Load Response of LDC501 TEC Controllers

An important property of a TEC controller is its dynamic response to a thermal load change. For example, when the laser current changes, the heating capability changes, which in turn causes the temperature to change. The TEC controller will sense this change and make a correction to bring the temperature back to the set value.

The SRS LDC500 and LDC501 controllers have an Auto-tuning capability to find PID parameters which minimizes response time for thermal load changes.

Tests were done to show the TEC's response to thermal load changes. Figure 1 shows the test setup.

A 10 Ω resistor is located on a TEC cooled metal plate. A current change in the 10 Ω resistor will cause a thermal load change. NTC thermistors (MC65F103C) are used in the control loop. These thermistors have a 10 kΩ resistance at 25 °C.

The LDC501 was set to 25.000 °C and auto tuned to optimize PID parameters. The laser output current was at 10mA for 25sec, and then rose to 250 mA and stayed there for 275 seconds.

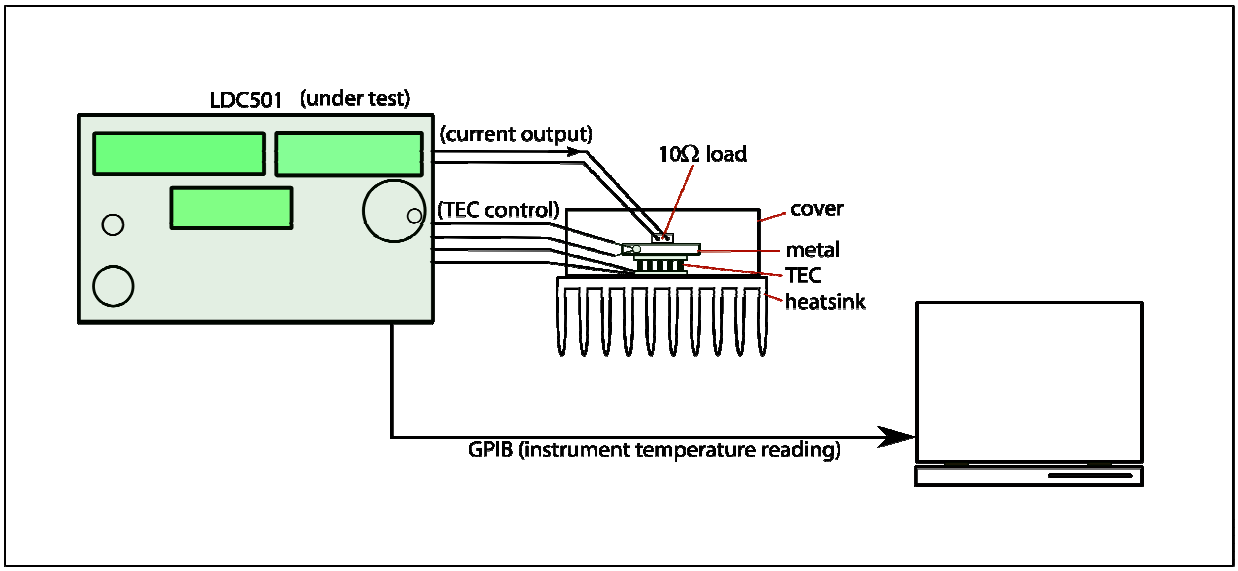

Figure 1: Thermal load response test setup

The blue trace in Figure 2 shows the LDC501's response to this load change. We also tested a competitor's TEC driver which doesn't have an auto-tuning function. Following instructions in its manual, we first set loop gain to ×10, and monitored the temperature, then changed to a higher gain until ×300. We noticed that the temperature became unstable (oscillations). So the gain was set back to ×100. In Figure 2, the green trace shows its response to a thermal load change. As can be seen, the LDC501 controller brought the temperature back to within 1 mK in 20 seconds, while the competing unit needed more than 275 seconds to stabilize.

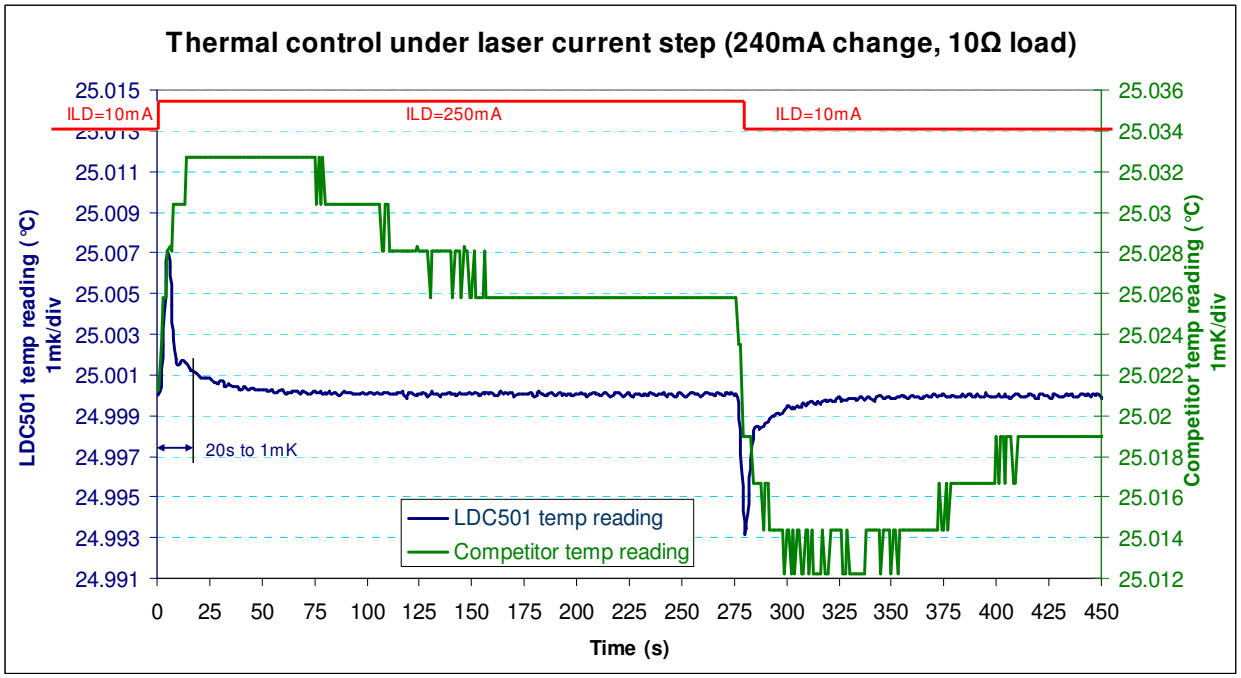

Figure 2: Thermal load step response for the SRS LDC501 and a competitor's TEC controller

A real laser in a butterfly package fixed on an LDM4980 mount was also used to test TEC controller response to thermal load changes. As shown in Figure 3, a TEC setpoint of 25.000 °C and a laser current step of 40 mA was used.

The curves show the instrument temperature reading. In less than 6 seconds, the LDC501 brought the temperature back to the setpoint but the competing model needed more than 30 seconds.

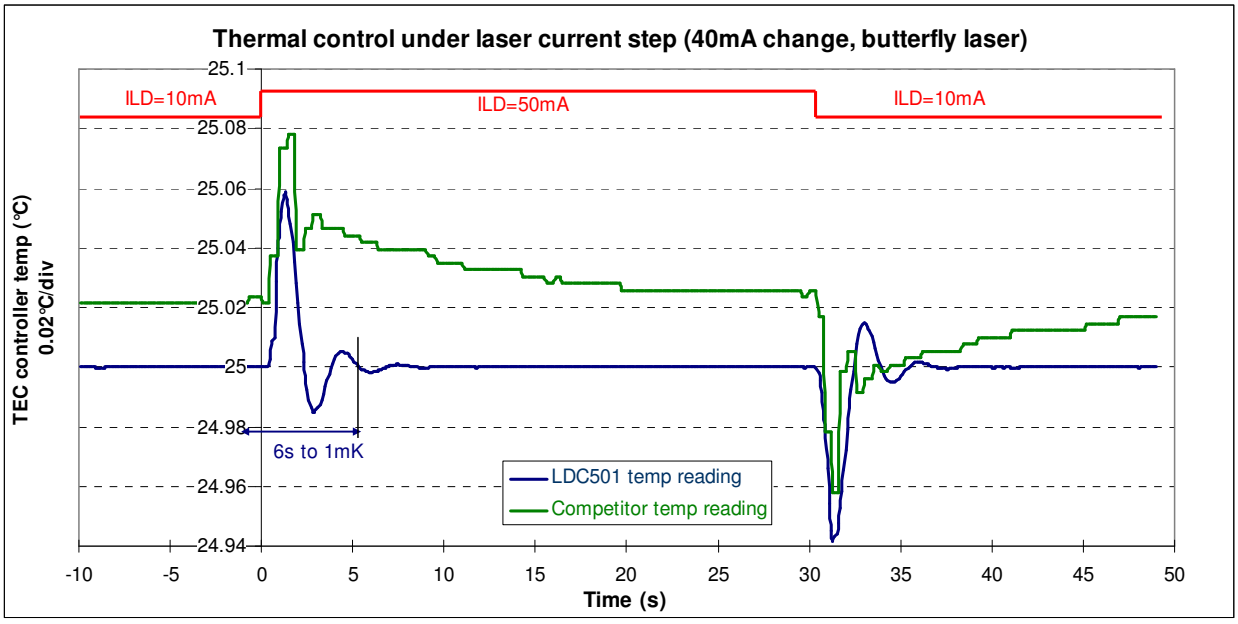

Figure 3: TEC response to 40 mA laser current change in a butterfly diode laser