TECH
NOTE

Typical Output Stability of the LDC-3724B

OVERVIEW

This technical note describes the results of output stability tests performed on a current production ILX Lightwave LDC-3724B laser diode controller. Two sets of data shall be presented. The first dataset includes voltage measurements taken from a temperature-stabilized, resistive load connected to the laser current source output to measure its stability. Also, resistance measurements from a thermistor embedded in a second Peltier-driven test load will be shown to demonstrate temperature control stability. The second dataset includes power and wavelength data from an actual laser diode connected to the controller to show how an active device performs under the same conditions.

RESISTIVE LOAD TEST SETUP

The test was performed with the 3724 and the test loads inside an environmental chamber set to 25°C ± 0.5°C. The test load used to measure laser drive current stability consisted of a temperature-controlled, ultrastable, 1W precision resistor and was driven with a current of 100mA set on the 200mA output range.

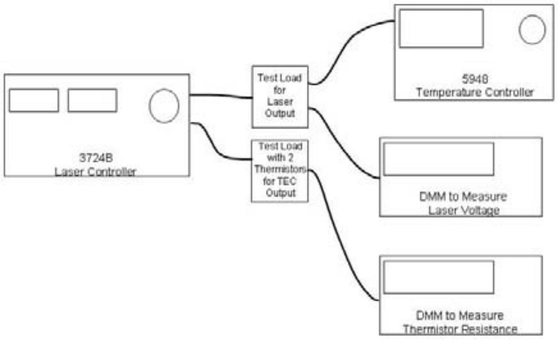

Figure 1: Resistive Load Test Setup

An ILX Lightwave LDT-5948 precision temperature controller was used to stabilize the temperature of this resistor to 25.00°C at all times. The test load used to measure temperature control stability consisted of an ILX Lightwave LDM-4412 laser fixture with two thermistors co-located in its coldplate. One thermistor was for feedback to the 3724 to control temperature. The second thermistor was used to independently monitor the load temperature by measuring its resistance with a digital multimeter (DMM). The controller was configured to keep the temperature at 20°C. A block diagram of the test is shown in Figure 1.

LASER LOAD TEST SETUP

This test was performed with the same 3724 connected to an ILX Lightwave LDM-4984 used to fixture a butterfly-style 1568nm DFB laser. The controller was set to drive the laser with 100 mA at 20°C. The output from the laser was connected to an ILX Lightwave OMM-6810B power meter and an Agilent 86122A sub-picometer resolution wavemeter through a 90/10 splitter. The 3724 and laser were placed inside an environmental chamber set to 25°C ± 0.5°C throughout the test. A block diagram of this test setup is shown in Figure 2.

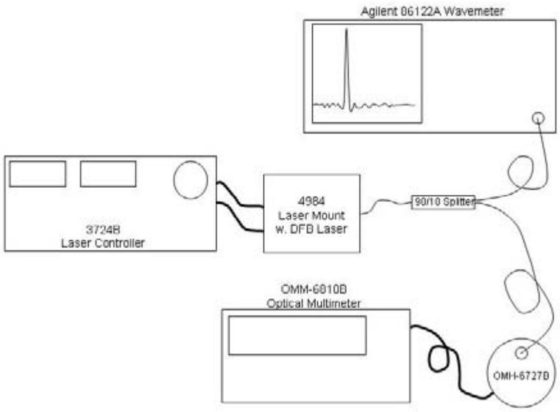

Figure 2: Laser Load Test Setup

Monitoring the output of a laser is an accurate way to measure the stability of the laser controller because the light output is directly proportional to the laser drive current (above threshold) and the wavelength is very sensitive to laser temperature. In fact, the laser's output wavelength can be shown to change ~0.11nm/°C or roughly 100 pm/°C. Because of this property, millidegree changes in temperature can be measured with an appropriate wavemeter.

In both tests, the test loads were monitored over a minimum of 18 hours with a computer collecting data via GPIB.

TEST RESULTS

Figures 3 - 6 show the results of both tests. It can be seen in Figure 3 that the laser drive current maintained <40 ppm stability, excluding the first hour after turn-on, over the entire test.

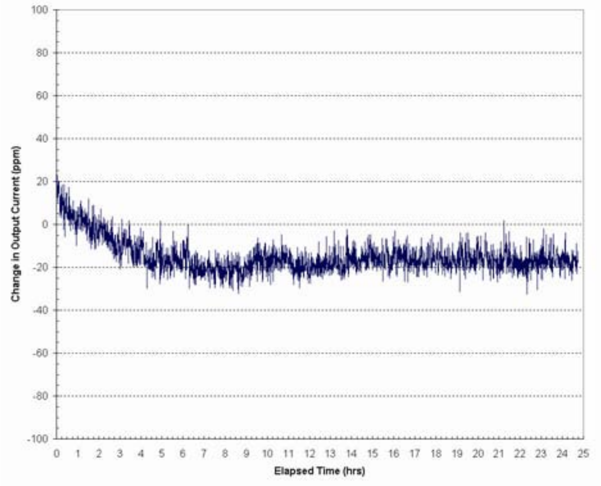

Figure 3: Laser Current Stability with 1Ω Load

Figure 4 shows the results of the TEC output section controlling the coldplate in an LDM-4412. Again, excluding the first hour of warm-up, the maximum temperature variations, either short-term or long-term, are significantly less than ±4 millidegrees, the short-term (1 hour) stability specification, and well under the long-term (24 hour) stability specification of ±10 millidegrees.

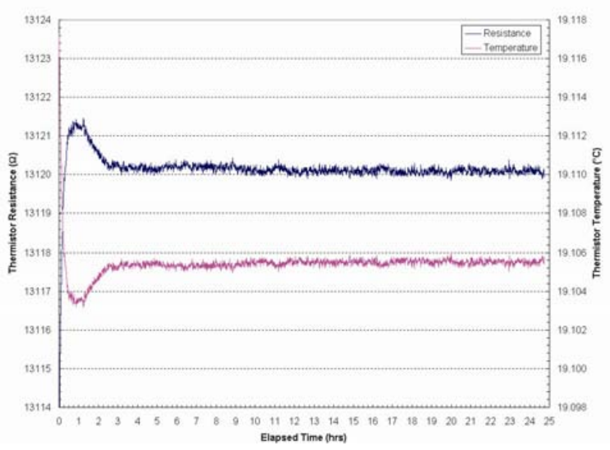

Figure 4: Temperature Stability

Figure 5 illustrates laser drive current stability in terms of optical power output. Long term power stability remains < ±0.01dB. Figure 6 shows how the laser output wavelength will vary over the course of several hours and how the measured temperature varies in the same time span.

During this test, the absolute maximum wavelength variation was 0.3pm. This wavelength shift roughly corresponds to a temperature shift of 0.003°C. This laser, typical among butterfly-packaged DFB lasers in the 1550nm telecom wavelength range, has a thermistor embedded within the package. The resistance measurement of the internal thermistor is graphed in Figure 6 as well. As can be seen, the 3724 measured no more than 1 Ω variation (the measurement resolution limit) during the entire run. Using typical thermistor constants, this 1 Ω variation corresponds to a temperature variation of 0.002°C - within a factor of 2 agreement with the value obtained due to wavelength shift.

SUMMARY

Figures 3 - 6 show the results In summary, the data presented displays the typical laser and TEC control stability of a current production ILX Lightwave LDC-3724B Laser Diode Controller. The data is presented in two sets. The first set uses passive test loads as was done when originally designed to show compliance to published specifications. The data from this test shows that the laser current source remains stable to ≤ 20 ppm over the course of a single hour and within 40 ppm over a 24 hour period. The temperature controller maintains setpoint temperature to within ±0.004°C over any hour interval and ±0.01°C over 24 hours when the ambient is held to 25°C ± 0.5°C.

The second set involves connecting the 3724 to a typical 20mW DFB laser using the same output settings as the first test to create a correlation between the two methods. The laser output is measured with an optical power meter and a sub-picometer-accuracy wavemeter. The data shows that long term stability of the instrument is within specification and will allow the optical output to remain stable to within 0.01dB and 0.3pm of its center wavelength.

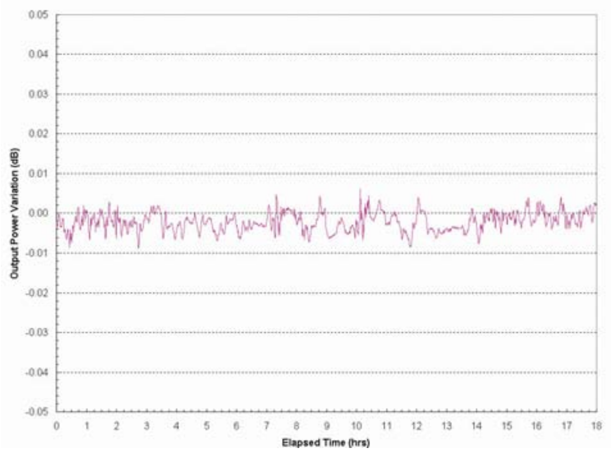

Figure 5: Optical Power Stability

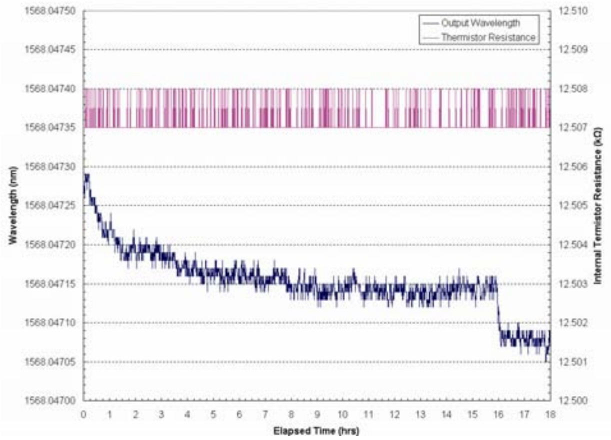

Figure 6: Wavelength Stability