Tektronix®

6485 Picoammeter

DATASHEET

The 5½-digit 6485 Picoammeter combines Keithley's expertise in sensitive current measurement instrumentation with enhanced speed and a robust design. With eight current measurement ranges and high speed autoranging, this cost-effective instrument can measure currents from 20 fA to 20 mA, taking measurements at speeds up to 1000 readings per second.

The 6485's 10 fA resolution and superior sensitivity make it well suited for characterizing low current phenomena, while its 20 mA range lets it measure currents high enough for applications such as measuring 4-20 mA sensor loops.

Although it employs the latest current measurement technology, it is significantly less expensive than other instruments that perform similar functions, such as optical power meters, competitive picoammeters, or user-designed solutions. With a price that's comparable to a general purpose DMM, the 6485 makes picoamp-level measurements affordable for virtually any laboratory or production floor.

Key Features

- Cost effective low current measurement solution
- 10 fA resolution
- 5½-digit resolution
- <200 µV burden voltage
- Up to 1000 readings/second
- Built in 485 emulation mode
- IEEE-488 and RS-232 interfaces
- Analog output

Low Voltage Burden and Higher Accuracy

While DMMs typically employ shunt ammeter circuitry to measure current, the 6485 is a feedback picoammeter. This design reduces voltage burden by several orders of magnitude, resulting in a voltage burden of less than 200 µV on the lower measurement ranges. The low voltage burden makes the 6485 function much more like an ideal ammeter than a DMM, so it can make current measurements with high accuracy, even in circuits with very low source voltages.

	485	**6485**
Current Ranges	2 nA–2 mA	2 nA–20 mA
Voltage Burden	200 µV	200 µV (1 mV on 20 mA range)
Reading Rate	3/s	1000/s
Digits	4½	5½
Analog Output	Yes	Yes
Battery Option	Yes	No
Storage Buffer	100 points	2500 points

Successor to the 485

The 6485 builds on the strengths of one of Keithley's most popular picoammeters, the 485, offering an additional 20 mA measurement range, as well as much higher measurement speeds. With a top speed of up to 1000 readings per second, the 6485 is the fastest picoammeter Keithley has ever made. It offers ten times greater resolution than the 485 on every range. A time-stamped 2500-reading data buffer provides minimum, maximum, and standard deviation statistics. A built-in emulation mode simplifies upgrading existing applications originally configured with a 485. This emulation mode makes it possible to control the 6485 with any custom code written to control the 485. Refer to the comparison table for additional information.

Features That Expand Test And Measurement Flexibility

- **Scaled voltage analog output.** This output allows the 6485 to transmit measurement results to devices like DMMs, data acquisition boards, oscilloscopes, or strip chart recorders.
- **220 V overload protection.** This high overload protection and a robust design let the 6485 withstand abusive overflows.
- **One-touch front panel design.** Functions can be configured easily with the push of a button, without complicated function menus.
- **Built-in Trigger Link interface.** The Trigger Link interface simplifies synchronizing the 6485 with other instruments and voltage sources. This interface combines six independent selectable trigger lines on a single connector for simple, direct control over all instruments in a system.
- **RS-232 and IEEE-488 interfaces.** These interfaces make it easy to integrate the 6485 into automated test and measurement systems.
- **Display on/off switch.** For research on light-sensitive components, such as measuring the dark currents of photodiodes, the front panel display can be switched off to avoid introducing light that could significantly reduce the accuracy of the results.
- **REL and LOG functions.** The 6485 can make relative readings with respect to a baseline value or display the logarithm of the absolute value of the measured current.

When do you need a picoammeter?

Measuring low DC currents often demands a lot more than a digital multimeter (DMM) can deliver. Generally, DMMs lack the sensitivity required to measure currents less than 100 nA. Even at higher currents, a DMM's input voltage drop (voltage burden) of hundreds of millivolts can make accurate current measurements impossible. Electrometers can measure low currents very accurately, but the circuitry needed to measure extremely low currents, combined with functions like voltage, resistance, and charge measurement, can increase an electrometer's cost significantly. The 6485 Picoammeter combines the economy and ease of use of a DMM with low current sensitivity near that of an electrometer.

Applications

- Beam monitoring and radiation monitoring
- Leakage current testing in insulators, switches, relays, and other components
- SEM beam current measurements
- Galvanic coupling measurements
- Optoelectronic device testing and characterization
- Optical fiber alignment
- Circuit test and analysis in DCLF circuits
- Sensor characterization
- I-V measurements of semiconductors and other devices
- Nanoelectronic device characterization
- Teaching labs

- **Resistance calculations**. The 6485 can calculate resistance by dividing an externally sourced voltage value by the measured current.
- **Rear panel BNC inputs**. Inexpensive, easy-to-use BNC cables can be employed, rather than more expensive triax cables.

Specifications

Range	5½ Digit Default Resolution	Accuracy (1 Year)[1] ±(% rdg. + offset) 18°–28°C, 0–70% RH	Typical RMS Noise[2]	Analog Rise Time[3] (10% to 90%)
2 nA	10 fA	0.4 % + 400 fA	20 fA	8 ms
20 nA	100 fA	0.4 % + 1 pA	100 fA	8 ms
200 nA	1 pA	0.2 % + 10 pA	1pA	500 µs
2 µA	10 pA	0.15% + 100 pA	10 pA	500 µs
20 µA	100 pA	0.1 % + 1 nA	100 pA	500 µs
200 µA	1 nA	0.1 % + 10 nA	1 nA	500 µs
2 mA	10 nA	0.1 % + 100 nA	10 nA	500 µs
20 mA	100 nA	0.1 % + 1 µA	100 nA	500 µs

Temperature Coefficient	0°–18°C & 28°–50°C. For each °C, add 0.1. (% rdg + offset) to accuracy spec.
Input Voltage Burden	<200 µV on all ranges except <1 mV on 20 mA range.
Input Connector	BNC on rear panel.
Display	12 character vacuum fluorescent.
Ranging	Automatic or manual.
Maximum Input Capacitance	Stable to 10 nF on all nA ranges and 2 µA range; 1 µF on 20 µA and 200 µA ranges, and on mA ranges.
Maximum Common Mode Voltage	42 V.
Maximum Continuous Input Voltage	220 VDC.
Isolation (Meter COMMON to chassis)	Typically >5×10^{11} Ω in parallel with <1 nF.
NMRR[1] (50 or 60 Hz)	60 dB.
Analog Output	Scaled voltage output (inverting 2 V full scale on all ranges) 3% ±2 mV, 1 kΩ impedance.

Notes

1. At 1 PLC – limited to 60 rdgs/second under this condition.
2. At 6 PLC, 1 standard deviation, 100 readings, filter off, capped input – limited to 10 rdgs/sec under this condition.
3. Measured at analog output with resistive load >100 kΩ.

IEEE-488 Bus Implementation

Multiline Commands	DCL, LLO, SDC, GET, GTL, UNT, UNL, SPE, SPD.
Implementation	SCPI (IEEE-488.2, SCPI-1996.0); DDC (IEEE-488.1).
Uniline Commands	IFC, REN, EOI, SRQ, ATN. Net Weight: <2.8 kg (<6.1 lbs).
Interface Functions	SH1, AH1, T5, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, E1.
Programmable Parameters	Range, Zero Check, Zero Correct, EOI (DDC mode only), Trigger, Terminator (DDC mode only), Calibration (SCPI mode only), Display Format, SRQ, REL, Output Format, V-offset Cal.
Address Modes	TALK ONLY and ADDRESSABLE.
Language Emulation	Keithley 485 emulation via DDC mode.
RS-232 Implementation	**Supports:** SCPI 1996.0. **Baud Rates:** 300, 600, 1200, 2400, 4800, 9600, 19.2k, 38.4k, 57.6k. **Protocols:** Xon/Xoff, 7 or 8 bit ASCII, parity-odd/even/none. **Connector:** DB-9 TXD/RXD/GND.

General

Input Connector	BNC on rear panel.
Display	12 character vacuum fluorescent.
Ranging	Automatic or manual.
Overrange Indication	Display reads "OVRFLOW."
Conversion Time	Selectable 0.01 PLC to 60 PLC (50 PLC under 50 Hz operation). (Adjustable from 200 µs to 1 s)
Reading Rate	**To internal buffer:** 1000 readings/second[1] **To IEEE-488 bus:** 900 readings/second[1, 2]
Notes	1. 0.01 PLC, digital filters off, front panel off, auto zero off. 2. Binary transfer mode. IEEE-488.1.
Buffer	Stores up to 2500 readings.
Programs	Provide front panel access to IEEE address, choice of engineering units or scientific notation, and digital calibration.
EMC	Conforms with European Union Directive 89/336/EEC, EN61326-1.
Safety	Conforms with European Union Directive 73/23/EEC, EN61010-1.
Trigger Line	Available, see manual for usage.
Digital Filter	Median and averaging (selectable from 2 to 100 readings).
Environment	
Operating	0°–50°C; relative humidity 70% non-condensing, up to 35°C. Above 35°C, derate humidity by 3% for each °C.
Storage	–25° to +65°C.
Warm-Up	1 hour to rated accuracy (see manual for recommended procedure).
Power	100–120 V or 220–240 V, 50–60 Hz, 30 VA.
Physical	
Case Dimensions	90mm high. 214mm wide. 369mm deep (3. in.. 83/8 in.. 149/16 in.).
Working Dimensions	From front of case to rear including power cord and IEEE-488 connector: 394 mm (15.5 in).
Net Weight	<2.8 kg (<6.1 lbs).
Shipping Weight	<5 kg (<11 lbs).

Ordering Information

6485	Picoammeter

Supplied Accessories

CAP 18	Protective shield/ Cap (2-lug)
4801	Low Noise BNC Input Cable, 1.2 m (4 ft)

Available Accessories

Cables

7007-1	Shielded IEEE-488 Cable, 1 m (3.3 ft)
8501-1	Trigger Link Cable with Male Micro-DIN Connectors at each end, 1 m (3.3 ft)
8503	DIN-to-BNC Trigger Cable

Adapters

CS-565	BNC Barrel
7078-TRX-BNC	Female BNC to 3-Slot Male Triax for connecting BNC cable into triax fixture

Rack Mount Kits

4288-1	Single Fixed Rack Mounting Kit
4288-2	Dual Fixed Rack Mounting Kit

GPIB Interfaces

KPCI-488LPA	IEEE-488 Interface/Controller for the PCI Bus
KUSB-488B	IEEE-488 USB-to-GPIB Interface Adapter

Available Services

6485-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
C/6485-3Y-ISO	3 (ISO-17025 accredited) calibrations within 3 years of purchase* *Not available in all countries

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Rev. 02.2022

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102025 SBG 1KW-74205-1