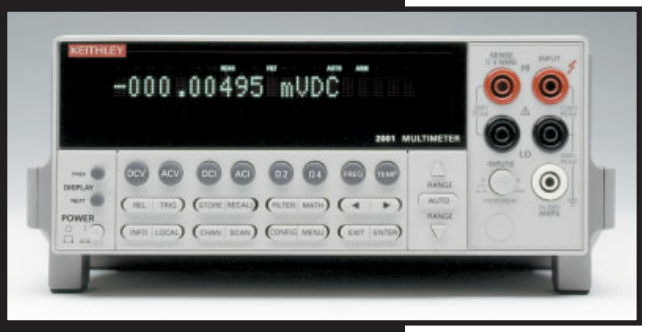
2001
2002

7½-Digit High Performance Multimeter
8½-Digit High Performance Multimeter



- **True 7½- (Model 2001) or 8½-digit (Model 2002) resolution**
- **Exceptional measurement integrity with high speed**
- **High speed function and range changing**
- **Broad range of built-in measurement functions**
- **Multiple measurement display**
- **Built-in 10 channel scanner option**
- **GPIB interface**
- **HP3458A emulation mode (Model 2002)**

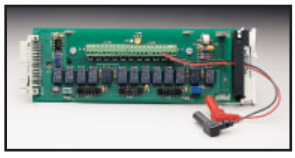
DMM users whose applications demand exceptional resolution, accuracy, and sensitivity combined with high throughput now have two attractive alternatives to high priced, high end DMMs. Keithley's 7½-digit Model 2001 and 8½-digit Model 2002 High Performance Digital Multimeters not only deliver performance specifications usually associated with instruments that cost thousands more, but they also offer a broad range of functions not typically available from DMMs. The 2002 is based on the same superior measurement technology as the 2001, and the front panels of both instruments have the same look, feel, and response.

True 7½- (or 8½-) Digit Resolution

While other DMMs may claim 7½- or 8½-digit resolution, they must average multiple readings to extend their resolution. The resolution specifications of the 2001 and 2002 are based on a 28-bit A/D converter that provides the resolution needed to discern smaller changes. This higher resolution also provides greater dynamic range, making it possible to measure from 1μV to 20V on a single range, thus avoiding range-shift errors and delays.

Built-In Scanner (Multiplexer) Options

With the addition of a plug-in scanner card, the 2001 or 2002 becomes a complete scan and measure system for applications involving up to ten measurement points. The additional resolution and measurement ranges provided by the 2002 make it an excellent choice for production test, design verification, and metrology applications where high accuracy is critical.



High Accuracy ACV Measurements

A patented circuit design makes the 2001 and 2002's AC measurements several times more accurate than competitive DMMs. In this circuit, the signal bypasses the prime error-contributing section of conventional rms converters. This increases the accuracy at almost any voltage level, and also increases sensitivity down to a guaranteed 1% of the selected range, compared to 5–10% for most other DMMs. The result is highly accurate measurements over a broad range of inputs.

Applications involving vibration, servo, guidance, shock, and control systems often require accurate low frequency ACV measurements. The 2001 and 2002 maintain very good accuracy (better than 0.1%) down to 1Hz. The wide bandwidth of these DMMs allows for accurate measurements of high frequency AC signals without the need for a special AC meter. Both the 2001 and 2002 feature TRMS AC, average AC, peak AC, AC+DC, and crest factor measurement capability for a wide variety of applications.

High Speed for High Throughput

In applications where high throughput is critical, both the 2001 and 2002 provide more than 2000 readings per second at 4½-digit resolution. At 7½ digits, the 2002 maintains full rated accuracy at reading rates up to 44/second on DCV and ohms.

High Speed, High Precision Resistance Measurements

The Model 2002 uses a unique single-phase method for 4-wire ohms measurements. This makes it twice as fast for a given power line cycle rate. This also eliminates errors due to changing lead resistances that can result from fast test handlers. A built-in open-lead detection circuit also eliminates many production test problems.

Fast, Flexible Triggering

Trigger latency—the delay between trigger and measurement—is often a barrier to higher throughput. Also, variability in latency can complicate predicting measurement timing. The 2001 and 2002 trigger is less than 2μs±1μs, which is much faster than typical system DMMs.

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www.keithley.com

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Ordering Information

2001 High Performance 7½-Digit DMM with 8K Memory

2002 High Performance 8½-Digit DMM with 8K Memory

2000-SCAN
10-channel Scanner Card

2001-SCAN
10-channel Scanner Card with two high-speed channels

2001-TCSCAN
9-channel Thermocouple Scanner Card

2001/MEM1
High Performance 7½-Digit DMM with 32K Memory

2001/MEM2
High Performance 7½-Digit DMM with 128K Memory

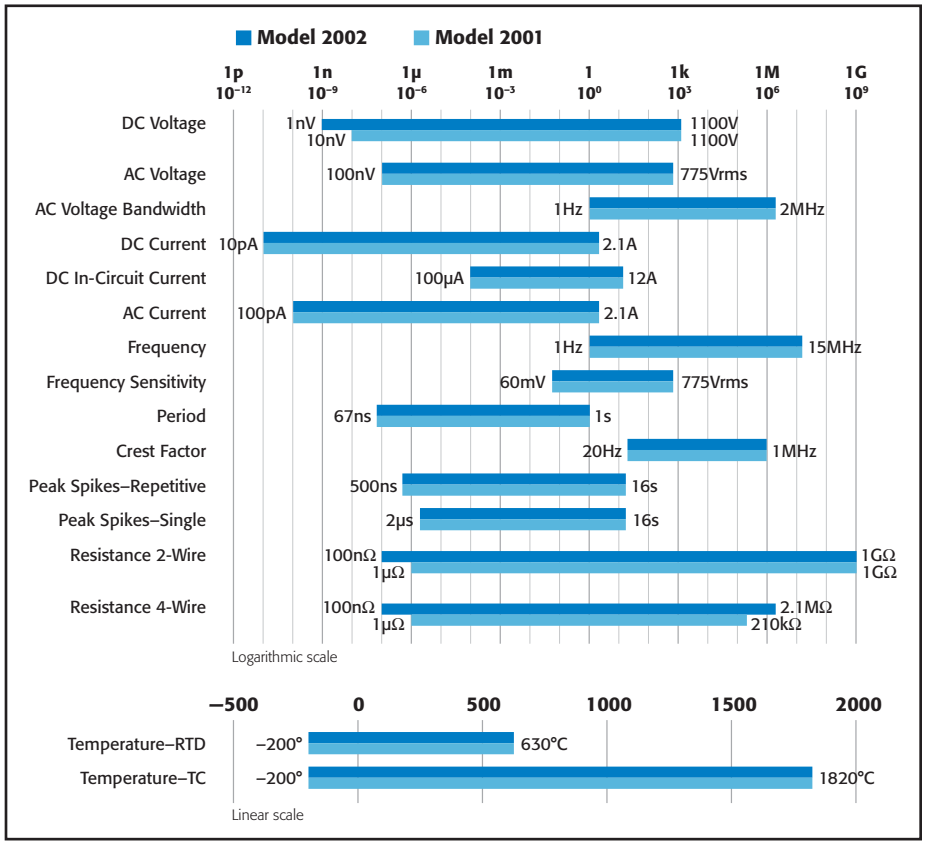
2002/MEM1
High Performance 8½-Digit DMM with 32K Memory

2002/MEM2
High Performance 8½-Digit DMM with 128K Memory

Accessories Supplied

Model 8605 High Performance Modular Test Leads, user's manual, option slot cover, and full calibration data.

For more information, request the Model 2001 and 2002 Technical Specifications books.



Both the 2001 and 2002 provide exceptional measurement range. In addition, the 2002 offers extended DCV and resistance measurement capabilities.

The unique Trigger-Link feature included in the Model 2001 and 2002 and most Keithley test and measurement products can be used to coordinate the operation of two or more instruments. Trigger-Link combines six independent software selectable trigger lines on a single connector for simple, direct control over all instruments in a system.

Spot Trends with the Bar-Graph Display

The ability to track reading trends around a target value easily can be just as important as the absolute readings. A unique bar-graph display function in the 2001 and 2002 indicates data as a percentage of the selected range from ±0.01% to ±100%. Whether adjusting about zero or any other desired value, this display can replace a nulling differential voltmeter.

Capture Spikes Down to 1µs

Both the 2001 and 2002 have internal peak detectors that can catch 1μs spikes such as power supply spikes and transients, AC line power surges, and short-duration dropouts on components. These peak detectors operate up to 1MHz for repetitive signals or down to 1μs for single spikes, so there is no need for a separate scope. The DMMs can automatically display and store the highest value or display the maximum and minimum values of spikes.

Built-in Features and Capabilities

The 2001 and 2002 offer many built-in measurements that are typically unavailable in instruments of this type, including in-circuit current, temperature with thermocouples or RTDs, and peak spikes. Four separate outputs linked to limits simplify configuring the DMMs for use in binning operations.

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The built-in AC crest factor measurement helps ensure the accuracy of AC measurements. Other DMMs typically perform AC measurements for signals without excessive crest factor—the ratio of peak value to rms values. However, when crest factor rises, measurements may not meet specs. With a 2001 or 2002, there is no need for an oscilloscope to determine if the crest factor is acceptable—the DMM measures it directly.

While some DMMs calculate average AC from the rms value, these calculations apply only to sine wave inputs. The 2001 and 2002 measure peak value, average and true rms directly to obtain a complete characterization of the signal. This capability makes these DMMs ideal for AC circuit design or test applications and for verifying test voltages specified only in averages.

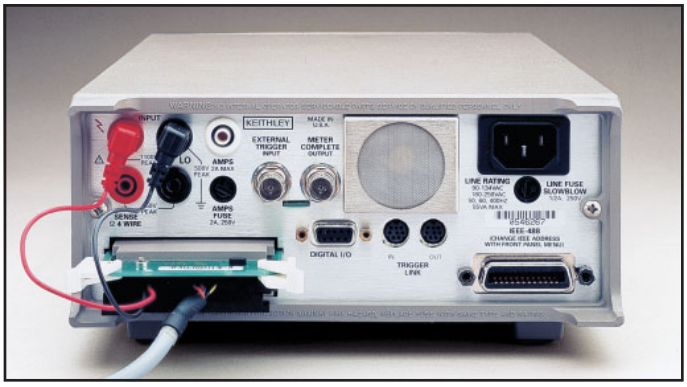
When measuring AC or digital signals, frequency is critical. The 2001 and 2002 accurately measure frequency up to 15MHz. Accurate triggering on the signal is critical to measure frequency reliably. The frequency counters in the 2001 and 2002 have a fully adjustable trigger level for good measurements of noisy signals.

Multiple Measurement Display

The 2001 and 2002 can display DC and AC volts and the AC frequency from a single measurement connection simultaneously. Several other multiple-measurement displays are available, including crest factor and bar graph. By measuring sequentially and displaying simultaneously, the 2001/2002 operates as if three different meters are working together.

Option Slot Extends DMM Performance

An option slot in the back of the 2001 and 2002 opens the door to a wide range of measurement capabilities. Choose a 10-channel general-purpose scanner card or a 9-channel thermocouple scanner card to make measurements on multiple test points or devices. This can eliminate the need for a separate scanner and significantly reduce programming and setup time.



ACCESSORIES AVAILABLE

TEST LEADS AND PROBES

5805	Kelvin Probes, 0.9m (3ft)
5805-12	Kelvin Probes, 3.6m (12ft)
5808	Low Cost, Single Pin, Kelvin Probes
5809	Low Cost, Kelvin Clip Lead Set
8502	Micro-DIN to 6 BNCs Adapter Box with 8501-1 Cable
8530	Centronics Adapter
8605	High Performance 2-Wire Modular Test Leads
8606	High Performance Modular Probe Kit
8610	Low Thermal Shorting Plug
8680	RTD Probe Adapter
8681	Low Cost RTD

CABLES/ADAPTERS

7007-1	Shielded GPIB Cable, 1m (3.3 ft)
7007-2	Shielded GPIB Cable, 2m (6.6 ft)
8501-1	Trigger-Link Cable, 1m (3.3 ft)
8501-2	Trigger Link Cable, 2m (6.6 ft)
8502	Trigger Link Adapter Box
8610	Low Thermal Shorting Plug
8620	4-Wire DMM Shorting Plug

RACK MOUNT KITS

4288-1	Single Fixed Rack Mount Kit
4288-4	Side-by-Side 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
2001/MEM1-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
2001/MEM2-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
2001-SCAN-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
2001-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
2002/MEM1-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
2002/MEM2-3Y-EW	1-year factory warranty extended to 3 years from date of shipment
2002-3Y-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 Model 2000-SCAN*
C/2001-3Y-ISO	3 (ISO-17025 accredited) calibrations within 3 years of purchase for Models 2001, 2001/MEM1, 2001/MEM2, 2001-SCAN, 2001-TCSCAN*
C/2002-3Y-ISO	3 (ISO-17025 accredited) calibrations within 3 years of purchase for Models 2002, 2002/MEM1, 2002/MEM2*

*Not available in all countries

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2001 Condensed Specifications

DC VOLTS

DCV INPUT CHARACTERISTICS AND ACCURACY

Range	Full Scale	Resolution	Default Resolution	Input Resistance	Accuracy ±(ppm of reading + ppm of range) 5 Minutes[4]	24 Hours[1]	90 Days[2]	1 Year[2]	2 Years[2]
200 mV[3]	±210.00000 mV	10 nV	100 nV	>10 GΩ	3 + 3	10 + 6	25 + 6	37 + 6	50 + 6
2 V	±2.1000000 V	100 nV	1 μV	>10 GΩ	2 + 1.5	7 + 2	18 + 2	25 + 2	32 + 2
20 V	±21.000000 V	1 μV	10 μV	>10 GΩ	2 + 1.5	7 + 4	18 + 4	24 + 4	32 + 4
200 V	±210.00000 V	10 μV	100 μV	10 MΩ ±1%	2 + 1.5	13 + 3	27 + 3	38 + 3	52 + 3
1000 V	±1100.0000 V	100 μV	1 mV	10 MΩ ±1%	10 + 1.5	17 + 6	31 + 6	41 + 6	55 + 6

DC VOLTS NOTES

1. For T_{CAL} ±1°C, following 55-minute warm-up. T_{CAL} is ambient temperature at calibration, which is 23°C from factory.
2. For T_{CAL} ±5°C, following 55-minute warm-up. Specifications include factory traceability to US NIST.
3. When properly zeroed using REL function.
4. DCV Transfer Stability typical applications are standard cell comparisons and relative accuracy measurements. Specs apply for 10 power line cycles, 20-reading digital filter, autozero on with type synchronous, fixed range following 2-hour warm-up at full scale to 10% of full scale, at T_{REF} ±1°C (T_{REF} is the initial ambient temperature). Specifications on the 1000V range are for measurements within 5% of the initial measurement value and following measurement settling.

AC VOLTS

Range	Normal Mode RMS[1] 90 Days, ±2°C from last AC self-cal for 1% to 100% of range[2] ±(% of reading + % of range) 20–50Hz	50–100Hz	0.1–2kHz	2–10kHz	10–30kHz	30–50kHz	50–100kHz	100–200kHz	0.2–1MHz	1–2MHz
200 mV	0.25 + 0.015	0.07 + 0.015	0.03 + 0.015	0.03 + 0.015	0.035 + 0.015	0.05 + 0.015	0.3 + 0.015	0.75 + 0.025	2 + 0.1	5 + 0.2
2 V	0.25 + 0.015	0.07 + 0.015	0.03 + 0.015	0.03 + 0.015	0.035 + 0.015	0.05 + 0.015	0.3 + 0.015	0.75 + 0.025	2 + 0.1	5 + 0.2
20 V	0.25 + 0.015	0.07 + 0.015	0.04 + 0.015	0.06 + 0.015	0.08 + 0.015	0.1 + 0.015	0.3 + 0.015	0.75 + 0.025	4 + 0.2	7 + 0.2[4]
200 V[3]	0.25 + 0.015	0.07 + 0.015	0.04 + 0.015	0.06 + 0.015	0.08 + 0.015	0.1 + 0.015	0.3 + 0.015	0.75 + 0.025[4]	4 + 0.2[4]	
750 V[3]	0.25 + 0.015	0.1 + 0.015	0.08 + 0.015	0.09 + 0.015	0.12 + 0.015	0.15 + 0.015[4]	0.5 + 0.015[4]			

AC VOLTS NOTES

1. Specifications apply for sinewave input, AC + DC coupling, 1 power line cycle, digital filter off, following 55 minute warm-up.
2. For 1% to 5% of range below 750V range, and for 1% to 7% of 750V range, add 0.01% to range uncertainty. For inputs from 200kHz to 2MHz, specifications apply above 10% of range.
3. Add 0.001% of reading × $(V_{IN}/100V)^2$ additional uncertainty above 100V rms.
4. Typical values.

OHMS

TWO-WIRE AND FOUR-WIRE OHMS (2W and 4W Ohms Functions)[6]

Range	Full Scale	Resolution	Default Resolution	Current Source[1]	Resistance Accuracy[3] ±(ppm of reading + ppm of range) 24 Hours[4]	90 Days[5]	1 Year[5]	2 Years[5]
20 Ω	21.000000 Ω	1 μΩ	10 μΩ	9.2 mA	29 + 7	52 + 7	72 + 7	110 + 7
200 Ω	210.00000 Ω	10 μΩ	100 μΩ	0.98 mA	24 + 7	36 + 7	56 + 7	90 + 7
2 kΩ	2100.0000 kΩ	100 μΩ	1 mΩ	0.98 mA	22 + 4	33 + 4	50 + 4	80 + 4.5
20 kΩ	21.000000 kΩ	1 mΩ	10 mΩ	89 μA	19 + 4	32 + 4	50 + 4	80 + 4.5
200 kΩ	210.00000 kΩ	10 mΩ	100 mΩ	7 μA	20 + 4.5	72 + 4.5	90 + 4.5	130 + 5
2 MΩ[2]	2.1000000 MΩ	100 mΩ	1 Ω	770 nA	50 + 4.5	110 + 4.5	160 + 4.5	230 + 5
20 MΩ[2]	21.000000 MΩ	1 Ω	10 Ω	70 nA	160 + 4.5	560 + 4.5	900 + 4.5	1100 + 5
200 MΩ[2]	210.00000 MΩ	10 Ω	100 Ω	4.4 nA	3000 + 100	10000 +100	20000 + 100	30000 + 100
1 GΩ[2]	1.0500000 GΩ	100 Ω	1 kΩ	4.4 nA	9000 + 100	20000 +100	40000 + 100	60000 + 100

OHMS NOTES

1. Current source is typically ±9% absolute accuracy.
2. For 2-wire mode.
3. Specifications are for 1 power line cycle, 10 reading digital filter, Auto Zero on, 4-wire mode, offset compensation on (for 20Ω to 20kΩ ranges).
4. For T_{CAL} ±1°C, following 55 minute warm-up. T_{CAL} is ambient temperature at calibration (23°C at the factory).
5. For T_{CAL} ±5°C, following 55-minute warm-up. Specifications include traceability to US NIST.
6. When measuring resistance of inductive loads, the inductance of that load must be 10mH or less.

DC AMPS

DCI INPUT CHARACTERISTICS AND ACCURACY[4]

Range	Full Scale	Resolution	Default Resolution	Maximum Burden Voltage[6]	Accuracy[1] ±(ppm of reading + ppm of range) 24 Hours[2]	90 Days[3]	1 Year[3]	2 Years[3]
200 μA	210.00000 μA	10 pA	100 pA	0.25 V	63 + 25	300 + 25	500 + 25	1350 + 25
2 mA	2.1000000 mA	100 pA	1 nA	0.31 V	64 + 20	300 + 20	400 + 20	750 + 20
20 mA	21.000000 mA	1 nA	10 nA	0.4 V	65 + 20	300 + 20	400 + 20	750 + 20
200 mA	210.00000 mA	10 nA	100 nA	0.5 V	96 + 20	300 + 20	500 + 20	750 + 20
2 A	2.1000000 A	100 nA	1 μA	1.5 V	500 + 20	600 + 20	900 + 20	1350 + 20

DC AMPS NOTES

1. Specifications are for 1 power line cycle, Auto Zero on, 10 reading digital filter.
2. For T_{CAL} ±1°C, following 55 minute warm-up.
3. For T_{CAL} ±5°C, following 55 minute warm-up. Specifications include traceability to US NIST.
4. Add 50 ppm of range for current above 0.5A for self heating.
6. Actual maximum voltage burden = (maximum voltage burden) × $(I_{MEASURED}/I_{FULL\ SCALE})$.

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2001 Condensed Specifications (continued)

AC AMPS

ACI ACCURACY[1, 2]

90 Days, 1 Year or 2 Years, T_{CAL} ±5°C, for 5% to 100% of range, ±(% of reading + % of range)

RANGE	20Hz–50Hz	50Hz–200Hz	200Hz–1kHz	1kHz–10kHz	10kHz–30kHz[3]	30kHz–50kHz[3]	50kHz–100kHz[3]
200 µA	0.35 + 0.015	0.2 + 0.015	0.4 + 0.015	0.5 + 0.015			
2 mA	0.3 + 0.015	0.15 + 0.015	0.12 + 0.015	0.12 + 0.015	0.25 + 0.015	0.3 + 0.015	0.5 + 0.015
20 mA	0.3 + 0.015	0.15 + 0.015	0.12 + 0.015	0.12 + 0.015	0.25 + 0.015	0.3 + 0.015	0.5 + 0.015
200 mA	0.3 + 0.015	0.15 + 0.015	0.12 + 0.015	0.15 + 0.015	0.5 + 0.015	1 + 0.015	3 + 0.015
2 A	0.35 + 0.015	0.2 + 0.015	0.3 + 0.015	0.45 + 0.015	1.5 + 0.015	4 + 0.015	

AC AMPS NOTES

1. Specifications apply for sinewave input, AC+DC coupling, 1 power line cycle, digital filter off, following 55 minute warm-up.
2. Add 0.005% of range uncertainty for current above 0.5A rms for self-heating.
3. Typical values.

FREQUENCY COUNTER

AC VOLTAGE INPUT: 1Hz–15MHz.

ACCURACY: ±(0.03% of reading).

DC IN-CIRCUIT CURRENT

TYPICAL RANGES: Current: 100µA to 12A. **Trace Resistance:** 1mΩ to 10Ω typical.

ACCURACY: ±(5% + 2 counts). For 1 power line cycle, Auto Zero on, 10 reading digital filter, T_{CAL} ±5°C, after being properly zeroed. 90 days, 1 year or 2 years.

TEMPERATURE

Built-in linearization for J, K, N, T, E, R, S, B thermocouple types to ITS-90 and 100Ω platinum RTDs DIN 43 760 or IPTS-68.

GENERAL

POWER: Voltage: 90–134V and 180–250V, universal self-selecting. **Frequency:** 50Hz, 60Hz, or 400Hz self-identifying. **Consumption:** <55VA.

ENVIRONMENTAL: Operating Temperature: 0° to 50°C. **Storage Temperature:** –40° to 70°C. **Humidity:** 80% R.H., 0° to 35°C, per MIL-T-28800E[1] Para 4.5.5.1.2.

PHYSICAL: Case Dimensions: 90mm high × 214mm wide × 369mm deep (3½ in. × 8½ in. × 14½ in.). **Net Weight:** <4.2kg (<9.2 lbs.). **Shipping Weight:** <9.1kg (<20 lbs.).

STANDARDS

EMI/RFI: Conforms to VDE 0871B (per Vfg 1046/1984), IEC 801-2. Meets FCC part 15 Class B, CISPR-22 (EN55022).

Safety: Conforms to IEC348, CAN/CSA-C22.2. No. 231, MIL-T-28800E[1]. Designed to UL1244.

Note 1: For MIL-T-28800E, applies to Type III, Class 5, Style E.

For complete specifications, refer to the 2001 Technical Data book.

2002 Condensed Specifications

DC VOLTS

DCV INPUT CHARACTERISTICS AND ACCURACY

Enhanced Accuracy[1] – 10PLC, DFILT 10

Range	Full Scale	Resolution	Input Resistance	Relative Accuracy ±(ppm of reading + ppm of range) Transfer[5]	24 Hours[2]	90 Days[3]	1 Year[3]	2 Years[3]
200mV[4]	±210.000000 mV	1 nV	>100 GΩ	0.4 + 1.5	3.5 + 3	15 + 8	19 + 9	23 + 10
2 V[4]	±2.10000000 V	10 nV	>100 GΩ	0.2 + 0.15	1.2 + 0.3	6 + 0.8	10 + 0.9	14 + 1
20 V	±21.0000000 V	100 nV	>100 GΩ	0.1 + 0.05	1.2 + 0.1	6 + 0.15	10 + 0.15	14 + 0.15
200 V	±210.000000 V	1 µV	10 MΩ ±1%	0.5 + 0.08	5 + 0.4	14 + 2	22 + 2	30 + 2
1000 V[6]	±1100.00000 V	10 µV	10 MΩ ±1%	1 + 0.05	5 + 0.08	14 + 0.4	22 + 0.4	30 + 0.4

Normal Accuracy[7] – 1PLC, DFILT off

Range	Full Scale	Resolution	Input Resistance	Relative Accuracy ±(ppm of reading + ppm of range) 24 Hours[2]	90 Days[3]	1 Year[3]	2 Years[3]
200mV[4]	±210.00000 mV	10 nV	>100 GΩ	3.5 + 6	15 + 11	19 + 12	23 + 13
2 V[4]	±2.1000000 V	100 nV	>100 GΩ	1.2 + 0.6	6 + 1.1	10 + 1.2	14 + 1.3
20 V	±21.000000 V	1 µV	>100 GΩ	3.2 + 0.35	8 + 0.4	12 + 0.4	16 + 0.4
200 V	±210.00000 V	10 µV	10 MΩ ±1%	5 + 1.2	14 + 2.8	22 + 2.8	30 + 2.8
1000 V[6]	±1100.0000 V	100 µV	10 MΩ ±1%	5 + 0.4	14 + 0.7	22 + 0.7	30 + 0.7

DC VOLTS NOTES

1. Specifications are for 10 power line cycles, synchronous autozero, 10-reading repeat digital filter, autorange off, except as noted.
2. For T_{CAL} ±1°C, following 4-hour warm-up. T_{CAL} is ambient temperature at calibration (23°C at the factory). Add 0.5ppm of reading uncertainty if the unit is power cycled during this interval.
3. For T_{CAL} ±5°C, following 4-hour warm-up.
4. Care must be taken to minimize thermal offsets due to operator cables.
5. Specifications apply for 20-reading repeat digital filter, T_{REF} ±0.5°C (T_{REF} is the initial ambient temperature), and for measurements within 10% of the initial measurement value and within 10 minutes of the initial measurement time.
6. Add 20ppm × $(V_{IN}/1000V)^2$ additional uncertainty for inputs above 200V, except in transfer accuracy specifications.
7. Specifications are for 1 power line cycle, normal autozero, digital filter off, autorange off.

AC VOLTS Normal Mode RMS[1]

90 Days, 1 Year or 2 Years, ±2°C from last AC self-cal, for 1% to 100% of range[2] ±(% of reading + % of range)

Range	20–50Hz	50–100Hz	0.1–2kHz	2–10kHz	10–30kHz	30–50kHz	50–100kHz	100–200kHz	0.2–1MHz	1–2MHz
200 mV	0.25 + 0.015	0.07 + 0.015	0.02 + 0.02	0.02 + 0.02	0.025 + 0.02	0.05 + 0.01	0.3 + 0.015	0.75 + 0.025	2 + 0.1	5 + 0.2
2 V	0.25 + 0.015	0.07 + 0.015	0.02 + 0.02	0.02 + 0.02	0.025 + 0.02	0.05 + 0.01	0.3 + 0.015	0.75 + 0.025	2 + 0.1	5 + 0.2
20 V	0.25 + 0.015	0.07 + 0.015	0.03 + 0.015	0.04 + 0.015	0.05 + 0.015	0.07 + 0.015	0.3 + 0.015	0.75 + 0.025	4 + 0.2	7 + 0.2[4]
200 V[3]	0.25 + 0.015	0.07 + 0.015	0.03 + 0.015	0.04 + 0.015	0.05 + 0.015	0.07 + 0.015	0.3 + 0.015	0.75 + 0.025[4]	4 + 0.2[4]	
750 V[3]	0.25 + 0.015	0.1 + 0.015	0.05 + 0.015	0.06 + 0.015	0.08 + 0.015	0.1 + 0.015[4]	0.5 + 0.015[4]			

AC VOLTS NOTES

1. Specifications apply for sinewave input, AC + DC coupling, 1 power line cycle, autozero on, digital filter off, following 55-minute warm-up.
2. For 1% to 5% of range below 750V range, and for 1% to 7% of 750V range, add 0.01% of range uncertainty. For inputs from 200kHz to 2MHz, specifications apply above 10% of range.
3. Add 0.001% of reading × $(V_{IN}/100V)^2$ additional uncertainty for inputs above 100V rms.
4. Typical values.

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2002 Condensed Specifications (continued)

OHMS

TWO-WIRE AND FOUR-WIRE OHMS

Range	Full Scale	Resolution	Current Source [1]	Relative Accuracy [3] ±(ppm of reading + ppm of range) Transfer [7]	24 Hours [4]	90 Days [5]	1 Year [5]	2 Years [5]
20 Ω	21.000000 Ω	100 nΩ	7.2 mA	2.5 + 3	5 + 4.5	15 + 6	17 + 6	20 + 6
200 Ω	210.00000 Ω	1 μΩ	960 μA	2.5 + 2	5 + 3	15 + 4	17 + 4	20 + 4
2 kΩ	2100.0000 kΩ	10 μΩ	960 μA	1.3 + 0.2	2.5 + 0.3	7 + 0.4	9 + 0.4	11 + 0.4
20 kΩ	21.000000 kΩ	100 μΩ	96 μA	1.3 + 0.2	2.5 + 0.3	7 + 0.4	9 + 0.4	11 + 0.4
200 kΩ	210.00000 kΩ	1 mΩ	9.6 μA	2.5 + 0.4	5.5 + 0.5	29 + 0.8	35 + 0.9	40 + 1
2 MΩ	2.1000000 MΩ	10 mΩ	1.9 μA	5 + 0.2	12 + 0.3	53 + 0.5	65 + 0.5	75 + 0.5
20 MΩ [2]	21.000000 MΩ	100 mΩ	1.4 μA [6]	15 + 0.1	50 + 0.2	175 + 0.6	250 + 0.6	300 + 0.6
200 MΩ [2]	210.00000 MΩ	1 Ω	1.4 μA [6]	50 + 0.5	150 + 1	500 + 3	550 + 3	600 + 3
1 GΩ [2]	1.0500000 GΩ	10 Ω	1.4 μA [6]	250 + 2.5	750 + 5	2000 + 15	2050 + 15	2100 + 15

OHMS NOTES

1. Current source has an absolute accuracy of ±5%.
2. For 2-wire mode.
3. Specifications are for 10 power line cycles, 10-reading repeat digital filter, synchronous autozero, autorange off, 4-wire mode, offset compensation on (for 20Ω to 20kΩ ranges), except as noted.
4. For T_{CAL} ±1°C, following 4-hour warm-up. T_{CAL} is ambient temperature at calibration (23°C at the factory).
5. For T_{CAL} ±5°C, following 4-hour warm-up.
6. Current source is paralleled with a 10MΩ resistance.
7. Specifications apply for 20-reading repeat digital filter, T_{REF} ±0.5°C (T_{REF} is the initial ambient temperature), and for measurements within 10% of the initial measurement value and within 10 minutes of the initial measurement time.

DC AMPS

DCI INPUT CHARACTERISTICS AND ACCURACY

Range	Full Scale	Resolution	Maximum Burden Voltage [3]	Relative Accuracy ±(ppm of reading + ppm of range) 24 Hours [1]	90 Days [2]	1 Year [2]	2 Years [2]
200 μA	210.00000 μA	10 pA	0.25 V	50 + 6	275 + 25	350 + 25	500 + 25
2 mA	2.1000000 mA	100 pA	0.3 V	50 + 5	275 + 20	350 + 20	500 + 20
20 mA	21.000000 mA	1 nA	0.35 V	50 + 5	275 + 20	350 + 20	500 + 20
200 mA	210.00000 mA	10 nA	0.35 V	75 + 5	300 + 20	375 + 20	525 + 20
2 A	2.1000000 A	100 nA	1.1 V	350 + 5	600 + 20	750 + 20	1000 + 20

DC AMPS NOTES

1. For T_{CAL} ±1°C, following 55-minute warm-up. T_{CAL} is ambient temperature at calibration (23°C at the factory).
2. For T_{CAL} ±5°C, following 55-minute warm-up.
3. Actual maximum burden voltage = (maximum burden voltage) × ($I_{MEASURED}/I_{FULL\ SCALE}$).

AC AMPS

Range	ACI Accuracy [1, 2] 90 Days, 1 Year or 2 Years, T_{CAL} ±5°C, for 5% to 100% of range, ±(% of reading + % of range) 20Hz–50Hz	50Hz–200Hz	200Hz–1kHz	1kHz–10kHz	10kHz–30kHz [3]	30kHz–50kHz [3]	50kHz–100kHz [3]
200 μA	0.35 + 0.015	0.2 + 0.015	0.4 + 0.015	0.5 + 0.015			
2 mA	0.3 + 0.015	0.15 + 0.015	0.12 + 0.015	0.12 + 0.015	0.25 + 0.015	0.3 + 0.015	0.5 + 0.015
20 mA	0.3 + 0.015	0.15 + 0.015	0.12 + 0.015	0.12 + 0.015	0.25 + 0.015	0.3 + 0.015	0.5 + 0.015
200 mA	0.3 + 0.015	0.15 + 0.015	0.12 + 0.015	0.15 + 0.015	0.5 + 0.015	1 + 0.015	3 + 0.015
2 A	0.35 + 0.015	0.2 + 0.015	0.3 + 0.015	0.45 + 0.015	1.5 + 0.015	4 + 0.015	

AC AMPS NOTES

1 Specifications apply for sinewave input, AC+DC coupling, 1 power line cycle, autozero on, digital filter off, following 55-minute warm-up.
2 Add 0.005% of range uncertainty for current above 0.5A rms for self-heating.
3. Typical values.

FREQUENCY COUNTER

AC VOLTAGE INPUT: 1Hz–15 MHz.

ACCURACY: ±(0.03% of reading).

DC IN-CIRCUIT CURRENT

TYPICAL RANGES: Current: 100μA to 12A. **Trace Resistance:** 1mΩ to 10Ω.

ACCURACY: ±(5% + 500μA). For 1 power line cycle, autozero on, 10-reading digital filter, T_{CAL} ±5°C, 90 days, 1 year or 2 years.

TEMPERATURE

Built-in linearization for J, K, N, T, E, R, S, B thermocouple types to ITS-90 and 100Ω platinum RTDs DIN 43760, IPTS-68, and ITS-90.

GENERAL

POWER: Voltage: 90–134V and 180–250V, universal self-selecting. **Frequency:** 50Hz, 60Hz, or 400Hz self-identifying at power-up. **Consumption:** <55VA.

ENVIRONMENTAL: Operating Temperature: 0° to 50°C. **Storage Temperature:** –40° to 70°C. **Humidity:** 80% R.H., 0° to 35°C.

PHYSICAL: Case Dimensions: 90mm high × 214mm wide × 369mm deep (3½ in. × 8½ in. × 14½ in.). **Net Weight:** <4.2kg (<9.2 lbs.). **Shipping Weight:** <9.1kg (<20 lbs.).

STANDARDS

EMI/RFI: Conforms to European Union EMC directive.

Safety: Conforms to European Union Low Voltage directive.

Note 1: For MIL-T-28800E, applies to Type III, Class 5, Style E.

Precision, multi-purpose solutions for evolving test needs

Series 2000 High Performance Digital Multimeters

KEITHLEY

A GREATER MEASURE OF CONFIDENCE

- A complete set of measurement tools in one compact enclosure
- Superior measurement integrity
- Easy to find a cost-effective solution for a specific application
- Easy migration from model to model as applications evolve
- Exceptional long-term reliability

Meet our high performance family

Each Series 2000 Digital Multimeter offers a unique combination of measurement capabilities that make them ideal for high speed production testing. Their half-rack design fits easily into just about any test rack or benchtop. With maximum resolutions from 6½ to 8½ digits and a variety of built-in capabilities, there's sure to be a Series 2000 DMM that matches your application.

Go to work with the right tools

Series 2000 multimeters are essentials for anyone's basic electrical toolbox because they combine all the measurement capabilities needed for electronic device and sub-system measurements, operational circuit measurements, and electronic product development and validation for bench and in ATE applications.

Be confident of your measurement integrity

All Series 2000 DMMs are based on the same high speed, low noise 28-bit A/D converter technology for superior measurement precision, sensitivity, and traceability. The Models 2001 and 2002 incorporate five distinct processors for tighter A/D control, higher accuracy, more precise triggering, higher throughput, and support for a variety of advanced capabilities.

Get high value plus high performance

A wide range of price and performance options are available, so it's easy to find a cost-effective match for your application. Whether you need the speed and economy of the basic Model 2000, the ultra-high precision of the Model 2002, or something in between, there's a Series 2000 DMM that's right for the job. All Series 2000 models are capable of reading rates of up to 2000 readings/sec (at 4½ digits).

Migrate your applications easily from instrument to instrument

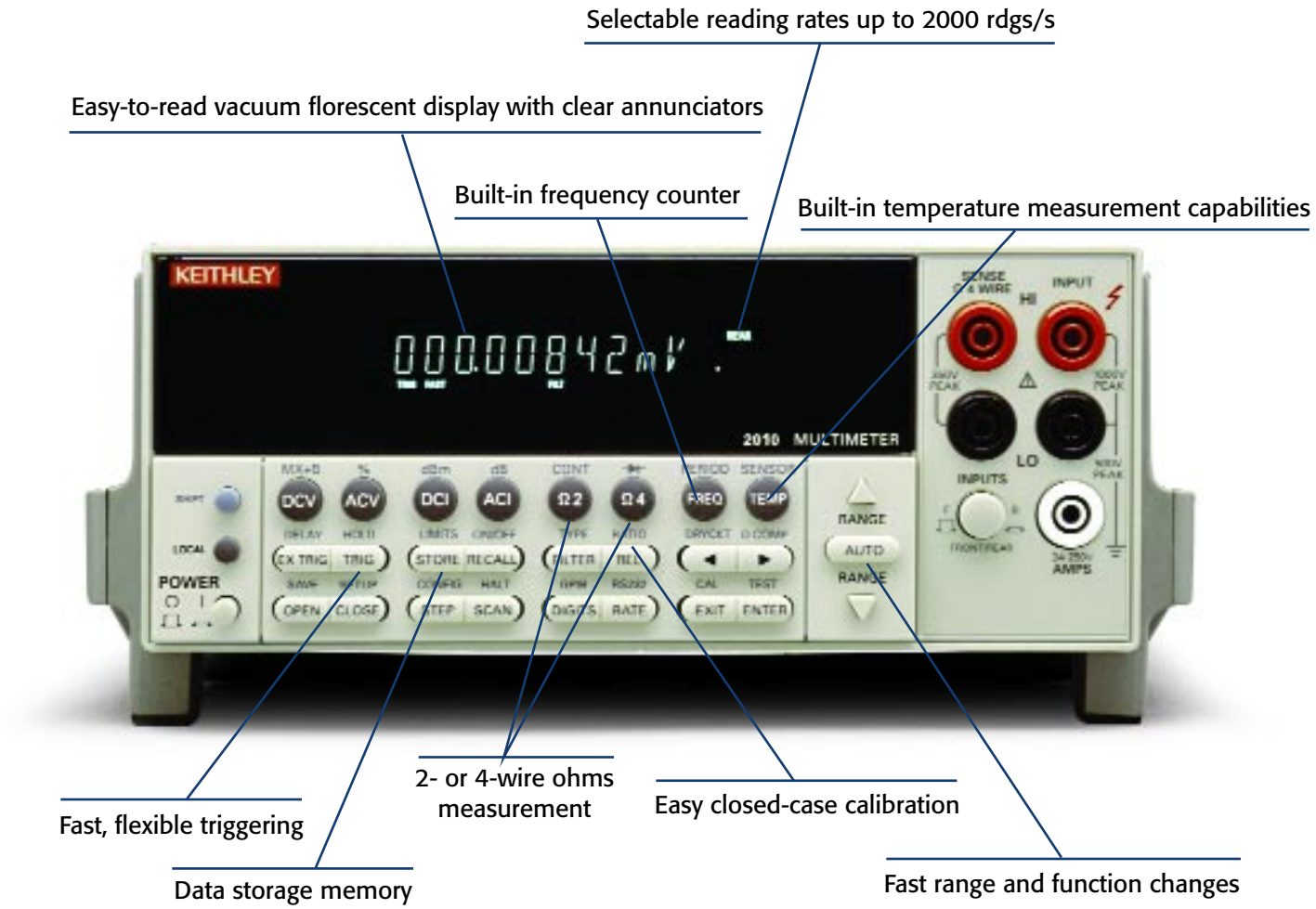
The common SCPI programming and software architecture simplifies migrating applications to more capable instruments as new test needs arise or when substituting a Keithley DMM for a meter from another manufacturer.

Handle tomorrow's test challenges with today's test solution

Series 2000 DMMs have earned a reputation for exceptional long-term performance and reliability. Each one is backed with a standard three-year warranty. Built-in measurement, signal conditioning, switching, and data communications functions give you the flexibility to repurpose your instrument readily as your test needs change over time.

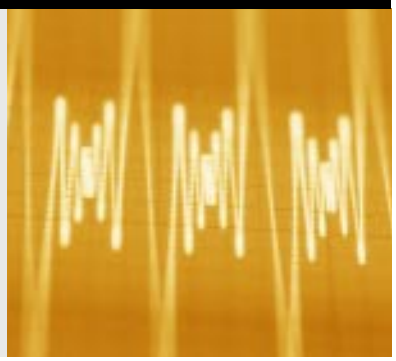
FIND IT FAST

A broad range of built-in functions



Application: Low level resistance testing

The Model 2010 is made for low resistance applications like testing the reliability of electrical connectors. With a measurement range of 1$\mu\Omega$ to 120MΩ, it ensures more precise low level readings. Device self-heating is minimized when testing low ohms components, because resistance measurements can be made with source current as low as 100μA. The Model 2010's dry circuit test mode clamps the open circuit voltage at 20mV to prevent punctures in any oxides or films that may have formed on contacts and connectors, so the measurement derived reflects the "in use" resistance. An offset compensated ohms function eliminates error-causing thermal effects from cabling and connections.



IEEE-488 bus simplifies controlling a wide range of GPIB instruments

Trigger Link for fast, precise, repeatable triggering of multiple instruments

Built-in scanner mainframe accepts optional switching cards for multi-point testing

*Visit **www.keithley.com** to download a wide range of application notes, articles, data sheets, and specifications on Series 2000 DMMs.*

Application: Power supply monitoring

The Model 2001's multiple display capability makes it easy to gather several pieces of information simultaneously from different aspects of a single signal. One of these displays is ideal for power supply monitoring because it shows the DC voltage of the supply's output, the AC noise level, and the frequency of that noise all at once, which simplifies tracking down the source of the noise and correcting it.

Individualized solutions for specific application needs

Model 2000: Get high accuracy without a high price tag

The 6½-digit Model 2000 has unique capabilities that simplify building and upgrading automated production test systems. For example, the built-in limit testing function can be used to sort or grade components or assemblies. It also offers a full resolution reading rate (50 rdg/s) that's nearly ten times faster than any other meter in its class and a maximum speed of 2000 rdgs/s. Built-in math functions let you make a variety of calculations on the acquired data without a computer controller.

Model 2010: Resolve low level signals quickly and accurately

With a noise floor of just 100nV RMS, the 7½-digit Model 2010 is designed for high accuracy millivolt- and microvolt-level measurements. It also wraps up all the functions needed for characterizing the resistance, linearity, or isolation of contacts, connectors, switches, or relays in a single instrument. With built-in capabilities like a low power ohms mode, dry circuit testing, offset-compensated ohms, and a 10Ω range, the Model 2010 DMM is ideal for developing, validating, or production testing sensors, transducers, A/D and D/A converters, regulators, references, connectors, switches and relays. It's equally appropriate for end-of-life contact testing per ASTM B539-90.

Model 2001: Advanced features you never thought a DMM could offer

The Model 2001 couples exceptional accuracy (0.0018% basic), resolution, and sensitivity with measurement and mathematical capabilities rarely found in DMMs. Its internal peak detector can catch 1μs spikes, such as power supply spikes and transients, AC line power surges, and short-duration dropouts on components, as well as up to 1MHz for repetitive signals. With the Model 2001, it's easy to measure AC peak value, average, and true rms directly to characterize the signal thoroughly.

Application: Precision resistor testing

The Model 2002's unique one-phase four-wire ohms measurement capability makes it a good solution for high speed production testing of precision resistors. Two high and two low limits can be tied to the status of any of four protected digital outputs, so the Model 2002 can sort or grade the resistors automatically after testing. For QA tests on small samples, the front panel bar graph display makes it easy to determine the tolerances of individual resistors.

Model 2002: Truly usable 8½-digit resolution

The Model 2002 offers the same advanced features and functions as the Model 2001, then adds an extra decade of resolution and broader DC voltage, temperature, and resistance ranges. The Model 2002's performance is specified for a ±5°C environment, not a ±1°C environment, and no daily re-calibration is required to stay in spec, so it's ideal for high accuracy production test applications. An "open lead" detection function helps identify problems that could lead the system to pass components that should have failed a test. Built-in digital I/O capabilities and a pass/fail testing function simplify connecting it to a variety of handlers for fast, efficient device binning and sorting.

Models 2015 and 2016: Audio analysis plus full-featured DMMs

Each of these specialized instruments combines audio band quality measurements and analysis with a full-function 6½-digit DMM for production testing of audio devices and sub-systems. The Models 2016 and 2016-P provide twice the sine wave generator output of the Models 2015 and 2015-P for applications that require test signals greater than 8Vrms. The Models 2015-P and 2016-P offer additional processing capacity for frequency spectrum analysis. All four models can measure Total Harmonic Distortion (THD) over the complete 20Hz to 20kHz audio band, as well as compute THD+Noise and Signal-to-Noise plus Distortion (SINAD). These capabilities are critical for applications such as assessing non-linear distortion in components, devices, and systems. Five industry-standard bandpass filters are provided for shaping the input signal for audio and telecommunication applications. Refer to the Selector Guide on pages 10-11 for specification information.

Refer to the Selector Guide on pages 10-11 to compare the capabilities of different models.

Application: THD analysis and frequency response

The Model 2015, 2016-P, 2016, and 2016-P can provide both time domain and frequency domain measurements in a single test protocol. Keithley can help you configure a system for testing telecommunication devices, such as mobile phones. These instruments can perform a frequency domain analysis of the Total Harmonic Distortion (THD) and the first three harmonics as a function of frequency, as well as a time domain analysis of microphone circuit output voltage as a function of frequency.

The Model 2015, 2015-P, 2016,

Building blocks for a comprehensive system solution

Plug-in scanner cards

To create test and measurement systems with up to ten measurement points quickly and economically, choose from three plug-in scanner cards designed specifically for several Series 2000 DMMs. Just slide one of these cards into the option slot on the meter's back panel and you'll combine scanning and measurement capabilities in a single instrument.

The Model 2000-SCAN 10-Channel Scanner Card is designed for use with Model 2000, 2010, 2001, and 2002 DMMs. It supports multiplexing one of ten two-pole or one of five four-pole signals into the DMM and/or any combination of two- or four-pole signals.

The Model 2001-SCAN Scanner Card is a high speed multiplexing scanner card developed for the Model 2000, 2010, 2001, and 2002 DMMs. This card transforms your meter into a high accuracy, high speed ten-channel datalogger for a variety of mixed-signal applications. Two high speed solid-state channels on the card allow calculating ratio and delta when it's installed in the Model 2001, 2002, or 2010.

When used with a Model 2000, 2001, 2002, or 2010 DMM, the **Model 2001-TCSCAN Thermocouple Scanner Card** provides up to nine channels of cold-junction compensated temperature measurements and/or voltage, resistance, and frequency measurements. When the card is installed in the Model 2001 or 2002, the DMM will linearize type J, K, E, R, S, B, and T thermocouples automatically. When used with the Model 2001, 2002, or 2010, it allows measuring temperature directly using two- or four-wire RTDs.

Extended range and sensitivity

The Model 1801 Nanovolt Pre-Amp extends the range and sensitivity of Model 2001 and 2002 DMMs by amplifying extremely low-level signals. It combines a variety of measurement functions, including DCV, ACV rms, four-wire ohms, frequency, and temperature. A nine-foot cable links the pre-amp unit to a power supply card, which installs in the DMM's back panel option slot. This remote architecture isolates the Model 1801's sensitive "chopper-type" amplification circuitry, so the unit can be located close to the test setup to keep test leads short, reducing interference.

Need greater switching capacity?

Choosing the right switching solution is often crucial to ensuring high measurement integrity and productivity in production testing. Keithley's Applications Engineers can help you determine the most appropriate configuration for your application.

If your application requires more than ten channels of switching capacity, consider Keithley's **Series 2700 Integra multimeter/data acquisition/switching systems**. The 80-channel Model 2700 and Model 2701 mainframes offer the industry's lowest per-channel installed cost in high performance data acquisition and control packages. A built-in Ethernet interface in the Model 2701 makes it the best choice for distributed applications. With five module slots, the Model 2750 simplifies configuring solutions for applications with hundreds of channels. A choice of 12 plug-in modules makes Integra systems almost infinitely adaptable.

Series 7000 switching solutions complement Series 2000 DMMs when building multi-point test systems. The 80-channel Model 7001 High Density Switch System will accept a wide variety of switching cards for signals up to 2GHz. Similarly, the Model 7002 Switch Mainframe will support up to 400 channels or crosspoints, with a unique interactive channel status display. Both mainframes are compatible with Keithley's line of more than 40 Series 7000 Switching Cards.

The two-slot **Model 7002-HD Switch Mainframe** combines the channel density of the Model 7002 with the half-rack footprint of the Model 7001. Two new high density switch cards mainframe let you create a system with up to 384 matrix crosspoints or 320 multiplexer channels.

Choose the Series 2000 DMM that matches your application

Models		2000	2010
	Digits	**6½**	**7½**
	Expansion Channels	10	10
DC Volts	Sensitivity	100 nV	10 nV
	Maximum Reading	1000 V	1000 V
	Basic Accuracy	0.002%	0.0018%
	Ratio		•
	DC Peak Spikes		
AC Volts (TRMS)	Sensitivity	100 nV	100 nV
	Maximum Reading	750 V	750 V
	Basic Accuracy	0.05%	0.05%
	Bandwidth	3 Hz-300 kHz	3 Hz-300 kHz
	dB, dBm	•	•
	Frequency, Period	•	•
	Peak/Avg/RMS		
	AC, AC+DC		
	THD, Harmonics		
	4V Sine Source		
	9V Sine Source		
Ohms (2/4 Wire)	Sensitivity	100 µΩ	1 µΩ
	Maximum Reading	120 MΩ	120 MΩ
	Basic Accuracy	0.008	0.0032%
	Continuity Test	•	•
	Diode Test	•	•
	Offset Compensation		•
	Dry Circuit		•
	Constant Current	•	•
	Open Source Detection		
DC Amps	Sensitivity	10 nA	10 nA
	Range Span	10 mA- 3A	10 mA-3 A
	Basic Accuracy	0.03%%	0.03%
	In Circuit Current		
AC Amps (TRMS)	Sensitivity	1 µA	1 µA
	Range Span	1 A-3 A	1 A- 3A
	Basic Accuracy	0.1%	0.1%
	Bandwidth	3 Hz-5 kHz	3 Hz-5 kHz
General Features	Interface	GPIB, RS-232	GPIB, RS-232
	Reading Hold	•	•
	Digital I/O		
	Reading Memory	1024 rdgs	1024 rdgs
	Maximum Speed	2000 rdgs	2000 rdgs
	Temperature Meas.	T/C	TC, RTD
	Language Emulation	8840/42, 196/199	196, 199
	Memory Options	–	–
		2000-SCAN	2000-SCAN
	Compatible Scanner Cards	2001-SCAN	2001-TCSCAN
		2001-TCSCAN	

Visit **www.keithley.com** or call your local office for more information on our other switching solutions (p. 9).

2001	2002	2015, 2015-P	2016, 2016-P
7½	**8½**	**6½**	**6½**
10	10		
10 nV	10 nV	100 nV	100 nV
1100 V	1100 V	1000 V	1000 V
0.0018%	0.0006%	0.002%	0.002%
Option	Option		
100 nV	100 nV	100 nV	100 nV
775 V (1100 V pk)	775 V (1100 V pk)	750 V	750 V
0.03%	0.02%	0.05%	0.05%
1 Hz-2 MHz	1 Hz-2 MHz	3 Hz-300 kHz	3 Hz-300 kHz
•	•	•	•
•	•	•	•
•	•		
•	•		
		•	•
		• (2015-P)	• (2016-P)
		•	•
1 µΩ	100 nΩ	100 µΩ	100 µΩ
1 GΩ	1 GΩ	120MΩ	120MΩ
0.0032%	0.0007%	0.008%	0.008%
		•	•
•	•	•	•
•	•	•	•
	•		
10 pA	10 pA	10 nA	10 nA
200 µA-2 A	200 µA-2 A	10 mA-3 A	10 mA-3 A
0.03%	0.027%	0.03%	0.03%
•	•		
100 pA	100 pA	1 µA	1 µA
200 µA-2 A	200 µA-2 A	1 A-3 A	1 A-3 A
0.1%	0.1%	0.1%	0.1%
20 Hz-100 kHz	20 Hz-100 kHz	3 Hz-5 kHz	3 Hz-5 kHz
GPIB	GPIB	GPIB, RS-232	GPIB, RS-232
		•	•
•	•	2 in/5 out (TTL)	2 in/5 out (TTL)
Opt. to 30,000	Opt. to 30,000	1024 rdgs	1024 rdgs
2000 rdgs	2000 rdgs	2000 rdgs	2000 rdgs
T/C, RTD	T/C, RTD	T/C	T/C
	HP 3458		
MEM1: 32K	MEM1: 32K	–	–
MEM2:128K	MEM2: 128		
2000-SCAN	2000-SCAN	–	–
2001-SCAN	2001-SCAN		
2001-TCSCAN	2001-TCSCAN		

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