

2502

듀얼-채널 피코암미터 (Picoammeter)

KEITHLEY
A Tektronix Company



- Dual-channel instrument for optical power measurements, beam measurements, and nanoscale materials and device research
- ±100V source for bias requirements
- Measure photodetector current from 1fA to 20mA
- 1fA current measurement resolution
- Measure optical power directly when used with Model 2500INT Integrating Sphere
- 0–10V analog output for high resolution optical power feedback
- Provides a high accuracy, high speed fiber alignment solution
- Supports assembly process, final testing, parts binning, and specification
- Allows faster alignment of the fiber with the laser diode's optimum light emitting region
- Combines fiber alignment and device characterization processes
- User-programmable photodetector calibration coefficients
- 3000-point buffer memory on each channel allows data transfer after test completion
- Digital I/O and Trigger Link for binning and sweep test operations
- IEEE-488 and RS-232 interfaces

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Ordering Information

2502 Dual-Channel Picoammeter

**Accessories Supplied
User's Manual**

ACCESSORIES AVAILABLE

7007-1	Shielded IEEE-488 Cable, 1m (3.3 ft)
7007-2	Shielded IEEE-488 Cable, 2m (6.6 ft)
7009-5	Shielded RS-232 Cable
7078-TRX-3	Low Noise Triax Cable, 0.9m (3 ft)
8501-1	Trigger Link Cable, 1m (3.3 ft)
KPCI-488LPA	IEEE-488 Interface/Controller for the PCI Bus
KUSB-488B	IEEE-488 USB-to-GPIB Interface Adapter

SERVICES AVAILABLE

2502-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
C/2502-3Y-DATA	3 (Z540-1 compliant) calibrations within 3 years of purchase*

*Not available in all countries

Dual-Channel Picoammeter

and many others. The Model 2502 meets industry testing requirements for the transmitter as well as pump laser modules. The extensive current measurement range provides excellent sensitivity and resolution for beam current and radiation monitoring measurements.

High Accuracy Dark Current Measurements

The Model 2502's 2nA current measurement range is ideal for measuring dark currents and other low currents with 1fA resolution. Once the level of dark current has been determined, the instrument's REL function automatically subtracts the dark current as an offset so the measured values are more accurate for optical power measurements.

Voltage Bias Capability

The Model 2502 provides a choice of voltage bias ranges: $\pm 10V$ or $\pm 100V$. This choice gives the system integrator the ability to match the bias range more closely to the type of photodetector being tested, typically $\pm 10V$ for large area photodetectors and $\pm 100V$ for avalanche-type photodetectors. This ability to match the bias to the photodetector ensures improved measurement linearity and accuracy. Also, the 100V range provides a source voltage for an SEM target bias supply.

High Testing Throughput

The Model 2502 is capable of taking 900 readings/second per channel at 4½-digit resolution. This speed is comparable with the measurement speed of the Model 2400 SourceMeter SMU instrument, which is often used in conjunction with the Model 2502 to perform optoelectronic device test and characterization. Both instruments support Trigger Link (a proprietary "hardware handshaking" triggering system that's unique to Keithley products) and buffer memory. When programmed to execute a sweep, Trigger Link ensures measurement integrity by keeping the source and measurement functions working in lock step while the buffer memories record the measurements. Together, source memory, buffer memory, and Trigger Link eliminate GPIB traffic during a test sweep, improving test throughput dramatically.

Ratio and Delta Measurements

The Model 2502 can provide ratio or delta measurements between the two completely isolated channels, such as the ratio of the back facet monitor detector to the fiber-coupled photodetector at varying levels of input current. These functions can be accessed via the front panel or the GPIB interface. For test setups with multiple detectors, this capability allows for targeted control capabilities for the laser diode module.

Programmable Limits and Filters

As with most Keithley instruments, the Model 2502's current and voltage limits can be programmed to ensure device protection during critical points such as start of test, etc. These instruments also provide Average and Median filters, which can be applied to the data stored in the buffer memory.

Adaptable to Evolving DUT Requirements

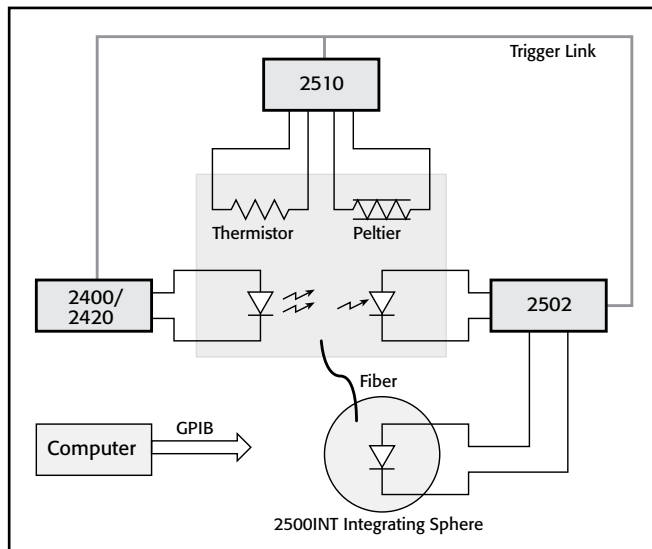
Unlike optical power meters with integrated detectors, the Model 2502 allows the user to choose from a wide range of measurement capabilities simply by selecting an appropriate photodetector and programming the calibration coefficient of this detector at the wavelength of choice.

Interface Options

To speed and simplify system integration and control, the Model 2502 includes the Trigger Link feature and digital I/O lines, as well as standard IEEE-488 and RS-232 interfaces. The Trigger Link feature combines six

APPLICATIONS

- Scanning electron microscope (SEM) beam measurements
- Production testing of:
 - Laser diode modules
 - Chip on submount laser diodes
- LEDs
- Passive optical components
- Laser diode bars
- Fiber alignment



The Model 2502 is designed for tight integration with other Keithley instruments that are often used in LIV test systems for laser diode modules. These other instruments include the Model 2400 SourceMeter® and Model 2510 TEC SourceMeter SMU instruments.

independent software selectable trigger lines on a single connector for simple, direct control over all instruments in a system. This feature is especially useful for reducing total test time if the test involves a sweep. The Model 2502 can sweep through a series of measurements based on triggers received from other instruments. The digital I/O lines simplify external handler control and binning operations.

The Model 2502 Dual-Channel Picoammeter can measure and display either photodiode current or optical power for two photodiodes with appropriate user-supplied optical power gain/wavelength calibration factors.

The Model 2502 includes an analog output jack on the rear panel for each channel.

Measurement Specifications

Range	Maximum Resolution	Accuracy ^{1,2} 23°C ±5°C ±(% rdg. + offset)	Temperature Coefficient 0°-18°C & 28°-50°C ±(%rdg. + offset)/°C	Dc Input Impedance ³ (Maximum)
2.000000 nA	1 fA	1.00% + 2 pA	0.01 + 200 fA	20 kΩ
20.00000 nA	10 fA	0.40% + 2 pA	0.01 + 200 fA	20 kΩ
200.0000 nA	100 fA	0.30% + 200 pA	0.02 + 20 pA	200 Ω
2.000000 μA	1 pA	0.20% + 200 pA	0.02 + 20 pA	200 Ω
20.00000 μA	10 pA	0.10% + 20 nA	0.01 + 2 nA	2.0 Ω
200.0000 μA	100 pA	0.10% + 20 nA	0.01 + 2 nA	2.0 Ω
2.000000 mA	1 nA	0.10% + 2 μA	0.02 + 200 nA	0.2 Ω
20.00000 mA	10 nA	0.10% + 2 μA	0.02 + 200 nA	0.2 Ω

MAXIMUM INPUT: ±20.0mA.

TYPICAL SPEED AND NOISE REJECTION⁴

Digits	Readings/s		NPLC	NMRR
	GPIB (SCPI)	GPIB (488.1)		
4½	700	900	0.01	—
5½	460	475	0.1	—
6½	58	58	1	60 dB

PHOTODIODE VOLTAGE BIAS SPECIFICATIONS²

Range	Resolution	Accuracy 23°C ±5°C ±(0.15% of setting + 5 mV)	Maximum Current	Load Regulation ⁵	Temperature Coefficient
0 to ±10 V	<400 μV	±(0.15% of setting + 5 mV)	20 mA	< 0.30%, 0 to 20 mA	150 ppm/°C
0 to ±100 V	<4 mV	±(0.3% of setting + 50 mV)	20 mA	< 0.30%, 0 to 20 mA	300 ppm/°C

ANALOG OUTPUT SPECIFICATIONS

OUTPUT VOLTAGE RANGE⁹: Output is inverting: -10V out for positive full scale input.
+10V out for negative full scale input.

Range	Accuracy 23°C ±5°C ±(%output + offset)	Temperature Coefficient 0°-18°C & 28°-50°C ±(%output + offset)/°C	Rise Time Typical (10% to 90%)
2.000000 nA	6.0% + 90 mV	0.30% + 7 mV	6.1 ms
20.00000 nA	3.0% + 9 mV	0.11% + 700 μV	6.1 ms
200.0000 nA	6.0% + 90 mV	0.30% + 4 mV	395 μs
2.000000 μA	3.0% + 9 mV	0.11% + 400 μV	395 μs
20.00000 μA	6.0% + 90 mV	0.30% + 4 mV	135 μs
200.0000 μA	2.5% + 9 mV	0.11% + 400 μV	135 μs
2.000000 mA	6.0% + 90 mV	0.30% + 4 mV	21 μs
20.00000 mA	2.5% + 9 mV	0.11% + 400 μV	21 μs

GENERAL

Typical Noise Floor Measurement Specification⁶

Range	Typical Noise Floor RMS (1 STDEV), 100 Samples			
	0.01 NPLC	0.1 NPLC	1.0 NPLC	10 NPLC
2.000000 nA	2 pA	1 pA	40 fA	15 fA
20.00000 nA	2 pA	1 pA	40 fA	15 fA
200.0000 nA	200 pA	100 pA	2 pA	500 fA
2.000000 μA	200 pA	100 pA	2 pA	500 fA
20.00000 μA	20 nA	10 nA	200 pA	50 pA
200.0000 μA	20 nA	10 nA	200 pA	50 pA
2.000000 mA	2 μA	1 μA	25 nA	5 nA
20.00000 mA	2 μA	1 μA	25 nA	5 nA

SOURCE CAPACITANCE: Stable to 10.0nF typical.

INPUT BIAS CURRENT⁷: 50fA max. @ 23°C.

INPUT VOLTAGE BURDEN⁸: 4.0mV max.

VOLTAGE SOURCE SLEW RATE: 3.0ms/V typical.

COMMON MODE VOLTAGE: 200VDC.

COMMON MODE ISOLATION: Typically 10⁶Ω in parallel with 150nF.

OVERRRANGE: 105% of measurement range.

MEMORY BUFFER: 6000 readings (two 3000 point buffers). Includes selected measured value(s) and time stamp.

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

DIGITAL INTERFACE:

Enable: Active low input.

Handler Interface: Start of test, end of test, 3 category bits. +5V @ 300mA supply.

Digital I/O: 1 trigger input, 4 TTL/Relay Drive outputs (33V @ 500mA, diode clamped).

POWER SUPPLY: 100V/120V/220V/240V ±10%.

LINE FREQUENCY: 50, 60Hz.

POWER DISSIPATION: 60VA.

EMC: Complies with European Union Directive 89/336/EEC.

VIBRATION: MIL-T-28800F Random Class 3.

SAFETY: Complies with European Directive 73/23/EEC.

WARM-UP: 1 hour to rated accuracy.

DIMENSIONS: 89mm high × 213mm wide × 370mm deep (3½ in × 8½ in × 14¼ in). Bench configuration (with handle and feet): 104mm high × 238mm wide × 370mm deep (4¼ in × 9¼ in × 14¼ in).

WEIGHT: 23.1kg (10.5 lbs).

ENVIRONMENT:

Operating: 0°-50°C, 70% R.H. up to 35°C non-condensing. Derate 3% R.H./°C, 35°-50°C.

Storage: -25° to 65°C, non-condensing.

NOTES

- Speed = Normal (1.0 NPLC), Filter On.
- 1 year.
- Measured as ΔVin/ΔIin at full scale (and zero) input currents.
- Dual channel, internal trigger, measure only, display off, Autorange off, Auto Zero off, source delay = 0, filters off, limits off, CALC5 and CALC6 off, 60Hz.
- Measured as ΔVin/ΔIin at full scale (20mA) and zero load currents.
- Noise floor measured as rms (1 standard deviation), 100 samples, Filter off, open (capped) input.
- Specification by design.
- Measured (at input triax) as ΔVin at full scale (20mA) vs. zero input currents.
- The analog output voltage for each channel is referenced to that channel's floating ground.