



Production test solutions for optoelectronic components



KEITHLEY

A GREATER MEASURE OF CONFIDENCE

Production testing of:

- Telecom Laser Diode Modules
- Tunable Laser Diode Modules
- Pump Lasers
- EDFAs
- Vertical Cavity Surface Emitting Lasers (VCSELs)
- Passive Optical Components
- Organic LEDs
- HiB LEDs
- Optical Storage Read/Write Heads
- Photodetectors
- Optical Switches
- IR Charge-Coupled Devices
- Solar Cells
- Optical Add/Drop Multiplexers (OADMs)



Complete solutions for optoelectronics test challenges

Integrated solutions that keep pace with production

Keithley offers a suite of products for electrical, RF, and optical production test applications that support manufacturers' needs for accuracy and throughput. Our integrated solutions combine power supplies, sensitive multi channel current meters, temperature controllers, and related test functions to deliver exceptional benefits in testing and characterizing laser diode modules and other DWDM components.

Collaborating for success

Innovative test solutions can't be invented in a vacuum. That's why Keithley has been forming working partnerships with a number of optoelectronics customers on the leading edge of device and product technology. Through these alliances, we gain applications insights that help us create test solutions for all our customers, allowing them to increase their device throughput and enhance yields, boosting production volumes. We combine these insights with more than a half-century of experience in making accurate low-level measurements to create an expanding line of flexible, easily integrated test solutions. As new device technologies evolve, our ongoing working partnerships will help our products keep pace with changing test requirements.

The Keithley difference is Keithley support

With some optoelectronics test suppliers, issuing the purchase order for a new instrument or system marks the end of the buyer/supplier relationship. At Keithley, it's just the beginning. Our team of optoelectronics applications engineers is dedicated to solving customers' test problems, both before and after the sale. Often, our applications engineers can help callers take advantage of the flexibility of their existing Keithley solutions, eliminating or delaying the need to purchase new equipment to adapt to new test requirements.

In addition to the support provided by our applications engineering group, every Keithley optoelectronics test solution is backed by the resources of our international call centers, state-of-the-art web site, and high quality calibration and repair services.



Pulsed L-I-V laser diode test solutions

INTEGRATED SOLUTIONS FOR ENHANCING YIELD AND THROUGHPUT

The Model 2520 Pulsed L-I-V Laser Diode Test System offers an integrated solution for enhancing yield and throughput when testing laser diodes early in the production process, at the bar or chip level, before they're integrated into temperature-controlled modules. This compact instrument synchronizes sourcing and measurement precisely and ensures high accuracy DC and pulsed L-I-V (light-current-voltage) testing, even with pulse widths as short as 500ns.

The Model 2520 can perform pulsed L-I-V testing up to 5A and DC L-I-V testing up to 1A. Its pulsed testing capability makes it suitable for testing a broad range of laser diodes, including the emerging pump laser designs for Raman amplifiers. It also allows operating a bar- or chip-level laser diode in DC mode above its threshold value in applications such as measuring spectral width with optical spectrum amplifiers (OSAs) or determining wavelength with wavelength meters.

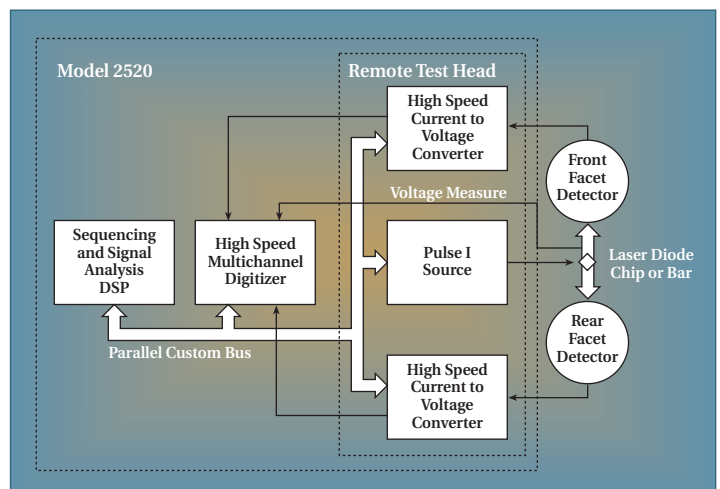
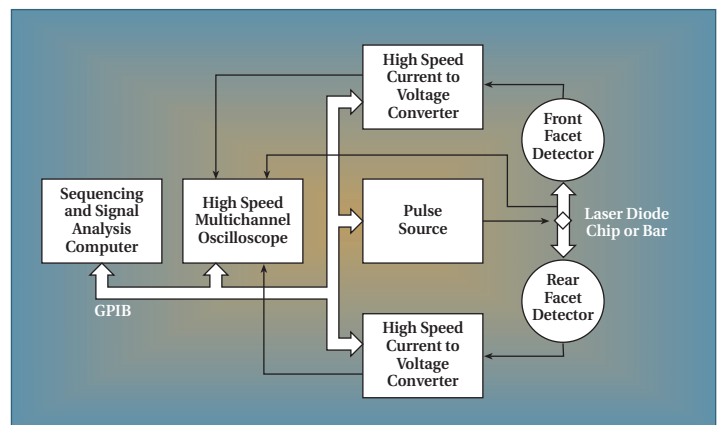
Applications

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

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

Features

- 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 highly accurate light intensity 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 three measurement channels (V_B , front photodiode, back photodiode).
- Measurement algorithm increases the pulse measurement's signal-to-noise ratio.
- 2500-point buffer memory (5000 pt/s) eliminates GPIB traffic during test, increasing throughput.
- Digital I/O binning and handling operations.
- IEEE-488 and RS-232 interfaces.



The Model 2520 makes it easy to replace a complicated system with single test instrument.

Integrated L-I-V test solutions

Keithley's L-I-V (light-current-voltage) test systems help manufacturers of laser diode modules (LDMs) boost yield and throughput. They combine DC measurement capabilities with optical power measurement and tight temperature control in an integrated package. All systems are configured from proven Keithley instrumentation. Basic configurations can be easily modified to add new measurement functions or allow for new connections.

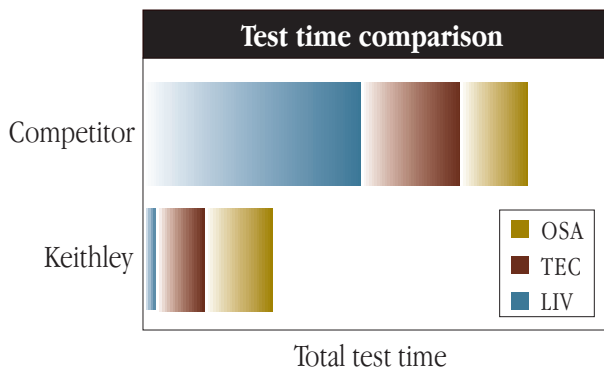
Tight integration ensures higher test speed

L-I-V test systems combine high test speeds with high configuration flexibility. The Trigger Link trigger bus combines multiple instruments for simple, direct control over all instruments in a system, reducing GPIB traffic. Digital I/O lines simplify external handler control and binning operations. These features work in concert to form an autonomous test system—all it takes to begin a 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.

Applications

It's easy to configure an L-I-V test system for a variety of laser characterization needs:

- Package module characterization.
- Continuous wave chip-on-submount testing.
- Fiber alignment.
- Telcordia verification.
- Incoming device qualification.



Standard system configurations

Several standard system configuration kits are available for testing fully assembled laser diode modules. They include all the cables and adapters required for communication, triggering, and connection to the DUT fixture, as well as rack-mounting hardware.

The **Model LIV-1 General-Purpose L-I-V System** provides all the instruments needed for DC testing and DUT temperature control.

The **Model LIV-2 Transmitter Module L-I-V System** is designed for testing transmitter laser modules in the 1330nm to 1550nm range.

The **Model LIV-3 980nm Pump L-I-V System** is configured specifically for testing 980nm pump lasers with input current levels of 3A or less.

The **Model LIV-4 High Power Pump Module L-I-V System** was developed for testing transmitter high power pump laser modules with a 14XXnm wavelength.

Features

- Programmable L-I-V test system for laser diode modules.
- Sweep and measure 400 points in <13s.
- Very low noise current source (50 μ A) for laser diode drive.
- Up to 5A laser diode drive current.
- Measures light intensity directly.
- 1fA resolution for dark current measurements.
- Fully digital PID loop for temperature control with autotune option.
- $\pm 0.005^{\circ}\text{C}$ 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.

High speed programmable laser drivers

Keithley's SourceMeter® instruments are often used as high speed programmable laser drivers. That's because they're designed specifically to increase throughput in production test applications that demand tightly coupled precision current sourcing and voltage measurement and high measurement accuracy. Choose from the SourceMeter family for testing:

- Metro VCSELs.
- Long range VCSELs.
- EDFA pump lasers.
- Raman pump lasers.
- S-, C-, and L- band transmitter lasers.
- Tunable lasers.
- CD/DVD lasers.

Features:

- Built-in sweep capability.
- Deterministic sweep timing.
- Easy to program.
- High execution speed—fast source settling time.
- Linear sweep for L-I-V.
- Log sweep capability.
- Custom sweep for proprietary source functions.
- Flexible/multiple source ranges.
- Independent ranges for all sourcing needs.
- True four-quadrant source capability.
- Reverse breakdown voltage testing.
- Precision voltage measurement..
- 5½-digit—4-wire voltage measure.
- Built-in current sweep function.



Choose the SourceMeter instrument that fits your laser testing requirements

Model 2400 - High test throughput, lower cost, 1A drive current (general purpose)

Model 2420 - High accuracy, 3A drive current

Model 2440 - High accuracy, 5A drive current

Optical power measurement solutions



Production testing laser diode modules demands instrumentation that can measure optical power quickly and accurately, and stand up to round-the-clock production schedules. It also demands instrumentation that combines low current measurement capabilities with a programmable bias source. Keithley's optical power measurement solutions ensure high throughput without sacrificing measurement integrity.

Model 2500 Dual Photodiode Meter

This dual-channel meter was designed in collaboration with major manufacturers of telecom laser diode modules. Each independent channel provides voltage biasing and current measurement capabilities.

- Dual-channel design in a space-saving, half-rack case.
- 1fA current resolution for accurate dark current measurements.
- Calibration constants can be entered directly to display results in milliwatts for optical power measurements.
- $\pm 10\text{V}$ and 100V bias ranges for different photodetector types, including APD and PIN diodes.
- High throughput—more than 1000 readings/sec.
- Trigger Link synchronization with other components of the L-I-V system.
- 100V bias supply. The 10V and 100V ranges allow reverse biasing detectors.
- $6\frac{1}{2}$ -digit resolution for precise DC current measurement.



Model 2500INT Integrating Sphere

When connected to the Model 2500 Dual Photodiode Meter, the Model 2500INT integrating sphere allows Keithley's L-I-V test systems to measure optical power directly, with results expressed in milliwatts. By eliminating common optical power measurement problems related to detector alignment, beam profile, polarization, and back reflection, the Model 2500INT simplifies production testing of laser diodes (LDs), light emitting diodes (LEDs), and other optical components.

- Simplifies beam alignment.
- Minimizes polarization concerns.
- Eliminates back reflections.
- Measures high power pumps directly.
- Offers a choice of silicon, germanium, or cooled indium gallium arsenide detectors.
- Ensures high reflectivity with a sphere interior with Spectralon® coating.

Precise temperature control



EXPERTISE IN HIGH SPEED DC SOURCING AND MEASUREMENT

The Model 2510 TEC SourceMeter® instrument ensures tight temperature control for the device under test during production testing of telecommunications laser diodes. It brings together Keithley's expertise in high speed DC sourcing and measurement with the ability to control the operation of a laser diode module's Thermo-Electric Cooler accurately. The Model 2510-AT expands these capabilities further, offering autotuning capability. This instrument can determine P, I, and D (proportional, integral, and derivative) values for closed loop temperature control, which saves time because there's no need to determine the optimal values for these coefficients experimentally.

The Model 2510 and Model 2510-AT combine precision voltage/current sourcing and measurement functions into a single instrument. Their integrated sourcing and measurement offer many advantages over the use of separate instruments, including lower acquisition and maintenance costs, lower rack space requirements, easier system integration and programming, and broad dynamic range.

Applications

Control and production testing of thermo-electric coolers/Peltier devices in:

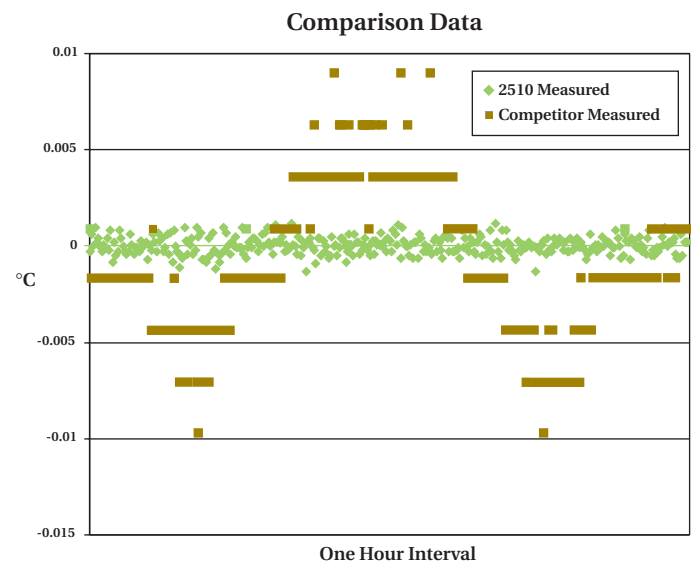
- Laser diode modules.
- IR charge-coupled device (CCD) arrays and charge-injection devices (CID).
- Cooled photodetectors.
- Cooled optical switches.

Features

- 50W TEC Controller combined with DC measurement functions.
- Provides fully digital PID control.
- 2510-AT provides autotuning capability for the thermal control loop.

- Designed to control temperature during laser diode module testing.
- Wide temperature set point range (-50°C to $+225^{\circ}\text{C}$) and high setpoint resolution ($\pm 0.001^{\circ}\text{C}$) and stability ($\pm 0.005^{\circ}\text{C}$).
- Compatible with a variety of temperature sensor inputs—thermistors, RTDs, and IC sensors.
- Maintains constant temperature, current, voltage, and sensor resistance.
- AC Ohms measurement function checks for mechanical damage to the TEC.
- Measures and displays TEC parameters during the control cycle.
- 4-wire open/short lead detection.
- Digital I/O and Trigger Link for sweep operations and synchronization.
- IEEE-488 and RS-232 interfaces.
- Compact, half-rack design.

Superior temperature stability



This graph compares the Model 2510's A/D converter resolution and temperature stability with that of a leading competitive instrument. While the competitive instrument uses an analog proportional-integral (PI) control loop, it displays information in digital format through a low resolution analog-to-digital converter. In contrast, the Model 2510 uses a high precision digital PID control loop, which provides greater temperature stability, both over the short term ($\pm 0.005^{\circ}\text{C}$) and the long term ($\pm 0.01^{\circ}\text{C}$).

Photodetector characterization



We've taken everything we've learned about characterizing semiconductor devices and applied it to testing photodiodes. Whether the application requires characterizing photodiodes in the lab, on a wafer, in production, or at the finished device stage, Keithley has an instrument that speeds and simplifies the process. Keithley instruments and systems have been used for many years for testing avalanche photodiodes (APD), positive intrinsic negative structure (PIN) photodiodes, and general-purpose photodiodes.

Applications

Research

- Model 6430 Sub-Femtoamp Remote SourceMeter® instrument
- Model 6517A Electrometer/High Resistance Meter
- Model 6485 Picoammeter

Production

- Model 236 Source-Measure Unit

General Purpose

- Model 2400 SourceMeter instrument



Research

The 5½-digit Model 6485 Picoammeter is significantly less expensive than other instruments that perform similar functions, such as optical power meters, competitive picoammeters, or user-designed solutions. With eight current measurement ranges and high speed autoranging, the Model 6485 can measure currents from 20fA to 20mA. A feedback picoammeter design gives it a voltage burden of less than 200 μ V on the lower measurement ranges, so it can make low current measurements with high accuracy, even in circuits with very low source voltages. For research on light-sensitive components, such as measuring photodiode dark currents, the front panel display can be switched off to avoid introducing light that could significantly reduce the accuracy of the results. Other optoelectronics test applications for the Model 6485 include materials and components characterization, including resistivity and leakage current measurements, device IV characterization, and fiber alignment.



Production Testing

Testing and characterizing APD and PIN photodiodes requires precision low-level sourcing and measurement capabilities, plus sophisticated test sequencing. The Model 236 Source-Measure Unit combines bipolar current and voltage sourcing and measurement capabilities with sensitive current ranges and high accuracy, as well as programmable functions that speed V_F , V_R , and I_R measurements. During testing, the Model 236's compliance capability prevents excessive current or voltage from damaging the photodiode. For wafer-level photodiode tests, several Model 236s can be used in conjunction with the Model 707 Switch Mainframe and Model 7174A 8x12 High Speed Low Current Matrix Cards.

The Model 236 can be programmed to make source-measurements as a function of a stepped voltage or current. Voltage and current may be swept linearly, logarithmically, or pulsed.

Hybrid switching – DC, RF, and optical

KEITHLEY OFFERS AN ARRAY OF ROBUST, RELIABLE SWITCH SYSTEMS

Keithley offers an array of robust, reliable switch systems for all types of signals, which simplifies configuring an optimum signal routing solution for just about any application. Whether the task calls for a matrix or multiplexer, or involves routing DC, RF, microwave, optical, or digital I/O signals, Keithley can offer a variety of cost-effective switch systems; both standard and custom solutions are available.



Model 7090 Optical Switch Cards

The Model 7090 Optical Switch Cards are Keithley's first optical switching products and the latest additions to our line of cards for Model 7001 and 7002 switch mainframes. These cards simplify making secure connections from one input fiber channel to four, eight, or sixteen output fiber channels. When combined with existing Series 7000 switch cards, they can be used to create hybrid solutions that bring together optical, RF, and DC switching in a single switch mainframe. This not only provides a more compact solution, but allows for simpler switching synchronization and reduced test time.

Series 7000 switch/control cards provide Keithley's broadest range of electrical and optical switching capabilities

The slots in the Series 7000 mainframes support a family of more than 40 switch/control cards for routing the industry's widest range of electrical and optical signals for production test and sensitive measurement applications. These cards make it easy to assemble a switch configuration that will ensure signal integrity, minimize errors, and prevent degradation due to offset voltage, isolation resistance, and leakage current.

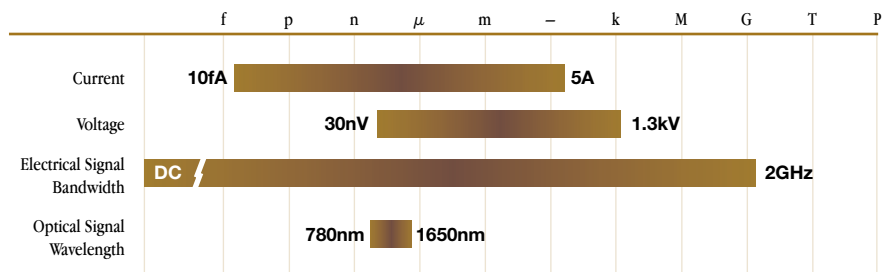


System 40/41–Standard and custom designs for a perfect fit

Signal routing solutions are designed and built to match specific application requirements from DC to 40GHz. Create a unique switching solution by integrating RF/microwave, optical, and low frequency switching.

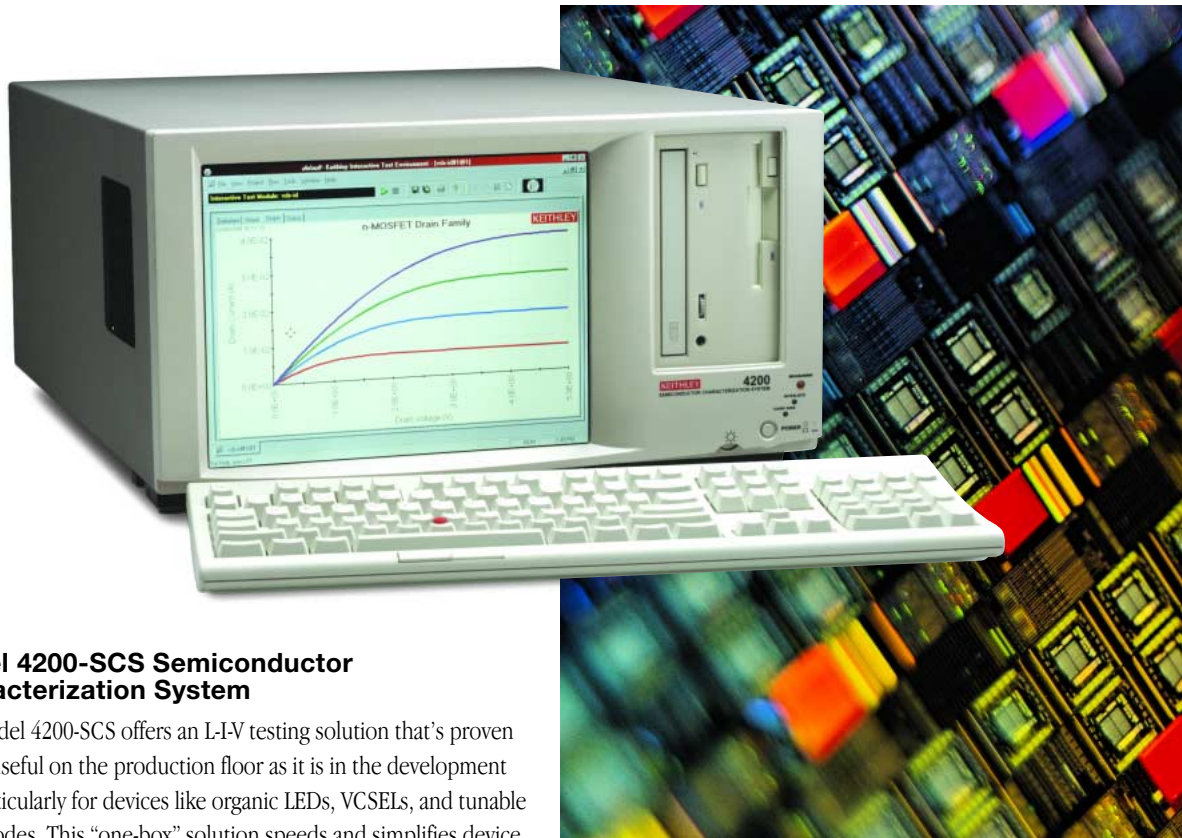
Applications

- Active component production testing.
- Laser diode modules.
- Chip on submount laser diode.
- Laser bar testing.
- LEDs.
- Passive component testing.
- Sub-assembly testing.
- OC48, OC192, OC768 receiver assembly.
- DWDM transmitter assembly.



Range of signals supported by the Series 7000 switch/control cards

From development lab to production floor



Model 4200-SCS Semiconductor Characterization System

The Model 4200-SCS offers an L-I-V testing solution that's proven just as useful on the production floor as it is in the development lab, particularly for devices like organic LEDs, VCSELs, and tunable laser diodes. This "one-box" solution speeds and simplifies device characterization at both the wafer level and the packaged device stage. The Model 4200-SCS can be configured with from two to eight Source-Measure Units. A GPIB interface makes it easy to integrate the system with external hardware, such as a TEC controller, wavelength meter, or power meter.

The Model 4200-SCS's familiar point-and-click Windows NT interface allows even infrequent users to begin testing productively right away, without programming assistance. Results are plotted automatically and can be exported easily in a choice of report-ready formats. A variety of parameter extraction functions and constants are supplied to simplify parameter analysis for kink testing, threshold current calculation, etc. As new test requirements emerge over time, the Model 4200-SCS's flexible, modular platform allows it to be reconfigured at the factory to perform new functions.

Are you ready for Keithley optoelectronics test performance?

A greater measure of confidence

With more than a half-century of expertise in making demanding low level measurements, Keithley offers its customers a greater measure of testing confidence on the production floor, in the QA lab, and in R&D. For more information on how Keithley test solutions can help you keep pace with changing technologies, call your local Keithley sales engineer or visit our website.

Switching Handbook

Request a FREE copy of Keithley's Switching Handbook or our Low Level Measurements handbook. Also, be sure to check out Keithley's website for downloadable technical literature, including articles, application notes, and white papers on automated switching. A new white paper titled "Product Testing Where RF Meets Broadband—Convergence of RF, Optical, and Digital Test Environments" offers valuable insights on hybrid switching solutions.



Keithley's expert applications engineers are here to help

Selecting and configuring a optoelectronics test system can sometimes be confusing. Ask to talk with one of the optoelectronics test experts in Keithley's Applications Engineering team. They're here to help you solve your toughest test and switching challenges, before and after the sale.

All the support you need

For applications assistance, call us on our toll-free hotline at 1-888-KEITHLEY (534-8453) from 8:00 am to 5:00 pm ET (U.S. only). If you need assistance beyond those hours, send our Applications Engineering Department a facsimile (440-248-6168) or an e-mail message (product_info@keithley.com) and we'll respond as soon as possible. Applications assistance is also available via the web, with many reference materials available online, as well as convenient forms for contacting our Applications Engineers. Keithley maintains facilities and affiliates worldwide, which offer native language support services. Visit our web site for current listings: www.keithley.com

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