

# 2000 6½-Digit Multimeter

See page 46 for the Model 2000-20, a 20-channel version of this DMM/Scanner combination.

- High performance design
- 13 built-in measurement functions
- 2000 readings/second at 4½ digits
- Optional scanner cards for multipoint measurements
- IEEE-488 and RS-232 interfaces
- Smooth migration to higher resolution DMMs
- Extensive support software library and applications
- Applications:
  - Benchtop testing
  - Production testing
  - Multipoint scan/measure solution with optional plug-in cards

## ORDERING INFORMATION

2000	6½-Digit Multimeter with Instruction Manual and Model 1751 Safety Test Leads
2000/2000-SCAN	6½-Digit DMM/Scanner Combination with Instruction Manual and Model 1751 Safety Test Leads

This product is available with an **Extended Warranty**. See page 635 for complete ordering information.

## ACCESSORIES AVAILABLE

2000-SCAN	10-Channel, General-Purpose Scanner Card
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)
8501-1,	Trigger-Link Cables, 1m (3.3 ft),
8501-2	2m (6.6 ft)
8502	Trigger Link Adapter Box
8503	Trigger Link Cable to 2 male BNCs, 1m (3.3 ft)
7009-5	RS-232 Cable

### RACK MOUNT KITS

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

### OTHER

KPCI-488	IEEE-488 Interface/Controller for the PCI Bus
KPC-488.2AT	IEEE-488 Interface Card for IBM PC/AT (full slot)
KPC-TM	Trigger Master Interface
TestPoint	Test Development Software
1050	Padded Carrying Case
2000-EW	1 Year Extended Warranty

See page 235 for descriptions of all accessories.



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 ohms from 100μΩ to 100MΩ (with 0.008% 90-day basic accuracy).

## 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.

Other capabilities that enhance throughput include high-speed autoranging (<30ms), fast range changes (50/s), low trigger latency and minimal trigger jitter. The 2000's wide dynamic range eliminates many range change delays. A one-year calibration interval means far less downtime, so critical applications can keep running.

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 ten measurement points, the 2000 is compatible with Keithley's 7000 Series switch matrices and cards.

## High Simplicity

The 2000 has a front panel design that's simple to understand and easy to use. There are no menus — a few key presses are all it takes to set up any measurement. Annunciators on the display screen make it easy to keep track of the measurement process.

## High Measurement Flexibility

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.

This multi-functional design minimizes added equipment costs. For example, built-in support for J, K, and

T-type thermocouples makes a separate thermometer unnecessary. Similarly, the frequency counter function can make accurate signal measurements up to 300 kHz, eliminating the need for a separate counter. 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.

## High Compatibility

Those who use the 2000 to upgrade the performance of an existing application will appreciate how it preserves their code investment. If the existing IEEE-488 code was written for the Fluke 8840/42 or the Keithley 196/199, the 2000 can be substituted for the old DMM without rewriting software. Later, if the application requires additional resolution or functionality, 2000 code developed in accordance with SCPI standards will allow smooth migration to the 2001 or 2002.

TestPoint Instrument Driver Libraries and run-time programs are included with the 2000 to simplify IEEE-488.2 and RS-232 program generation. A variety of ready-to-run applications programs are also included. A LabVIEW library for the 2000 is available, as well as QuickBASIC example programs, which assist in programming the 2000 using SCPI.

## High Reliability

The 2000 conforms to rigorous standards governing safety and reliability, including CSA, IEC-1010, FCC, and VDE. A 1000V input rating guards against accidental overloads, and the instrument recovers from overloads in milliseconds. It can accommodate 1500V from high-to-earth for added protection and increased reliability.

# 2000 6<sup>1</sup>/<sub>2</sub>-Digit Multimeter

## DC CHARACTERISTICS

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

Accuracy:  $\pm$ (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	Accuracy			TEMPERATURE COEFFICIENT 0°–18°C & 28°–50°C
					24 HOUR <sup>14</sup> 23°C $\pm$ 1°	90 DAY 23°C $\pm$ 5°	1 YEAR 23°C $\pm$ 5°	
VOLTAGE	100.0000 mV	0.1 $\mu$ V		> 10 G $\Omega$	30 + 30	40 + 35	50 + 35	2 + 6
	1.000000 V	1.0 $\mu$ V		> 10 G $\Omega$	15 + 6	25 + 7	30 + 7	2 + 1
	10.00000 V	10 $\mu$ V		> 10 G $\Omega$	15 + 4	20 + 5	30 + 5	2 + 1
	100.0000 V	100 $\mu$ V		10 M $\Omega$ $\pm$ 1%	15 + 6	30 + 6	45 + 6	5 + 1
	1000.000 V <sup>9</sup>	1 mV		10 M $\Omega$ $\pm$ 1%	20 + 6	35 + 6	45 + 6	5 + 1
RESISTANCE <sup>15</sup>	100.0000 $\Omega$	100 $\mu$ $\Omega$	1 mA		30 + 30	80 + 40	100 + 40	8 + 6
	1.000000 k $\Omega$	1 m $\Omega$	1 mA		20 + 6	80 + 10	100 + 10	8 + 1
	10.00000 k $\Omega$	10 m $\Omega$	100 $\mu$ A		20 + 6	80 + 10	100 + 10	8 + 1
	100.0000 k $\Omega$	100 m $\Omega$	10 $\mu$ A		20 + 6	80 + 10	100 + 10	8 + 1
	1.000000 M $\Omega$	1 $\Omega$	10 $\mu$ A		20 + 6	80 + 10	100 + 10	8 + 1
	10.00000 M $\Omega$ <sup>11</sup>	10 $\Omega$	700 nA // 10M $\Omega$		150 + 6	200 + 10	400 + 10	25 + 1
	100.0000 M $\Omega$ <sup>11</sup>	100 $\Omega$	700 nA // 10M $\Omega$		800 + 30	1500 + 30	1500 + 30	150 + 1
CURRENT	10.00000 mA	10 nA	< 0.15 V		60 + 15	300 + 40	500 + 40	50 + 5
	100.0000 mA	100 nA	< 0.03 V		100 + 150	300 + 400	500 + 400	50 + 50
	1.000000 A	1 $\mu$ A	< 0.3 V		200 + 15	500 + 40	800 + 40	50 + 5
	3.000000 A	10 $\mu$ A	< 1 V		1000 + 10	1200 + 15	1200 + 15	50 + 5
CONTINUITY 2W	1 k $\Omega$	100 m $\Omega$	1 mA		40 + 100	100 + 100	120 + 100	8 + 1
DIODE TEST	3.00000 V	10 $\mu$ V	1 mA		20 + 6	30 + 7	40 + 7	8 + 1
	10.00000 V	10 $\mu$ V	100 $\mu$ A		20 + 6	30 + 7	40 + 7	8 + 1
	10.00000 V	10 $\mu$ V	10 $\mu$ A		20 + 6	30 + 7	40 + 7	8 + 1

## DC OPERATING CHARACTERISTICS<sup>2</sup>

FUNCTION	DIGITS	READINGS/s	PLCs <sup>8</sup>
DCV (all ranges),	6 <sup>1</sup> / <sub>2</sub> <sup>3,4</sup>	5	10
DCI (all ranges), and	6 <sup>1</sup> / <sub>2</sub> <sup>3,7</sup>	30	1
2W Ohms (<10M range)	6 <sup>1</sup> / <sub>2</sub> <sup>3,5</sup>	50	1
	5 <sup>1</sup> / <sub>2</sub> <sup>3,5</sup>	270	0.1
	5 <sup>1</sup> / <sub>2</sub> <sup>5</sup>	500	0.1
	5 <sup>1</sup> / <sub>2</sub> <sup>5</sup>	1000	0.04
	4 <sup>1</sup> / <sub>2</sub> <sup>5</sup>	2000	0.01

## DC SYSTEM SPEEDS<sup>2,6</sup>

RANGE CHANGE<sup>3</sup>: 50/s.

FUNCTION CHANGE<sup>3</sup>: 45/s.

AUTORANGE TIME<sup>3,10</sup>: <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:  $\pm$ (2ppm of reading + 1ppm of range).

DCV,  $\Omega$ , TEMPERATURE, CONTINUITY, DIODE TEST INPUT PROTECTION: 1000V, all ranges.

MAXIMUM 4W $\Omega$  LEAD RESISTANCE: 10% of range per lead for 100 $\Omega$  and 1k $\Omega$  ranges; 1k $\Omega$  per lead for all other ranges.

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

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

CONTINUITY THRESHOLD: Adjustable 1 $\Omega$  to 1000 $\Omega$ .

AUTOZERO OFF ERROR: Add  $\pm$ (2ppm of range error + 5 $\mu$ V) for <10 minutes and  $\pm$ 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 <sup>12</sup>	CMRR <sup>13</sup>
10 PLC	5	6 <sup>1</sup> / <sub>2</sub>	< 1.5 $\mu$ V	60 dB	140 dB
1 PLC	50	6 <sup>1</sup> / <sub>2</sub>	< 4 $\mu$ V	60 dB	140 dB
0.1 PLC	500	5 <sup>1</sup> / <sub>2</sub>	< 22 $\mu$ V	—	80 dB
0.01 PLC	2000	4 <sup>1</sup> / <sub>2</sub>	< 150 $\mu$ V	—	80 dB

## DC Notes

- Add the following to ppm of range accuracy specification based on range: 1V and 100V, 2ppm; 100mV, 15ppm; 100 $\Omega$ , 15ppm; <1M $\Omega$ , 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  $\pm$ 0.1%.
- For 1k $\Omega$  unbalance in LO lead.
- Relative to calibration accuracy.
- Specifications are for 4-wire ohms or 2-wire ohms with REL function.

## QUESTIONS?

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# 2000 6<sup>1</sup>/<sub>2</sub>-Digit Multimeter

## TRUE RMS AC VOLTAGE AND CURRENT CHARACTERISTICS

VOLTAGE RANGE	RESOLUTION	CALIBRATION CYCLE	ACCURACY <sup>1</sup> : ±(% 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	90 Days	0.35 + 0.03	0.05 + 0.03	0.11 + 0.05	0.60 + 0.08	4 + 0.5
1.000000 V	1.0 μV						
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 <sup>8</sup>			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	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 <sup>8</sup>			0.035 + 0.006	0.015 + 0.006

### HIGH CREST FACTOR ADDITIONAL ERROR ±(% of reading)<sup>7</sup>

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

### AC OPERATING CHARACTERISTICS<sup>2</sup>

FUNCTION	DIGITS	READINGS/s	RATE	BANDWIDTH
ACV (all ranges), and	6 <sup>1</sup> / <sub>2</sub> <sup>3</sup>	2s/reading	SLOW	3 Hz–300 kHz
ACI (all ranges)	6 <sup>1</sup> / <sub>2</sub> <sup>3</sup>	1.4	MED	30 Hz–300 kHz
	6 <sup>1</sup> / <sub>2</sub> <sup>4</sup>	4.8	MED	30 Hz–300 kHz
	6 <sup>1</sup> / <sub>2</sub> <sup>3</sup>	2.2	FAST	300 Hz–300 kHz
	6 <sup>1</sup> / <sub>2</sub> <sup>4</sup>	35	FAST	300 Hz–300 kHz

### ADDITIONAL LOW FREQUENCY ERRORS ±(% of reading)

	SLOW	MED	FAST
20Hz – 30Hz	0	0.3	—
30Hz – 50Hz	0	0	—
50Hz – 100Hz	0	0	1.0
100Hz – 200Hz	0	0	0.18
200Hz – 300Hz	0	0	0.10
> 300Hz	0	0	0

### AC SYSTEM SPEEDS<sup>2,5</sup>

FUNCTION/RANGE CHANGE<sup>6</sup>: 4/s.

AUTORANGE TIME: <3s.

ASCII READINGS TO RS-232 (19.2K BAUD)<sup>4</sup>: 50/s.

MAX. INTERNAL TRIGGER RATE<sup>4</sup>: 300/s.

MAX. EXTERNAL TRIGGER RATE<sup>4</sup>: 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 × 10<sup>7</sup> V-Hz.

OVERRANGE: 120% of range except on 750V and 3A ranges.

### AC Notes

- Specifications are for SLOW rate and sine wave 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-sine waves >5Hz.
- Applies to 0°–18°C and 28°–50°C.

### QUESTIONS?

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# 2000 6<sup>1</sup>/<sub>2</sub>-Digit Multimeter

## 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:** 200 $\mu$ s + <300 $\mu$ s 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 9999 $\Omega$  in 1 $\Omega$  increments.

## STANDARD PROGRAMMING LANGUAGES

SCPI (Standard Commands for Programmable Instruments)

## REMOTE INTERFACE

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

## FREQUENCY AND PERIOD CHARACTERISTICS<sup>1,2</sup>

ACV RANGE	FREQUENCY RANGE	PERIOD RANGE	GATE TIME	RESOLUTION $\pm$ (ppm of reading)	ACCURACY 90 DAY/1 YEAR $\pm$ (% of reading)
100 mV to 750 V	3 Hz to 500 kHz	333 ms to 2 $\mu$ s	1 s (SLOW)	0.333	0.01

### Frequency Notes

- Specifications are for square wave inputs >10% of ACV range, except 100mV range. On 100mV range frequency must be >10Hz if voltage is <20mV.
- 20% overrange on all ranges except 750V range.

## TEMPERATURE CHARACTERISTICS

THERMOCOUPLE <sup>2,3,4</sup>		90 DAY/1 YEAR (23°C $\pm$ 5°C) ACCURACY <sup>1</sup> Relative to Reference Junction			USING 2001-TCSCAN <sup>5</sup>
TYPE	RANGE	RESOLUTION			
J	-200 to + 760°C	0.001°C		$\pm$ 0.5°C	$\pm$ 0.65°C
K	-200 to + 1372°C	0.001°C		$\pm$ 0.5°C	$\pm$ 0.70°C
T	-200 to + 400°C	0.001°C		$\pm$ 0.5°C	$\pm$ 0.68°C

### Temperature Notes

- For temperatures <-100°C, add  $\pm$ 0.1°C and >900°C add  $\pm$ 0.3°C.
- Temperature can be displayed in °C, K, or °F.
- Accuracy based on ITS-90.
- Exclusive of thermocouple error.
- Specifications apply to channels 2-6. Add 0.06°C/channel for Channel 6.

## GENERAL SPECIFICATIONS

**POWER SUPPLY:** 100V / 120V / 220V / 240V  $\pm$ 10%.

**LINE FREQUENCY:** 45Hz to 66Hz, automatically sensed at power-up.

**POWER CONSUMPTION:** 22VA.

**OPERATING ENVIRONMENT:** Specified for 0°C to 50°C. Specified to 80% R.H. at 35°C.

**STORAGE ENVIRONMENT:** -40°C to 70°C.

**WARRANTY:** 3 years.

**SAFETY:** Conforms with European Union Directive 73/23/EEC, EN 610110-1, 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  $\times$  213mm wide  $\times$  370mm deep (3 $\frac{1}{2}$  in  $\times$  8 $\frac{3}{8}$  in  $\times$  14 $\frac{5}{16}$  in).

**Bench Configuration (with handle and feet):** 104mm high  $\times$  238mm wide  $\times$  370mm deep (4 $\frac{1}{8}$  in  $\times$  9 $\frac{3}{8}$  in  $\times$  14 $\frac{5}{16}$  in).

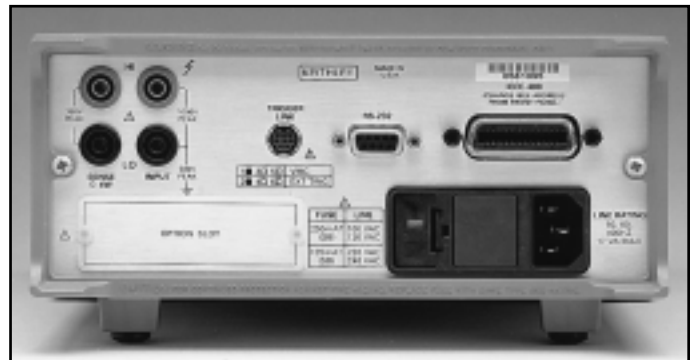
**NET WEIGHT:** 2.9kg (6.3 lbs).

**SHIPPING WEIGHT:** 5kg (11 lbs).

**VOLT HERTZ PRODUCT:**  $\leq$ 8  $\times$  10<sup>7</sup>V $\cdot$ Hz.

**ACCESSORIES SUPPLIED:** Model 1751 Safety Test Leads, User Manual, Service Manual.

Specifications are subject to change without notice.



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