

**Keithley Instruments**

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### VOLTS

| Range | 6½ digit resolution | Accuracy (1 year) <sup>1</sup><br>18 °C to 28 °C<br>±(% reading + offset) | Temperature coefficient<br>0 °C to 18 °C and 28 °C to 50 °C<br>±(% 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:** 60 dB on 2 V, 20 V, >55 dB on 200 V at 50 Hz or 60 Hz ±0.1 percent.

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

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

**Small signal bandwidth at preamp output:** Typically 100 kHz (–3 dB).

### AMPERES

| Range  | 6½ digit resolution | Accuracy (1 year) <sup>1</sup><br>18 °C to 28 °C<br>±(% reading + offset) | Temperature coefficient<br>0 °C to 18 °C and 28 °C to 50 °C<br>±(% reading + offset)/ °C |
|--------|---------------------|---|--|
| 20 pA  | 10 aA <sup>2</sup>  | 1 + 3 fA  | 0.1 + 500 aA   |
| 200 pA | 100 aA              | 1 + 5 fA  | 0.1 + 1 fA   |
| 2 nA   | 1 fA <sup>2</sup>   | 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   |

<sup>1</sup> When properly zeroed. 6 ½ digit. Slow (100 ms integration time).

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



**Input bias current:** <3 fA at  $T_{CAL}$  (user adjustable). Temperature coefficient = 0.5 fA per °C.

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

**Input voltage burden at  $T_{CAL} \pm 1$  °C (user adjustable):**

- <20  $\mu$ V on 20 pA, 2 nA, 20 nA, 2  $\mu$ A, 20  $\mu$ A ranges.
- <100  $\mu$ V on 200 pA, 200 nA, 200  $\mu$ A ranges.
- <2 mV on 2 mA range.
- <4 mV on 20 mA range.

**Temperature coefficient of input voltage burden:** <10  $\mu$ V per °C on pA, nA,  $\mu$ A ranges.

**Preamplifier settling time (to 10 percent of final value):** 2.5 s typical on pA ranges, damping off; 3 s typical on pA ranges, damping on; 15 ms on nA ranges; 5 ms on  $\mu$ A and mA ranges.

**NMRR:** >95 dB on pA, 60 dB on nA,  $\mu$ A, and mA ranges at 50 Hz or 60 Hz  $\pm 0.1$  percent. Digital filter = 40.

## OHMS

| Range          | 6½ digit resolution | Accuracy (1 year) <sup>1</sup><br>18 °C to 28 °C<br>$\pm$ (% reading + offset) | Temperature coefficient<br>0 °C to 18 °C and 28 °C to 50 °C<br>$\pm$ (% reading + offset)/ °C | Test current<br>(nominal) |
|----------------|---------------------|--|---|---------------------------|
| 2 k $\Omega$   | 1 m $\Omega$        | 0.20 + 100 m $\Omega$  | 0.01 + 20 m $\Omega$  | 0.9 mA                    |
| 20 k $\Omega$  | 10 m $\Omega$       | 0.15 + 300 m $\Omega$  | 0.01 + 100 m $\Omega$   | 0.9 mA                    |
| 200 k $\Omega$ | 100 m $\Omega$      | 0.25 + 3 $\Omega$  | 0.01 + 1 $\Omega$   | 0.9 mA                    |
| 2 M $\Omega$   | 1 $\Omega$          | 0.25 + 40 $\Omega$   | 0.02 + 20 $\Omega$  | 0.9 $\mu$ A               |
| 20 M $\Omega$  | 10 $\Omega$         | 0.25 + 300 $\Omega$  | 0.02 + 100 $\Omega$   | 0.9 $\mu$ A               |
| 200 M $\Omega$ | 100 $\Omega$        | 0.30 + 3 k $\Omega$  | 0.02 + 1 k $\Omega$   | 0.9 $\mu$ A               |
| 2 G $\Omega$   | 1 k $\Omega$        | 1.5 + 40 k $\Omega$  | 0.04 + 20 k $\Omega$  | 0.9 nA                    |
| 20 G $\Omega$  | 10 k $\Omega$       | 1.5 + 300 k $\Omega$   | 0.04 + 100 k $\Omega$   | 0.9 nA                    |
| 200 G $\Omega$ | 100 k $\Omega$      | 1.5 + 3 M $\Omega$   | 0.04 + 1 M $\Omega$   | 0.9 nA                    |

**Maximum open circuit voltage:** 250 VDC.

**Preamplifier settling time (to 10 percent of final reading with <100 pf input capacitance):**

- 2 k $\Omega$  through 200 k $\Omega$ , 2 ms.
- 20 M $\Omega$  through 200 M $\Omega$  90 ms.
- 2 G $\Omega$  through 200 G $\Omega$  1 s.

**COULOMBS**

| Range  | 6½ digit resolution | Accuracy (1 year) <sup>3, 4</sup><br>18 °C to 28 °C<br>±(% reading + offset) | Temperature coefficient<br>0 °C to 18 °C and 28 °C to 50 °C<br>±(% reading + offset)/ °C |
|--------|---------------------|--|--|
| 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                | 1 + 50 pC  | 0.05 + 10 pC   |
| 20 µC  | 10 pC               | 1 + 500 pC   | 0.05 + 100 pC  |

**Input bias current:** <4 fA at T<sub>CAL</sub>. Temperature coefficient = 0.5 fA per °C.

**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.

**INTERFACE FUNCTIONS:** SH1, AH1, T5, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, E1.

**PROGRAMMABLE PARAMETERS:** Function, range, zero check, zero correct, EOI (DDC mode only), trigger, terminator (DDC mode only), data storage 2500, calibration (SCPI mode only), display format, SRQ, REL, output format, guard, V-offset Cal, I-offset Cal.

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

**LANGUAGE EMULATION:** 6512, 617, 617HIQ emulation using DDC mode.

**TRIGGER TO READING DONE:** 150 ms typical, with external trigger.

**RS-232 IMPLEMENTATION**

**Supports:** SCPI 1996.0.

**Baud rates:** 300, 600, 1200, 2400, 4800, 9600, 19.2 k, 38.4 k, 57.6 k.

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

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

**GENERAL**

**DISPLAY:** 6½ digit vacuum fluorescent.

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

**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:** 250 V<sub>PEAK</sub>, DC to 60 Hz sine wave; 10 s per minute maximum on mA ranges.

<sup>3</sup> Charge acquisition time must be <1000 s; derate 2 percent for each additional 10,000 s.

<sup>4</sup> When properly zeroed, 6½ digit. Rate: Slow (100 ms integration time).

**MAXIMUM COMMON MODE VOLTAGE (DC to 60 Hz sine wave):** Electrometer 500 V<sub>PEAK</sub>.

**ISOLATION (Meter COMMON to chassis):** Typically 10<sup>10</sup> Ω in parallel with 500 pF.

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

**2 V ANALOG OUTPUT:** 2 V for full-range input. Inverting in Amps and Coulombs modes. Output impedance 10 kΩ.

**PREAMP OUTPUT:** Provides a guard output for measurements in Volts mode. Can be used as an inverting output or with external feedback in Amps and Coulombs modes.

**DIGITAL INTERFACE:**

- **Handler interface:** Start of test, end of test, 3 category bits.
- **Digital I/O:** One trigger input, four outputs with 500 mA sink capability.
- **Connector:** Nine pin D subminiature, male pins.

**EMC:** Conforms to European Union Directive 89/336/EEC EN55011, EN50082-1, EN61000-3-2, EN61000-3-3, FCC part 15 class B.

**SAFETY:** Conforms to European Union Directive 73/23/EEC EN61010-1.

**GUARD:** Switchable voltage and ohm guard available.

**TRIGGER LINE:** Available, see manual for usage.

**READING STORAGE:** 2500 readings.

**READING RATE:**

- **To internal buffer:** 1200 readings/second<sup>5</sup>
- **To IEEE-488 bus:** 500 readings/second<sup>5, 6</sup>
- **To front-panel:** 17 readings/second at 60 Hz<sup>7</sup>; 15 readings/second at 50 Hz<sup>7</sup>

**DIGITAL FILTER:** Median and averaging (selectable from 2 to 100 readings).

**DAMPING:** User selectable in Amps mode.

**ENVIRONMENT**

**Operating:** 0 °C to 50 °C; relative humidity 70 percent noncondensing, up to 35 °C.

**Storage:** -25 °C to + 65 °C.

**Warm-up:** One hour to rated accuracy (see manual for recommended procedure).

**Power:** 90 V to 125 V or 210 V to 250 V, 50 V to 60 Hz, 60 VA.

**Physical:**

- **Case dimensions:** 90 mm high × 214 mm wide × 369 mm deep (3.5 in. × 8.375 in. × 14.5625 in.)
- **Working dimensions:** From front of case to rear, including power cord and IEEE-488 connector: 393.7 mm (15.5 in.)
- **Net weight:** <4.6 kg (<10.1 lb).
- **Shipping weight:** <9.5 kg (<21 lb).

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<sup>5</sup> 0.01 PLC, digital filters off, front panel off, autozero off.

<sup>6</sup> Binary transfer mode.

<sup>7</sup> 1.00 PLC, digital filters off.