

# 2001 and 2002 High Performance Multimeters



- 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
- Flexible option slot design
- Nanovolt Preamp option (Model 1801)
- IEEE-488.2 and SCPI compatible
- Model 2002 has HP 3458A emulation mode

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 only 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. The front panels of both instruments have the same look, feel, and response, so the learning curve is reduced dramatically.

### True 7½- (or 8½-) Digit Resolution

While other DMMs may claim 7½-or 8½-digit resolution, those instruments 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 and to avoid range-shift errors.

### Applications

The 2001 is well suited to general-purpose measurements that require high resolution and accuracy. With the addition of a plug-in scanner card, it 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 not only increases the accuracy at almost any voltage level, but 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 input signals.

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, and AC+DC measurement capability for a wide variety of applications.

### High Speed for High Throughput

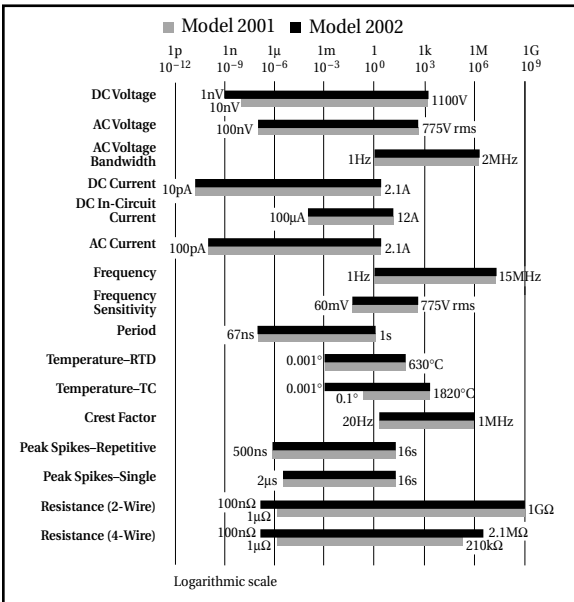
In applications where high throughput is critical, both the 2001 and 2002 provide more than 2000 readings per second at 4½-digit resolution. At 7½ digits, the 2002 maintains full rated accuracy at reading rates up to 44/second on DCV and ohms.

### ORDERING INFORMATION

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

2001	High Performance 7½-Digit DMM with 8K Memory
2001/MEM1	High Performance 7½-Digit DMM with 32K Memory
2001/MEM2	High Performance 7½-Digit DMM with 128K Memory
2002	High Performance 8½-Digit DMM with 8K Memory
2002/MEM1	High Performance 8½-Digit DMM with 32K Memory
2002/MEM2	High Performance 8½-Digit DMM with 128K Memory

These products are available with an **Extended Warranty**. See page 635 for complete ordering information.



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



# 2001 and 2002 High Performance Multimeters

## High Speed, High Precision Resistance Measurement

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 in less than  $2\mu\text{s} \pm 1\mu\text{s}$ , which is 100–1000 times faster than other DMMs.

The unique Trigger-Link feature included in the Model 2001 and 2002 and a growing number of other 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  $\pm 0.01\%$  to  $\pm 100\%$ . Whether adjusting about zero or any other desired value, this display can replace a nulling differential voltmeter.

## Capture Spikes Down to $1\mu\text{s}$

Both the 2001 and 2002 have internal peak detectors that can catch  $1\mu\text{s}$  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  $1\mu\text{s}$  for single spikes, so there's no need for a separate scope. The DMMs will 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.

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's no need for an oscilloscope to determine if the crest factor is acceptable—the DMM measures it directly.

While some DMMs will calculate average AC from the rms value, these calculations apply only to sine wave inputs. The 2001 and 2002 allow measuring 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 simultaneously display DC and AC volts and the AC frequency from a single measurement connection. Several other multiple-measurement displays are available, including crest factor and bar graph. By measuring sequentially and displaying simultaneously, the 2001/2002 operate 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. The **Model 1801 Nanovolt Preamp** extends the performance of either DMM by extending the low-level measurement ranges and amplifies the voltage sensitivity dramatically.

## ACCESSORIES AVAILABLE

### ACCESSORIES AND COMPANION PRODUCTS

2000-SCAN	10-Channel Scanner Card
2001-SCAN	10-Channel Scanner Card with two high-speed channels
2001-TCSCAN	9-Channel Thermocouple Scanner Card
1801	Nanovolt Preamp

### TEST LEADS AND PROBES

5805	Kelvin Probes, 0.9m (3 ft)
5805-12	Kelvin Probes, 3.6m (12 ft)
5806	Kelvin Clip Leads
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
8693	General Purpose RTD Probe
8695	Surface RTD Probe
8696	Air/Gas RTD Probe

### CABLES/ADAPTERS

7007-1	Shielded GPIB Cable, 1m (3.3 ft)
7001-2	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
7009-5	RS-232 Cable

### RACK MOUNT KITS

4288-1	Single Fixed Rack Mount Kit
4288-4	Side by Side 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 1050	Test Development Software Padded Carrying Case
2001-EW	1 Year Extended Warranty
2002-EW	1 Year Extended Warranty

See page 235 for descriptions of all accessories.

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



# 2001 and 2002 High Performance Multimeters

## 2001 Condensed Specifications

### DC VOLTS 10PLC, D<sub>FILT</sub>10

RANGE	FULL SCALE	RESOLUTION	DEFAULT RESOLUTION	INPUT RESISTANCE	5 Minutes	ACCURACY ± (ppm of reading + ppm of range)			
						24 Hours	90 Days	1 Year	2 Years
200 mV	±210.00000	10 nV	100 nV	>10 GΩ	3 + 3	10 + 6	25 + 6	37 + 6	50 + 6
2 V	±2.1000000	100 nV	1 μV	>10 GΩ	2 + 1.5	7 + 2	18 + 2	25 + 2	32 + 2
20 V	±21.000000	1 μV	10 μV	>10 GΩ	2 + 1.5	7 + 4	18 + 4	24 + 4	32 + 4
200 V	±210.00000	10 μV	100 μV	10 MΩ ±1%	2 + 1.5	13 + 3	27 + 3	38 + 3	52 + 3
1000 V	±1100.0000	100 μV	1 mV	10 MΩ ±1%	10 + 1.5	17 + 6	31 + 6	41 + 6	55 + 6

### AC VOLTS ACCURACY (Normal Mode-TRMS), Low Freq. mode extends down to 1Hz; Peak AC, dB, AC+DC also available. 90 Days, ±2°C from last AC self-cal for 1% to 100% of range ±(% 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	0.03 + 0.015	0.03 + 0.015	0.035 + 0.015	0.05 + 0.015	0.17 + 0.015	0.5 + 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	0.17 + 0.015	0.5 + 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	0.17 + 0.015	0.5 + 0.025	4 + 0.2	7 + 0.2
200 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	0.17 + 0.015	0.5 + 0.025	4 + 0.2	
750 V	0.25 + 0.015	0.1 + 0.015	0.08 + 0.015	0.09 + 0.015	0.12 + 0.015	0.15 + 0.015	0.5 + 0.015			

### RESISTANCE

RANGE	FULL SCALE	RESOLUTION	CURRENT SOURCE	24 Hours	ACCURACY ± (ppm of reading + ppm of range)			
					90 Days	1 Year	2 Years	
20 Ω	21.000000	1 μΩ	9.2 mA	29 + 7	52 + 7	72 + 7	110 + 7	
200 Ω	210.00000	10 μΩ	0.98 mA	24 + 7	36 + 7	56 + 7	90 + 7	
2 kΩ	2100.0000	100 μΩ	0.98 mA	22 + 4	33 + 4	50 + 4	80 + 4.5	
20 kΩ	21.000000	1 mΩ	89 μA	19 + 4	32 + 4	50 + 4	80 + 4.5	
200 kΩ	210.00000	10 mΩ	7 μA	20 + 4.5	72 + 4.5	90 + 4.5	130 + 5	
2 MΩ	2.1000000	100 mΩ	770 nA	50 + 4.5	110 + 4.5	160 + 4.5	230 + 5	
20 MΩ	21.000000	1 Ω	70 nA	160 + 4.5	560 + 4.5	900 + 4.5	1100 + 5	
200 MΩ	210.00000	10 Ω	4.4 nA	3000 + 100	10000 + 100	20000 + 100	30000 + 100	
1 GΩ	1.0500000	100 Ω	4.4 nA	9000 + 100	20000 + 100	40000 + 100	60000 + 100	

### DC AMPS

RANGE	FULL SCALE	RESOLUTION	MAXIMUM BURDEN VOLTAGE	24 Hours	ACCURACY ± (ppm of reading + ppm of range)			
					90 Days	1 Year	2 Years	
200 μA	210.00000	10 pA	0.25 V	63 + 25	300 + 25	500 + 25	1350 + 25	
2 mA	2.1000000	100 pA	0.31 V	64 + 20	300 + 20	400 + 20	750 + 20	
20 mA	21.000000	1 nA	0.4 V	65 + 20	300 + 20	400 + 20	750 + 20	
200 mA	210.00000	10 nA	0.5 V	96 + 20	300 + 20	500 + 20	750 + 20	
2 A	2.1000000	100 nA	1.5 V	500 + 20	600 + 20	900 + 20	1350 + 20	

### AC AMPS ACCURACY 90 Days, 1 Year or 2 Years, TCAL ±5°C, for 5% to 100% of range, ±(% of reading + % of range)

RANGE	20Hz - 50Hz	50Hz - 200Hz	200Hz - 1kHz	1kHz - 10kHz	10kHz - 30kHz	30kHz - 50kHz	50kHz - 100kHz
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	0.2 + 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	

### FREQUENCY COUNTER

RANGE: 1Hz-15MHz.  
ACCURACY: ±(0.03% of reading).

### DC IN-CIRCUIT CURRENT

RANGE: 100μA to 12A.  
ACCURACY: ±(5% + 2 counts) over 2 years.  
TRACE RESISTANCE: 1mΩ to 10Ω typical.

### 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, or ITS-90.

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

### GENERAL/STANDARDS COMPLIANCE

#### POWER

Voltage: 90-134V and 180-264V, universal self-selecting.  
Frequency: 50Hz, 60Hz, or 400Hz self-identifying.  
Consumption: <55 VA.

#### ENVIRONMENT

Operating Temperature: 0° to 50°C.  
Storage Temperature: -40° to +70°C.  
Humidity: 80% R.H., 0° to 35°C.  
Altitude: 4,500m (15,000 ft) operating; 12,000m (40,000 ft.) non-operating.

#### PHYSICAL

Case Dimensions: 90mm high × 214mm wide × 369mm deep  
(3½ in × 8½ in × 14½ in).  
Unit Weight: 4.2kg (9.2 lbs).

#### STANDARDS

EMI/RFI: Conforms to VDE 0871B (per Vfg 1046/1984), IEC 801-2, FCC part 15 Class B, CISPR-22 (EN55022).  
Safety: Conforms to IEC348, CAN/CSC22.2 No. 231, MIL-T-28800E1.



# 2001 and 2002 High Performance Multimeters

## 2002 Condensed Specifications

### DC VOLTS 10PLC, D<sub>FILT</sub> 10

RANGE	FULL SCALE	RESOLUTION	INPUT RESISTANCE	Transfer	24 Hours	ACCURACY ± (ppm of reading + ppm of range)		
						90 Days	1 Year	2 Years
200 mV	±210.000000	1 nV	>100 GΩ	0.4 + 1.5	3.5 + 3	15 + 8	19 + 9	23 + 10
2 V	±2.10000000	10 nV	>100 GΩ	0.2 + 0.15	1.2 + 0.3	6 + 0.8	10 + 0.9	14 + 1
20 V	±21.0000000	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	1 μV	10 MΩ ±1%	0.5 + 0.08	5 + 0.4	14 + 2	22 + 2	30 + 2
1000 V	±1100.00000	10 μV	10 MΩ ±1%	1 + 0.05	5 + 0.08	14 + 0.4	22 + 0.4	30 + 0.4

### AC VOLTS ACCURACY (Normal Mode-TRMS), Low Freq. mode extends down to 1Hz; Peak AC, dB, AC+DC also available.

90 Days, 1 Year or 2 Years, ±2°C from last AC self-cal for 1% to 100% of range, ±(% 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 + 0.01	0.02 + 0.01	0.025 + 0.01	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 + 0.01	0.02 + 0.01	0.025 + 0.01	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
200 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	
750 V	0.25 + 0.015	0.1 + 0.015	0.05 + 0.015	0.06 + 0.015	0.08 + 0.015	0.1 + 0.015	0.5 + 0.015			

### RESISTANCE 10PLC, Offset comp. on, D<sub>FILT</sub> 10

RANGE	FULL SCALE	RESOLUTION	SOURCE	Transfer	24 Hours	ACCURACY ± (ppm of reading + ppm of range)		
						90 Days	1 Year	2 Years
20 Ω	21.0000000	100 nΩ	7.2 mA	2.5 + 3	5 + 4.5	15 + 6	17 + 6	20 + 6
200 Ω	210.000000	1 μΩ	960 μA	2.5 + 2	5 + 3	15 + 4	17 + 4	20 + 4
2 kΩ	2100.00000	10 μΩ	960 μA	1.3 + 0.2	2.5 + 0.3	7 + 0.4	9 + 0.4	11 + 0.4
20 kΩ	21.0000000	100 μΩ	96 μA	1.3 + 0.2	2.5 + 0.3	7 + 0.4	9 + 0.4	11 + 0.4
200 kΩ	210.000000	1 mΩ	9.6 μA	2.5 + 0.4	5.5 + 0.5	29 + 0.8	35 + 0.9	40 + 1
2 MΩ	2.10000000	10 mΩ	1.9 μA	5 + 0.2	12 + 0.3	53 + 0.5	65 + 0.5	75 + 0.5
20 MΩ	21.0000000	100 mΩ	1.4 μA	15 + 0.1	50 + 0.2	175 + 0.6	250 + 0.6	300 + 0.6
200 MΩ	210.000000	1 Ω	1.4 μA	50 + 0.5	150 + 1	500 + 3	550 + 3	600 + 3
1 GΩ	1.05000000	10 Ω	1.4 μA	250 + 2.5	750 + 5	2000 + 15	2050 + 15	2100 + 15

### DC AMPS

RANGE	FULL SCALE	RESOLUTION	MAXIMUM BURDEN VOLTAGE	24 Hours	ACCURACY ± (ppm of reading + ppm of range)		
					90 Days	1 Year	2 Years
200 μA	210.00000	10 pA	0.25 V	50 + 6	275 + 25	350 + 25	500 + 25
2 mA	2.1000000	100 pA	0.3 V	50 + 5	275 + 20	350 + 20	500 + 20
20 mA	21.000000	1 nA	0.35 V	50 + 5	275 + 20	350 + 20	500 + 20
200 mA	210.00000	10 nA	0.35 V	75 + 5	300 + 20	375 + 20	525 + 20
2 A	2.1000000	100 nA	1.1 V	350 + 5	600 + 20	750 + 20	1000 + 20

### AC AMPS ACCURACY 90 Days, 1 Year or 2 Years, TCAL ±5°C, for 5% to 100% of range, ±(% of reading + % of range)

RANGE	20Hz - 50Hz	50Hz - 200Hz	200Hz - 1kHz	1kHz - 10kHz	10kHz - 30kHz	30kHz - 50kHz	50kHz - 100kHz
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	

### GENERAL/STANDARDS COMPLIANCE

#### POWER

**Voltage:** 90-134V and 180-264V, universal self-selecting.  
**Frequency:** 50Hz, 60Hz, or 400Hz self-identifying.  
**Consumption:** <55 VA.

#### ENVIRONMENT

**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).  
**Unit Weight:** <4.2kg (<9.2 lbs).

#### STANDARDS

**EMI/RFI:** Conforms to VDE 0871B (per Vfg 1046/1984), IEC 801-2, FCC part 15 Class B, CISPR-22 (EN55022).  
**Safety:** Conforms to IEC348, CAN/CSC22.2 No. 231, MIL-T-28800E1.

### FREQUENCY COUNTER

**RANGE:** 1Hz-15MHz.  
**ACCURACY:** ±(0.03% of reading)

### DC IN-CIRCUIT CURRENT

**RANGE:** 100μA to 12A.  
**ACCURACY:** ±(5% + 500μA), 1 year or 2 years.  
**TRACE RESISTANCE:** 1mΩ to 10Ω.

### TEMPERATURE

Built-in linearization for J, K, T, E, R, S, N, B thermocouple types to ITS-90 and 100Ω platinum RTDs DIN43760, IPTS-68, ITS-90, and SPRTs to ITS-90.

For complete specifications, refer to the 2002 Technical Data Book.