

# 6517A Electrometer/High Resistance Meter

## VOLTS

RANGE	5½-DIGIT RESOLUTION	ACCURACY (1 Year) <sup>1</sup> 18°-28°C ±(%rdg+counts)	TEMPERATURE COEFFICIENT 0°-18°C & 28°-50°C ±(%rdg+counts)/°C
2 V	10 µV	0.025 + 4	0.003 + 2
20 V	100 µV	0.025 + 3	0.002 + 1
200 V	1 mV	0.06 + 3	0.002 + 1

<sup>1</sup> When properly zeroed, 5½-digit, 1 PLC (power line cycle), median filter on, digital filter = 10 readings.

NMR: 60dB on 2V, 20V, >55dB on 200V, at 50Hz or 60Hz ±0.1%.

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

INPUT IMPEDANCE: >200TΩ in parallel with 20pF, < 2pF guarded (10MΩ with zero check on).

SMALL SIGNAL BANDWIDTH AT PREAMP OUTPUT: Typically 100kHz (-3dB).

## AMPS

RANGE	5½-DIGIT RESOLUTION	ACCURACY (1 Year) <sup>1</sup> 18°-28°C ±(%rdg+counts)	TEMPERATURE COEFFICIENT 0°-18°C & 28°-50°C ±(%rdg+counts)/°C
20 pA	100 aA <sup>2</sup>	1 + 30	0.1 + 5
200 pA	1 fA <sup>2</sup>	1 + 5	0.1 + 1
2 nA	10 fA	0.2 + 30	0.1 + 2
20 nA	100 fA	0.2 + 5	0.03 + 1
200 nA	1 pA	0.2 + 5	0.03 + 1
2 µA	10 pA	0.1 + 10	0.005 + 2
20 µA	100 pA	0.1 + 5	0.005 + 1
200 µA	1 nA	0.1 + 5	0.005 + 1
2 mA	10 nA	0.1 + 10	0.008 + 2
20 mA	100 nA	0.1 + 5	0.008 + 1

<sup>1</sup> When properly zeroed, 5½-digit, 1 PLC (power line cycle), median filter on, digital filter = 10 readings.

<sup>2</sup> aA = 10<sup>-18</sup>A, fA = 10<sup>-15</sup>A.

INPUT BIAS CURRENT: <3fA at T<sub>CAL</sub>. Temperature coefficient = 0.5fA/°C.

INPUT BIAS CURRENT NOISE: <750aA p-p (capped input), 0.1Hz to 10Hz bandwidth, damping on. Digital filter = 40 readings.

INPUT VOLTAGE BURDEN at T<sub>CAL</sub> ±1°C: <20µV on 20pA, 2nA, 20nA, 2µA, 20µA ranges. <100µV on 200pA, 200nA, 200µA ranges. <2mV on 2mA range. <4mV on 20mA range.

TEMPERATURE COEFFICIENT OF INPUT VOLTAGE BURDEN: <10µV/°C on pA, nA, µA ranges.

PREAMP SETTLING TIME (to 10% of final value): 2.5s typical on pA ranges, damping off, 4s typical on pA ranges damping on, 15ms on nA ranges, 2ms on µA and mA ranges.

NMR: >95dB on pA, 60dB on nA, µA, and mA ranges at 50Hz or 60Hz ±0.1%.

## COULOMBS

RANGE	5½-DIGIT RESOLUTION	ACCURACY (1 Year) <sup>1,2</sup> 18°-28°C ±(%rdg+counts)	TEMPERATURE COEFFICIENT 0°-18°C & 28°-50°C ±(%rdg+counts)/°C
2 nC	10 fC	0.4 + 5	0.04 + 3
20 nC	100 fC	0.4 + 5	0.04 + 1
200 nC	1 pC	0.4 + 5	0.04 + 1
2 µC	10 pC	0.4 + 5	0.04 + 1

<sup>1</sup> Specifications apply immediately after charge acquisition. Add

$$(4fA + \frac{1Q_{AV}}{RC}) T_A$$

where T<sub>A</sub> = period of time in seconds between the coulombs zero and measurement, Q<sub>AV</sub> = average charge measured over T<sub>A</sub>, and RC = 300,000 typical.

<sup>2</sup> When properly zeroed, 5½-digit, 1 PLC (power line cycle), median filter on, digital filter = 10 readings.

INPUT BIAS CURRENT: <4fA at T<sub>CAL</sub>. Temperature coefficient = 0.5fA/°C.

## OHMS (Normal Method)

RANGE	5½-DIGIT RESOLUTION	ACCURACY <sup>1</sup> (10-100% Range) 18°-28°C (1 Yr.) ±(%rdg+counts)	TEMPERATURE COEFFICIENT (10-100% Range) 0°-18°C & 28°-50°C ±(%rdg+counts)	AUTO V SOURCE	AMPS RANGE
2 MΩ	10 Ω	0.125 + 1	0.01 + 1	40 V	200 µA
20 MΩ	100 Ω	0.125 + 1	0.01 + 1	40 V	20 µA
200 MΩ	1 kΩ	0.15 + 1	0.015 + 1	40 V	2 µA
2 GΩ	10 kΩ	0.225 + 1	0.035 + 1	40 V	200 nA
20 GΩ	100 kΩ	0.225 + 1	0.035 + 1	40 V	20 nA
200 GΩ	1 MΩ	0.35 + 1	0.110 + 1	40 V	2 nA
2 TΩ	10 MΩ	0.35 + 1	0.110 + 1	400 V	2 nA
20 TΩ	100 MΩ	1.025 + 1	0.105 + 1	400 V	200 pA
200 TΩ	1 GΩ	1.15 + 1	0.125 + 1	400 V	20 pA

<sup>1</sup> 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<sup>18</sup>Ω) calculated from measured current. Accuracy is equal to accuracy of V-source plus accuracy of selected Amps range.

PREAMP SETTLING TIME: Add voltage source settling time to preamp settling time in Amps specification.

## 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: ΔI<sub>BG</sub> × R/V<sub>ALT</sub> + 0.1% (1σ) (instrument temperature constant ±1°C).

ACCURACY: (V<sub>SRC</sub>Err + I<sub>MEAS</sub>Err × R)/V<sub>ALT</sub>

where: ΔI<sub>BG</sub> is a measured, typical background current noise from the sample and fixture.

V<sub>ALT</sub> is the alternating polarity voltage used.

V<sub>SRC</sub>Err is the accuracy (in volts) of the voltage source using V<sub>ALT</sub> as the setting.

I<sub>MEAS</sub>Err is the accuracy (in amps) of the ammeter using V<sub>ALT</sub>/R as the rdg.

## VOLTAGE SOURCE

RANGE	5½-DIGIT RESOLUTION	ACCURACY (1 Year) 18°-28°C ±(% setting + offset)	TEMPERATURE COEFFICIENT 0°-18°C & 28°-50°C ±(% setting+offset)/°C
100 V	5 mV	0.15 + 10 mV	0.005 + 1 mV
1000 V	50 mV	0.15 + 100 mV	0.005 + 10 mV

MAXIMUM OUTPUT CURRENT:

±10mA; active current limit at <1.15mA for 100V range.

±1mA; active current limit at <1.15mA for 1000V range.

SETTLING TIME: <8ms to rated accuracy for 100V range.

<50ms to rated accuracy for 1000V range.

NOISE:

<150µV p-p from 0.1Hz to 10Hz for 100V range.

<1.5mV p-p from 0.1Hz to 10Hz for 1000V range.

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## TEMPERATURE (THERMOCOUPLE)

THERMOCOUPLE		ACCURACY (1 Year) <sup>1</sup>
TYPE	RANGE	18°-28°C ±(% rdg + °C)
K	-25°C to 150°C	± (0.3% + 1.5°C)

<sup>1</sup> Excluding probe errors, T<sub>cal</sub> ± 5°C, 1 PLC integration time.

## HUMIDITY

RANGE	ACCURACY (1 Year) <sup>1</sup>
	18°-28°C, ±(% rdg + % RH)
0-100%	± (0.3% + 0.5)

<sup>1</sup> Humidity probe accuracy must be added. This is ±3% RH, for Model 6517RH, up to 65°C probe environment, not to exceed 85°C.

## IEEE-488 BUS IMPLEMENTATION

**MULTILINE COMMANDS:** DCL, LLO, SDC, GET, GTL, UNT, UNL, SPE, SPD.

**IMPLEMENTATION:** SCPI (IEEE-488.2, SCPI-1993); DDC (IEEE-488.1).

**UNILINE COMMANDS:** IFC, REN, EOI, SRQ, ATN.

**INTERFACE FUNCTIONS:** SH1, AH1, T5, TE0, I4, LE0, SR1, RL1, PPO, DC1, DT1, CO, EI.

**PROGRAMMABLE PARAMETERS:** Function, Range, Zero Check, Zero Suppress, EOI (DDC mode only), Trigger, Terminator (DDC mode only), 100-Reading Storage (DDC mode), 15706 Max. Reading Storage (SCPI mode), Calibration (SCPI mode only), V-Source Output, Display Format, SRQ, Status (including V-Source I-Limit), Output Format, Guard.

**ADDRESS MODES:** TALK ONLY and ADDRESSABLE.

**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.

**PROTOCOLS:** Xon/Xoff, 7- or 8-bit ASCII, parity-odd/even/none.

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

## GENERAL

**DISPLAY:** 6½-digit vacuum fluorescent multiline.

**OVERRANGE INDICATION:** Display reads "OVERFLOW."

**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, and digital calibration.

**MAXIMUM INPUT:** 250V peak, DC to 60Hz sine wave; 10s 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):** Typically 10<sup>10</sup>Ω in parallel with 500pF.

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

**2V ANALOG OUTPUT:** 2V for full range input. Non-inverting in Volts and Ohms modes, inverting when measuring Amps or Coulombs. Output impedance 10kΩ.

**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.

**EMI/RFI:** Meets VDE-0871 and FCC Class B limits.

**EMC:** Conforms to European Union Directive 89/336/EEC.

**SAFETY:** Conforms to European Union Directive 73/23/EEC (meets EN61010-1/IEC 1010).

**TEST SEQUENCES:** Device-Characterization (Diode, Capacitor, Cable, Resistor), Resistivity, Surface-Insulation-Resistance, Sweep.

**READING STORAGE:** 100 readings (DDC mode), 15706 max. readings (SCPI mode).

### READING RATE:

To internal buffer 125 readings/second<sup>1</sup>

To IEEE-488 bus 115 readings/second<sup>1,3</sup>

To front panel 17 readings/second<sup>2</sup>

Bus transfer 2500 readings/second<sup>3</sup>

<sup>1</sup> 0.01 PLC, digital filters off, front panel off, temperature + RH off.

<sup>2</sup> 1.00 PLC, digital filters off, temperature + RH off.

<sup>3</sup> Binary transfer mode.

**DIGITAL FILTER:** Median and averaging.

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

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

**POWER:** 105-125V or 210-250V (external switch selected), 90-110V (internal switch selected), 50-60Hz, 50VA.

**PHYSICAL: Case Dimensions:** 90mm high × 214mm wide × 369mm deep (3½ in. × 8½ in. × 14½ in.).

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

**Net Weight:** <4.6 kg (<10.1 lbs).

**Shipping Weight:** <9.5 kg (<21 lbs).