KEITHLEY

**Model 6517B**

# Electrometer / High Resistance Meter Specifications

**Keithley Instruments, Inc.**
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## VOLTS

| Range | 5½-Digit resolution | Accuracy (1 Year)[1] 18°C-28°C ±(%rdg+counts) | Temperature coefficient 0°C-18°C & 28°C-50°C ±(%rdg+counts)/ °C |
|---|---|---|---|
| 2V | 10µV | 0.025+4 | 0.003+2 |
| 20V | 100µV | 0.025+3 | 0.002+1 |
| 200V | 1mV | 0.06+3 | 0.002+1 |

**NMRR:** 2V and 20V range > 60dB, 200V range > 55dB. 50Hz or 60Hz[2]
**CMRR:** >120dB at DC, 50Hz or 60Hz.
**Input Impedance: >**200TΩ in parallel with 20pF, < 2pF guarded (1MΩ with zero check on).
**Small signal bandwidth at preamp output:** Typically 100kHz (–3dB).

## AMPS

| Range | 5½-Digit resolution | Accuracy (1 Year)[1] 18°C-28°C ±(%rdg+counts) | Temperature coefficient 0°C-18°C & 28°C-50°C ±(%rdg+counts)/ °C |
|---|---|---|---|
| 20pA | 100aA[3] | 1+30 | 0.1+5 |
| 200pA | 1fA[3] | 1+5 | 0.1+1 |
| 2nA | 10fA | 0.2+30 | 0.1+2 |
| 20nA | 100fA | 0.2+5 | 0.03+1 |
| 200nA | 1pA | 0.2+5 | 0.03+1 |
| 2µA | 10pA | 0.1+10 | 0.005+2 |
| 20µA | 100pA | 0.1+5 | 0.005+1 |
| 200µA | 1nA | 0.1+5 | 0.005+1 |
| 2mA | 10nA | 0.1+10 | 0.008+2 |
| 20mA | 100nA | 0.1+5 | 0.008+1 |

[1] When properly zeroed, 5½-digit, 1 PLC (power line cycle), median filter on, digital filter = 10 readings.
[2] Line sync on
[3] aA =10E–18A, fA=10E–15A.

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**Input bias current:** <3fA at Tcal. Temperature coefficient = 0.5fA/°C, 20pA range

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

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

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

**Preamp settling time (to 10% of final value) typical:** 0.5sec (damping off) 2.0 sec (damping on) on pA ranges. 15msec on nA ranges damping off, 1msec on µA ranges damping off. 500usec on mA ranges damping off.

**NMRR**: >60dB on all ranges at 50Hz or 60Hz. [2]

**COULOMBS**

| Range | 5½-Digit resolution | Accuracy (1 Year)[4, 5] 18°C-28°C ±(%rdg+counts) | Temperature coefficient 0°C-18°C & 28°C-50°C ±(%rdg+counts)/ °C |
|---|---|---|---|
| 2nC | 10fC | 0.4+5 | 0.04+3 |
| 20nC | 100fC | 0.4+5 | 0.04+1 |
| 200nC | 1pC | 0.4+5 | 0.04+1 |
| 2µC | 10pC | 0.4+5 | 0.04+1 |

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

[4] 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.

[5] When properly zeroed, 5½-digit, 1 PLC (power line cycle), median filter on, digital filter = 10 readings.

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**OHMS**

| Range | 5½-Digit resolution | Accuracy[6] (10-100% Range) 18°C-28°C (1 Year) ±(%rdg+counts) | Temperature coefficient (10-100% Range) 0°C-18°C & 28°C-50°C ±(%rdg+counts)/ °C | Auto V source | Amps range |
|---|---|---|---|---|---|
| 2MΩ | 10Ω | 0.125+1 | 0.01+1 | 40V | 200µA |
| 20MΩ | 100Ω | 0.125+1 | 0.01+1 | 40V | 20µA |
| 200MΩ | 1kΩ | 0.15+1 | 0.015+1 | 40V | 2µA |
| 2GΩ | 10kΩ | 0.225+1 | 0.035+1 | 40V | 200nA |
| 20GΩ | 100kΩ | 0.225+1 | 0.035+1 | 40V | 20nA |
| 200GΩ | 1MΩ | 0.35+1 | 0.110+1 | 40V | 2nA |
| 2TΩ | 10MΩ | 0.35+1 | 0.110+1 | 400V | 2nA |
| 20TΩ | 100MΩ | 1.025+1 | 0.105+1 | 400V | 200pA |
| 200TΩ | 1GΩ | 1.15+1 | 0.125+1 | 400V | 20pA |

**Preamp settling time:** Add voltage source settling time to preamp settling time in Amps specification. Ranges over 20Gohm 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 8002A or 8009 fixture**

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

**Accuracy:** $(V_{SRC}Err + I_{MEAS}Err \times R)/V_{ALT}$

$\Delta I_{BG}$ 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 amps) of the ammeter using $V_{ALT}$ /R as the rdg.

[6] Specifications are for auto V-source ohms, when properly zeroed, 5½ -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 $10^{18}\Omega$) calculated from measured current. Accuracy is equal to the accuracy of the V-source plus the accuracy of the selected Amps range.

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**VOLTAGE SOURCE**

| Range | 5½-Digit resolution | Accuracy (1 Year) 18°C-28°C ±(%setting+offset) | Temperature coefficient 0°C-18°C & 28°C-50°C ±(%setting+offset)/ °C |
|---|---|---|---|
| 100V | 5mV | 0.15+10mV | 0.005+1mV |
| 1000V | 50mV | 0.15+100mV | 0.005+10mV |

**Maximum output current:**

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

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

**Settling time:**

100V Range: <8ms to rated accuracy

1000V Range: <50ms to rated accuracy

**Noise** (typical)**:** 10Hz-20Mhz
100V Range: < 2.6mVrms
1000V Range: < 2.9mVrms

**TEMPERATURE (thermocouple)**

| Thermocouple type | Range | Accuracy (1 Year)[7] 18°C-28°C, ±(%rdg+°C) |
|---|---|---|
| K | -25°C to 150°C | ±(0.3%+1.5°C) |

**HUMIDITY**

| Range | Accuracy (1 Year)[8] 18°C-28°C, ±(%rdg+%RH) |
|---|---|
| 0-100% | ±(0.3%+0.5) |

**IEEE-488 BUS IMPLEMENTATION**

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

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

**RS-232 implementation:** Supports: SCPI 1991.0. Baud Rates: 300, 600, 1200, 2400, 4800, 9600, 19.2k, 38.4k, 57.6k, and 115.2k.

**Flow control:** none, Xon/Xoff.

**Connector:** DB-9 TXD/RXD/GND.

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

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# Electrometer / High Resistance Meter Specifications

## 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:** 250V peak, DC to 60Hz sine wave; 10sec per minute maximum on mA ranges.
**MAXIMUM COMMON MODE VOLTAGE (DC to 60Hz sine wave):** Electrometer, 500V peak; V Source, 750V peak.

**ISOLATION (Meter COMMON to chassis):** $> 10^{10}\Omega$, < 500pF

**INPUT CONNECTOR:** Three lug triaxial on rear panel.

**2V ANALOG OUTPUT:** 2V for full range input. Non-inverting in volts mode, inverting when measuring amps, ohms or coulombs. Output impedance 10kΩ nominal.

**PREAMP OUTPUT:** Provides a guard output for Volts 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[9] |
| To IEEE-488 bus | 400 | readings/second[9,10] |
| Bus transfer | 3300 | readings/second[10] |

**DIGITAL FILTER:** Median and averaging.

**ENVIRONMENT:** Operating: 0°–50°C; relative humidity 70% non-condensing, up to 35°C. Storage: –25° to +65°C. For indoor use only.

**ALTITUDE:** Maximum 2000 meters above sea level per EN61010-1.

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

**POWER:** User selectable 100, 120, 220, 240VAC, 50/60Hz, 100VA Max.

**PHYSICAL:**

**Case Dimensions:** 90mm x 214mm x 369mm (3 ½ in X 8 ½ in X 14 ½ in)

**Working Dimensions:** From front of case to rear including power cord and IEEE-488 connector: 15.5 inches.

**Net Weight:** 5.4 kg (11.8 lbs).

**Shipping Weight:** 6.9 kg (15.1 lbs).

[9] 0.01 PLC, digital filters off, front panel off, temperature + RH off, line sync off
[10] Binary transfer mode.