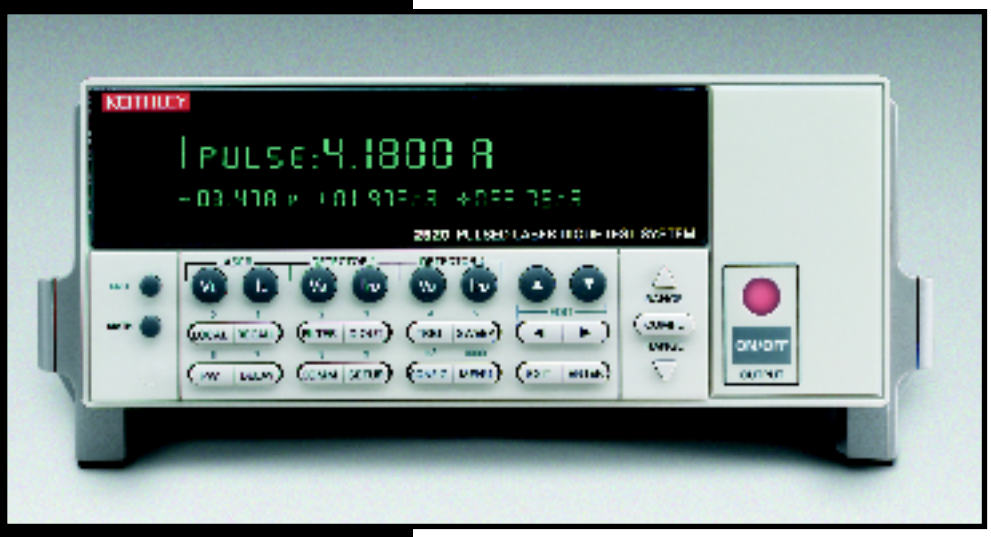
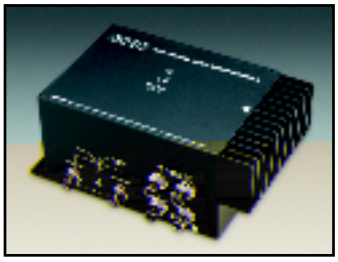
Complete pulse test of laser diode bars and chips with dual photocurrent measurement channels

OPTOELECTRONIC TEST SOLUTIONS

2520

Pulsed Laser Diode Test System





- **Simplifies laser diode L-I-V testing prior to packaging or active temperature control**
- **Integrated solution for in-process L-I-V production testing of laser diodes at the chip or bar level**
- **Combines high accuracy source and measure capabilities for pulsed and DC testing**
- **Synchronized DSP based measurement channels ensure accurate optical power and voltage measurements**
- **Programmable pulse on time from 500ns to 5ms up to 4% duty cycle**
- **Pulse capability up to 5A, DC capability up to 1A**
- **14-bit measurement accuracy on t cycle•Digital I/O binning and handlin Diode Test System is an integrated, sy chronized system for testing laser diodes at the bar or chip level, prior t integration into a temperature con- trolled module. The Model 2520 pro- vides all sourcing and measurement capabilities needed for pulsed and DC L-I-V (light-current-voltage) testing of laser diodes in one compact, half-rac instrument. The tight synchronization of source and measure capabilities ensures high measurement accuracy, even when testing with pulse widths a short as 500ns.**

L-I-V Test Capability

The Model 2520 can perform pulsed L-I-V testing up to 5A and continuous

amplifiers. The instrument's ability to per- pulsed L-I-V sweeps on the same device with impact of thermal transients on the L-I-V

APPLICATIONS

Wafer-, bar-, or chip-level L-I-V production testing of:

- **Telecommunication laser diodes**
- **Optical storage read/write head laser diodes**
- **Vertical Cavity Surface-Emitting Lasers (VCSELs)**

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2520

Pulsed Laser Diode Test System

Ordering Information

2520 **Pulsed Laser Diode Test System with Remote Test Head**

This product is available with an Extended Warranty.

Accessories Supplied

User's Manual, Quick Reference Guide, Triax Cables (2), BNC 10Ω Coaxial Cables (4)

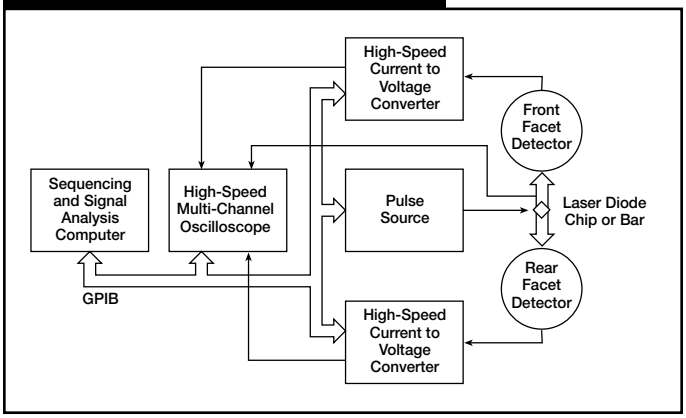


Figure 1. This schematic reflects the current testing practices of major laser diode manufacturers. Note that the use of discrete test components increases the integration and programming effort, while severely limiting the flexibility of the test system.

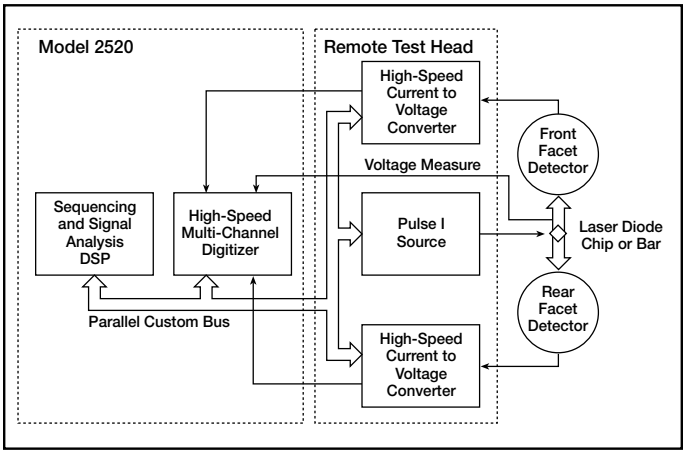


Figure 2. The Model 2520 integrates synchronization, source, and measure capabilities in a single half-rack instrument (with remote test head) to provide maximum flexibility and test throughput.

waveforms measured. This means the Model 2520 stores only that portion of the pulse that is "flat" and contains meaningful data. All measurements made in the flat portion of the pulse are averaged to improve the Signal-to-Noise ratio still further. If greater resolution is required, the Model 2520 can be programmed to perform several pulse and measure cycles at the same pulse amplitude. By making it possible to conduct more thorough testing at the bar or chip level, the Model 2520 also eliminates the wasted time and costs associated with assembling then scrapping modules with non-compliant diodes.

Simple, One-Box Test Solution

The Model 2520 offers three channels of source and measurement circuitry. All three channels are controlled by a single digital signal processor (DSP), which ensures tight synchronization of the sourcing and measuring functions. The laser diode drive channel provides a current source coupled with voltage measurement capability. Each of the two photodetector channels supplies an adjustable voltage bias and voltage compliance, in addition to current measurement capability. These three channels provide all the source and measure capabilities needed for full L-I-V characterization of laser diodes prior to integration into temperature controlled modules. By eliminating the need for GPIB commands to perform test sweeps with multiple separate instruments, the Model 2520's integrated sourcing and measurement allows a significant improvement in throughput.

Remote Test Head Maximizes Signal-to-Noise Ratio

The mainframe and remote test head architecture of the Model 2520 is designed to enhance pulsed measurement accuracy, even at the sub-microsecond level. The remote test head ensures the measurement circuitry is located near the DUT, mounted on the fixture, minimizing cable effects. As the schematic in **Figure 1** shows, traditional semi-custom systems typically employed in the past require significant integration. The architecture of the Model 2520 (**Figure 2**) offers a far more compact and ready-to-use solution.

High-Speed Pulse and Measure to Minimize Thermal Effects

The Model 2520 can accurately source and measure pulses as short as 500 nanoseconds to minimize unwanted thermal effects during L-I-V testing. Users can program the pulse width from 500ns to 5ms and pulse off time from 20μs to 500ms. There is a software duty cycle limit of 4% for currents higher than 1A. To ensure greater accuracy, the instrument provides pulse width programming resolution levels of 10μs (off time) and 100ns (on time).

Prior to the introduction of the Model 2520, test instrument limitations often placed barriers on test performance. However, with the Model 2520, the limiting factor is not the test instrument, but the physics of the connections to the device. Keithley's optoelectronics applications engineers have addressed these issues by studying and documenting the optimum cable configuration to enhance measurement accuracy with extremely fast pulses. **Figure 3** illustrates the results of a typical pulse L-I-V sweep test with the Model 2520. In this test, a 100-point pulsed L-I-V sweep using a 1μs pulse width, at 1% duty cycle, was completed in just 10ms, several orders of magnitude faster than existing, semi-custom test systems.

ESD Protection

A laser diode's material make-up, design, and small size make it extremely sensitive to temperature increases and electrostatic discharges (ESDs). To prevent damage, prior to the start of the test and after test completion, the Model 2520 shorts the DUT to prevent transients from destroying the device. The instrument's 500 nanosecond pulse and measure test cycle minimizes device heating during test, especially when a short duty cycle is used.

Test Sequencing and Optimization

Up to five user-definable test setups can be stored in the Model 2520 for easy recall. The Model 2520's built-in Buffer Memory and Trigger Link interface can reduce or even eliminate time-consuming GPIB traffic during a test sequence.

2520 Pulsed Laser Diode Test System

The Buffer Memory can store up to 2500 points of measurement data during the test sweep. The Trigger Link combines six independent software selectable trigger lines on a single connector for simple, direct control over all instruments in a system. This interface allows the Model 2520 to operate autonomously following an input trigger. The Model 2520 can be programmed to output a trigger to a compatible OSA or wavelength meter several nanoseconds prior to outputting a programmed drive current value to initiate spectral measurements.

Accessories and Options

The Model 2520 comes with all the interconnecting cables required for the main instrument and the remote test head. Production test practices vary widely (automated vs. semi-automated vs. manual), so the cable assemblies from the remote test head to the DUT can vary significantly. To accommodate these differing requirements, Keithley has developed the Model 2520 RTH to DUT Cable Configuration Guide to help customers determine the proper cable assemblies to use to connect the remote test head (RTH) to the DUT.

Interface Options

The Model 2520 provides standard IEEE-488 and RS-232 interfaces to speed and simplify system integration and control. A built-in digital I/O interface can be used to simplify external handler control and binning operations.

Additional L-I-V Test Solutions

For production testing laser diodes after they have been packaged in temperature controlled modules, Keithley offers the Laser Diode L-I-V Test System with increased 28-bit core measurement resolution, allowing for more detailed characterization. This flexible system combines all the DC measurement capabilities required to test these modules with tight temperature control over the DUT in a modular instrument package. Configured from proven Keithley instrumentation, the basic configuration can be easily modified to add new measurement functions as new testing needs evolve.

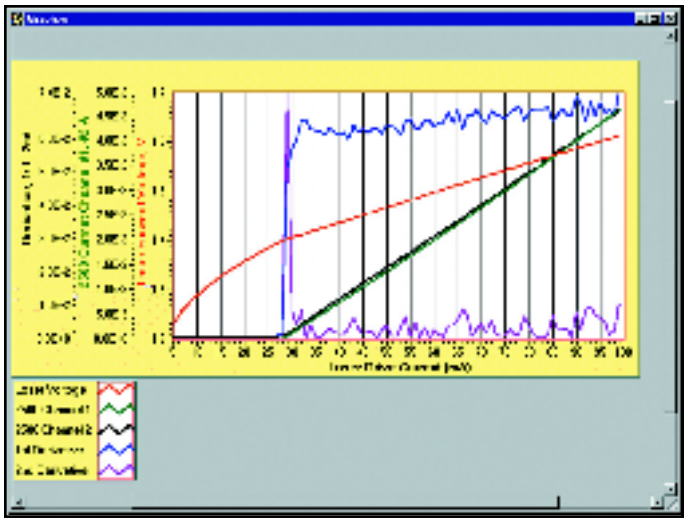
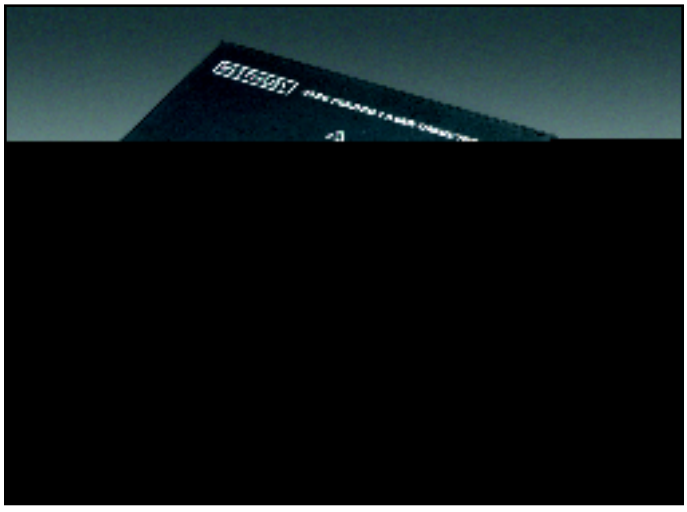


Figure 3. This plot illustrates the Model 2520's pulsed L-I-V sweep capability. The sweep was programmed from 0 to 100mA in 1mA steps. Pulse width was programmed at 1µs at 1% duty cycle, providing for a complete sweep in just 10ms (excluding data transfer time).



Model 2520 Remote Test Head

2520 Pulsed Laser Diode Test System

LASER DIODE PULSE OR DC CURRENT SOURCE SPECIFICATIONS

		DRIVE CURRENT			OFF CURRENT[4]		
		ACCURACY[1] ±(% rdg. + mA)		RMS NOISE (typical)			
SOURCE RANGE	RESOLUTION	DC[2]	Pulsed[3]	(1kHz–20MHz)[5]	RANGE	RESOLUTION	ACCURACY[1] ±(% rdg. + mA)
0–500 mA	10 μA	0.3 + 0.45	0.2 + 0.45	70 μA	0–18 mA	8 μA	0.2 + 0.45
0–5.00 A	100 μA	0.5 + 4.5	0.2 + 4.5	800 μA	0–180 mA	80 μA	0.2 + 4.5

[1] 1 year, 23°C ±5°C.
[2] Current on for less than 10 seconds, 10% duty cycle. Longer pulse width and shorter delay between pulses may cause self heating and degrade this performance.
[3] Not including overshoot and settling time.
[4] Pulse mode only.
[5] Output: 500mA DC on 500mA range and 1A DC on 5A range.

TEMPERATURE COEFFIECIENT (0°–18°C & 28°–50°C): ±(0.15 × accuracy specification)/°C.
PULSE ON TIME: 500ns to 5ms, 100ns programming resolution, up to 4% duty cycle.
PULSE OFF TIME: 20μs to 500ms, 10μs programming resolution; valid only in sweep mode.
PULSE DUTY CYCLE: ≤4%.
VOLTAGE COMPLIANCE: 3V to 10V, 100mV programming resolution, ±200mV accuracy.
MAX. PULSE SOURCE POWER: 45W, 5A @ 9.5V on 5A range at output BNCs.
MAX. DC SOURCE POWER: 9.9W, 1.0A @ 9.9V on 5A range at output BNCs.

SETTING AND RANGE	LOAD[1]	PULSE MODE[5]	PULSE OVERSHOOT MAX.[2, 3, 4]	RISE/FALL TIME[2, 3, 5] TYPICAL	MAX.
500 mA	10Ω ¼ Watt	Fast	1.0%	55 ns	80 ns
500 mA	10Ω ¼ Watt	Slow	0.1%	1 μs	1.3 μs
5.0 A	1.8Ω 1 Watt	Fast	1.0%	100 ns	130 ns
5.0 A	1.8Ω 1 Watt	Slow	0.1%	1 μs	1.3 μs

[1] Figure 4 depicts the cable arrangement for these characteristics. The 10Ω load is a RN-55D resistor; the 1.8Ω load is formed by ten 18Ω RN-55D resistors in parallel. Figures 6 and 7 are typical pulse outputs into resistive loads.
[2] Typical.
[3] Per ANSI/IEEE Std 181-1977
[4] Per ANSI/IEEE Std 181-1977 10% to 90%
[5] Slow mode is used for longer than nominal interconnection cables.

POLARITY: 1 quadrant source, polarity reversal available through internal relay inversion.
OUTPUT OFF: < 200mW short across laser diode; measured at Remote Test Head connector.

LASER DIODE VOLTAGE MEASURE SPECIFICATIONS

RANGE	MINIMUM RESOLUTION[4]	ACCURACY ±(% rdg. + volts)[1, 2]	RMS NOISE (typical)[3]
5.000 V	0.33 mV	0.3% + 6.5 mV	0.3 mV
10.00 V	0.66 mV	0.3% + 8 mV	0.6 mV

[1] 1 Year, 23°C ±5°C.
[2] At DC, 10ms measurement pulse width.
[3] Standard deviation of 10,000 readings with 10ms pulse width, filter off, with Figure 4 cable configuration and I source set to 0 Amps DC.
[4] The A/D converter has 14 bit resolution. The useful resolution is improved by reading averaging. The useful resolution is:

$$\text{Useful Resolution} = \frac{\text{Range}}{2^{14}} \cdot \frac{1}{\sqrt{\frac{\text{Pulse Width (ns)} - 400\text{ns}}{100\text{ns}}}} \cdot \text{Averaging Filter Setting}$$

TEMPERATURE COEFFIECIENT (0°–18°C & 28°–50°C): ±(0.15 × accuracy specification)/°C.
MAX. LEAD RESISTANCE: 100Ω for rated accuracy.
INPUT IMPEDANCE: 2MΩ differential typical.

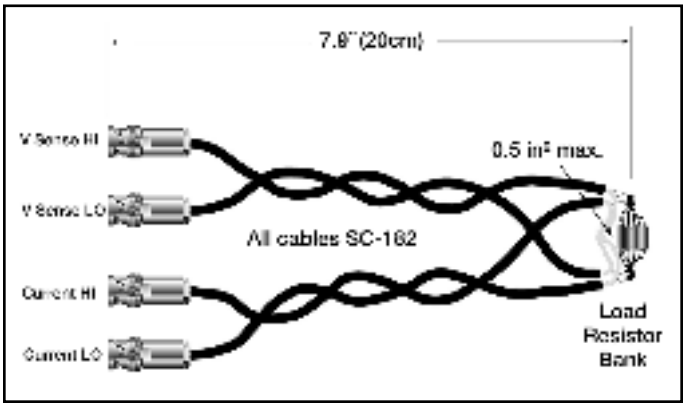


Figure 4. Nominal interconnection diagram

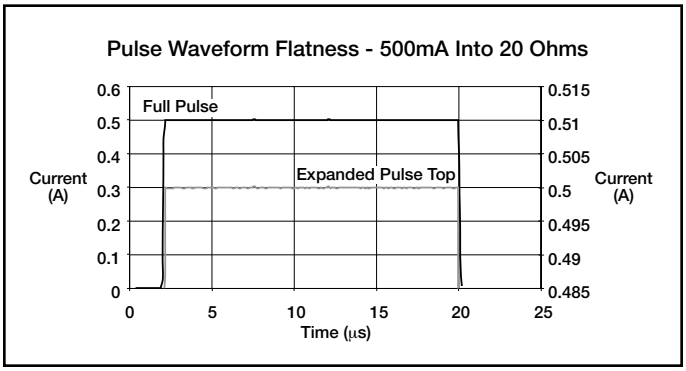


Figure 5.

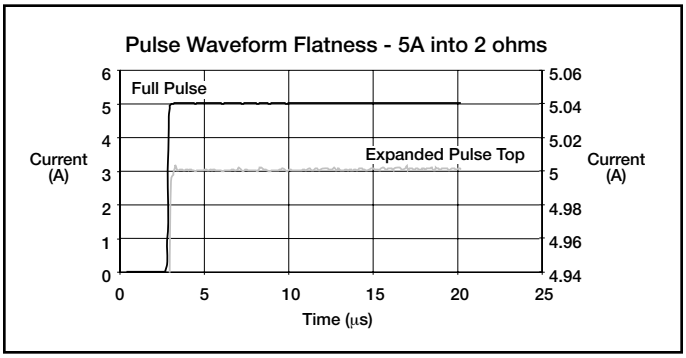


Figure 6

2520 Pulsed Laser Diode Test System

Model 2520 Specifications

OPTOELECTRONIC TEST SOLUTIONS

GENERAL

DC FLOATING VOLTAGE: User may float common ground up to ±10VDC from chassis ground.

COMMON MODE ISOLATION: >$10^9\Omega$.

OVERRANGE: 105% of range on all functions.

SOURCE OUTPUT MODES:

Fixed DC Level
Fixed Pulse Level
DC Sweep (linear, log and list)
Pulse Sweep (linear, log and list)

PROGRAMMABILITY: IEEE-488 (SCPI-1995.0), RS-232, 5 user-definable power-up states plus factory default and *RST.

DIGITAL INTERFACE:

Safety Interlock: External mechanical contact connector and removable key switch.

Aux. Supply: +5V @ 300mA supply.

Digital I/O: 2 trigger input, 4 TTL/Relay Drive outputs (33V @ 500mA Max, diode clamped).

Tlink: 6 programmable trigger input/outputs.

Pulse Trigger Out BNC: +5V, 50Ω output impedance, output trigger corresponding to current source pulse; pulse to trigger delay <100ns. See Figure 7.

MAINS INPUT: 100V to 240V rms, 50–60Hz.

WARRANTY: 1 year.

EMC: Complies to European Union Directive 89/336/EEC (EN61326-1.)

VIBRATION: MIL-PRF-28800F Class 3, Random.

WARM-UP: 1 hour to rated accuracy.

DIMENSIONS:

Main Chassis, bench configuration (with handle & feet): WEIGHT: 2.67kg (5.90 lbs) 89mm high × 238mm wide × 416mm deep (4⅛ in × 9⅜ in × 16⅜ in).

Remote Test Head: WEIGHT: 1.23kg (2.70lbs), 95mm high × 168mm deep (with interlock key installed) × 241mm wide (3? in × 6⅝ in × 9½ in).

Cable Length, From Main Unit to Remote Test Head: 2m (79 in).

ENVIRONMENT:

Operating: