Voltage Limit Protection of an LDC-3916 Laser Diode Controller

TECH NOTE

This technical note presents the results of measurements on the voltage limit protection circuitry in a typical LDC-3916 Laser Diode Controller.

BACKGROUND

Laser diodes are highly susceptible to damage if too much energy is supplied, so most users drive their diodes with highly accurate, precision current sources. However, even with an accurate current source, laser damaging conditions can occur if the total control system is not considered. One such condition to consider is intermittent contact in the laser drive current connections. When driving a laser diode in constant current mode, current is driven to the laser until the measured current matches the desired setpoint. In such a "closed-loop" condition, the control electronics will try and "force" the output current to equal the setpoint (up to a user-defined limit current). If the connection to the laser diode opens briefly, the current source will sense a decrease in delivered current and drive the output voltage higher to compensate. If the contact closes again (such as in an intermittent connection), this higher energy output will be released into the diode in a burst, potentially damaging the laser diode. To reduce the chance of damage, a smart current source will sense this condition and turn off the output fast enough to prevent any energy bursts. ILX Lightwave has addressed this risk by incorporating a new adjustable voltage limit protection feature and a faster shut-off circuit in its latest current source designs (LDC-3916 and LDC-3700B Series Laser Diode Controllers).

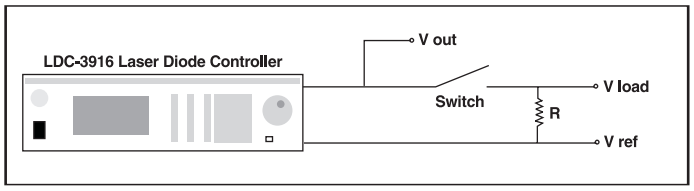

Figure 1. Measurement Setup.

MEASUREMENT SETUP

The measurement setup is shown in Figure 1. A 20 ohm resistor was connected to the laser current source of the LDC-3916 Laser Diode Controller. A switch to simulate an intermittent contact opening was inserted between the current source and the resistive load. An oscilloscope was connected to measure the voltages on the output (V out) and across the resistor (V load). The current source was set to drive 100 mA. The switch was opened and the voltages recorded. This procedure was done with the voltage limit set at 2.5 volts, and repeated with the voltage limit set at 6.0 volts.

RESULTS

Figure 2 shows the results with the voltage limit set at 2.5 volts. There is an internal series resistance in the output path of the current source; therefore, when the switch was opened, the output voltage (V out) immediately jumped up because current was no longer flowing through the series output resistor. The output voltage

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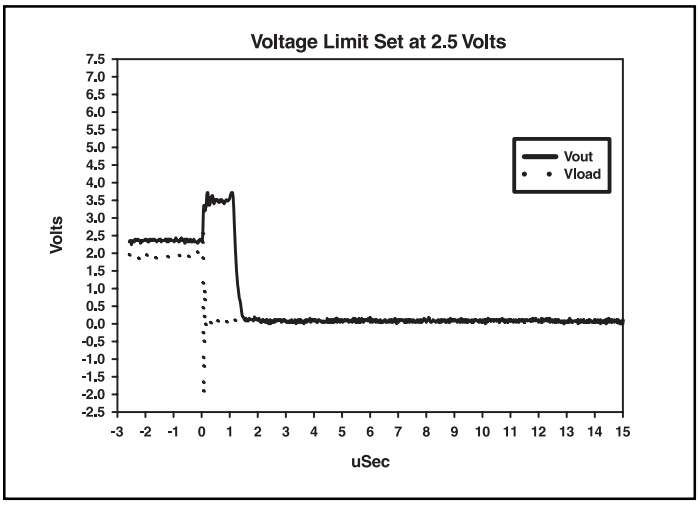

Figure 2. Results with Voltage Limit at 2.5 V.

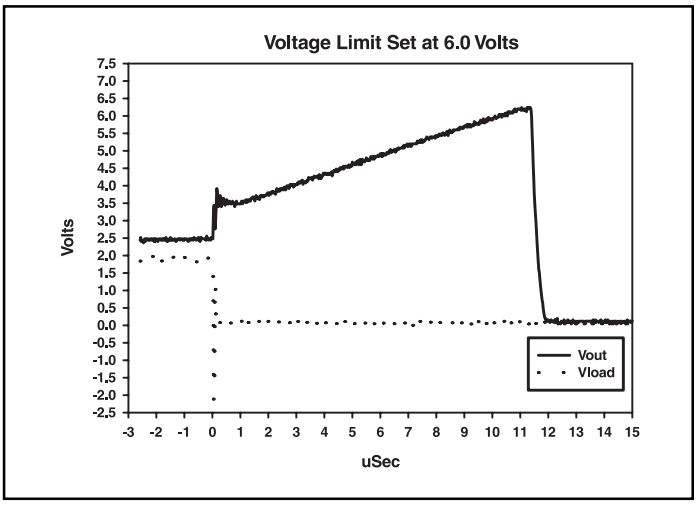

Figure 3. Results with Voltage Limit at 6.0 V.

would drop by the same amount if the switch were immediately closed, so this does not represent stored energy that could damage a laser. The voltage jump trips the voltage limit protection circuitry, which shuts off the current source in approximately 1 microsecond.

Figure 3 shows the results with the voltage limit set at 6.0 volts. The first microsecond looks the same as in Figure 2, but the voltage limit has not been reached yet, so the current source does not shut off. The output voltage rises as the current source drives energy onto the output node. When the current source output reaches 6.0 volts, the voltage limit is sensed and the output shuts off within 1 microsecond.

Comparing Figure 2 and Figure 3, it can be seen that by setting the LDC-3916 adjustable voltage limit to a value just above the operating voltage of your laser diode, you will provide a greater level of protection. The combination of a fast shut-off time and a properly set adjustable voltage limit decreases the amount of energy available to damage laser diodes when intermittent connections, such as contact bounce, occur.