KEITHLEY

Model 6517B

Electrometer / High-Resistance Meter Specifications

Keithley Instruments
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VOLTS

Range	6½-digit resolution	Accuracy (1 year)[1] 18 °C to 28 °C ± (% reading + offset)	Temperature coefficient 0 °C to 18°C and 28 °C to 50 °C ± (% reading + offset)/ °C
2 V	1 µV	0.025 + 40 µV	0.003 + 20 µV
20 V	10 µV	0.025 + 300 µV	0.002 + 100 µV
200 V	100 µV	0.06 + 3 mV	0.002 + 1 mV

NMRR: 2 V and 20 V range > 60 dB, 200 V range > 55 dB. 50 Hz or 60 Hz[2]

CMRR: > 120 dB at DC, 50 Hz or 60 Hz

Input Impedance: > 200 TΩ in parallel with 20 pF, < 2 pF guarded (1 MΩ with zero check on)

Small signal bandwidth at preamplifier output: Typically 100 kHz (–3 dB)

AMPS

Range	6½-digit resolution	Accuracy (1 year)[1] 18 °C to 28 °C ± (% reading + offset)	Temperature coefficient 0 °C to 18 °C and 28 °C to 50 °C ± (% reading + offset)/ °C
20 pA	10 aA[3]	1 + 3 fA	0.1 + 500 aA
200 pA	100 aA[3]	1 + 5 fA	0.1 + 1 fA
2 nA	1 fA	0.2 + 300 fA	0.1 + 20 fA
20 nA	10 fA	0.2 + 500 fA	0.03 + 100 fA
200 nA	100 fA	0.2 + 5 pA	0.03 + 1 pA
2 µA	1 pA	0.1 + 100 pA	0.005 + 20 pA
20 µA	10 pA	0.1 + 500 pA	0.005 + 100 pA
200 µA	100 pA	0.1 + 5 nA	0.005 + 1 nA
2 mA	1 nA	0.1 + 100 nA	0.008 + 20 nA
20 mA	10 nA	0.1 + 500 nA	0.008 + 100 nA

[1] When properly zeroed, 6½-digit, 1 PLC (power line cycle), median filter on, digital filter = 10 readings.
[2] Line sync on.
[3] aA = 10^{-18} A, fA = 10^{-15} A.

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Input bias current: < 3 fA at Tcal; temperature coefficient = 0.5 fA/°C, 20 pA range

Input bias current noise: < 750 aA peak-peak (capped input), 0.1 Hz to 10 Hz bandwidth, damping on; digital filter = 40 readings, 20 pA range

Input voltage burden at Tcal ± 1 °C: < 20 µV on 20 pA, 2 nA, 20 nA, 2 µA, 20 µA ranges; < 100 µV on 200 pA, 200 nA, 200 µA ranges; < 2 mV on 2 mA range; < 5 mV on 20 mA range

Temperature coefficient of input voltage burden: < 10 µV/°C on pA, nA, µA ranges

Preamplifier settling time (to 10% of final value) typical: 0.5 s (damping off), 2.0 s (damping on) on pA ranges; 15 ms on nA ranges damping off, 1 ms on µA ranges damping off; 500 µs on mA ranges damping off

NMRR: > 60 dB on all ranges at 50 Hz or 60 Hz[4]

COULOMBS

Range	6½-digit resolution	Accuracy (1 year)[5, 6] 18 °C to 28 °C ± (% reading + offset)	Temperature coefficient 0 °C to 18 °C and 28 °C to 50 °C ± (% reading + offset)/°C
2 nC	1 fC	0.4 + 50 fC	0.04 + 30 fC
20 nC	10 fC	0.4 + 500 fC	0.04 + 100 fC
200 nC	100 fC	0.4 + 5 pC	0.04 + 1 pC
2 µC	1 pC	0.4 + 50 pC	0.04 + 10 pC

Input bias current: < 4 fA at T_{CAL}; Temperature coefficient = 0.5 fA/°C, 2 nC range

[4] Line sync on.

[5] Specifications apply immediately after charge acquisition. Add

$$\left(4\,fA + \frac{|Q_{AV}|}{RC}\right)T_A$$

where T_A = period of time in seconds between the coulombs zero and measurement, Q_{AV} = average charge measured over T_A, and RC = 300,000 typical.

[6] When properly zeroed, 6½-digit, 1 PLC (power line cycle), median filter on, digital filter = 10 readings.

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OHMS

Range	6½-digit resolution	Accuracy[7] (10 % to 100 % range) 18 °C to 28 °C (1 year) ± (% reading + offset)	Temperature coefficient (10 % to 100 % range) 0 °C to 18 °C and 28 °C to 50 °C ± (% reading + offset)/°C	Auto V source	Amps range
2 MΩ	1 Ω	0.125 + 10 Ω	0.01 + 10 Ω	40 V	200 µA
20 MΩ	10 Ω	0.125 + 100 Ω	0.01 + 100 Ω	40 V	20 µA
200 MΩ	100 Ω	0.15 + 1 kΩ	0.015 + 1 kΩ	40 V	2 µA
2 GΩ	1 kΩ	0.225 + 10 kΩ	0.035 + 10 kΩ	40 V	200n A
20 GΩ	10 kΩ	0.225 + 100 kΩ	0.035 + 100 kΩ	40 V	20 nA
200 GΩ	100 kΩ	0.35 + 1 MΩ	0.110 + 1 MΩ	40 V	2 nA
2 TΩ	1 MΩ	0.35 + 10 MΩ	0.110 + 10 MΩ	400 V	2 nA
20 TΩ	10 MΩ	1.025 + 100 MΩ	0.105 + 100 MΩ	400 V	200 pA
200 TΩ	100 MΩ	1.15 + 1 GΩ	0.125 + 1 GΩ	400 V	20 pA

Preamplifier settling time: Add voltage source settling time to preamplifier settling time in current specification. Ranges over 20 GΩ require additional settling based on the characteristics of the load.

OHMS (alternating polarity method)

The alternating polarity sequence compensates for the background (offset) currents of the material or device under test. Maximum tolerable offset up to full scale of the current range used.

Using Keithley Model 8002A or 8009 fixture

Repeatability: $\Delta I_{BG} \times R/V_{ALT}$ + 0.1 % (1σ) (instrument temperature constant ± 1 °C).

Accuracy: $(V_{SRC}Err + I_{MEAS}Err \times R)/V_{ALT}$
ΔI_{BG} is a measured, typical background current noise from the sample and fixture.
V_{ALT} is the alternating polarity voltage used.
$V_{SRC}Err$ is the accuracy (in volts) of the voltage source using V_{ALT} as the setting.
$I_{MEAS}Err$ is the accuracy (in amperes) of the ammeter using V_{ALT} /R as the reading.

[7] Specifications are for auto V-source ohms, when properly zeroed, 6½ -digit, 1 PLC, median filter on, digital filter = 10 readings. If user-selectable voltage is required, use manual mode. Manual mode displays resistance (up to 10^{18} Ω) calculated from measured current. Accuracy is equal to the accuracy of the V-source plus the accuracy of the selected current range.

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VOLTAGE SOURCE

Range	5½-digit resolution	Accuracy (1 year) 18 °C to 28 °C ± (% setting + offset)	Temperature coefficient 0 °C to 18 °C and 28 °C to 50°C ± (% setting + offset)/°C
100 V	5 mV	0.15 +10 mV	0.005 + 1mV
1000 V	50 mV	0.15 +100 mV	0.005 + 10mV

Maximum output current:

100 V range: ± 10 mA, hardware short circuit protection at < 14.0 mA

1000 V range: ± 1 mA, hardware short circuit protection at < 1.4 mA

Settling time:

100 V range: < 8 ms to rated accuracy

1000 V range: < 50 ms to rated accuracy

Noise (typical):10 Hz to 20 Mhz

100V range: < 2.6 mV_{RMS}

1000V range: < 2.9 mV_{RMS}

TEMPERATURE (THERMOCOUPLE)

Thermocouple type	Range	Accuracy (1 year)[8] 18 °C to 28°C, ± (% reading + °C)
K	−25 °C to 150 °C	± (0.3 + 1.5 °C)

HUMIDITY

Range	Accuracy (1 year)[9] 18 °C to 28°C, ± (% reading + % relative humidity)
0 % to 100 %	± (0.3 + 0.5)

[8] Excluding probe errors, T_{CAL} ± 5 °C, 1 PLC integration time.
[9] Humidity probe accuracy must be added. This is ± 3 % relative humidity, for Model 6517RH, up to 65 °C probe environment, not to exceed 85 °C.

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IEEE-488 BUS IMPLEMENTATION

Implementation: SCPI (IEEE-488.2, SCPI-1999.0)

Trigger to reading done: 150 ms typical, with external trigger

RS-232 implementation: Supports: SCPI 1991.0; baud rates: 300, 600, 1200, 2400, 4800, 9600, 19.2 k, 38.4 k, 57.6 k, and 115.2 k

Flow control: None, Xon/Xoff

Connector: DB-9 TXD/RXD/GND

GENERAL

DISPLAY: 6½-digit vacuum fluorescent multiline

OVERRANGE INDICATION: Display reads "OVERFLOW"; for readings > 105 % of range, the display reads "OUT OF LIMIT" for excessive overrange conditions

RANGING: Automatic or manual

CONVERSION TIME: Selectable 0.01 PLC to 10 PLC

PROGRAMS: Provide front-panel access to IEEE address, choice of engineering units or scientific notation

MAXIMUM INPUT: 250 V peak, DC to 60 Hz sine wave; 10 s per minute maximum on mA ranges

MAXIMUM COMMON MODE VOLTAGE (DC to 60 Hz sine wave): Electrometer, 500 V peak; V-source, 750 V peak

ISOLATION (meter COMMON to chassis): $> 10^{10}$ Ω, < 500 pF

INPUT CONNECTOR: Three-lug triaxial on rear panel

2 V ANALOG OUTPUT: 2 V for full range input; noninverting in volts mode, inverting when measuring amperes, ohms, or coulombs; output impedance 10 kΩ nominal

PREAMPLIFIER OUTPUT: Provides a guard output for voltage measurements; can be used as an inverting output or with external feedback in Amps and Coulombs modes

EXTERNAL TRIGGER: TTL compatible external trigger and electrometer complete

GUARD: Switchable voltage guard available

DIGITAL I/O AND TRIGGER LINE: Available, see manual for usage

EMC: Conforms to European Union Directive 89/336/EEC, EN 61326-1

SAFETY: Conforms to European Union Directive 73/23/EEC, EN 61010-1

TEST SEQUENCES: Device-characterization (diode, capacitor, cable, resistor), resistivity, surface-insulation resistance, sweep

READING STORAGE: 50,000

READING RATE:

To internal buffer	425	readings/second[11]
To IEEE-488 bus	400	readings/second[10, 11]
Bus transfer	3300	readings/second[11]

DIGITAL FILTER: Median and averaging

[10] 0.01 PLC, digital filters off, front panel off, temperature + relative humidity off, line sync off.
[11] Binary transfer mode.

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ENVIRONMENT: Operating: 0 °C to 50 °C; relative humidity 70 % noncondensing, up to 35 °C; storage: –25 °C to +65 °C; for indoor use only

ALTITUDE: Maximum 2000 m (6562 ft) above sea level per EN61010-1

WARM-UP: 1 hour to rated accuracy (see manual for recommended procedure)

POWER: User selectable 100 V AC, 120 V AC, 220 V AC, 240 V AC, 50 Hz/60 Hz, 100 VA maximum

PHYSICAL:

Case dimensions: 90 mm × 214 mm × 369 mm (3½ in. × 8½ in. × 14½ in.)

Working dimensions: From front of case to rear, including power cord and IEEE-488 connector: 397.7 mm (15.5 in.)

Net weight: 5.4 kg (11.8 lbs)

Shipping weight: 6.9 kg (15.1 lbs)