Load Response of LDC501 TEC Controllers

Rev B. Revised Oct 2012

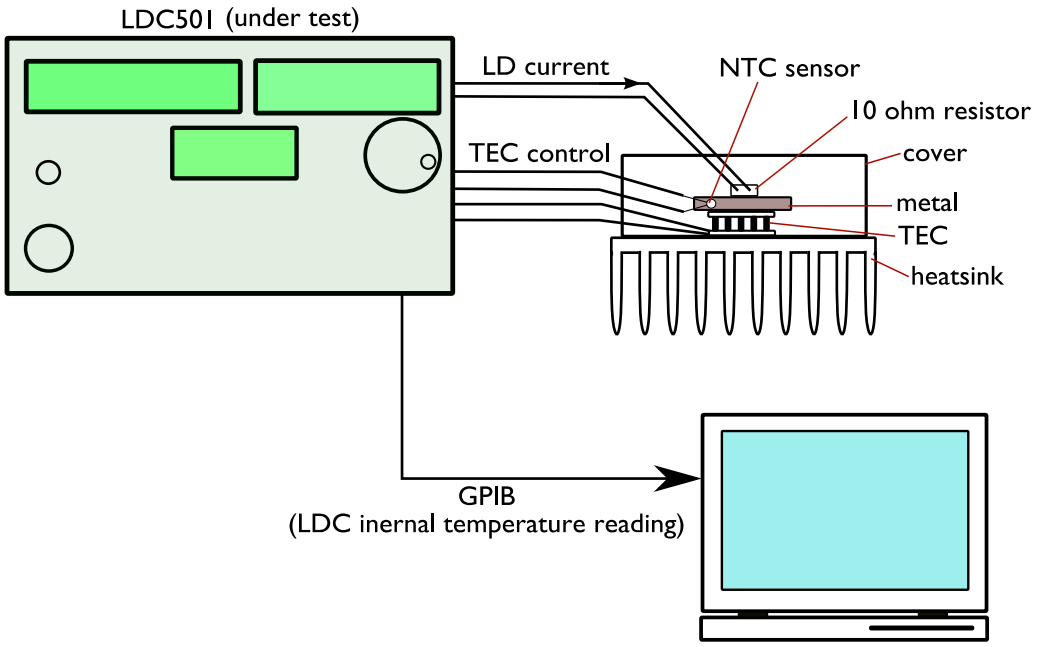

Figure 1 Thermal load response test setup

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 temperature to change. The TEC controller will sense this change and make a correction to bring temperature back to the set value.

The Stanford Research Systems' LDC500, LDC501 and LDC502 controllers have an Auto-tuning capability to find PID parameters which minimize 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 10Ω resistor is located on a TEC cooled metal plate. A current change in the 10Ω resistor will cause a thermal load change. A NTC thermistor (MC65F103C) is used in the control loop. This thermister has a 10kΩ resistance at 25°C.

The LDC501 was set to 25.000°C and auto tuned to optimize PID parameters.

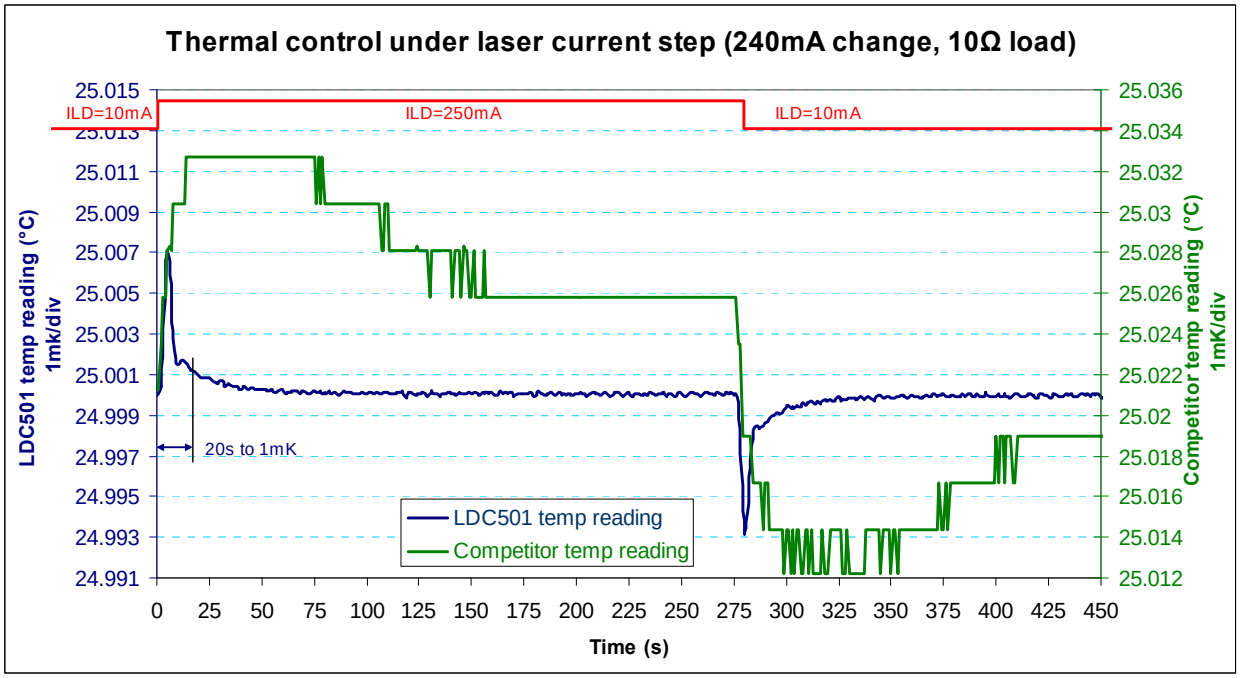

Figure 2 Thermal load step response of LDC501 and competitor's TEC controller

The laser output current was first at 10mA for 25sec, and then rose to 250mA and stayed there for 275sec as the red trace is shown in Figure 2.

The blue trace in Figure 2 shows the LDC501's response to this load change.

We also tested a competitor's TEC controller which doesn't have an auto-tuning function. Following instructions in its manual, we first set loop gain to ×10, and monitor the temperature, then change to higher gain until ×300. We notice 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, LDC501's TEC controller brought the temperature back to within 1mK in 20 seconds, while the competing unit needed more than 275sec to stabilize.

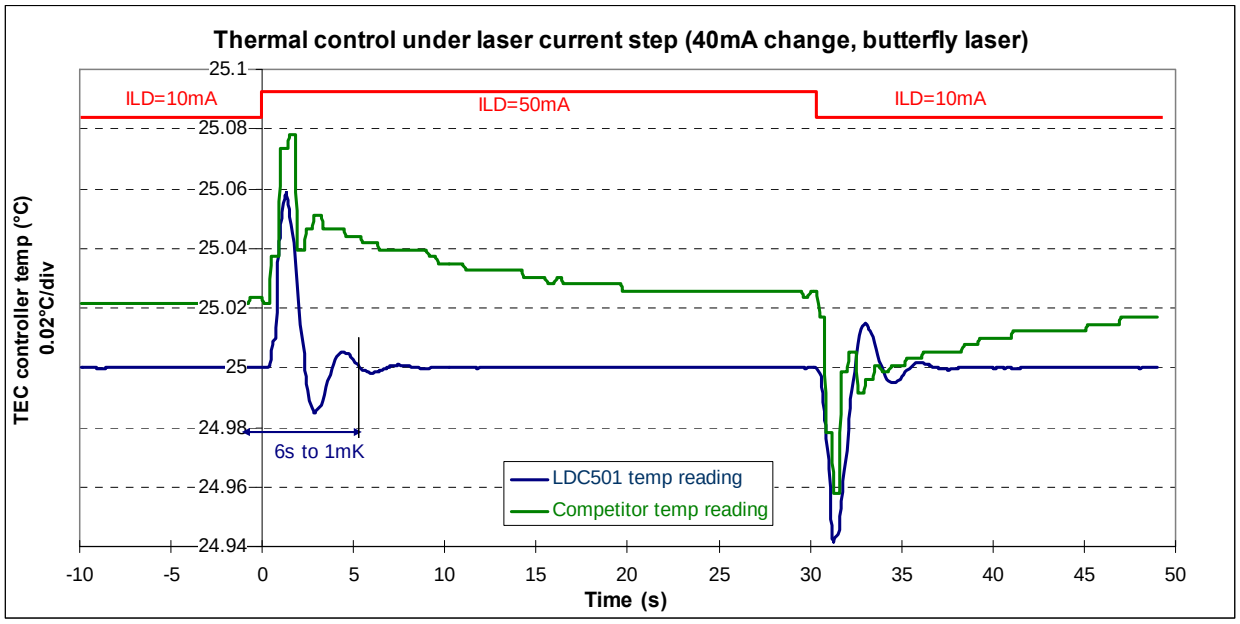

Figure 3 TEC controller response to 40mA laser current change in a butterfly diode laser

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 40mA was used.

The blue and green curves show the instrument temperature readings. In less than 6 seconds, the LDC501 brought temperature back to the setpoint (blue trace), but the competing model needed more than 30 seconds (green trace).