

2000

6½-Digit Multimeter



The Model 2000 6½-Digit Multimeter is part of Keithley's family of high performance DMMs. Based on the same high speed, low noise A/D converter technology as the Model 2001 and 2002, the 2000 is a fast, accurate, and highly stable instrument that's as easy to operate as it is to afford. It combines broad measurement ranges with superior accuracy specifications — DC voltage from 100nV to 1kV (with 0.002% 90-day basic accuracy) and DC resistance from 100μΩ to 100MΩ (with 0.008% 90-day basic accuracy). Optional switch cards enable multiplexing up to 20 different input signals for multipoint measurement applications.

High Throughput

The 2000 offers exceptional measurement speed at any resolution. At 6½ digits, it delivers 50 triggered rdgs/s over the IEEE-488 bus. At 4½ digits, it can read up to 2000 rdgs/s into its internal 1024 reading buffer, making it an excellent choice for applications where throughput is critical.

For benchtop or stand-alone applications, the 2000 has a front panel design that's simple to understand and easy to use. The 2000 has 13 built-in measurement functions, including DCV, ACV, DCI, ACI, 2WΩ, 4WΩ, temperature, frequency, period, dB, dBm, continuity measurement, and diode testing. A built-in RS-232 interface connects to a notebook or full-sized PC's serial port to take, store, process, and display measurements automatically.

General-purpose instrument that's as easy to operate as it is to afford

- 13 built-in measurement functions
- 2000 readings/second at 4½ digits
- Optional scanner cards for multipoint measurements
- IEEE-488 and RS-232 interfaces
- Fluke 8840/42 command set

Ordering Information

2000 6½-Digit DMM
2000/2000-SCAN 6½-Digit DMM/Scanner Combination

Accessories Supplied

Instruction Manual and Model 1751 Safety Test Leads

ACCESSORIES AVAILABLE

| | |
|-------------|--|
| 2000-SCAN | 10-channel, General-Purpose Scanner Card |
| 2001-SCAN | 10-channel Scanner Card with two high-speed channels |
| 2001-TCSCAN | 9-channel, Thermocouple Scanner Card with built-in cold junction |

CABLES/ADAPTERS

| | |
|--------|--------------------------------------|
| 7007-1 | Shielded IEEE-488 Cable, 1m (3.3 ft) |
| 7007-2 | Shielded IEEE-488 Cable, 2m (6.6 ft) |
| 7009-5 | RS-232 Cable |

RACK MOUNT KITS

| | |
|--------|-----------------------------|
| 4288-1 | Single Fixed Rack Mount Kit |
| 4288-2 | Dual Fixed Rack Mount Kit |

GPIB INTERFACES

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

SERVICES AVAILABLE

| | |
|-------------------|--|
| 2000-SCAN-3Y-EW | 1-year factory warranty extended to 3 years from date of shipment |
| 2000-3Y-EW | 1-year factory warranty extended to 3 years from date of shipment |
| 2001-TCSCAN-3Y-EW | 1-year factory warranty extended to 3 years from date of shipment |
| C/2000-3Y-ISO | 3 (ISO-17025 accredited) calibrations within 3 years of purchase for Models 2000, 2000-SCAN* |
| C/2001-3Y-ISO | 3 (ISO-17025 accredited) calibrations within 3 years of purchase for Model 2001-TCSCAN* |

*Not available in all countries

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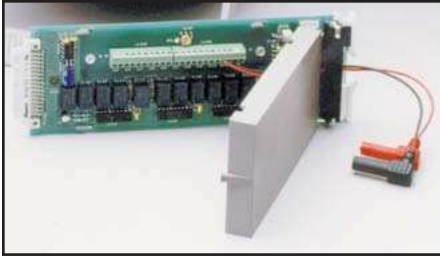
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DIGITAL MULTIMETERS & SYSTEMS

2000

6½-Digit Multimeter



Optional Multiplexer Cards

Creating a self-contained multipoint measurement solution is as simple as plugging a scanner card into the option slot on the 2000's back panel. This approach eliminates the complexities of triggering, timing, and processing issues and helps reduce test time significantly. For applications involving more than 10 measurement points, the 2000 is compatible with Keithley's Series 7000 switch matrices and cards.

Model 2000-SCAN Scanner Card

- Ten analog input channels (2-pole)
- Configurable as 4-pole, 5-channel

Model 2001-SCAN Scanner Card

- Ten analog input channels
- Two channels of 2-pole, high-speed, solid-state switching

Model 2001-TCSCAN Thermocouple Scanner Card

- Nine analog input channels
- Built-in temperature reference for thermocouple cold-junction compensation

SCANNER OPTION 2000-SCAN

GENERAL: 10 channels of 2-pole relay input. All channels configurable to 4-pole.

CAPABILITIES: Multiplex one of ten 2-pole or one of five 4-pole signals into DMM.

INPUTS

Maximum Signal Level:

DC Signals: 110V DC, 1A switched, 30VA maximum (resistive load).

AC Signals: 125V AC rms or 175V AC peak, 100kHz maximum, 1A switched, 62.5VA maximum (resistive load).

Contact Life: >10⁸ operations at maximum signal level; >10⁸ operations cold switching.

Contact Resistance: <1Ω at end of contact life.

Actuation Time: 2.5ms maximum on/off.

Contact Potential: <±500nV typical per contact, 1μV max. <±500nV typical per contact pair, 1μV max.

Connector Type: Screw terminal, #22 AWG wire size.

Isolation Between Any Two Terminals: >10⁹Ω, <75pF.

Isolation Between Any Terminal and Earth: >10⁹Ω, <150pF.

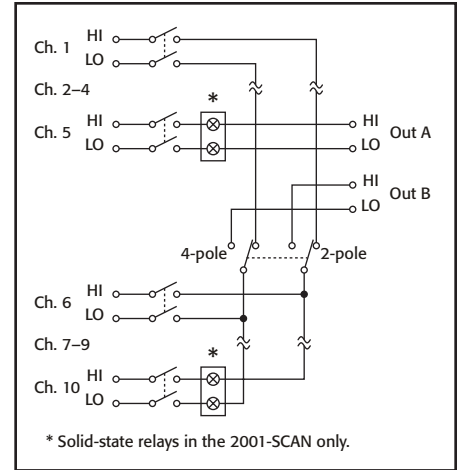
Common Mode Voltage: 350V peak between any terminal and earth.

Maximum Voltage Between Any Two Terminals: 200V peak.

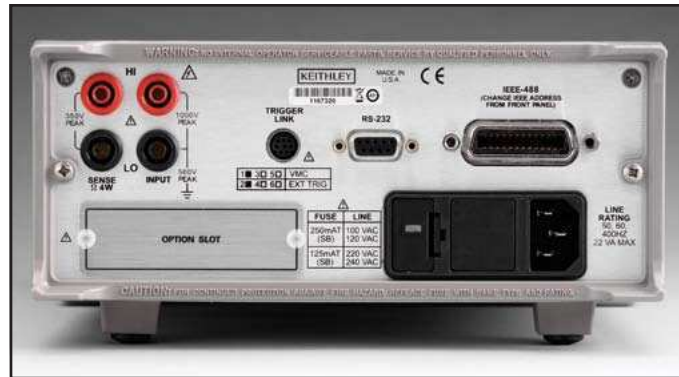
Maximum Voltage Between Any Terminal and Model 2001 Input LO: 200V peak.

ENVIRONMENTAL: Meets all Model 2000 environmental specifications.

DIMENSIONS, WEIGHT: 21mm high × 72mm wide × 221mm deep (0.83 in. × 2.83 in. × 8.7 in.). Adds 0.4kg (10 oz.).



Scanner Configuration for Models 2000-SCAN and 2001-SCAN



General-purpose instrument that's as easy to operate as it is to afford

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6¹/₂-Digit Multimeter

DC Characteristics

Conditions: MED (1 PLC)¹ or SLOW (10 PLC) or MED (1 PLC) with filter of 10

Accuracy: ±(ppm of reading + ppm of range)
(ppm = parts per million)
(e.g., 10ppm = 0.001%)

| Function | Range | Resolution | Test Current or Burden Voltage | Input Resistance | 24 Hour ¹⁴ 23°C ± 1° | 90 Day 23°C ± 5° | 1 Year 23°C ± 5° | Temperature Coefficient 0°–18°C & 28°–50°C |
|--------------------------|-------------------------------|------------|--------------------------------|------------------|---------------------------------|------------------|------------------|--|
| Voltage | 100.0000 mV | 0.1 μV | | > 10 GΩ | 30 + 30 | 40 + 35 | 50 + 35 | 2 + 6 |
| | 1.000000 V | 1.0 μV | | > 10 GΩ | 15 + 6 | 25 + 7 | 30 + 7 | 2 + 1 |
| | 10.00000 V | 10 μV | | > 10 GΩ | 15 + 4 | 20 + 5 | 30 + 5 | 2 + 1 |
| | 100.0000 V | 100 μV | | 10 MΩ ±1% | 15 + 6 | 30 + 6 | 45 + 6 | 5 + 1 |
| | 1000.000 V ⁹ | 1 mV | | 10 MΩ ±1% | 20 + 6 | 35 + 6 | 45 + 6 | 5 + 1 |
| Resistance ¹⁵ | 100.0000 Ω | 100 μΩ | 1 mA | | 30 + 30 | 80 + 40 | 100 + 40 | 8 + 6 |
| | 1.000000 kΩ | 1 mΩ | 1 mA | | 20 + 6 | 80 + 10 | 100 + 10 | 8 + 1 |
| | 10.00000 kΩ | 10 mΩ | 100 μA | | 20 + 6 | 80 + 10 | 100 + 10 | 8 + 1 |
| | 100.0000 kΩ | 100 mΩ | 10 μA | | 20 + 6 | 80 + 10 | 100 + 10 | 8 + 1 |
| | 1.000000 MΩ | 1 Ω | 10 μA | | 20 + 6 | 80 + 10 | 100 + 10 | 8 + 1 |
| | 10.00000 MΩ ^{11, 16} | 10 Ω | 700 nA // 10MΩ | | 150 + 6 | 200 + 10 | 400 + 10 | 70 + 1 |
| | 100.0000 MΩ ^{11, 16} | 100 Ω | 700 nA // 10MΩ | | 800 + 30 | 1500 + 30 | 1500 + 30 | 385 + 1 |
| Current | 10.00000 mA | 10 nA | < 0.15 V | | 60 + 30 | 300 + 80 | 500 + 80 | 50 + 5 |
| | 100.0000 mA | 100 nA | < 0.03 V | | 100 + 300 | 300 + 800 | 500 + 800 | 50 + 50 |
| | 1.000000 A | 1 μA | < 0.3 V | | 200 + 30 | 500 + 80 | 800 + 80 | 50 + 5 |
| | 3.00000 A | 10 μA | < 1 V | | 1000 + 15 | 1200 + 40 | 1200 + 40 | 50 + 5 |
| Continuity 2W | 1 kΩ | 100 mΩ | 1 mA | | 40 + 100 | 100 + 100 | 120 + 100 | 8 + 1 |
| Diode Test | 3.00000 V | 10 μV | 1 mA | | 20 + 6 | 30 + 7 | 40 + 7 | 8 + 1 |
| | 10.00000 V | 10 μV | 100 μA | | 20 + 6 | 30 + 7 | 40 + 7 | 8 + 1 |
| | 10.00000 V | 10 μV | 10 μA | | 20 + 6 | 30 + 7 | 40 + 7 | 8 + 1 |

DC OPERATING CHARACTERISTICS²

| Function | Digits | Readings/s | PLCs ⁸ |
|-----------------------|---|------------|-------------------|
| DCV (all ranges), | 6 ¹ / ₂ ^{3, 4} | 5 | 10 |
| DCI (all ranges), and | 6 ¹ / ₂ ^{3, 7} | 30 | 1 |
| 2W Ohms (<10M range) | 6 ¹ / ₂ ^{3, 5} | 50 | 1 |
| | 5 ¹ / ₂ ^{3, 5} | 270 | 0.1 |
| | 5 ¹ / ₂ ⁵ | 500 | 0.1 |
| | 5 ¹ / ₂ ⁵ | 1000 | 0.04 |
| | 4 ¹ / ₂ ⁵ | 2000 | 0.01 |

DC SYSTEM SPEEDS^{2, 6}

RANGE CHANGE³: 50/s.

FUNCTION CHANGE³: 45/s.

AUTORANGE TIME^{3, 10}: <30ms.

ASCII READINGS TO RS-232 (19.2K BAUD): 55/s.

MAX. INTERNAL TRIGGER RATE: 2000/s.

MAX. EXTERNAL TRIGGER RATE: 400/s.

DC GENERAL

LINEARITY OF 10VDC RANGE: ±(1ppm of reading + 2ppm of range).

DCV, Ω, TEMPERATURE, CONTINUITY, DIODE TEST INPUT PROTECTION: 1000V, all ranges.

MAXIMUM 4WΩ LEAD RESISTANCE: 10% of range per lead for 100Ω and 1kΩ ranges; 1kΩ per lead for all other ranges.

DC CURRENT INPUT PROTECTION: 3A, 250V fuse.

SHUNT RESISTOR: 0.1Ω for 3A, 1A, and 100mA ranges. 10Ω for 10mA range.

CONTINUITY THRESHOLD: Adjustable 1Ω to 1000Ω.

AUTOZERO OFF ERROR: Add ±(2ppm of range error + 5μV) for <10 minutes and ±1°C change.

OVERRANGE: 120% of range except on 1000V, 3A, and diode.

SPEED AND NOISE REJECTION

| Rate | Readings/s | Digits | RMS Noise 10V Range | NMRR ¹² | CMRR ¹³ |
|----------|------------|-------------------------------|---------------------|--------------------|--------------------|
| 10 PLC | 5 | 6 ¹ / ₂ | < 1.5 μV | 60 dB | 140 dB |
| 1 PLC | 50 | 6 ¹ / ₂ | < 4 μV | 60 dB | 140 dB |
| 0.1 PLC | 500 | 5 ¹ / ₂ | < 22 μV | — | 80 dB |
| 0.01 PLC | 2000 | 4 ¹ / ₂ | < 150 μV | — | 80 dB |

DC NOTES

- Add the following to ppm of range accuracy specification based on range: 1V and 100V, 2ppm; 100mV, 15ppm; 100Ω, 15ppm; <1MΩ, 2ppm; 10mA and 1A, 2ppm; 100mA, 20ppm.
- Speeds are for 60Hz operation using factory default operating conditions (*RST). Autorange off, Display off, Trigger delay = 0.
- Speeds include measurement and binary data transfer out the GPIB.
- Auto zero off.
- Sample count = 1024, auto zero off.
- Auto zero off, NPLC = 0.01.
- Ohms = 24 readings/second.
- 1 PLC = 16.67ms @ 60Hz, 20ms @ 50Hz/400Hz. The frequency is automatically determined at power up.
- For signal levels >500V, add 0.02ppm/V uncertainty for the portion exceeding 500V.
- Add 120ms for ohms.
- Must have 10% matching of lead resistance in Input HI and LO.
- For line frequency ±0.1%.
- For 1kΩ unbalance in LO lead.
- Relative to calibration accuracy.
- Specifications are for 4-wire ohms. For 2-wire ohms, add 1Ω additional uncertainty.
- For rear inputs, add the following to temperature coefficient "ppm of reading" uncertainty 10MΩ 70 ppm, 100MΩ 385ppm. Operating environment specified for 0°C to 50°C RH at 35°C.

Model 2000 specifications

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True RMS AC Voltage and Current Characteristics

| Voltage Range | Resolution | Calibration Cycle | Accuracy 1: ±(% of reading + % of range), 23°C ± 5 °C | | | | | |
|----------------------------------|------------|-------------------|---|---------------|---------------|----------------|-----------------|--|
| | | | 3 Hz–10 Hz | 10 Hz–20 kHz | 20 kHz–50 kHz | 50 kHz–100 kHz | 100 kHz–300 kHz | |
| 100.0000 mV | 0.1 µV | | | | | | | |
| 1.000000 V | 1.0 µV | 90 Days | 0.35 + 0.03 | 0.05 + 0.03 | 0.11 + 0.05 | 0.60 + 0.08 | 4 + 0.5 | |
| 10.00000 V | 10 µV | | | | | | | |
| 100.0000 V | 100 µV | 1 Year | 0.35 + 0.03 | 0.06 + 0.03 | 0.12 + 0.05 | 0.60 + 0.08 | 4 + 0.5 | |
| 750.000 V | 1 mV | | | | | | | |
| Temperature Coefficient 8 | | | 0.035 + 0.003 | 0.005 + 0.003 | 0.006 + 0.005 | 0.01 + 0.006 | 0.03 + 0.01 | |

| Current Range | Resolution | Calibration Cycle | Accuracy 1: ±(% of reading + % of range), 23°C ± 5 °C | |
|----------------------------------|------------|-------------------|---|---------------|
| | | | 3 Hz–10 Hz | 10 Hz–5 kHz |
| 1.000000 A | 1 µA | 90 Day/1 Year | 0.30 + 0.04 | 0.10 + 0.04 |
| 3.00000 A | 10 µA | 90 Day/1 Year | 0.35 + 0.06 | 0.15 + 0.06 |
| Temperature Coefficient 8 | | | 0.035 + 0.006 | 0.015 + 0.006 |

HIGH CREST FACTOR ADDITIONAL ERROR ±(% of reading) 7

| | | | | |
|-------------------|------|------|------|------|
| CREST FACTOR: | 1–2 | 2–3 | 3–4 | 4–5 |
| ADDITIONAL ERROR: | 0.05 | 0.15 | 0.30 | 0.40 |

AC OPERATING CHARACTERISTICS 2

| Function | Digits | Readings/s | Rate | Bandwidth |
|-----------------------|-----------------|------------|------|----------------|
| ACV (all ranges), and | 6½ ³ | 2s/reading | SLOW | 3 Hz–300 kHz |
| ACI (all ranges) | 6½ ³ | 1.4 | MED | 30 Hz–300 kHz |
| | 6½ ⁴ | 4.8 | MED | 30 Hz–300 kHz |
| | 6½ ³ | 2.2 | FAST | 300 Hz–300 kHz |
| | 6½ ⁴ | 35 | FAST | 300 Hz–300 kHz |

ADDITIONAL LOW FREQUENCY ERRORS ±(% of reading)

| | Slow | Med | Fast |
|-----------------|------|-----|------|
| 20 Hz – 30 Hz | 0 | 0.3 | — |
| 30 Hz – 50 Hz | 0 | 0 | — |
| 50 Hz – 100 Hz | 0 | 0 | 1.0 |
| 100 Hz – 200 Hz | 0 | 0 | 0.18 |
| 200 Hz – 300 Hz | 0 | 0 | 0.10 |
| > 300 Hz | 0 | 0 | 0 |

AC SYSTEM SPEEDS 2, 5

FUNCTION/RANGE CHANGE 4: 4/s.
 AUTORANGE TIME: <3s.
 ASCII READINGS TO RS-232 (19.2K BAUD) 4: 50/s.
 MAX. INTERNAL TRIGGER RATE 4: 300/s.
 MAX. EXTERNAL TRIGGER RATE 4: 260/s.

AC GENERAL

INPUT IMPEDANCE: 1MΩ ±2% paralleled by <100pF.
 ACV INPUT PROTECTION: 1000Vp.
 MAXIMUM DCV: 400V on any ACV range.
 ACI INPUT PROTECTION: 3A, 250V fuse.
 BURDEN VOLTAGE: 1A Range: <0.3V rms. 3A Range: <1V rms.
 SHUNT RESISTOR: 0.1Ω on all ACI ranges.
 AC CMRR: >70dB with 1kΩ in LO lead.
 MAXIMUM CREST FACTOR: 5 at full scale.
 VOLT HERTZ PRODUCT: ≤8 × 10⁷ V-Hz.
 OVERRANGE: 120% of range except on 750V and 3A ranges.

AC NOTES

- Specifications are for SLOW rate and sinewave inputs >5% of range.
- Speeds are for 60Hz operation using factory default operating conditions (*RST). Auto zero off, Auto range off, Display off, includes measurement and binary data transfer out the GPIB.
- 0.01% of step settling error. Trigger delay = 400ms.
- Trigger delay = 0.
- DETECTOR: BANDwidth 300, NPLC = 0.01.
- Maximum useful limit with trigger delay = 175ms.
- Applies to non-sinewaves >5Hz.
- Applies to 0°–18°C and 28°–50°C.

Model 2000 specifications

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Model 2000 specifications

DIGITAL MULTIMETERS & SYSTEMS

Triggering and Memory

READING HOLD SENSITIVITY: 0.01%, 0.1%, 1%, or 10% of reading.
 TRIGGER DELAY: 0 to 99 hrs (1ms step size).
 EXTERNAL TRIGGER LATENCY: 200µs + <300µs jitter with autozero off, trigger delay = 0.
 MEMORY: 1024 readings.

Math Functions

Rel, Min/Max/Average/StdDev (of stored reading), dB, dBm, Limit Test, %, and mX+b with user defined units displayed.
 DBM REFERENCE RESISTANCES: 1 to 9999Ω in 1Ω increments.

Standard Programming Languages

SCPI (Standard Commands for Programmable Instruments)

Remote Interface

GPIO (IEEE-488.1, IEEE-488.2) and RS-232C.

Frequency and Period Characteristics

| ACV Range | Frequency Range | Period Range | Gate Time | Resolution ±(ppm of reading) | Accuracy 90 Day/1 Year ±(% of reading) |
|-----------------|-----------------|----------------|------------|------------------------------|--|
| 100 mV to 750 V | 3 Hz to 500 kHz | 333 ms to 2 µs | 1 s (SLOW) | 0.333 | 0.01 |

Temperature Characteristics

Thermocouple^{2,3,4}

| Type | Range | Resolution | Accuracy ¹ 90 Day/1 Year (23°C ± 5°C) Relative to Reference Junction |
|------|------------------|------------|---|
| J | -200 to + 760°C | 0.001°C | ±0.5°C |
| K | -200 to + 1372°C | 0.001°C | ±0.5°C |
| T | -200 to + 400°C | 0.001°C | ±0.5°C |

TEMPERATURE NOTES

- For temperatures <-100°C, add ±0.1°C and >900°C add ±0.3°C.
- Temperature can be displayed in °C, K or °F.
- Accuracy based on ITS-90.
- Exclusive of thermocouple error.

GENERAL

POWER SUPPLY: 100V / 120V / 220V / 240V ±10%.
LINE FREQUENCY: 45Hz to 66Hz, automatically sensed at power-up.
POWER CONSUMPTION: 22VA.
VOLT HERTZ PRODUCT: ≤8 × 10⁷V·Hz.
OPERATING ENVIRONMENT: Specified for 0°C to 50°C. Specified to 80% R.H. at 35°C and at an altitude of up to 2000m.
STORAGE ENVIRONMENT: -40°C to 70°C.
SAFETY: Conforms with European Union Directive 73/23/EEC, EN 61010-1, UL 3111-1.
EMC: Conforms with European Union Directive 89/336/EEC, EN 55011, EN 50082-1, EN 61000-3-2, EN 61000-3-3, FCC part 15 class B.
WARMUP: 1 hour to rated accuracy.
DIMENSIONS:
Rack Mounting: 89mm high × 213mm wide × 370mm deep (3½ in × 8½ in × 14½ in).
Bench Configuration (with handle and feet): 104mm high × 238mm wide × 370mm deep (4½ in × 9½ in × 14½ in).
NET WEIGHT: 2.9kg (6.3 lbs.).
SHIPPING WEIGHT: 5kg (11 lbs.).

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