95% of maximum cooling power) and temperature was allowed to reach steady state at heat loads of 0W, 5W, 10W, 15W and 20W. Steady state temperature was noted at each power level. The following graph illustrates the results.

Minimum temperature vs. heat load, LDM-4872,
10°C water, 1.8 L/min, 100 mTorr vacuum



The graph above is valid for 10°C circulating water. Minimum temperature will shift with water temperature. Minimum temperatures for different water temperatures can be estimated by the following equation:

$$T_{mx} = T_{m10} - (10 - X)$$

where:

- T_{mx} = minimum mount temperature at given power and user water temperature
- X = user water temperature
- T_{m10} = minimum mount temperature at given power and 10°C water (from graph)

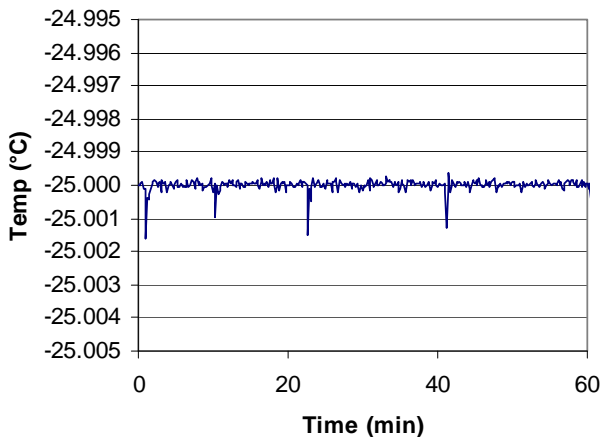
Notes:

1. The T_{mx} value will provide an approximation since TEC efficiency varies somewhat with temperature.
2. When setting circulating water temperature, be sure that the temperature set point is high than the ambient dew point to prevent condensation.

TEMPERATURE STABILITY

For the stability test, the LDT-5980 was set to temperature control mode. P, I, and D values of 10.0, 0.80, and 0.10 were entered, respectively. The temperature set point was set to -25°C and the resistive heat load was turned on to 5W. Temperature was monitored using a PC connected to the instrument via GPIB. Once the mount reached set point, the temperature was monitored for a one hour period. The resulting temperature stability is shown in the following graph.

One Hour Temperature Stability, LDM-4872, 10°C water, 1.8 L/min, 100 mTorr vacuum



CONCLUSIONS

Minimum achievable temperature depends on laser heat load and circulating water temperature. With 10°C water the LDM-4872 was able to reach -35°C with a no heat load, -30°C with a 10W load, and -25°C with a 20W load. When paired with the LDT-5980 High Power Temperature controller, the mount was able to achieve stability of better than $\pm 0.002^\circ\text{C}$ over a one hour period.