

Keithley Instruments, Inc.
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Multimeter Specifications

This document contains the complete specifications for the 2002. Every effort has been made to make these specifications complete by characterizing its performance under the variety of conditions often encountered in production, engineering, and research.

The Model 2002 provides Transfer, 24-hour, 90-day, 1-year, and 2-year specifications, with full specifications for the 90-day, 1-year, and 2-year intervals. This allows the operator to utilize 90-day, 1-year, or 2-year recommended calibration intervals, depending upon the level of accuracy desired. As a general rule, the 2002's 2-year performance exceeds a 6½-digit DMM's 90-day, 180-day, or 1-year specifications.

ABSOLUTE ACCURACY

All DC and AC specifications are given as relative accuracies. To obtain absolute accuracies, the absolute uncertainties of the calibration sources must be added to the relative accuracies. The absolute uncertainties for the calibration sources used during Keithley's factory calibration are given in a table included in the specifications. The uncertainties of the operator's sources may be different.

TYPICAL ACCURACIES

Accuracy can be specified as typical or warranted. All specifications shown are warranted unless specifically noted. Almost 99% of the 2002's specifications are warranted specifications. In some cases it is not possible to obtain sources to maintain traceability on the performance of every unit in production on some measurements (e.g., high-voltage, high-frequency signal sources with sufficient accuracy do not exist). These values are listed as typical.

2002 SPECIFIED CALIBRATION INTERVALS

Measurement Function	24 Hour ¹	90 Day ²	1 Year ²	2 Year ²
DC Volts	*	*	*	*
DC Volts Peak Spikes		*	*	*
AC Volts RMS		* ³	* ³	* ³
AC Volts Peak		*	*	*
AC Volts Average		* ³	* ³	* ³
AC Volts Crest Factor		*	*	*
Ohms	*	*	*	*
DC Current	*	*	*	*
DC In-Circuit Current		*	*	*
AC Current		*	*	*
Frequency		*	*	*
Temperature (Thermocouple)		*	*	*
Temperature (RTD)	*	*	*	*

¹ For T_{CAL} ±1°C.

² For T_{CAL} ±5°C.

³ For ±2°C of last AC self-cal.

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Multimeter Specifications

DC VOLTS

DCV INPUT CHARACTERISTICS AND ACCURACY Enhanced Accuracy⁴ – 10PLC, DFILT 10

Range	Full Scale	Resolution	Input Resistance	Relative Accuracy ±(ppm of reading + ppm of range)					Temperature Coefficient ±(ppm of reading + ppm of range)/°C Outside T _{CAL} ±5°C
				Transfer ⁵	24 Hours ⁵	90 Days ⁷	1 Year ⁷	2 Years ⁷	
200mV ⁸	±210.0mV	1nV	>100GΩ	0.4 + 1.5	3.5 + 3	15 + 8	19 + 9	23 + 10	2 + 1.8
2V ⁸	±2.10V	10nV	>100GΩ	0.2 + 0.15	1.2 + 0.3	6 + 0.8	10 + 0.9	14 + 1	0.2 + 0.18
20V	±21.0V	100nV	>100GΩ	0.1 + 0.05	1.2 + 0.1	6 + 0.15	10 + 0.15	14 + 0.15	0.3 + 0.02
200V	±210.0V	1μV	10MΩ ±1%	0.5 + 0.08	5 + 0.4	14 + 2	22 + 2	30 + 2	1.5 + 0.3
1000V ⁹	±1100.0V	10 μV	10 MΩ ±1%	1 + 0.05	5 + 0.08	14 + 0.4	22 + 0.4	30 + 0.4	1.5 + 0.06

DC Voltage Uncertainty: = ±[(ppm of reading) x (measured value) + (ppm of range) x (range used)] / 1,000,000.

% Accuracy: = (ppm accuracy) / 10,000.

1ppm of Range: = 20 counts for ranges up to 200V and 10 counts on 1000V range at 7½-digits.

NORMAL ACCURACY¹⁰ – 1PLC, DFILT OFF

Range	Full Scale	Resolution	Input Resistance	Relative Accuracy ±(ppm of reading + ppm of range)				Temperature Coefficient ±(ppm of reading + ppm of range)/°C Outside T _{CAL} ±5°C
				24 Hours ⁸	90 Days ⁷	1 Year ⁷	2 Years ⁷	
200mV ⁸	±210.0mV	10nV	>100GΩ	3.5 + 6	15 + 11	19 + 12	23 + 13	2 + 1.8
2V ⁸	±2.10V	100nV	>100GΩ	1.2 + 0.6	6 + 1.1	10 + 1.2	14 + 1.3	0.2 + 0.18
20V	±21.0V	1μV	>100GΩ	3.2 + 0.35	8 + 0.4	12 + 0.4	16 + 0.4	0.3 + 0.02
200V	±210.0V	10μV	10MΩ ±1%	5 + 1.2	14 + 2.8	22 + 2.8	30 + 2.8	1.5 + 0.3
1000V ⁹	±1100.0V	100μV	10MΩ ±1%	5 + 0.4	14 + 0.7	22 + 0.7	30 + 0.7	1.5 + 0.06

SPEED AND ACCURACY

Range	Accuracy ^{4,11} 90 DAYS ±(ppm of reading+ppm of range+ppm of range RMS noise ¹²)					
	10PLC DFILT On, 10 Readings	10PLC DFILT Off	1PLC DFILT On, 10 Readings	1PLC DFILT Off	0.1PLC DFILT Off	0.01PLC ¹³ DFILT Off
200mV ⁸	15 + 8 + 0	15 + 8 + 0.5	15 + 8 + 0.7	15 + 8 + 1	25 + 10 + 13	100 + 200 + 15
2V ⁸	6 + 0.8 + 0	6 + 0.8 + 0.05	6 + 0.8 + 0.07	6 + 0.8 + 0.1	7 + 1 + 1.3	130 + 200 + 3
20V	6 + 0.15 + 0	6 + 0.15 + 0.03	7 + 0.15 + 0.05	8 + 0.15 + 0.08	15 + 0.5 + 0.7	130 + 200 + 3
200V	14 + 2 + 0	14 + 2 + 0.1	14 + 2 + 0.15	14 + 2 + 0.25	15 + 2 + 1	130 + 200 + 3
1000V ⁹	14 + 0.4 + 0	14 + 0.4 + 0.05	14 + 0.4 + 0.05	14 + 0.4 + 0.1	15 + 0.5 + 0.5	90 + 200 + 2

PLC = Power Line Cycles. DFILT = Digital Filter.

NOISE REJECTION (dB)¹⁴

Speed (Number of Power Line Cycles)	AC and DC CMRR ¹⁵		AC NMRR		
	Line Sync On ¹⁶	Internal Trigger	Line Sync On ¹⁶ , 25 Readings DFILT On	Line Sync On ¹⁶ DFILT Off	Internal Trigger DFILT Off
PLC ≥ 1	140	120	90	80	60
PLC < 1	90	60	60	50	0

⁴ Specifications are for 10 power line cycles, synchronous autozero, 10-reading repeat digital filter, autorange off, except as noted.

⁵ Specifications apply for 20-reading repeat digital filter, TREF ± 0.5°C (TREF 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 For T_{CAL} ±1°C, following 4-hour warm-up. T_{CAL} is ambient temperature at calibration (23°C at the factory). Add 0.5 ppm of reading uncertainty if the unit is power cycled during this interval.

⁷ For T_{CAL} ±5°C, following 4-hour warm-up.

⁸ Care must be taken to minimize thermal offsets due to operator cables.

⁹ Add 20ppm × (V_{IN}/1000V)² additional uncertainty for inputs above 200V, except in transfer accuracy specifications

¹⁰ Specifications are for 1 power line cycle, normal autozero, digital filter off, autorange off.

¹¹ For T_{CAL} ±5°C, normal autozero. 1-year or 2-year accuracy can be found by applying the same speed accuracy ppm changes to the 1-year or 2-year base accuracy.

¹² Typical values. Peak-to-peak noise equals 6 times RMS noise.

¹³ In burst mode, display off. Burst mode requires autozero refresh (by changing resolution or measurement function) once every 24 hours.

¹⁴ For line frequency ±0.1%.

¹⁵ Applies for 1kΩ imbalance in the LO lead. For 400Hz operation, subtract 10dB. For the 200V and 1000V ranges, subtract 20dB.

¹⁶ For noise synchronous to the line frequency.

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Effective noise is reduced by a factor of 10 for every 20dB of noise rejection (140dB reduces effective noise by 10,000,000:1).
CMRR is rejection of undesirable AC or DC signal between LO and earth. NMRR is rejection of undesirable power line related AC signal between HI and LO.

KEITHLEY FACTORY CALIBRATION UNCERTAINTY

Range	ppm of reading
200mV	3.2
2V	3.2
20V	2.6
200V	2.6
1000V	2.6

Factory calibration uncertainty represents traceability to NIST. This uncertainty is added to relative accuracy specifications to obtain absolute accuracies. The 200mV and 2V range uncertainties are equal to the uncertainty of the 2V calibration source. The 20V, 200V, and 1000V range uncertainties are equal to the uncertainty of the 20V calibration source.

DCV READING RATES^{17,22}

PLC	Measurement Aperture	Bits	Default Digits	Readings/Second to Memory		Readings/Second to IEEE-488 ¹⁸		Readings/Second with Time Stamp to IEEE-488 ¹⁸	
				Autozero Off	Autozero On	Autozero Off	Autozero On	Autozero Off	Autozero On
10	167ms (200ms)	29	8½	6 (5)	2 (1.7)	6 (5)	2 (1.6)	6 (5)	2 (1.6)
2	33.4ms (40ms)	27	7½	29 (25)	9 (7.6)	29 (24)	9 (7.4)	27 (22)	9 (7.4)
1	16.7ms (20ms)	26	7½	56 (48)	47 (40)	55 (45)	46 (38)	50 (41)	42 (34)
0.2	3.34ms (4ms)	23	6½	235 (209)	154 (137)	225 (200)	146 (130)	152 (135)	118 (105)
0.1	1.67ms (2ms)	22	6½	318 (305)	173 (166)	308 (295)	168 (161)	181 (174)	121 (116)
0.02	334µs (400µs)	20	5½	325 (325)	179 (179)	308 (308)	173 (173)	182 (182)	124 (124)
0.01	167µs (167µs)	19	4½	390 (390)	186 (186)	365 (365)	182 (182)	201 (201)	125 (125)
0.01 ¹³	167µs (167µs)	19	4½	2000 (2000)		2000 (2000)			

Linearity: <0.1ppm of range typical, <0.2ppm maximum.

Zero Stability: Typical maximum variation in 1 hour, T_{REF} ± 0.5°C, 7½-digits resolution, 10-reading digital filter, synchronous autozero.

Range	1 PLC	10 PLC
200mV ⁹	± 60 counts	± 40 counts
2V ⁹	± 6 counts	± 4 counts
20V	± 4 counts	± 1 count
200V	± 5 counts	± 2 counts
1000V	± 2 counts	± 1 count

Polarity Reversal Error: This is the portion of the instrument error that is seen when HI and LO are reversed. This is not an additional error—it is included in the overall instrument accuracy specification.

Reversal Error: <4 counts at 10V input at 7½-digits, 10 power line cycles, synchronous autozero, 10-reading repeat digital filter.

Input Bias Current: <100pA at 25°C.

Settling Characteristics: <50µs to 10ppm of step size for the 200mV–20V ranges. <1ms to 10ppm of step size for the 200V and 1000V ranges. Reading settling times are affected by source impedance and cable dielectric absorption characteristics.

Autoranging: Autoranges up at 105% of range, down at 10% of range.

¹⁷ For on-scale readings, no trigger delays, internal trigger, digital filter off, normal autozero, display off, SREAL format. These rates are for 60Hz and (50Hz). Rates for 400Hz equal those for 50Hz.

¹⁸ Using Internal Buffer.

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DCV PEAK SPIKES MEASUREMENT

REPETITIVE SPIKES ACCURACY¹⁹ 90 Days, 1 Year or 2 Years, T_{CAL} ±5°C ±(% of reading+% of range)

Range	0–1kHz ²⁰	1kHz–10kHz	10kHz–30kHz	30kHz–50kHz	50kHz–100kHz	100kHz–300kHz	300kHz–500kHz	500kHz–750kHz	750kHz–1MHz	Temperature Coefficient ±(% of reading +% of range)/°C Outside T _{CAL} ±5°C
200mV	0.08+0.7	0.09+0.7	0.1 +0.7	0.15+0.7	0.25+0.7	1.0+0.7	2.5+0.7	5.5+0.7	9+0.7	0.002+0.03
2V	0.08+0.3	0.09+0.3	0.1 +0.3	0.15+0.3	0.25+0.3	1.0+0.3	2.5+0.3	5.5+0.3	9+0.3	0.002+0.03
20V	0.1 +0.7	0.11+0.7	0.14+0.7	0.19+0.7	0.25+0.7	1.0+0.7	2.5+0.7	5.5+0.7	9+0.7	0.004+0.03
200V ²¹	0.1 +0.3	0.11+0.3	0.14+0.3	0.19+0.3	0.25+0.3	1.0+0.3 ²²	2.5+0.3 ²²	5.5+0.3 ²²	9+0.3 ²²	0.004+0.03
1000V ²¹	0.12+0.6	0.16+0.6	0.2 +0.6	0.25+0.6 ²²	0.5 +0.6 ²²					0.01 +0.02
Max. % of Range	±125%	±125%	±125%	±125%	±125%	±125%	±125%	±100%	±75%	

Default Measurement Resolution: 3½ -digits.

Maximum Input: ±1100V peak value, 2x10⁷V·Hz (for inputs above 20V).

Non-Repetitive Spikes: 10% of range per μs typical slew rate.

Spike Width: Specifications apply for spikes ≥1μs.

Range Control: In Multiple Display mode, voltage range is the same as DCV range.

Spikes Measurement Window: Default is 100ms per reading (settable from 0.1 to 9.9s in Primary Display mode).

Input Characteristics: Same as ACV input characteristics.

Spikes Display: Access as multiple display on DC Volts. First option presents positive peak spikes and highest spike since reset. Second option presents negative spikes and lowest spike. Highest and lowest spike can be reset by pressing DCV function button. Third option displays the maximum and minimum levels of the input signal. Spikes displays are also available through CONFIG-ACV-ACTYPE as primary displays.

AC VOLTS

AC magnitude: RMS or average; peak and crest factor measurements also available.

ACV INPUT CHARACTERISTICS

RMS Range	Peak Input	Full Scale RMS	Resolution	Input Impedance	Temperature Coefficient ²³ ±(% of reading + % of range) / °C Outside T _{CAL} ±5°C
200mV	1V	210.0mV	100nV	1MΩ ±2% with <140pF	0.004 + 0.001
2V	8V	2.10V	1μV	1MΩ ±2% with <140pF	0.004 + 0.001
20V	100V	21.0V	10μV	1MΩ ±2% with <140pF	0.006 + 0.001
200V	800V	210.0V	100μV	1MΩ ±2% with <140pF	0.006 + 0.001
750V	1100V	775.0V	1mV	1MΩ ±2% with <140pF	0.012 + 0.001

AC Voltage Uncertainty = ±[(% of reading) x (measured value) + (% of range) x (range used)] / 100.

PPM Accuracy = (% accuracy) x 10,000.

0.015% of Range = 30 counts for ranges up to 200V and 113 counts on 750V range at 5½ -digits.

LOW FREQUENCY MODE RMS²⁴ 90 Days, 1 Year or 2 Years, ±2°C from last AC self-cal, for 1% to 100% of range²⁵, ±(% of reading + % of range)

Range	1–10Hz ²²	10–50Hz	50–499Hz	501Hz–2kHz	2–10kHz	10–30kHz	30–50kHz	50–100kHz	100–200kHz	0.2–1MHz	1–2MHz
200mV	0.09+0.015	0.06+0.015	0.035+0.015	0.03+0.02	0.02+0.02	0.025+0.02	0.05+0.02	0.3+0.015	0.75+0.025	2+0.1	5+0.2
2V	0.09+0.015	0.04+0.015	0.025+0.015	0.02+0.02	0.02+0.02	0.025+0.02	0.05+0.02	0.3+0.015	0.75+0.025	2+0.1	5+0.2
20V	0.1 +0.015	0.06+0.015	0.035+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 ²²
200V ²⁶	0.1 +0.015	0.05+0.015	0.03 +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 ²²	4+0.2 ²²	
750V ²⁶	0.13+0.015	0.09+0.015	0.05 +0.015	0.05+0.015	0.06+0.015	0.08 +0.015	0.1 +0.015 ²²	0.5+0.015 ²²			

¹⁹ Specifications apply for sine wave input with a 10-reading digital filter. If no filter is used, add 0.25% of range typical uncertainty.

²⁰ Specifications assume AC+DC coupling for frequencies below 200Hz. Below 20Hz add 0.1% of reading additional uncertainty.

²¹ Add 0.001% of reading × (V_{IN}/100V)² additional uncertainty for inputs above 100V.

²² Typical values.

²³ Temperature coefficient applies to RMS and average readings. For frequencies above 100kHz, add 0.01% of reading/°C to temperature coefficient.

²⁴ Specifications apply for sinewave input, AC + DC coupling, 1 power line cycle, autozero on, digital filter off, following 55-minute warm-up.

²⁵ 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.

²⁶ Add 0.001% of reading × (V_{IN}/100V)² additional uncertainty for inputs above 100V RMS.

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NORMAL MODE RMS²⁴ 90 Days, 1 Year or 2 Years, $\pm 2^{\circ}\text{C}$ from last AC self-cal, for 1% to 100% of range²⁵, $\pm(\%$ 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
200mV	0.25+0.015	0.07+0.015	0.02+0.02	0.02+0.02	0.025+0.02	0.05+0.02	0.3+0.015	0.75+0.025	2+0.1	5+0.2
2V	0.25+0.015	0.07+0.015	0.02+0.02	0.02+0.02	0.025+0.02	0.05+0.02	0.3+0.015	0.75+0.025	2+0.1	5+0.2
20V	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 ²²
200V ²⁶	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 ²²	4+0.2 ²²	
750V ²⁶	0.25+0.015	0.1+0.015	0.05+0.015	0.06+0.015	0.08+0.015	0.1+0.015 ²²	0.5+0.015 ²²			

dB ACCURACY RMS \pm dB, 90 Days, 1 Year or 2 Years, TCAL $\pm 5^{\circ}\text{C}$, Reference=1V, Autoranging, Low Frequency Mode, AC+DC Coupling

Input	1–100Hz	0.1–30kHz	30–100kHz	100–200kHz	0.2–1MHz	1–2MHz
–54 to –40dB (2mV to 10mV)	0.230	0.225	0.236	0.355		
–40 to –34dB (10mV to 20mV)	0.036	0.031	0.041	0.088		
–34 to 6dB (20mV to 2V)	0.023	0.018	0.028	0.066	0.265	0.630
6 to 26dB (2V to 20V)	0.024	0.024	0.028	0.066	0.538	0.820 ²²
26 to 46dB (20V to 200V)	0.024	0.024	0.028	0.066 ²²	0.538 ²²	
46 to 57.8dB (200V to 775V)	0.018	0.021	0.049 ²²			

ACV READING RATES^{22,27}

PLC	Measurement Aperture	Bits	Default Digits	Readings/Second to Memory		Readings/Second to IEEE-488 ¹⁸		Readings/Second with Time Stamp to IEEE-488 ¹⁸	
				Autozero Off	Autozero On	Autozero Off	Autozero On	Autozero Off	Autozero On
10	167ms (200ms)	29	6½	6 (5)	2 (1.7)	6 (5)	2 (1.6)	6 (5)	2 (1.6)
2	33.4ms (40ms)	27	5½	29 (25)	9 (7.6)	28 (23)	9 (7.4)	26 (21)	9 (7.4)
1	16.7ms (20ms)	26	5½	56 (48)	47 (40)	52 (43)	44 (36)	48 (39)	40 (33)
0.2	3.34ms (4ms)	23	5½	145 (129)	110 (98)	131 (117)	100 (88)	102 (91)	79 (70)
0.1	1.67ms (2ms)	22	5½	150 (144)	112 (108)	132 (127)	101 (97)	102 (98)	80 (77)
0.02	334µs (400µs)	20	5½	150 (150)	115 (115)	132 (132)	103 (103)	102 (102)	80 (80)
0.01	167µs (167µs)	19	4½	382 (382)	116 (116)	251 (251)	103 (103)	163 (163)	80 (80)
0.01 ¹³	167µs (167µs)	19	4½	2000 (2000)		2000 (2000)			

ACV CREST FACTOR MEASUREMENT²⁸

Crest Factor: = Peak AC / RMS AC.

Crest Factor Resolution: 3 digits.

Crest Factor Accuracy: Peak AC uncertainty + AC normal mode RMS uncertainty.

Measurement Time: 100ms plus RMS measurement time.

Input Characteristics: Same as ACV input.

Crest Factor Frequency Range: 20Hz – 1MHz.

Crest Factor Display: Access as multiple display on AC volts.

AC COUPLING

For AC only coupling, add the following % of reading:

	1–10Hz	10–20Hz	20–50Hz	50–100Hz	100–200Hz
Normal Mode (RMS, average)	—	—	0.41	0.07	0.015
Low Frequency Mode (RMS)	0.1	0.01	0	0	0

For low frequency mode below 200Hz, specifications apply for sine wave inputs only.

AC+DC COUPLING

For DC >20% of AC RMS voltage, apply the following additional uncertainty, multiplied by the ratio (DC/total RMS). Applies to RMS and average measurements.

Range	% of Reading	% of Range
200mV, 20V	0.05	0.1
2V, 200V, 750V	0.07	0.01

AVERAGE ACV MEASUREMENT

Normal mode RMS specifications apply from 10% to 100% of range, for 20Hz–1MHz. Add 0.025% of range uncertainty for 50kHz–100kHz, 0.05% of range uncertainty for 100kHz–200kHz, and 0.5% of range uncertainty for 200kHz–1MHz.

²⁷ For on-scale readings, no trigger delays, internal trigger, digital filter off, normal autozero, display off, SREAL format. These rates are for 60Hz and (50Hz). Rates for 400Hz equal those for 50Hz. Applies for normal RMS and average mode. Low frequency RMS mode rate is typically 0.2 readings per second.

²⁸ Subject to peak input voltage specification.

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HIGH CREST FACTOR ADDITIONAL ERROR ±(% OF READING)

Applies to RMS measurements.

Crest Factor	1 – 2	2 – 3	3 – 4	4 – 5
Additional Error	0	0.1	0.2	0.4

ACV PEAK VALUE MEASUREMENT¹⁹ Repetitive Peak Accuracy, ±(% of reading+% of range), 90 Days, 1 Year or 2 Years, T_{CAL} ±5°C

Range	20Hz–1kHz ²⁹	1kHz–10kHz	10kHz–30kHz	30kHz–50kHz	50kHz–100kHz	100kHz–300kHz	300kHz–500kHz	500kHz–750kHz	750kHz–1MHz	Temperature Coefficient ±(% of reading +% of range)/°C Outside T _{CAL} ±5°C
200mV	0.08+0.7	0.09+0.7	0.1 +0.7	0.15+0.7	0.25+0.7	1.0+0.7	2.5+0.7	5.5+0.7	9+0.7	0.002 + 0.03
2V	0.08+0.3	0.09+0.3	0.1 +0.3	0.15+0.3	0.25+0.3	1.0+0.3	2.5+0.3	5.5+0.3	9+0.3	0.002 + 0.03
20V	0.1 +0.7	0.11+0.7	0.14+0.7	0.19+0.7	0.25+0.7	1.0+0.7	2.5+0.7	5.5+0.7	9+0.7	0.004 + 0.03
200V ²⁶	0.1 +0.3	0.11+0.3	0.14+0.3	0.19+0.3	0.25+0.3	1.0+0.3 ²²	2.5+0.3 ²²	5.5+0.3 ²²	9+0.3 ²²	0.004 + 0.03
750V ²⁶	0.12+0.6	0.16+0.6	0.2 +0.6	0.25+0.6 ²²	0.5 +0.6 ²²					0.01 + 0.02
Valid % of Range ³⁰	10–400%	10–400%	10–400%	10–350%	10–350%	10–250%	10–150%	10–100%	7.5–75%	

Default Measurement Resolution: 4 digits.

Non-Repetitive Peak: 10% of range per μs typical slew rate for single spikes.

Peak Width: Specifications apply for all peaks ≥1μs.

Peak Measurement Window: 100ms per reading.

Maximum Input: ±1100V peak, 2x10⁷V·Hz (for inputs above 20V).

Settling Characteristics:

Normal Mode (RMS, avg.):
<300ms to 1% of step change
<450ms to 0.1% of step change
<500ms to 0.01% of step change

Low Frequency Mode (RMS) <5s to 0.1% of final value

Common Mode Rejection: For 1kΩ imbalance in either lead: >60dB for line frequency ±0.1%.

Maximum Volt-Hz Product: 2 x 10⁷V·Hz (for inputs above 20V).

Autoranging: Autoranges up at 105% of range, down at 10% of range.

OHMS

TWO-WIRE AND FOUR-WIRE OHMS

Range	Full Scale	Resolution	Current Source ³¹	Open Circuit ²²	Maximum HI Lead Resistance ³²	Maximum LO Lead Resistance ³²	Maximum Offset Compensation ³³
20Ω	21.0Ω	100nΩ	7.2mA	5V	50Ω	10Ω	±0.2 V
200Ω	210.0Ω	1μΩ	960μA	5V	200Ω	100Ω	±0.2 V
2kΩ	2100.0kΩ	10μΩ	960μA	5V	200Ω	150Ω	–0.2 V to +2 V
20kΩ	21.0kΩ	100μΩ	96μA	5V	1.5kΩ	1.5kΩ	–0.2 V to +2 V
200kΩ	210.0kΩ	1mΩ	9.6μA	5V	1.5kΩ	1.5kΩ	
2MΩ	2.10MΩ	10mΩ	1.9μA	6V	1.5kΩ	1.5kΩ	
2MΩ ³⁴	21.0MΩ	100mΩ	1.4μA ³⁵	14V			
20MΩ ³⁴	210.0MΩ	1Ω	1.4μA ³⁵	14V			
1GΩ ³⁴	1.050GΩ	10Ω	1.4μA ³⁵	14V			

²⁹ AC peak specifications assume AC + DC coupling for frequencies below 200Hz.

³⁰ For overrange readings 200–300% of range, add 0.1% of reading uncertainty. For 300–400% of range, add 0.2% of reading uncertainty.

³¹ Current source has an absolute accuracy of ±5%.

³² Refers to source lead resistance. Sense lead resistance is limited only by noise considerations. For best results, it is suggested that it be limited to 1.5kΩ.

³³ Offset compensation voltage plus source current times measured resistance must be less than source current times resistance range selected.

³⁴ For 2-wire mode.

³⁵ Current source is paralleled with a 10MΩ resistance.

Keithley Instruments, Inc.
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Multimeter Specifications

KEITHLEY FACTORY CALIBRATION UNCERTAINTY

Range	ppm of reading
20Ω	29.5
200Ω	7.7
2kΩ	6.4
20kΩ	7.8
200kΩ	7.3
2MΩ	14.9
20MΩ	14.9
200MΩ	14.9
1GΩ	14.9

Factory calibration uncertainty represents traceability to NIST. This uncertainty is added to relative accuracy specifications to obtain absolute accuracies.

The 20Ω - 2MΩ range uncertainties are equal to the uncertainty of the respective calibration sources.

The 20MΩ, 200MΩ, and 1GΩ range uncertainties are equal to the uncertainty of the 2MΩ calibration source.

ENHANCED ACCURACY³⁶ 10PLC, Offset comp. on, DFILT 10

Range	Transfer ⁵	24 Hours ³⁷	Relative Accuracy ± (ppm of reading + ppm of range)			Temperature Coefficient ± (ppm of reading + ppm of range) / °C Outside T _{CAL} ±5°C
			90 Days ⁷	1 Year ⁷	2 Years ⁷	
20Ω	2.5 + 3	5 + 4.5	15 + 6	17 + 6	20 + 6	2.5 + 0.7
200Ω	2.5 + 2	5 + 3	15 + 4	17 + 4	20 + 4	2.5 + 0.5
2kΩ	1.3 + 0.2	2.5 + 0.3	7 + 0.4	9 + 0.4	11 + 0.4	0.8 + 0.05
20kΩ	1.3 + 0.2	2.5 + 0.3	7 + 0.4	9 + 0.4	11 + 0.4	0.8 + 0.05
200kΩ	2.5 + 0.4	5.5 + 0.5	29 + 0.8	35 + 0.9	40 + 1	3.5 + 0.18
2MΩ	5 + 0.2	12 + 0.3	53 + 0.5	65 + 0.5	75 + 0.5	7 + 0.1
20MΩ ³⁴	15 + 0.1	50 + 0.2	175 + 0.6	250 + 0.6	300 + 0.6	20 + 0.1
200MΩ ³⁴	50 + 0.5	150 + 1	500 + 3	550 + 3	600 + 3	80 + 0.5
1GΩ ³⁴	250 + 2.5	750 + 5	2000 + 15	2050 + 15	2100 + 15	400 + 2.5

Resistance Uncertainty: = ±[(ppm of reading) x (measured value) + (ppm of range) x (range used)] / 1,000,000.

% Accuracy: = (ppm accuracy) / 10,000.

1ppm of Range: = 20 counts for ranges up to 200MΩ and 10 counts on 1GΩ range at 7½-digits.

SPEED AND ACCURACY

Accuracy ^{11, 38} 90 Days ±(ppm of reading+ppm of range+ppm of range RMS noise ¹²)						
RANGE	10PLC DFILT On, 10 Readings	10PLC DFILT Off	1PLC DFILT On, 10 Readings	1PLC DFILT Off	0.1PLC ³⁹ DFILT Off	0.01PLC ^{39, 13} DFILT Off
20Ω	15+11+0	15+11+0.5	15+13+0.5	15+13+1	15+16+25	110+200+35
200Ω	15+8+0	15+8+0.5	17+8+0.5	17+8+1	17+10+15	110+200+35
2kΩ	7+0.8+0	7+0.8+0.05	8+0.8+0.07	8+0.8+0.2	8+1+2	130+230+5
20kΩ	7+0.8+0	7+0.8+0.1	8+0.8+0.1	9+0.8+0.2	40+1+2	130+230+5
200kΩ	29+0.8+0	29+0.8+0.1	31+0.8+0.1	34+0.8+0.2	250+1+2	
2MΩ	55+0.5+0	53+0.5+0.1	58+0.5+0.1	68+0.5+0.2	750+0.7+2	
20MΩ ³⁴	175+0.6+0	175+0.6+0	175+0.6+0	200+0.6+0		
200MΩ ³⁴	500+3+0	510+3+0	510+3+0	550+3+0		
1GΩ ³⁴	2000+15+0	2100+15+0	2100+15+0	2500+15+0		

PLC = Power Line Cycles. DFILT = Digital Filter.

2-WIRE ACCURACY ±(ppm of range)

Range	Additional Uncertainty (inside T _{CAL} ± 5°C)	Temperature Coefficient (outside T _{CAL} ±5°C)
20Ω	30ppm	70ppm/°C
200Ω	30ppm	7ppm/°C
2kΩ	3ppm	0.7ppm/°C

³⁶ 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.

³⁷ For T_{CAL} ±1°C, following 4-hour warm-up. T_{CAL} is ambient temperature at calibration (23°C at the factory).

³⁸ Specifications are for 1 power line cycle, normal autozero, digital filter off, autorange off, 4-wire mode, offset compensation off, except as noted.

³⁹ Ohms measurements at rates lower than 1 power line cycle are subject to potential noise pickup. Care must be taken to provide adequate shielding.

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Multimeter Specifications

NORMAL ACCURACY³⁸ 1PLC, Offset comp. off, DFILT off

RANGE	Relative Accuracy ± (ppm of reading + ppm of range)				Temperature Coefficient ± (ppm of reading + ppm of range)/°C Outside T _{CAL} ± 5°C
	24 Hours ³⁷	90 Days ⁷	1 Year ⁷	2 Years ⁷	
20Ω	5+12	15+16	17+17	20+19	2.5+2.5
200Ω	7+8	17+11	19+12	22+13	2.5+1.8
2kΩ	3.5+1.1	8+1.4	10+1.5	12+1.6	0.8+0.18
20kΩ	4.5+1.1	9+1.4	11+1.5	13+1.6	0.8+0.18
200kΩ	11+1.1	34+1.4	40+1.5	45+1.6	3.5+0.18
2MΩ	27+0.9	68+1.1	80+1.1	90+1.1	7+0.1
20MΩ ³⁴	75+0.2	200+0.6	275+0.6	325+0.6	20+0.1
200MΩ ³⁴	200+1	550+3	600+3	650+3	80+0.5
1GΩ ³⁴	1250+5	2500+15	2550+15	2600+15	400+2.5

Settling Characteristics: Pre-programmed settling delay times are for <500pF external circuit capacitance. Reading settling times are affected by source impedance and cable dielectric absorption characteristics.

Ohms Voltage Drop Measurement: Available as a multiple display.

Autoranging: Autoranges up at 105% of range, down at 10% of range.

2-WIRE RESISTANCE READING RATES^{17,22}

PLC	Measurement Aperture	Bits	Default Digits	Readings/Second to Memory		Readings/Second to IEEE-488 ¹⁸		Readings/Second with Time Stamp to IEEE-488 ¹⁸	
				Autozero Off	Autozero On	Autozero Off	Autozero On	Autozero Off	Autozero On
10	167ms (200ms)	29	8½	6 (5)	2 (1.7)	6 (5)	2 (1.6)	6 (5)	2 (1.6)
2	33.4ms (40ms)	27	7½	29 (25)	9 (7.6)	29 (24)	9 (7.4)	27 (22)	9 (7.4)
1	16.7ms (20ms)	26	7½	56 (48)	47 (40)	55 (45)	46 (38)	50 (41)	42 (34)
0.2 ³⁹	3.34ms (4ms)	23	6½	222 (197)	156 (139)	220 (196)	148 (132)	156 (139)	107 (95)
0.1 ³⁹	1.67ms (2ms)	22	6½	330 (317)	176 (169)	305 (293)	166 (159)	157 (151)	110 (106)
0.02 ³⁹	334µs (400µs)	20	5½	330 (330)	182 (182)	305 (305)	172 (172)	160 (160)	113 (113)
0.01 ³⁹	167µs (167µs)	19	4½	384 (384)	186 (186)	352 (352)	172 (172)	179 (179)	123 (123)
0.01 ^{13,39}	167µs (167µs)	19	4½	2000 (2000)		2000 (2000)			

4-WIRE RESISTANCE READING RATES^{22,17}

PLC	Measurement Aperture	Bits	Default Digits	Readings or Readings with Time Stamp/Second to Memory or IEEE-488 ¹⁸			
				Autozero Off Offset Comp. Off	Autozero Off Offset Comp. On	Autozero On Offset Comp. Off	Autozero On Offset Comp. On
10	167ms (200ms)	29	8½	6 (5)	3 (2.5)	2 (1.6)	1 (0.8)
2	33.4ms (40ms)	27	7½	27 (22)	13 (10.7)	9 (7.4)	4 (3.5)
1	16.7ms (20ms)	26	7½	50 (41)	25 (20)	42 (34)	20 (16)
0.2 ³⁹	3.34ms (4ms)	23	6½	154 (137)	76 (68)	115 (102)	54 (48)
0.1 ³⁹	1.67ms (2ms)	22	6½	184 (176)	92 (88)	123 (118)	63 (60)
0.02 ³⁹	334µs (400µs)	20	5½	186 (186)	107 (107)	126 (126)	72 (72)
0.01 ³⁹	167µs (167µs)	19	4½	211 (211)	107 (107)	133 (133)	72 (72)

DC AMPS

DCI INPUT CHARACTERISTICS AND ACCURACY

Range	Full Scale	Resolution	Maximum Burden Voltage ⁴⁰	Relative Accuracy ± (ppm of reading + ppm of range)				Temperature Coefficient ⁴¹ ± (ppm of reading + ppm of range)/°C Outside T _{CAL} ± 5°C
				24 Hours ⁴²	90 Days ⁴³	1 Year ⁴³	2 Years ⁴³	
200µA	210.0µA	10pA	0.25V	50 + 6	275 + 25	350 + 25	500 + 25	50 + 5
2mA	2.10mA	100pA	0.3V	50 + 5	275 + 20	350 + 20	500 + 20	50 + 5
20mA	21.0mA	1nA	0.35V	50 + 5	275 + 20	350 + 20	500 + 20	50 + 5
200mA	210.0mA	10nA	0.35V	75 + 5	300 + 20	375 + 20	525 + 20	50 + 5
2A	2.10A	100nA	1.1V	350 + 5	600 + 20	750 + 20	1000 + 20	50 + 5

DC Current Uncertainty: = ± [(ppm reading) × (measured value) + (ppm of range) × (range used)] / 1,000,000.

% Accuracy: = (ppm accuracy) / 10,000.

5ppm of Range: = 10 counts at 6½ digits.

⁴⁰ Actual maximum burden voltage = (maximum burden voltage) × (I_{MEASURED}/I_{FULL SCALE}).

⁴¹ Specifications are for 1 power line cycle, autozero on, 10-reading repeat digital filter.

⁴² For T_{CAL} ± 1°C, following 55-minute warm-up. T_{CAL} is ambient temperature at calibration (23°C at the factory).

⁴³ For T_{CAL} ± 5°C, following 55-minute warm-up.

Specifications are subject to change without notice.

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Multimeter Specifications

DCI READING RATES^{17,22}

PLC	Measurement Aperture	Bits	Default Digits	Readings/Second to Memory		Readings/Second to IEEE-488 ¹⁸		Readings/Second with Time Stamp to IEEE-488 ¹⁸	
				Autozero Off	Autozero On	Autozero Off	Autozero On	Autozero Off	Autozero On
10	167ms (200ms)	29	7½	6 (5)	2 (1.7)	6 (5)	2 (1.6)	6 (5)	2 (1.6)
2	33.4ms (40ms)	27	7½	29 (25)	9 (7.6)	29 (24)	9 (7.4)	27 (22)	9 (7.4)
1	16.7ms (20ms)	26	6½	56 (48)	47 (40)	55 (45)	46 (38)	50 (41)	42 (34)
0.2	3.34ms (4ms)	23	6½	222 (197)	157 (140)	209 (186)	150 (133)	156 (139)	113 (100)
0.1	1.67ms (2ms)	22	5½	334 (321)	178 (171)	310 (298)	168 (161)	186 (178)	124 (119)
0.02	334µs (400µs)	20	5½	334 (334)	184 (184)	310 (310)	174 (174)	187 (187)	127 (127)
0.01	167µs (167µs)	19	4½	387 (387)	186 (186)	355 (355)	176 (176)	202 (202)	128 (128)
0.01 ¹³	167µs (167µs)	19	4½	2000 (2000)		2000 (2000)			

SPEED AND ACCURACY

ACCURACY ^{41, 11} 90 Days ±(ppm of reading+ppm of range+ppm of range RMS noise ¹³)				
Range	1PLC DFILT On, 10 Readings	1PLC DFILT Off	0.1PLC DFILT Off	0.01PLC ¹³ DFILT Off
200µA	275+25+0	275+25+0.5	300+25+50	300+200+80
2mA	275+20+0	275+20+0.5	300+20+50	300+200+80
20mA	275+20+0	275+20+0.5	300+20+50	300+200+80
200mA	300+20+0	300+20+0.5	325+20+50	325+200+80
2A	600+20+0	600+20+0.5	625+20+50	625+200+80

PLC = Power Line Cycles. DFILT = Digital Filter.

KEITHLEY FACTORY CALIBRATION UNCERTAINTY

Range	ppm of reading
200µA	43
2mA	40
20mA	55
200mA	162
2A	129

Factory calibration uncertainty represents traceability to NIST. This uncertainty is added to relative accuracy specifications to obtain absolute accuracies. The 20Ω – 2MΩ range uncertainties are equal to the uncertainty of the respective calibration sources. The 20MΩ, 200MΩ, and 1GΩ range uncertainties are equal to the uncertainty of the 2MΩ calibration source.

Settling Characteristics: <500µs to 50ppm of step size. Reading settling times are affected by source impedance and cable dielectric absorption characteristics.

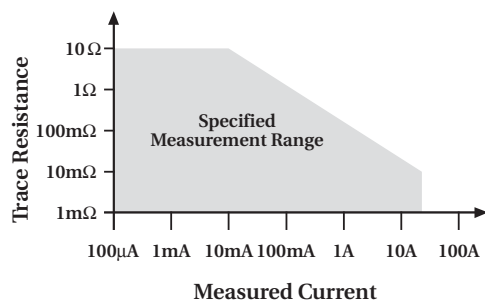
Maximum Allowable Input: 2.1A, 250V.

Overload Protection: 2A fuse (250V), accessible from front (for front input) and rear (for rear input).

Autoranging: Autoranges up at 105% of range, down at 10% of range.

DC IN-CIRCUIT CURRENT

Measurement Range Chart



The DC in-circuit current measurement function allows a user to measure the current through a wire or a circuit board trace without breaking the circuit.

When the In-Circuit Current Measurement function is selected, the 2002 will first perform a 4-wire resistance measurement, then a voltage measurement, and will display the calculated current.

TYPICAL RANGES

Current: 100µA to 12A.

Trace Resistance: 1mΩ to 10Ω.

Voltage: ±200mV max. across trace.

Speed: 4 measurements/second at 1 power line cycle.

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.

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Multimeter Specifications

AC AMPS

AC magnitude: RMS or average.

ACI INPUT CHARACTERISTICS

RMS Range	Peak Input	Full Scale RMS	Resolution	Maximum Burden Voltage ⁴⁰	Temperature Coefficient ±(% of reading + % of range)/°C Outside T _{CAL} ±5°C
200µA	1mA	210.0mA	100pA	0.35V	0.01 + 0.001
2mA	10mA	2.10mA	1nA	0.45V	0.01 + 0.001
20mA	100mA	21.0mA	10nA	0.5V	0.01 + 0.001
200mA	1A	210.0A	100nA	0.5V	0.01 + 0.001
2A	2A	2.10A	1µA	1.5V	0.01 + 0.001

ACI ACCURACY^{24, 44} 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 ²²	30kHz–50kHz ²²	50kHz–100kHz ²²
200µA	0.35 + 0.015	0.2 + 0.015	0.4 + 0.015	0.5 + 0.015			
2mA	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
20mA	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
200mA	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
2A	0.35 + 0.015	0.2 + 0.015	0.3 + 0.015	0.45 + 0.015	1.5 + 0.015	4 + 0.015	

AC Current Uncertainty: = ±[(% of reading) x (measured value) + (% of range) x (range used)] / 100.

ppm Accuracy: = (% accuracy) x 10,000.

0.015% of Range: = 30 counts at 5½ -digits.

ACI READING RATES^{17, 22}

PLC	Measurement Aperture	Bits	Default Digits	Readings/Second to Memory		Readings/Second to IEEE-488 ¹⁸		Readings/Second with Time Stamp to IEEE-488 ¹⁸	
				Autozero Off	Autozero On	Autozero Off	Autozero On	Autozero Off	Autozero On
10	167ms (200ms)	29	6½	6 (5)	2 (1.7)	6 (5)	2 (1.6)	6 (5)	2 (1.6)
2	33.4ms (40ms)	27	5½	29 (25)	9 (7.6)	28 (23)	9 (7.4)	27 (22)	9 (7.4)
1	16.7ms (20ms)	26	5½	56 (48)	47 (40)	53 (43)	44 (36)	47 (38)	40 (33)
0.2	3.34ms (4ms)	23	5½	163 (145)	102 (91)	139 (124)	100 (89)	95 (84)	74 (66)
0.1	1.67ms (2ms)	22	5½	163 (156)	104 (100)	139 (133)	101 (97)	95 (91)	75 (72)
0.02	334µs (400µs)	20	5½	163 (163)	107 (107)	139 (139)	103 (103)	95 (95)	76 (76)
0.01	167µs (167µs)	19	4½	384 (384)	110 (110)	253 (253)	103 (103)	164 (164)	76 (76)
0.01 ¹³	167µs (167µs)	19	4½	2000 (2000)		2000 (2000)			

AC COUPLING

For AC only coupling, add the following % of reading:

	20–50Hz	50–100Hz	100–200Hz
RMS, Average	0.55	0.09	0.015

AC+DC COUPLING

For DC>20% of AC RMS voltage, apply the following additional uncertainty, multiplied by the ratio (DC/total RMS).

	% of Reading	% of Range
RMS, Average	0.05	0.1

HIGH CREST FACTOR ADDITIONAL ERROR ±(% of reading)

Applies to RMS measurements.

Crest Factor	1–2	2–3	3–4	4–5
Additional Error	0	0.1	0.2	0.4

⁴⁴ Add 0.005% of range uncertainty for current above 0.5A RMS for self-heating.

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Multimeter Specifications

AVERAGE ACI MEASUREMENT

RMS specifications apply for 10% to 100% of range.

Settling Characteristics: <300ms to 1% of step change
<450ms to 0.1% of step change
<500ms to 0.01% of step change

Autorangeing: Autoranges up at 105% of range, down at 10% of range.

FREQUENCY COUNTER

FREQUENCY/PERIOD INPUT CHARACTERISTICS AND ACCURACY 90 Days, 1 Year, or 2 Years

	Frequency Range ⁴⁵	Period Range	Resolution	Minimum Signal Level ⁴⁶			Maximum Input	Trigger Level	Accuracy ±(% of reading)
				1Hz–1MHz	1–5MHz	5–15MHz			
AC Voltage Input	1Hz–15 MHz	67ns – 1s	5 digits	60mV	60mV	400mV	1100V pk ⁴⁵	0–600V	0.03
AC Current Input	1Hz– 1 MHz	1µs – 1s	5 digits	150µA			1A pk	0–600mA	0.03

Time Base: 7.68MHz ± 0.01%, 0°C to 55°C.

Reading Time: 420ms maximum.

Voltage Input Impedance: 1MΩ ± 2% with <140pF.

Trigger Level Adjustment: Trigger level is adjustable in 0.5% of range steps to ±60% of range in real-time using the up and down range buttons.

Frequency Ranging: Autoranging from Hz to MHz.

Frequency Coupling: AC only.

TEMPERATURE (RTD)

Range	Resolution	4-Wire Accuracy ⁴⁷			
		24 Hours ⁴⁸	90 Days ⁷	1 Year ⁷	2 Years ⁷
–100° to +100°C	0.001°C	±0.016°C	±0.020°C	±0.021°C	±0.022°C
–200° to +630°C	0.001°C	±0.061°C	±0.066°C	±0.068°C	±0.070°C
–148° to +212°F	0.001°F	±0.029°F	±0.036°F	±0.038°F	±0.040°F
–328° to +1166°F	0.001°F	±0.110°F	±0.119°F	±0.122°F	±0.126°F

RTD Type: 100Ω platinum, DIN 43760, 4-wire. ITS-90 (PT100, D100, F100) and IPTS-68 (PT385, PT3916).

Sensor Current: 960µA (pulsed).

Temperature Coefficient: ±0.001°C/°C or ±0.002°F/°C outside T_{CAL} ±5°C.

Maximum Source HI Lead Resistance: 200Ω.

Maximum Source LO Lead Resistance: 100Ω.

RTD TEMPERATURE READING RATES^{17,22} (2- or 4-Wire)

Readings or Readings with Time Stamp/Second to Memory or IEEE-488		
PLC	Autozero Off	Autozero On
10	3 (2.5)	1 (0.8)
2	12 (10)	4 (3.3)
1	20 (16)	17 (13)
0.1	51 (49)	41 (39)
0.01	58 (58)	46 (46)

⁴⁵ Subject to 2×10^7 V·Hz product (for inputs above 20V).

⁴⁶ Valid for the lowest range. For each range increase, multiply these numbers by 10.

⁴⁷ Specifications are for 10 power line cycles, autozero on, 10 reading repeat digital filter, 4-wire mode. Exclusive of RTD probe errors.

⁴⁸ For T_{CAL} ± 1°C, following 4-hour warm-up.

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Multimeter Specifications

TEMPERATURE (THERMOCOUPLE)

Thermocouple Type	Range	Resolution	Accuracy ⁴⁹
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
E	-200° to +1000°C	0.001°C	±0.6°C
R	0° to +1768°C	0.001°C	±3 °C
S	0° to +1768°C	0.001°C	±3 °C
B	+350° to +1820°C	0.001°C	±5 °C

TC Temperature Reading Rates^{22,50}

PLC	Readings/Second to Memory		Readings/Second to IEEE-488 ¹⁸		Readings/Second with Time Stamp to IEEE-488 ¹⁸	
	Autozero Off	Autozero On	Autozero Off	Autozero On	Autozero Off	Autozero On
10	6 (5)	2 (1.7)	6 (5)	2 (1.6)	6 (5)	2 (1.6)
2	29 (25)	9 (7.6)	29 (24)	9 (7.4)	27 (22)	9 (7.4)
1	57 (48)	47 (40)	56 (46)	46 (38)	50 (41)	42 (34)
0.1	131 (126)	107 (103)	100 (96)	84 (81)	83 (80)	72 (69)
0.01	168 (168)	112 (112)	121 (121)	89 (89)	96 (96)	74 (74)

OPERATING SPEED

FUNCTION CHANGE SPEED⁵¹

Typical delay before measurement initiation after making a function change.

From Function	To Function	Range	Time
Any except 4WΩ, Temp	DCV	Any	4.6ms
4WΩ, Temp		Any	7.6ms
Any	ACV	Any	574ms
ACV, DCV, 2WΩ, Freq	DCI	Any	7.1ms
4WΩ, Temp		Any	10ms
ACI		Any	22ms
Any	ACI	Any	523ms
Any except 4WΩ, Temp	2WΩ	20Ω to 2kΩ	4.7ms
		20kΩ	15ms
		200kΩ	27ms
		2MΩ	103ms
		20MΩ	153ms
		200MΩ, 1GΩ	253ms
4WΩ, Temp	2WΩ	20Ω to 2kΩ	7.7ms
		20kΩ	18ms
		200kΩ	30ms
		2MΩ	105ms
		20MΩ	157ms
		200MΩ, 1GΩ	256ms
Any	4WΩ	20Ω to 2kΩ	7.7ms
		20kΩ	18ms
		200kΩ	30ms
		2MΩ	105ms
Any except ACV, ACI	Freq ⁵²	Any	60ms
ACV, ACI		Any	573ms
Any	Temp	Any	7.6ms

⁴⁹ Relative to external 0°C reference junction; exclusive of thermocouple errors. Junction temperature may be external. Applies for 90 days, 1 year or 2 years, T_{CAL} ±5°C.

⁵⁰ For on-scale readings, no trigger delays, digital filter off, display off, normal autozero, internal trigger, SREAL format. These rates are for 60Hz (and 50Hz). Rates for 400Hz equal those for 50Hz. Typical values.

⁵¹ For display off, 0.01 power line cycles, autorange off, digital filter off, autozero on, offset compensation off. Display on may impact time by 3% worst case. To eliminate this impact, press ENTER (hold) to freeze display.

⁵² Based on 100kHz input frequency.

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Multimeter Specifications

RANGE CHANGE SPEED⁵¹

Typical delay before measurement initiation after making a range change.

Function	From	To	Time
DCV	Any	Any	5.2ms
ACV	Any	Any	559ms
DCI	Any	Any	7.6ms
ACI	Any	Any	503ms
2W Ω	Any	20 Ω to 2k Ω	5.2ms
	Any	20k Ω	15ms
	Any	200k Ω	27ms
	Any	2M Ω	103ms
	Any	20M Ω	153ms
	Any	200M Ω , 1G Ω	253ms
4W Ω	Any	20 Ω to 2k Ω	5.2ms
	Any	20k Ω	15ms
	Any	200k Ω	27ms
	Any	2M Ω	103ms

TRIGGER SPEED (EXTERNAL TRIGGER OR TRIGGER-LINK)

	Autozero Off	Autozero On
Trigger Latency:	< 2 μ s	1.2ms typical
Trigger Jitter:	\pm 0.5 μ s	

GPIB DATA FORMATTING TRANSMISSION TIME⁵³

Format	Readings Only		Readings with Time Stamp	
	Time	Rdg./s	Time	Rdg./s
DREAL (Double precision real)	0.51ms	1961	3.1ms	323
SREAL (Single precision real)	0.38ms	2632	3.3ms	303
ASCII	6.2ms	161	10.2ms	98

SINGLE FUNCTION SCAN SPEED⁵⁴ (INTERNAL SCANNER)

TYPE	DCV (20V)		2W Ω (2k Ω)		4W Ω (2k Ω)		ACV		Freq		TC Temp		RTD Temp (2-Wire)	
	Time per Chan.	Rate (Chan./second)	Time per Chan.	Rate (Chan./second)	Time per Chan.	Rate (Chan./second)	Time per Chan.	Rate (Chan./second)	Time per Chan.	Rate (Chan./second)	Time per Chan.	Rate (Chan./second)	Time per Chan.	Rate (Chan./second)
Ratio or Delta ⁵⁵ (2 channels)	8.2ms	122	8.5ms	118	18.8ms	53								
Fast Scan (using solid state channels)	8.2ms	122	6.3ms	159			501ms	2	559ms	1.8	12.8ms	78		
Normal Scan	14ms	71	11.4ms	88	14.4ms	69	506ms	2	564ms	1.8	17.2ms	58	43ms	23

⁵³ Using 386/33 computer, average time for 1000 readings, byte order swapped, display off.

⁵⁴ For on-scale readings, no trigger delays, display off, 0.01 power line cycles, autorange off, digital filter off, offset compensation off, autozero off.

⁵⁵ Ratio and delta functions output one value for each pair of measurements.

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Multimeter Specifications**MAXIMUM INPUT LEVELS**

	Rated Input⁵⁶	Overload Recovery Time
HI to LO	±1100V	< 900ms
HI Sense to LO	± 350V pk 250V RMS	< 900ms
LO Sense to LO	± 150V pk 100V RMS	< 900ms
I Input to LO	2A, ± 250V (fused)	—
HI to Earth	±1600V	< 900ms
LO to Earth	± 500V	

DELAY AND TIMER

Time Stamp **Resolution:** 1µs.
Accuracy: ±0.01% of elapsed time ± 1µs.
Maximum: 2,100,000.000000 seconds (24 days, 7 hours).

Delay Time **(Trigger edge to reading initiation)**
Maximum: 999,999.999 seconds (11 days, 14 hours).
Resolution: 1ms.
Jitter: ±1ms.

Timer **(Reading initiation to reading initiation)**
Maximum: 999,999.999 seconds (11 days, 14 hours).
Resolution: 1ms.
Jitter: ±1ms.

IEEE-488 BUS IMPLEMENTATION

Implementation: IEEE-488.2, SCPI-1991.0.

Multiline Commands: DCL, LLO, SDC, GET, GTL, UNT, UNL, SPE, SPD.

Uniline Commands: IFC, REN, EOI, SRQ, ATN.

Interface Commands: SH1, AH1, T5, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, E1.

DIGITAL I/O

Connector Type: 8 pin "D" subminiature.

Input: One pin, TTL compatible.

Outputs: Four pins. Open collector, 30V maximum pull-up voltage, 100mA maximum sink current, 10Ω output impedance.

Control: Direct control by output or set real-time with limits.

GENERAL SPECIFICATIONS AND STANDARDS COMPLIANCE

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°C to 50°C.
Storage Temperature: –40°C to 70°C.
Humidity: 80% R.H., 0°C to 35°C, per MIL-T-28800E⁵⁷ Para 4.5.5.1.2.

Calibration **Type:** Software. No manual adjustments required.
Sources: 2 DC voltages, 6 resistances, and 5 DC currents. All other functions calibrated (adjusted) from these sources and a short circuit. No AC calibrator required for adjustment.
Average Time to Perform: 40 minutes for comprehensive calibration, 6 minutes for AC-only calibration.
Process: MIL-STD 45662A.

⁵⁶ For voltages between other terminals, these ratings can be added.

⁵⁷ For MIL-T-28800E, applies to Type III, Class 5, Style E.

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Multimeter Specifications

- Physical** **Case Dimensions:** 90mm high × 214mm wide × 369mm deep (3½ in. × 8½ in. × 14½ in.).
Working Dimensions: From front of case to rear including power cord and IEEE-488 connector: 15.0 inches.
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-28800E⁵⁸. Designed to UL1244.
- Accessories Supplied** The unit is shipped with line cord, high performance modular test leads, operator's manual, option slot cover, and full calibration data.

EXTENDED MEMORY/NON-VOLATILE MEMORY OPTIONS

DATA STORAGE						
Model	Size (Bytes)	4½-Digit	6½-Digit with Time Stamp	Type	Setup Storage	
					Number	Type
2002	8k	2,027	404	volatile	1	non-volatile
2002/MEM1	32k	6,909	1,381	non-volatile	5	non-volatile
2002/MEM2	128k	29,908	5,980	non-volatile	10	non-volatile

These are the minimum sizes to expect.

⁵⁸ For MIL-T-28800E, applies to Type III, Class 5, Style E.