LRS-9434 and LMS-9406 Transient Protection

OVERVIEW

Protection from harmful electrical transients is important in all applications of laser diodes due to the highly sensitive nature of these semiconductor devices. This is particularly true in life-test and burn-in applications where data integrity and production cost may be impacted. During life-test of laser diodes, thousands of hours of data are collected in order to calculate the life times of the devices. Any damage or loss of devices caused by the test system or an external power line transient can result in erroneous data or loss of thousands of hours of test time. During production burn-in, any loss of devices due to the burn-in test system reduces yield and increases the overall cost of test. Fortunately, with careful design it is possible to eliminate these risks.

The protection technologies available in all LRS-9434 and LMS-9406 systems include:

- Shorting FETs clamp the laser pins together during turn-off sequence prior to relay engaging.
- Normally closed shorting relays protect lasers while system is powered down.
- Monitoring circuitry ensures that power systems have stabilized before current is supplied to the lasers
- Turn-on protection of the laser diodes is accomplished by slowly ramping the laser diode current.
- AC power monitoring circuitry quickly shuts down lasers in the event of power failure.
- System is tested to ensure that operational and power line induced transients result in less than 10 mA surge at the laser diode.
- Lasers loaded into fixtures are ESD grounded to the fixture tray.
- All touchable surfaces on the LRS-9434 and LMS-9406 are either directly or ESD grounded to earth.
- LRS-9434 and LMS-9406 shelves contain ESD grounding plugs for user operation.

This technical note focuses on the transient protection of the LRS-9434 and LMS-9406 during turn on, turn off, power failure, and instances of a surge in the power line. For turn on, turn off, and power failure it is expected that there will be no transients and for a surge on the power line no more than a 10 mA spike will be observed on any device under test in the system.

TEST SET UP

All tests were conducted on an LRS-9434321 Control-Measure Module of a typical LRS-9434 sitting on an environmental bench (the LMS-9406321 Control Module on the LMS-9406 has an identical device protection architecture). A 3.3ohm resistor was used as a laser analog for the on-off transient testing. The resistor was connected to a Tektronix ADA400A differential probe amplifier. The amplifier was monitored via a calibrated Tektronix TDS 3054 oscilloscope. The Tektronix oscilloscope was configured to trigger on a falling or rising edge, whichever was appropriate for the test.

A Fitel 1480nm laser diode module was used for the surge transient testing. This laser was coupled to a 24dB attenuator which was then coupled to a New Focus 1811 high-speed photodetector. A Keytek CE Master surge generator was used to create the power line surge. The Tektronix TDX 3054 and New Focus 1811 units were placed on a grounded ESD safe cart two meters away from the LRS-9434321 Control-Measure Module and KeyTek CE Master units. A measurement transfer function of 67.64mA/V was determined for the Fitel laser in order to analyze surge transient measurements.

RESULTS

Slow Turn-On. Figure 1 at right shows the slow start protection of the LRS-9434. By slowly ramping up the current over several seconds, the laser diodes are protected from significant thermal stresses and against any over-shoot.

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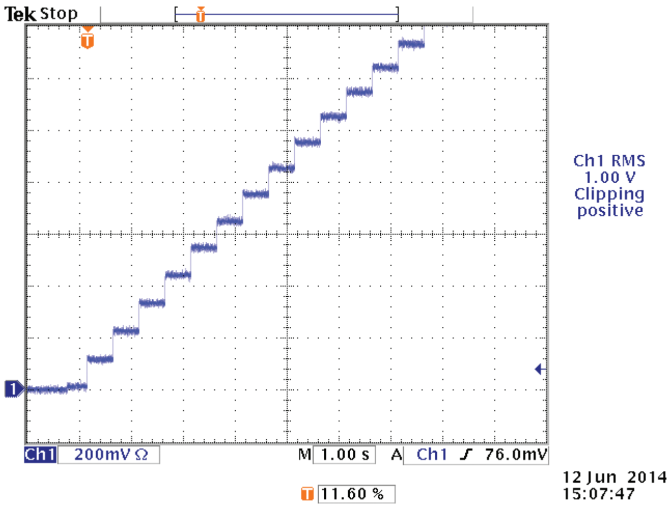

FIGURE 1

Slow Turn-On. Figure 1 at right shows the slow start protection of the LRS-9434. By slowly ramping up the current over several seconds, the laser diodes are protected from significant thermal stresses and against any over-shoot.

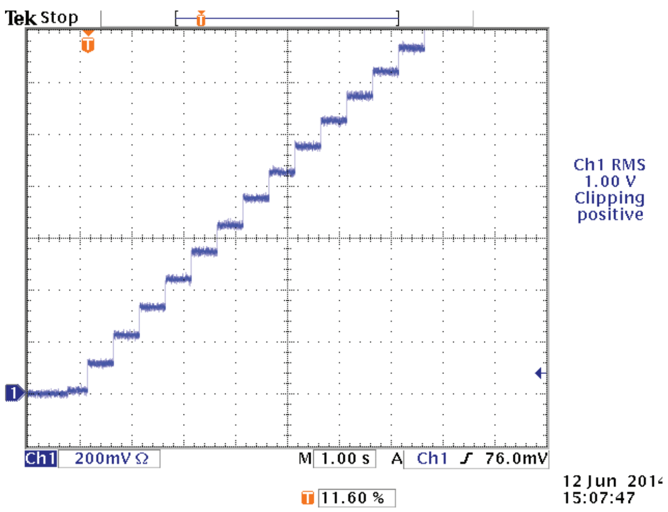

FIGURE 2

Slow Turn-On. Figure 2 zooms in on a single step of the slow-start ramp. Notice there is absolutely zero over-shoot of the laser diode current.

Fast Turn-Off. During power down of the laser diodes, a signal is sent from the control logic of the laser diode driver to adjust the current output set point to zero. After the output is set to zero, the shorting FETs engage and clamp the current source to zero. Lastly after tens of milliseconds a "normally closed" relay engages and shorts the output for protection of the devices even when the system is powered down. Figure 3 shows the first two stages of turn-off. Notice that no transients occurred during shut down of the laser diode drive current. The figure also displays that the system is capable of setting the laser drive current

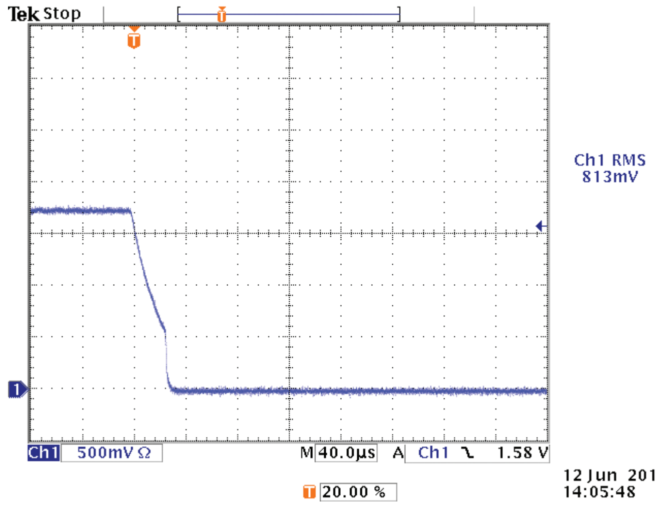

FIGURE 3

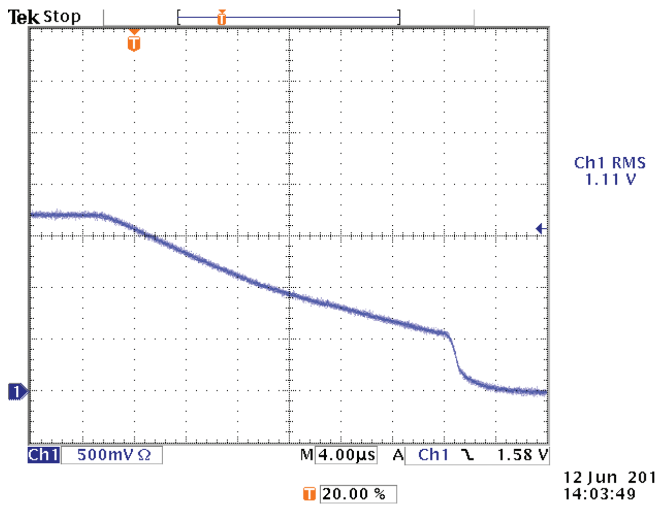

FIGURE 4

to zero and clamping the shorting FETs in under 50 µs.

Fast Turn-Off. Figure 4 zooms in on the first two stages of turn-off. Notice there is absolutely zero under-shoot of the laser diode current. All energy has been dissipated by the time the shorting relay engages.

Loss of AC Power. Figure 5 confirms that the LRS-9434 initiates the same turn-off sequence when AC power is lost as it does during a normal turn-off request. As in the previous test, setting the output to

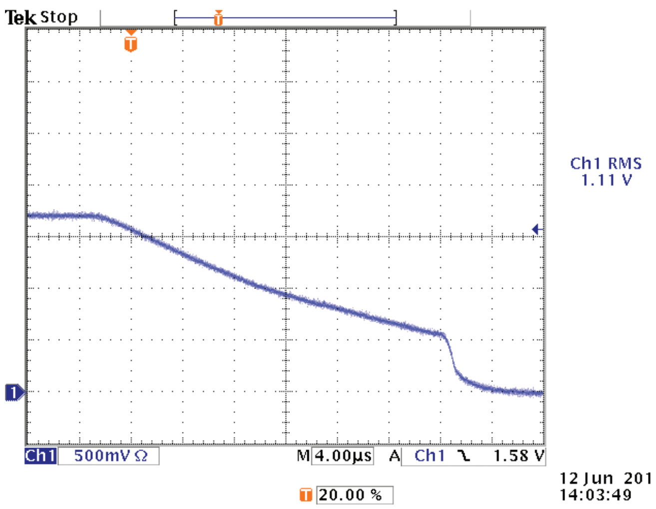

FIGURE 5

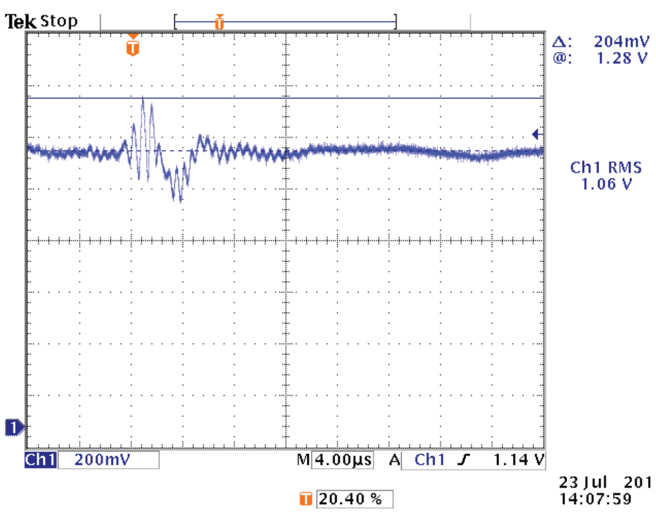

FIGURE 6

zero occurred in under 50µs.

AC Power Line Surge. A 1kV/10A AC power line surge was introduced at the power input of the LRS-9434. This test was repeated several times across different line/earth configurations. Figure 6 shows worst surge captured, which resulted in a 204 mV signal observed on the Tektronix monitoring oscilloscope. Using the measurement transfer function of 67.64 mA/V a transient of 13.79 mA was calculated. This transient level is well below the specification of 36 mA for the LRS-9434321 Control-Measure Module.

CONCLUSION

The results of the tests reported here show that the LRS-9434 Laser Reliability and Burn-In Test system, as well as the LMS-9406 Laser Limited Monitoring Burn-In Test system, provides a safe, transient free test environment for static sensitive devices under all anticipated operating conditions. For additional information on laser diode protection please see our Application Note #3, “Protecting Your Laser Diode” and for additional information on measuring transients please see our White Paper, “A Standard for Measuring Transient Suppression of Laser Diode Drivers.”

The following publications are available for download at www.newport.com/ilxlightwave.

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White Papers

- A Standard for Measuring Transient Suppression of Laser Diode Drivers
- Calibration and Traceability Ensure Measurement Accuracy
- Degree of Polarization vs. Poincare Sphere Coverage
- Improving Splice Loss Measurement Repeatability
- Laser Diode Bum-In and Reliability Testing
- Power Supplies: Performance Factors Characterize High Power Laser Diode Drivers
- Simplifying Parametric Analysis of Laser Diodes
- Reliability Counts for Laser Diodes
- Reducing the Cost of Test in Laser Diode Manufacturing

Technical Notes

- Accuracy and Repeatability of Power Measurements Using the FPM-8220
- Automatic Wavelength Compensation of Photodiode Power Measurements Using the OMM-6810B Optical Multimeter
- Bandwidth of OMM-6810B Optical Multimeter Analog Output
- Broadband Noise Measurements for Laser Diode Current Sources
- Callendar-Van Dusen Equation and RTD Temperature Sensors
- Clamping Limit of an LDX-3525B Precision Current Source
- Connecting Your Laser to the LDP-3830
- Determining the Polarization Response of the FPM-8220
- Effects of Cabling and Inductance When Pulsing High Power Laser Diodes
- Facility Power Requirements for the LDX-36000
- Four-Wire TEC Voltage Measurement with the LDT-5900 Series
- Guide to Selecting a Bias-T Laser Diode Mount
- High Power Linearity of the OMM-6810B and OMH-6790B Detector Heads
- Large-Signal Frequency Response of the 3916338 Current Source Module
- Laser Wavelength Measuring Using a Colored Glass Filter
- LDC-3736 Laser Protection
- LDM-4982 and 4984 Quick Setup Guide
- LDP-3830 Independent Current Limit
- LDP-3830 Laser Protection
- LDP-3830 Pulse Performance
- LDT-5900C Temperature Stability
- LDT-5910C PID Control Quick Start
- LDT-5940C Voltage Measurement Techniques
- LDX-3232 Modulation Bandwidth
- LDX-36000 CQW Pulse Characteristics
- Long-Term Output Stability of an LDX-3620B Laser Diode Current Source
- Long-Term Output Stability of an LDX-3525B Precision Current Source
- LRS-9434 Temperature Set Point Accuracy
- LRS-9434 Temperature Coefficient
- LRS-9434 Threshold Current Measurement Repeatability
- LRS-9434 and LMS-9406 Transient Protection
- LRS-9550 Device Temperature Algorithm
- LRS-9550 Fixture Temperature Range
- LRS-9550 Laser Drive Current Setpoint Accuracy
- LRS-9550 Laser Eye Safety Features
- LRS-9550 Water Quality Guidelines
- Measurement of 4-Wire Voltage Sense on an LDC-3916 Controller
- Measuring the Power and Wavelength of Pulsed Sources Using the OMM-6810B Optical Multimeter
- Measuring the Wavelength of Noisy Sources Using the OMM-6810B
- Minimum Temperature Range of the LDM-4405
- Minimum Temperature Control Range of the LDM-4982M / LDM-4894T
- Nominal PID Constants for the LDT-5900 Series Controller
- Output Current Accuracy of an LDX-3525B Precision Current Source
- Paralleling Laser Diodes
- Pulse Parameters and LDP-3830 Control Modes
- Quick Start: Modulation a Laser Diode Driver
- Repeatability of Wavelength and Power Measurements Using the OMM-6810B Optical Multimeter
- Square Wave Modulation of the LDX-3500B
- Stability of the OMM-6810B Optical Multimeter and OMH-6727B InGaAs Power/Wavehead
- Temperature Control Range of the LDM-4409
- Temperature Measurement Using a Linearized Thermistor Network
- Temperature Stability Using the LDT-5948 / LDT-5980
- Thermal Resistance of the LDM-4409
- Thermistor Constant Conversions: Beta to Steinhart-Hart
- Triboelectric Effects in High Precision Temperature Measurements
- Tuning the LDP-3840B for Optimum Pulse Response
- Typical Long-Term Temperature Stability of a LDT-5525 TEC
- Typical Output Drift / Noise of an LDX-3412
- Typical Temperature Stability of the LDT-5500B
- Using Status Event Registers for Event Monitoring
- Using the Dual Modulation Inputs of the LDX-3620B
- Using the LDM-4984 with the LDP-3840B
- Using Three-Wire RTDs with the LDT-5900 Series Temperature Controllers
- Voltage Drop Across High Current Laser Interconnect Cable
- Voltage Drop Across High Current TEC Interconnect Cable
- Voltage Limit Protection of an LDC-3916 Laser Diode Controller

Application Notes

- App Note 1: Controlling Temperatures of Diode Lasers Thermoelectrically
- App Note 2: Selecting and Using Thermistors for Temperature Control
- App Note 3: Protecting Your Laser Diode
- App Note 4: Thermistor Calibration and the Steinhart-Hart Equation
- App Note 5: An Overview of Laser Diode Characteristics
- App Note 6: Choosing the Right Laser Diode Mount for Your Application
- App Note 8: Mode Hopping in Semiconductor Lasers
- App Note 11: Pulsing a Laser Diode
- App Note 12: The Differences between Threshold Current Calculation Methods
- App Note 13: Testing Bond Quality by Measuring Thermal Resistance of Laser Diodes
- App Note 14: Optimizing TEC Drive Current
- App Note 16: Measuring Wide Linewidth Source with the OMH-6700B Series Waveheads
- App Note 17: AD590 and LM335 Sensor Calibration
- App Note 18: Basic Test Methods for Passive Fiber Optic Components
- App Note 20: PID Control Loops in Thermoelectric Temperature Controllers
- App Note 21: High Performance Temperature Control in Laser Diode Test Applications
- App Note 22: Modulating Laser Diodes
- App Note 23: Laser Diode Reliability and Burn-In Testing
- App Note 25: Novel Power Meter Design Minimizes Fiber Power Measurement Inaccuracies
- App Note 26: ReliaTest L/I Threshold Calculations
- App Note 27: Intensity Noise Performance of Semiconductor Lasers
- App Note 28: Characterization of High Power Laser Diode Bars
- App Note 29: Accelerated Aging Test of 1310 nm Laser Diodes
- App Note 30: Measuring High Power Laser Diode Junction Temperature and Package Thermal Impedance
- App Note 31: Mounting Considerations for High Power Laser Diodes
- App Note 32: Using a Power/ Wavehead for Emitter Level Screening of High Power Laser Diode Bars
- App Note 33: Estimating Laser Diode Lifetimes and Activation Energy
- App Note 34: Using USB Through Virtual COM Ports
- App Note 37: Measuring and Reducing Noise Using an LDX-3620B Ultra Low Noise Laser Diode Current Source
- App Note 38: Achieving Millikelvin Temperature Stability