

# Laser Diode L-I-V Test System



## Complete DC Test System with Temperature Control

Keithley's L-I-V (light-current-voltage) Test System is designed to help manufacturers of laser diode modules (LDMs) keep pace with production demands by allowing them to boost yield and throughput. The L-I-V test system combines all the DC measurement capabilities required to test these modules with optical power measurement and tight temperature control over the device under test in an integrated instrument package. The L-I-V test system is configured from proven Keithley instrumentation; the basic configuration can be easily modified to add new measurement functions or to allow for new connections.

## High Accuracy Building Blocks

The standard L-I-V test system provides a fast, flexible solution for testing LDMs by combining the functions of several high speed, high accuracy Keithley instruments:

- Programmable L-I-V test system for laser diode modules
- Sweep and measure 400 points in <8s
- Very low noise current source (50 $\mu$ A) for laser diode drive
- Up to 5A laser diode drive current
- Measures optical power directly
- 1fA resolution for dark current measurements
- Fully digital P-I-D loop for temperature control
- $\pm 0.005^\circ\text{C}$  temperature stability,  $\pm 0.001^\circ\text{C}$  set point resolution
- Trigger Link, Source Memory and buffer memory support automatic test sequencing. Reduced GPIB bus traffic improves test throughput.
- Expandable and flexible for future requirements

- **Model 2420 or 2440 High Current SourceMeter instrument.** During L-I-V testing, the SourceMeter instrument provides a current sweep to drive the laser diode. It also synchronizes the measurements made by other instruments in the system. The Model 2420 and 2440 SourceMeter instruments are part of Keithley's SourceMeter family and were developed specifically for test applications that demand tightly coupled precision voltage and current sourcing and measurement. Selecting the instrument's high current range eliminates the potential for range change glitches if currents higher than 1A are needed during the L-I-V sweep. The Model 2420 offers drive current of up to 3A. The Model 2440 offers up to 5A of drive current for demanding pump laser control.
- **Model 2500 Dual Photodiode Meter.** The Model 2500 measures the current flow in the back facet photo detector and combines with the Model 2500INT Integrating Sphere to directly measure optical power. Each optical power measurement channel is fully independent. The measurement timing circuitry is shared between both channels to provide simultaneous measurements to optimize L-I-V performance. Each channel has eight measurement ranges and provides a resolution high enough to measure dark currents of the photo diode. The isolated bias sources provide up to 100V of bias.
- **Model 2510/2510-AT TEC SourceMeter instrument.** The Model 2510 is a 50W bipolar instrument that controls the operation of an LDM's Thermo-Electric Cooler or TEC (sometimes called a "Peltier device") during L-I-V testing. During testing, the Model 2510 measures the internal temperature of the LDM from any of a variety of temperature sensors, then drives power through the TEC in order to maintain the LDM's temperature at the desired set point.

The Model 2510's software-based, fully digital P-I-D (proportional-integral-differential) control provides excellent temperature stability. This high stability allows for very fine control over the output wavelength and optical power of the LDM during testing. An additional 2510 can also be added to include ambient fixture control, if the test will be done under a variety of ambient conditions. The instrument includes a low-level TEC resistance measurement function to check TECs for mechanical damage during module assembly.

The Model 2510-AT expands the capability of the Model 2510 further by offering autotuning capability. P, I, and D (proportional, integral, and derivative) values for closed loop temperature control are determined by the instrument using a modified Zeigler-Nichols algorithm. This

## ACCESSORIES AVAILABLE

8000-10	10-inch Equipment Rack
LIV-EW	1 Year Extended Warranty
KPCI-488	IEEE-488.2 Interface for the PCI Bus
KPCMCIA-GPIB95	PCMCIA/GPIB Card with Windows 95/98 Drivers. Includes Interface Cable
KPCMCIA-GPIBNT	PCMCIA/GPIB Card with Windows NT/2000 Drivers. Includes Interface Cable

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## Ordering Information

LIV-1	General-Purpose L-I-V System
LIV-2	Transmitter Module L-I-V System
LIV-3	980nm Pump L-I-V System
LIV-4	High Power Pump Module L-I-V System
LIV-1-F	General Purpose L-I-V System w/Fixture Control
LIV-2-F	Transmitter Module L-I-V System w/Fixture Control
LIV-3-F	980nm Pump L-I-V System w/Fixture Control
LIV-4-F	High Power Pump Module L-I-V System w/Fixture Control

## Custom Configurations

Refer to the L-I-V Custom Configuration and Ordering Guide.

Call the Optoelectronic Component Test Applications Group at 1-888-KEITHLEY (534-8453) to define the system requirements and obtain a quote.

This product is available with an Extended Warranty.

## Accessories Supplied

### All Models

237-ALG-2	Triax Cable, 3-Slot to Alligator, 2m
2510-CAB	TEC Controller Cable
4288-1	Single Rack Mounting Kit
4288-2	Dual Rack Mounting Kit*
7007-05	GPIB Cable, 0.5m (2)*
7007-2	GPIB Cable, 2m
8501-1	Trigger Link Cable, 1m
7754-3	BNC to Alligator Cable (2)
BG-18	Banana to BNC Coaxial Adapter (2)
LIVCD-950-01A	Getting Started CD
LIV-2, LIV-3, LIV-4 Add:	
2500INT-FC/PC	FC/PC Connector for 2500INT
6172	2-Slot Male to 3-Lug Female Adapter
7078-TRX-5	3-Lug Triax Cable, 5 ft

\*One additional supplied with -F option

eliminates the need for users to experiment by inputting various P, I, and D coefficients repeatedly in order to determine the optimal values.

- **Model 2500INT Integrating Sphere.** This accessory for the Model 2500 accepts direct optical input and provides for accurate L measurement without being sensitive to polarization mode or beam profile at the end of the fiber. The integrating sphere is available with a silicon, germanium, or cooled indium gallium arsenide detector to ensure accurate optical power measurements at any wavelength.

For additional information on any of the building blocks of the L-I-V test system, refer to the data sheet for that instrument or to Keithley's full-line catalog.

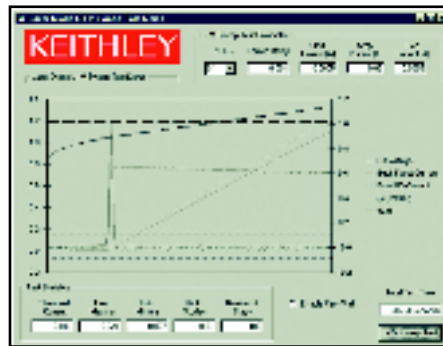
## Tight Integration Ensures Higher Test Speed

The L-I-V test system allows for fast, easy integration and high test speeds because all the building blocks come from the same supplier. All newer Keithley instruments include the Trigger Link feature and digital I/O lines, as well as standard IEEE-488 and RS-232 interfaces, to speed and simplify system integration and control. The Trigger Link feature combines six independent software selectable trigger lines on a single connector for simple, direct control over all instruments in a system, without the need for constant traffic over the GPIB. This feature is particularly useful for reducing total test time if the test involves a sweep. The digital I/O lines simplify external handler control and binning operations.

Source Memory and Buffer Memory, provided by Models 2420, 2440, and 2500, enable elimination of GPIB traffic during sweep testing. Source Memory is a built-in "programmable test sequencer" for configuring up to 100 different tests. The Buffer Memory stores data that can be downloaded to the PC via the GPIB after an L-I-V test sweep is complete. The Source Memory, Buffer Memory, and Trigger Link work in concert to form an autonomous test system—all it takes to begin the test sequence is a "start of test" command from the PC. Benchmark testing has demonstrated these features allow the system to complete a 400-point L-I-V test sweep with data transfer to the PC in less than 13 seconds.

## Easy to Program, Easy to Use

Having all the instrumentation supplied by the same vendor simplifies system programming and improves ease of use. All instruments in the standard system respond to the same SCPI command structure. LabVIEW™ and TestPoint™ instrument drivers are also available to simplify application development.



A demonstration software package, written in Visual Basic, is available with the L-I-V test system to give programmers a head start on creating their own applications. Using the demonstration package, system integrators can set a variety of test parameters, including NPLC (integration time), Source Delay (settling time before measurement), Start Current, Stop Current, and Step Current. These parameters allow the integrator to define the current sweep range and make speed and accuracy trade-offs by adjusting Source Delay and NPLC. The resulting data can be analyzed to determine threshold current and kink statistics. The total test time includes the instrument setup, L-I-V sweep, and data transfer times (but not the computation times).

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## Standard System Configuration Kits

Keithley has developed a number of standard system configurations for testing fully assembled laser diode modules. These configurations include all the cables and adapters required for communication, triggering, and connection to the device to be tested. All hardware necessary for rack mounting the instruments is also included.

### MODEL LIV-1: GENERAL-PURPOSE L-I-V SYSTEM

This general-purpose system includes:

- Model 2400 SourceMeter instrument for laser drive and forward voltage measurement
- Model 2500 Photodiode Meter for back facet detector measurement and front facet optical power measurement
- Model 2510 TEC Controller for temperature control of the internal TEC module

### MODEL LIV-2: TRANSMITTER MODULE L-I-V SYSTEM

This system is configured specifically for testing transmitter laser modules in the 1330nm to 1550nm range, and includes:

- Model 2420 SourceMeter instrument for laser drive and forward voltage measurement
- Model 2500 Photodiode Meter for back facet detector measurement and front facet optical power measurement
- Model 2510-AT TEC Controller for temperature control of the internal TEC module
- Model 2500INT Integrating Sphere with a cooled InGaAs detector and an FC/PC input connector for optical power measurement

### MODEL LIV-3: 980NM PUMP L-I-V SYSTEM

This system is configured specifically for testing 980nm pump lasers with input current levels of 3A or less. It includes:

- Model 2420 SourceMeter instrument for laser drive up to 3A and forward voltage measurement
- Model 2500 Photodiode Meter for back facet detector measurement and front facet optical power measurement
- Model 2510-AT TEC Controller for temperature control of the internal TEC module
- Model 2500INT Integrating Sphere with a silicon detector and an FC/PC input connector for optical power measurement

### MODEL LIV-4: HIGH POWER PUMP MODULE L-I-V SYSTEM

Configured specifically for testing transmitter high power pump laser modules with a 14XXnm wavelength, this system includes:

- Model 2440 SourceMeter instrument for laser drive up to 5A and forward voltage measurement
- Model 2500 Photodiode Meter for back facet detector measurement and front facet optical power measurement
- Model 2510-AT TEC Controller for temperature control of the internal TEC module
- Model 2500INT Integrating Sphere with a germanium detector and an FC/PC input connector for optical power measurement

## Ambient Temperature Control Options

If it is necessary to adjust the ambient temperature during testing, each of the standard configurations is available with an additional Model 2510-AT TEC Controller for Fixture Control. To order, simply add "-F" to the model number.

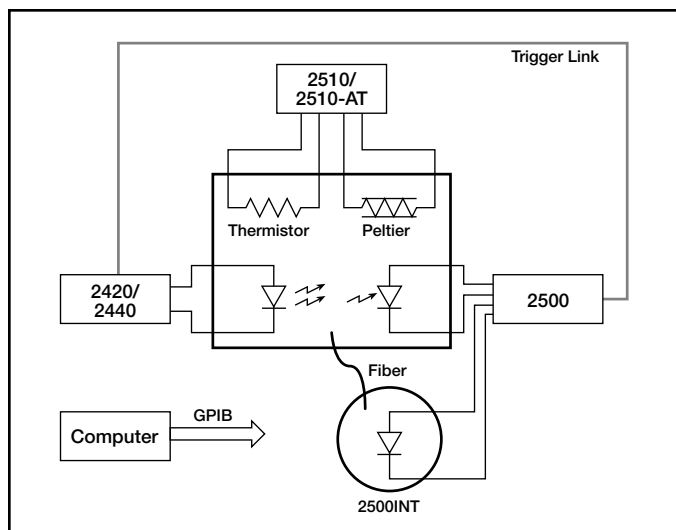


Figure 1. The standard L-I-V test system is designed for applications that require the highest measurement accuracy. The Model 2420 SourceMeter drives the laser diode, sweeping the drive current from 0A up to 3A in programmable steps. At each step in the sweep, the Model 2420 records the current and voltage measurements, while the Model 2500 measures and records the current flow in the photodiodes. When the sweep is complete, the raw measurement data from the Model 2420 and the Model 2500 is uploaded to the PC for analysis. The L-I-V Demo Software can calculate first and second derivatives of the back facet monitor diode or the external photo detector.

## Flexible System Configuration Options

In addition to the standard system configurations, L-I-V test systems can be customized to accommodate virtually any test sequence or set-up requirement. Adding new capabilities or expanding existing ones is as simple as adding a new Keithley instrument or switch system. For example, to add isolation resistance measurements, just include any of Keithley's Series 2000 Digital Multimeters in the configuration.

To accommodate multiple pin-out schemes, choose a Series 7000 Switch Mainframe and plug in one or more switch cards, such as the Model 7012 4x10 Matrix Card or the Model 7053 High Current Scanner Card for switching up to 5A. Automated switching makes it simple to accommodate future pin-out configuration changes.

A custom configuration and ordering guide is available to simplify selecting all the critical items need to complete a system.

## Single Vendor Solution

In addition to the assurance of hardware and software compatibility, systems integrators can be confident they'll get all the technical support they need to complete and maintain their systems from a single source. Keithley's applications engineers can help systems integrators optimize the performance of each instrument in the system to ensure high speed and accuracy from the system as a whole.

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