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7-1/2 Digit Graphical Sampling Multimeter Specifications

SPECIFICATION CONDITIONS

This document contains specifications and supplemental information for the Model DMM7510 7-1/2 Digit Graphical Sampling Multimeter instrument. Specifications are the standards against which the Model DMM7510 is tested. Upon leaving the factory, the Model DMM7510 meets these specifications. Supplemental and typical values are nonwarranted, apply at 23 °C (73 °F), and are provided solely as useful information. Measurement accuracies are specified at the Model DMM7510 terminals under these conditions:

- Temperature 23 °C \pm 5 °C, 5 % to 80 % relative humidity, noncondensing
- After a 90-minute warmup period
- 1 PLC or 5 PLC; for NPLC settings less than 1 PLC, add appropriate ppm of range for peak noise uncertainty from the [RMS noise table](#)
- Autozero enabled unless otherwise noted
- Remote sense operation or properly zeroed local operation
- Calibration period: One year or two years (calibration period may vary depending on customer requirements)
- T_{ACAL} = Ambient temperature of last automatic calibration
- T_{CAL} = Ambient temperature of last external calibration; factory calibration performed at 23 °C \pm 1 °C

DC VOLTAGE

ACCURACY (INPUT IMPEDANCE AUTO)

Range ¹	Resolution	Input impedance	Accuracy ±[ppm of reading + ppm of range]				
			24 hour T _{CAL} ±1 °C ²	90 day T _{CAL} ±5 °C	1 year T _{CAL} ±5 °C	2 year T _{CAL} ±5 °C	Temperature coefficient ³
100.00000 mV ⁴	10 nV	> 10 GΩ or 10 MΩ ±1 %	6 + 9	12 + 9	18 + 9	29 + 9	0.1 + 2.5
1.0000000 V ⁴	100 nV	> 10 GΩ or 10 MΩ ±1 %	4 + 1	9 + 2	15 + 2	26 + 2	0.1 + 0.5
10.000000 V ⁴	1 μV	> 10 GΩ or 10 MΩ ±1 %	2 + 0.7	9 + 1.2	14 + 1.2	22 + 1.2	0.1 + 0.05
100.00000 V ⁴	10 μV	10 MΩ ±1 %	8 + 3	[18 + 5] ⁵	[22 + 5] ⁵	[30 + 5] ⁵	[0.15 + 0.05] ⁵
				35 + 5	40 + 5	45 + 5	2.0 + 0.5
1000.0000 V ^{4,6}	100 μV	10 MΩ ±1 %	8 + 3	[19 + 5] ⁵	[23 + 5] ⁵	[31 + 5] ⁵	[0.15 + 0.05] ⁵
				35 + 5	40 + 5	45 + 4	2.0 + 0.5

RMS NOISE (ADDITIONAL PEAK NOISE UNCERTAINTY)⁷

- Applies to ± ppm of range
- Peak noise uncertainty is included in DC specifications for ≥ 1 PLC
- Add peak noise uncertainty to measurements for < 1 PLC
- Input impedance set to auto

Examples:

- 10 V at 0.006 PLC: 1.2 (from Accuracy table) + 11 (additional peak noise uncertainty) = 12.2 ppm of range
- 10 V at 1 PLC: 1.2 + 0 = 1.2 ppm of range

NPLC	Digits	100 mV	1 V	10 V	100 V	1000 V
5	7½	0.5	0.08	0.06	0.3	0.06
1	7½	0.5	0.09	0.07	0.4	0.07
0.2 ⁸	6½	2 (10)	0.2 (1.6)	0.1 (1.1)	1.1 (9.4)	0.1 (1)
0.2	6½	2 (12)	0.2 (1.6)	0.1 (1)	1.1 (8.9)	0.2 (1.1)
0.06	5½	3 (17)	0.4 (2.7)	0.3 (2.1)	3 (17)	0.3 (2.4)
0.006	4½	6 (42)	3 (18)	1 (11)	20 (100)	3 (18)
0.0005	3½	30 (220)	20 (150)	20 (130)	120 (690)	20 (150)

¹ 20 % overrange on all ranges except 1 % for 1000 V range.

² Relative to calibration accuracy.

³ Add per degree from T_{CAL} ± 5 °C.

⁴ When properly zeroed using the Rel function with external cables.

⁵ Specified within 30 days of autocalibration, T_{OPER} ± 5 °C from T_{ACAL}.

⁶ For signal levels greater than 500 V, add 0.02 ppm/V to the ppm of the readings specification for measurements exceeding 500 V.

⁷ Noise values are based on 1000 readings with autozero on and using low thermal 4-wire short. V_{RMS} noise is typical. Additional peak noise is guaranteed.

⁸ With line sync on.

Specifications and characteristics are subject to change without notice.

DC VOLTAGE SENSE ACCURACY

Range	Accuracy ±[ppm of reading + ppm of range]				
	24 hour T _{CAL} ±1 °C	90 day T _{CAL} ±5 °C	1 year T _{CAL} ±5 °C	2 year T _{CAL} ±5 °C	Temperature coefficient ⁹
100.00000 mV	6 + 14	12 + 14	18 + 14	29 + 14	0.1 + 2.5
1.0000000 V	4 + 1.5	9 + 3	15 + 3	26 + 3	0.1 + 0.5
10.000000 V	2 + 1.0	9 + 1.8	14 + 1.8	22 + 1.8	0.1 + 0.05

DC VOLTAGE RATIO

For input signals ≥ 1 % of the range, ratio accuracy =	$\pm[(V_{\text{INPUT}} \text{ ppm of reading} + V_{\text{INPUT}} \text{ ppm of range} * (V_{\text{INPUT}} \text{ range}/V_{\text{INPUT}} \text{ input})) + (V_{\text{SENSE}} \text{ ppm of reading} + V_{\text{SENSE}} \text{ ppm of range} * (V_{\text{SENSE}} \text{ range}/V_{\text{SENSE}} \text{ input}))]$
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DC VOLTAGE CHARACTERISTICS

ADC linearity	1.0 ppm of reading + 1.0 ppm of range
Input impedance	100 mV to 10 V ranges: Selectable > 10 GΩ < 400 pF (auto) or 10 MΩ ±1 % (10 MΩ) 100 V to 1000 V ranges: 10 MΩ ±1 %
Input bias current	< 50 pA at 23 °C under the following conditions: Autozero off or input impedance 10 MΩ
Common mode current	< 2.1 μA peak-peak in 1 MHz bandwidth < 100 nA peak-peak in 1 kHz bandwidth
Common mode voltage	500 V _{peak} LO terminal to chassis maximum
DC voltage autozero off error	For ±1 °C and ≤ 10 minutes, add ± (8 ppm of reading + 15 μV)

NORMAL MODE REJECTION

For DC voltage, line frequency ±0.1 %

	5 PLC	1 PLC	≤ 0.2 PLC	≤ 0.01 PLC
Line sync on	110 dB	90 dB	45 dB	—
Line sync off	60 dB	60 dB	—	—

COMMON MODE REJECTION

For DC voltage and 1 kΩ unbalanced in LO terminal; AC CMRR is 70 dB

NPLC	5	1	0.2	≤ 0.2
Line sync	On	On	On	Off
CMRR	140 dB	140 dB	120 dB	80 dB

⁹ Add per degree from T_{CAL} ± 5 °C.

RESISTANCE

ENHANCED ACCURACY (WITHIN 30 DAYS OF AUTOCALIBRATION, $T_{OPER} \pm 5\text{ }^{\circ}\text{C}$ FROM T_{ACAL})¹⁰

Range ¹¹	Resolution	Test current ¹² ($\pm 5\%$)	Accuracy \pm [ppm of reading + ppm of range]				
			24 hour $T_{CAL} \pm 1\text{ }^{\circ}\text{C}$ ¹³	90 day $T_{CAL} \pm 5\text{ }^{\circ}\text{C}$	1 year $T_{CAL} \pm 5\text{ }^{\circ}\text{C}$	2 year $T_{CAL} \pm 5\text{ }^{\circ}\text{C}$	Temperature coefficient ¹⁴
1.0000000 Ω	0.1 $\mu\Omega$	10 mA	15 + 50	30 + 50	30 + 50	30 + 50	0.15 + 0.1
10.000000 Ω	1 $\mu\Omega$	10 mA	15 + 5	30 + 5	30 + 5	30 + 5	0.15 + 0.1
100.00000 Ω	10 $\mu\Omega$	1 mA	12 + 4	27 + 4	27 + 4	27 + 4	0.15 + 0.1
1.0000000 $k\Omega$	100 $\mu\Omega$	1 mA	12 + 3	24 + 3	24 + 3	24 + 3	0.15 + 0.1
10.000000 $k\Omega$ ¹⁵	1 $m\Omega$	100 μA	13 + 3	30 + 3	30 + 3	30 + 3	0.15 + 0.1
100.00000 $k\Omega$ ^{15,16}	10 $m\Omega$	10 μA	13 + 3	30 + 3	30 + 3	30 + 3	0.15 + 0.1
1.0000000 $M\Omega$ ^{15,17}	100 $m\Omega$	10 μA	14 + 3	30 + 4	30 + 4	30 + 4	0.15 + 0.1
10.000000 $M\Omega$ ¹⁸	1 Ω	0.69 μA 10 $M\Omega$	150 + 6	200 + 10	200 + 10	200 + 10	70 + 1
100.00000 $M\Omega$ ¹⁸	10 Ω	0.69 μA 10 $M\Omega$	800 + 30	2000 + 30	2000 + 30	2000 + 30	385 + 1
1.0000000 $G\Omega$ ¹⁸	100 Ω	0.69 μA 10 $M\Omega$	9000 + 100	9000 + 100	9000 + 100	9000 + 100	3000 + 1

¹⁰ Specifications are for 4-wire resistance, offset compensation on for $\leq 10\text{ }k\Omega$ measurements, and offset compensation off for $\geq 10\text{ }k\Omega$ measurements. 1 Ω range is 4-wire only. For 2-wire, with Rel, add 50 $m\Omega$ to ppm of range uncertainty. Without Rel and with Model 1756 test leads, add 100 $m\Omega$ to ppm of range uncertainty.

¹¹ 20 % overrange on all ranges.

¹² Test current with offset compensation off.

¹³ Relative to calibration accuracy.

¹⁴ Add per degree from $T_{CAL} \pm 5\text{ }^{\circ}\text{C}$.

¹⁵ Specifications are for external cable and load capacitance < 1 nF.

¹⁶ For offset compensation on, add 10 ppm uncertainty to ppm of reading.

¹⁷ For 4-wire 1 $M\Omega$, open lead detector on, add 10 ppm uncertainty to ppm of reading.

¹⁸ Specified for < 10 % lead resistance mismatch in HI and LO.

Specifications and characteristics are subject to change without notice.

ACCURACY¹⁹

Range ²⁰	Resolution	Test current ²¹ (±5 %)	Accuracy ±[ppm of reading + ppm of range]				
			24 hour T _{CAL} ±1 °C ²²	90 day T _{CAL} ±5 °C	1 year T _{CAL} ±5 °C	2 year T _{CAL} ±5 °C	Temperature coefficient ²³
1 Ω	0.1 μΩ	10 mA	15 + 50	40 + 50	50 + 50	70 + 50	2.5 + 5
10 Ω	1 μΩ	1 mA	15 + 5	40 + 5	50 + 5	70 + 5	2.5 + 0.5
100 Ω	10 μΩ	1 mA	12 + 4	35 + 4	47 + 4	65 + 4	5 + 0.25
1 kΩ	100 μΩ	1 mA	12 + 3	30 + 3	41 + 3	65 + 3	5 + 0.25
10 kΩ ²⁴	1 mΩ	100 μA	10 + 3	30 + 3	42 + 3	65 + 3	2.5 + 0.25
100 kΩ ^{24,25}	10 mΩ	10 μA	13 + 3	38 + 3	50 + 3	65 + 3	5 + 1
1 MΩ ^{24,26}	100 mΩ	10 μA	14 + 3	38 + 5	50 + 5	65 + 5	5 + 1
10 MΩ ²⁷	1 Ω	0.69 μA 10 MΩ	150 + 6	200 + 10	400 + 10	600 + 12	70 + 1
100 MΩ ²⁷	10 Ω	0.69 μA 10MΩ	800 + 30	2000 + 30	2000 + 30	2600 + 30	385 + 1
1 GΩ ²⁷	100 Ω	0.69 μA 10 MΩ	9000 + 200	9000 + 200	13000 + 200	14000 + 200	3000 + 1

RESISTANCE OPEN CIRCUIT DC VOLTAGE²⁸

Range ²⁰	2-wire	Offset compensation off	Offset compensation on
		4-wire	4-wire
1 Ω	–	9.2 V	9.5 V
10 Ω	9.2 V	9.2 V	9.5 V
100 Ω, 1 kΩ	14.0 V	14.2 V	14.3 V
10 kΩ	9.5 V	9.5 V	0.0 V
100 kΩ, 1 MΩ	12.7 V	14.3 V	0.0 V (100 kΩ range only)
10 MΩ to 1 GΩ	6.9 V	6.9 V	–

¹⁹ Specifications are for 4-wire resistance, offset compensation on for ≤10 kΩ measurements, and offset compensation off for ≥10 kΩ measurements. 1 Ω range is 4-wire only. For 2-wire, with Rel, add 50 mΩ to ppm of range uncertainty. Without Rel and with Model 1756 test leads, add 100 mΩ to ppm of range uncertainty.

²⁰ 20 % overrange on all ranges.

²¹ Test current with offset compensation off.

²² Relative to calibration accuracy.

²³ Add per degree from T_{CAL} ±5 °C.

²⁴ Specifications are for external cable and load capacitance < 1 nF.

²⁵ For offset compensation on, add 10 ppm of uncertainty to ppm of reading.

²⁶ For 4-wire, 1 MΩ, open lead detection on, add 10 ppm uncertainty to ppm of reading.

²⁷ Specified for < 10 % lead resistance mismatch in HI and LO.

²⁸ Open circuit voltage is typical, measured from input HI to LO, SHI and SLO open. For 1 Ω to 1 MΩ ranges using an external digital multimeter (DMM) set to 10 MΩ input impedance; for 10 MΩ to 1 GΩ ranges, set external DMM to >10 GΩ input impedance.

Specifications are subject to change without notice.

4-WIRE OHMS (≤ 10 kΩ) OFFSET COMPENSATION ON

RMS NOISE (ADDITIONAL PEAK NOISE UNCERTAINTY)²⁹

- Applies to ± ppm of range
- Peak noise uncertainty is included in DC specifications for ≥ 1 PLC
- Add peak noise uncertainty to measurements for < 1 PLC

Examples

- 1 kΩ at 0.006 PLC: 3 (from Accuracy table) + 26 (additional peak noise uncertainty) = 29 ppm of range
- 1 kΩ at 1 PLC: 3 + 0 = 3 ppm of range

NPLC	Digits	1 Ω	10 Ω	100 Ω	1 kΩ	10 kΩ
5	7½	2.8	0.3	0.3	0.07	0.3
1	7½	4.2	0.4	0.4	0.12	0.5
0.2 ³⁰	6½	30 (160)	3 (13)	3 (13)	0.4 (2.6)	1.2 (8.2)
0.2	6½	50 (250)	5 (22)	5 (22)	0.6 (3.2)	1.2 (8.3)
0.06	5½	110 (490)	11 (47)	11 (46)	1.1 (6.6)	2 (16)
0.006	4½	110 (710)	10 (70)	10 (70)	4 (26)	10 (60)
0.0005	3½	520 (3420)	50 (340)	50 (340)	40 (220)	50 (300)

2-WIRE OHMS

RMS NOISE (ADDITIONAL PEAK NOISE UNCERTAINTY)²⁹

- Applies to ± ppm of range
- Peak noise uncertainty is included in DC specifications for ≥ 1 PLC
- Add peak noise uncertainty to measurements for < 1 PLC

Examples:

- 10 kΩ at 0.006 PLC: 3 (from Accuracy table) + 5 (50 mΩ with Rel) + 43 (additional peak noise uncertainty) = 51 ppm of range
- 10 kΩ at 1 PLC: 3 + 5 + 0 = 8 ppm of range

NPLC	Digits	10 Ω	100 Ω	1 kΩ	10 kΩ
5	7½	1.1	0.8	0.1	0.2
1	7½	0.6	0.6	0.09	0.4
0.2 ³⁰	6½	2 (17)	2 (10)	0.2 (1.5)	0.8 (6.3)
0.2	6½	2 (17)	2 (14)	0.3 (1.6)	0.8 (6.4)
0.06	5½	3 (22)	3 (19)	0.4 (3.7)	2 (12)
0.006	4½	6 (50)	6 (50)	3 (21)	6 (43)
0.0005	3½	30 (300)	30 (230)	20 (150)	30 (210)

²⁹ Noise values are based on 1000 readings with autozero on and using low thermal 4-wire short. RMS noise is typical. Additional peak noise is guaranteed.

³⁰ With line sync on.

RESISTANCE CHARACTERISTICS

Maximum 4-wire ohms lead resistance	5 Ω per lead for 1 Ω range, 10 % of range per lead for 10 Ω to 1 k Ω ranges; 1 k Ω per lead for all other ranges
Offset compensation	Selectable on 4-wire, 1 Ω to 100 k Ω ranges
Open lead detector	Default is off
Autozero off error	For 2-wire ohms, ± 1 $^{\circ}\text{C}$ and ≤ 10 minutes, add $\pm(8$ ppm of reading) and 1.5 m Ω for 10 Ω range, 15 m Ω for 100 Ω and 1 k Ω ranges, 150 m Ω for 10 k Ω range, 1.5 Ω for 100 k Ω range, and 15 Ω for all other ranges For 4-wire ohms, ± 1 $^{\circ}\text{C}$ and ≤ 10 minutes, add $\pm(8$ ppm of reading)
Input current limit	For signals with a magnitude of +12 V to +40 V or -12 V to -40 V: ± 13 mA source or sink, typical For signals with a magnitude of greater than +40 V or -40 V: ± 130 μA source or sink, typical

DRY CIRCUIT RESISTANCE

ENHANCED ACCURACY (WITHIN 30 DAYS OF AUTOCALIBRATION, $T_{OPER} \pm 5 \text{ }^\circ\text{C}$ FROM T_{ACAL})

Range ³¹	Resolution	Test current ³⁵ ($\pm 5 \%$)	Open circuit DUT voltage ³²	Accuracy \pm [ppm of reading + ppm of range]				
				24 hour $T_{CAL} \pm 1 \text{ }^\circ\text{C}$ ³³	90 day $T_{CAL} \pm 5 \text{ }^\circ\text{C}$	1 year $T_{CAL} \pm 5 \text{ }^\circ\text{C}$	2 year $T_{CAL} \pm 5 \text{ }^\circ\text{C}$	Temperature coefficient ³⁴
1.000000 Ω	1 $\mu\Omega$	10 mA	25 mV	25 + 80	50 + 80	50 + 80	50 + 80	1.5 + 0.1
10.00000 Ω	10 $\mu\Omega$	1 mA	25 mV	25 + 80	50 + 80	50 + 80	50 + 80	1.5 + 0.1
100.0000 Ω	100 $\mu\Omega$	100 μA	25 mV	25 + 80	90 + 80	90 + 80	90 + 80	1.5 + 0.1
1.000000 k Ω	1 m Ω	10 μA	25 mV	25 + 80	180 + 80	180 + 80	180 + 80	1.5 + 0.1
10.00000 k Ω	10 m Ω	5 μA	25 mV	25 + 80	320 + 80	320 + 80	320 + 80	1.5 + 0.1

ACCURACY

Range ³¹	Resolution	Test current ³⁵ ($\pm 5 \%$)	Open circuit DUT voltage ³²	Accuracy \pm [ppm of reading + ppm of range]				
				24 hour $T_{CAL} \pm 1 \text{ }^\circ\text{C}$ ³³	90 day $T_{CAL} \pm 5 \text{ }^\circ\text{C}$	1 year $T_{CAL} \pm 5 \text{ }^\circ\text{C}$	2 year $T_{CAL} \pm 5 \text{ }^\circ\text{C}$	Temperature coefficient ³⁴
1.000000 Ω	1 $\mu\Omega$	10 mA	25 mV	25 + 80	50 + 80	70 + 80	90 + 80	2.5 + 1
10.00000 Ω	10 $\mu\Omega$	1 mA	25 mV	25 + 80	50 + 80	70 + 80	90 + 80	5 + 1
100.0000 Ω	100 $\mu\Omega$	100 μA	25 mV	25 + 80	90 + 80	140 + 80	200 + 80	2.5 + 1
1.000000 k Ω	1 m Ω	10 μA	25 mV	25 + 80	180 + 80	400 + 80	600 + 80	5 + 1
10.00000 k Ω	10 m Ω	5 μA	25 mV	25 + 80	320 + 80	800 + 80	1300 + 80	8 + 1

³¹ 20 % overrange on all ranges, except 2.4 k Ω for the 10 K range.

³² Maximum clamp voltages are DC, typical accuracy is $\pm 20 \%$. Add 20 % for offset compensation on.

³³ Relative to calibration accuracy.

³⁴ Add per degree from $T_{CAL} \pm 5 \text{ }^\circ\text{C}$.

³⁵ Test current with offset compensation off.

Specifications and characteristics are subject to change without notice.

RMS NOISE (ADDITIONAL PEAK NOISE UNCERTAINTY)³⁶

- Applies to ± ppm of range
- Peak noise uncertainty is included in DC specifications for ≥ 1 PLC
- Add peak noise uncertainty to measurements when < 1 PLC

Examples:

- 10 Ω at 0.2 PLC: 80 (from Accuracy table) + 230 (additional peak noise uncertainty) = 310 ppm of range
- 10 Ω at 1 PLC: 80 + 0 = 80 ppm of range

NPLC	Digits	1 Ω	10 Ω	100 Ω	1 kΩ	10 kΩ
5	7½	10	11	6	5	0.9
1	7½	9	9	7	7	0.8
0.2 ³⁷	6½	30 (130)	30 (120)	30 (120)	30 (120)	3 (16)
0.2	6½	60 (220)	60 (230)	50 (190)	50 (190)	9 (35)
0.06	5½	70 (350)	70 (350)	50 (290)	50 (280)	20 (90)
0.006	4½	130 (750)	120 (830)	110 (700)	100 (690)	20 (110)
0.0005	3½	520 (3550)	530 (3520)	530 (3380)	500 (3370)	100 (670)

DRY CIRCUIT RESISTANCE CHARACTERISTICS

Maximum 4-wire ohm lead resistance	0.5 Ω per lead for 1 Ω range 10 % of range per lead for 10 Ω to 100 Ω ranges 50 Ω per lead for 1 kΩ to 10 kΩ ranges
Input current limit	For signals > [±20 mV], current limited, ±13 mA, typical
Offset compensation	Selectable on 1 Ω to 10 kΩ ranges
Autozero off error	For ±1 °C and ≤ 10 minutes, add ± 8 ppm of reading

³⁶ Noise values are based on 1000 readings with autozero on and using low thermal 4-wire short. RMS noise is typical. Additional peak noise is guaranteed.

³⁷ With line sync on.

DC CURRENT

ENHANCED ACCURACY (WITHIN 30 DAYS OF AUTOCALIBRATION, $T_{OPER} \pm 5 \text{ }^\circ\text{C}$ FROM T_{ACAL})

Range ³⁸	Resolution	Maximum burden voltage	Accuracy \pm [ppm of reading + ppm of range]				
			24 hour $T_{CAL} \pm 1 \text{ }^\circ\text{C}$ ³⁹	90 day $T_{CAL} \pm 5 \text{ }^\circ\text{C}$	1 year $T_{CAL} \pm 5 \text{ }^\circ\text{C}$	2 year $T_{CAL} \pm 5 \text{ }^\circ\text{C}$	Temperature coefficient ⁴⁰
10.000000 μA	1 pA	15 mV	30 + 30	75 + 30	75 + 30	75 + 30	0.15 + 0.1
100.00000 μA	10 pA	15 mV	20 + 5	60 + 9	60 + 9	60 + 9	0.15 + 0.1
1.0000000 mA	100 pA	15 mV	30 + 5	60 + 9	60 + 9	60 + 9	0.15 + 0.1
10.000000 mA	1 nA	20 mV	40 + 5	60 + 9	60 + 9	60 + 9	0.15 + 0.1
100.00000 mA	10 nA	200 mV	50 + 18	150 + 30	150 + 30	150 + 30	0.15 + 0.1
1.0000000 A	100 nA	400 mV	150 + 50	400 + 50	400 + 50	400 + 50	0.15 + 0.1
3.000000 A	1 μA	1300 mV	200 + 40	400 + 40	400 + 40	400 + 40	0.15 + 0.1
10.000000 A ⁴¹	1 μA	650 mV	700 + 275	800 + 275	1500 + 275	2000 + 275	50 + 10

ACCURACY

Range ³⁸	Resolution	Maximum burden voltage	Accuracy \pm [ppm of reading + ppm of range]				
			24 hour $T_{CAL} \pm 1 \text{ }^\circ\text{C}$ ³⁹	90 day $T_{CAL} \pm 5 \text{ }^\circ\text{C}$	1 year $T_{CAL} \pm 5 \text{ }^\circ\text{C}$	2 year $T_{CAL} \pm 5 \text{ }^\circ\text{C}$	Temperature coefficient ⁴⁰
10.000000 μA	1 pA	15 mV	30 + 30	100 + 30	125 + 40	175 + 50	10 + 8
100.00000 μA	10 pA	15 mV	20 + 5	75 + 12	100 + 15	150 + 20	10 + 3
1.0000000 mA	100 pA	15 mV	30 + 5	75 + 12	100 + 15	150 + 20	10 + 3
10.000000 mA	1 nA	20 mV	40 + 5	75 + 12	100 + 15	150 + 20	10 + 3
100.00000 mA	10 nA	200 mV	50 + 18	300 + 30	400 + 30	500 + 30	50 + 5
1.0000000 A	100 nA	400 mV	150 + 50	400 + 50	450 + 50	500 + 50	10 + 10
3.000000 A	1 μA	1300 mV	200 + 40	400 + 40	450 + 40	500 + 40	10 + 10
10.000000 A ⁴¹	1 μA	650 mV	700 + 275	800 + 275	1500 + 275	2000 + 275	50 + 10

³⁸ 20 % overrange supported for all ranges except for 3 A and 10 A, which are 1 % supported.

³⁹ Relative to calibration accuracy.

⁴⁰ Add per degree from $T_{CAL} \pm 5 \text{ }^\circ\text{C}$.

⁴¹ Rear input terminals only.

Specifications and characteristics are subject to change without notice.

RMS NOISE (ADDITIONAL PEAK NOISE UNCERTAINTY)⁴²

- Applies to \pm ppm of range
- Peak noise uncertainty is included in DC Specifications for PLC ≥ 1
- Add peak noise uncertainty to measurements for PLC < 1

Examples:

- 1 mA at 0.006 PLC: 9 (from Accuracy table) + 20 (additional peak noise uncertainty) = 29 ppm of range
- 1 mA at 1 PLC: 9 + 0 = 9 ppm of range

NPLC	Digits	10 μ A	100 μ A	1 mA	10 mA	100 mA	1 A	3 A	10 A ⁴³
5	7½	0.15	0.14	0.09	0.1	0.3	0.3	0.2	0.8
1	7½	0.4	0.13	0.1	0.1	0.5	0.5	0.3	1.2
0.2 ⁴⁴	6½	0 (220)	0 (23)	0.2 (3.4)	0.2 (1.6)	2 (10)	2 (11)	0.7 (4.6)	4 (32)
0.2	6½	120 (260)	12 (26)	1.2 (3.8)	0.3 (1.8)	1.9 (9.8)	2 (10)	0.8 (5)	8 (37)
0.06	5½	130 (280)	12 (29)	1.3 (5.6)	0.4 (3.9)	2 (14)	2 (14)	1.2 (7.7)	10 (59)
0.006	4½	130 (350)	14 (42)	3 (20)	2 (20)	4 (30)	4 (31)	7 (51)	20 (110)
0.0005	3½	260 (2110)	30 (300)	20 (150)	20 (160)	30 (190)	30 (190)	70 (510)	60 (420)

DC CURRENT CHARACTERISTICS

Range	10 μ A	100 μ A	1 mA	10 mA	100 mA	1 A	3 A	10 A ⁴³
Effective internal shunt value⁴⁵	1 k Ω	100 Ω	10 Ω	1 Ω	0.1 Ω	0.1 Ω	0.1 Ω	0.005 Ω
Autozero off error: For ± 1 °C and ≤ 10 minutes add $\pm(8$ ppm of reading + range error)	150 pA	1.5 nA	15 nA	150 nA	15 μ A	150 μ A	150 μ A	3 mA
Overload recovery: For each additional sustained amp beyond ± 1.5 A, add the following initial ppm of range error until thermally settled after overload recovery	15500	1800	150	150	6500	200	—	—

⁴² Noise values are based on 1000 readings with autozero on and AMPS terminal open. RMS noise is typical. Additional peak noise is guaranteed.

⁴³ Rear input terminals only.

⁴⁴ With line sync on.

⁴⁵ Values are typical and guaranteed by design.

Specifications are subject to change without notice.

TEMPERATURE

4-WIRE RTD OR 3-WIRE RTD

Types: 100 Ω platinum PT100, D100, F100, PT385, PT3916; or user-configurable 0 Ω to 10 k Ω

Type	Range	Resolution	Accuracy \pm $^{\circ}\text{C}$	
			2 year $T_{\text{CAL}} \pm 5$ $^{\circ}\text{C}$	Temperature coefficient ⁴⁶
4-Wire RTD	-200 $^{\circ}\text{C}$ to 850 $^{\circ}\text{C}$	0.01 $^{\circ}\text{C}$	0.06 $^{\circ}\text{C}$	0.003 $^{\circ}\text{C}/^{\circ}\text{C}$
3-Wire RTD ⁴⁷	-200 $^{\circ}\text{C}$ to 850 $^{\circ}\text{C}$	0.01 $^{\circ}\text{C}$	0.75 $^{\circ}\text{C}$	0.003 $^{\circ}\text{C}/^{\circ}\text{C}$

THERMISTOR

Types: 2.252 k Ω , 5 k Ω , and 10 k Ω

Type	Range	Resolution	Accuracy \pm $^{\circ}\text{C}$	
			2 year $T_{\text{CAL}} \pm 5$ $^{\circ}\text{C}$	Temperature coefficient ⁴⁶
Thermistor	-80 $^{\circ}\text{C}$ to +150 $^{\circ}\text{C}$	0.01 $^{\circ}\text{C}$	0.08 $^{\circ}\text{C}$	0.002 $^{\circ}\text{C}/^{\circ}\text{C}$

THERMOCOUPLE

Types: B, E, J, K, N, R, S, T

Type	Range	Resolution	Accuracy \pm $^{\circ}\text{C}$	
			2 year $T_{\text{CAL}} \pm 5$ $^{\circ}\text{C}$ ⁴⁸ Simulated reference junction	Temperature coefficient ⁴⁶
B	350 $^{\circ}\text{C}$ to +1820 $^{\circ}\text{C}$	0.1 $^{\circ}\text{C}$	0.6 $^{\circ}\text{C}$	0.03 $^{\circ}\text{C}/^{\circ}\text{C}$
E	-200 $^{\circ}\text{C}$ to +1000 $^{\circ}\text{C}$	0.001 $^{\circ}\text{C}$	0.2 $^{\circ}\text{C}$	0.03 $^{\circ}\text{C}/^{\circ}\text{C}$
J	-200 $^{\circ}\text{C}$ to +760 $^{\circ}\text{C}$	0.001 $^{\circ}\text{C}$	0.2 $^{\circ}\text{C}$	0.03 $^{\circ}\text{C}/^{\circ}\text{C}$
K	-200 $^{\circ}\text{C}$ to +1372 $^{\circ}\text{C}$	0.001 $^{\circ}\text{C}$	0.2 $^{\circ}\text{C}$	0.03 $^{\circ}\text{C}/^{\circ}\text{C}$
N	-200 $^{\circ}\text{C}$ to +1300 $^{\circ}\text{C}$	0.001 $^{\circ}\text{C}$	0.2 $^{\circ}\text{C}$	0.03 $^{\circ}\text{C}/^{\circ}\text{C}$
R	0 $^{\circ}\text{C}$ to +1768 $^{\circ}\text{C}$	0.1 $^{\circ}\text{C}$	0.6 $^{\circ}\text{C}$	0.03 $^{\circ}\text{C}/^{\circ}\text{C}$
S	0 $^{\circ}\text{C}$ to +1768 $^{\circ}\text{C}$	0.1 $^{\circ}\text{C}$	0.6 $^{\circ}\text{C}$	0.03 $^{\circ}\text{C}/^{\circ}\text{C}$
T	-100 $^{\circ}\text{C}$ to +400 $^{\circ}\text{C}$	0.001 $^{\circ}\text{C}$	0.2 $^{\circ}\text{C}$	0.03 $^{\circ}\text{C}/^{\circ}\text{C}$

⁴⁶ Add per degree from $T_{\text{CAL}} \pm 5$ $^{\circ}\text{C}$; specifications without autocalibration.

⁴⁷ For 3-wire RTD, accuracy is for < 0.1 Ω lead resistance mismatch for input HI and LO. Add 0.25 $^{\circ}\text{C}/0.1$ Ω of HI-LO lead resistance mismatch.

⁴⁸ Exclusive of cold-junction errors.

Specifications and characteristics are subject to change without notice.

CONTINUITY

Range ⁴⁹	Resolution	Test current	Open circuit voltage	Accuracy ±[ppm of reading + ppm of range]	
				2 year T _{CAL} ±5 °C	Temperature coefficient ⁵⁰
1.0000 kΩ	100 mΩ	1 mA	14.0 V	100 + 100	2.5 + 1

CONTINUITY CHARACTERISTICS

Continuity high limit	User-selectable; default 10 Ω
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CAPACITANCE

Accuracies specified for additional cable and stray capacitance properly zeroed with the Rel function.

ACCURACY

Range ⁵¹	Resolution	Charge current ^{52, 53}	Maximum circuit voltage	Accuracy ±[% of reading + % of range]	
				2 year T _{CAL} ±5 °C	Temperature coefficient ⁵⁰
1.0000 nF	0.1 pF	1.1 μA	2.8 V	1 + 0.2	0.15 + 0.05
10.000 nF	1 pF	1.1 μA	2.8 V	1 + 0.1	0.15 + 0.01
100.00 nF	10 pF	10 μA	3 V	0.4 + 0.1	0.01 + 0.01
1.0000 μF	0.1 nF	100 μA	3 V	0.4 + 0.1	0.01 + 0.01
10.000 μF	1 nF	100 μA	3 V	0.4 + 0.1	0.01 + 0.01
100.00 μF	10 nF	1 mA	3 V	0.4 + 0.1	0.01 + 0.01
1000.0 μF	0.1 μF	10 mA	3 V	0.5 + 0.1	0.01 + 0.01

DIODE

Voltage measure range ⁵¹	Resolution	Bias level (selectable)	Accuracy ±[ppm of reading + ppm of range]			
			90 day T _{CAL} ±5 °C	1 year T _{CAL} ±5 °C	2 year T _{CAL} ±5 °C	Temperature coefficient ⁵⁰
10.000000 V	1 μV	10 μA / 100 μA / 1 mA	20 + 5	30 + 5	45 + 5	2.5 + 1

⁴⁹ Specifications exclude lead resistance.

⁵⁰ Add per degree from T_{CAL} ±5 °C; specifications without autocalibration.

⁵¹ 20 % overrange on all ranges.

⁵² Charging current values are typical, guaranteed by design.

⁵³ Discharge current limited to < 13 mA.

Specifications are subject to change without notice.

DIGITIZE VOLTAGE

ACCURACY (INPUT IMPEDANCE AUTO)

Range ^{54,55}	Resolution ⁵⁶	Input impedance ⁵⁷	Accuracy ±[ppm of reading + ppm of range]			
			90 day T _{CAL} ±5 °C	1 year T _{CAL} ±5 °C	2 year T _{CAL} ±5 °C	Temperature coefficient ⁵⁸
100.000 mV	1 µV	> 10 GΩ or 10 MΩ ±1 %	210 + 100	220 + 100	230 + 100	15 + 20
1.00000 V	10 µV	> 10 GΩ or 10 MΩ ±1 %	110 + 75	120 + 75	130 + 75	15 + 20
10.0000 V	0.1 mV	> 10 GΩ or 10 MΩ ±1 %	110 + 75	120 + 75	130 + 75	10 + 20
100.000 V ⁵⁹	1 mV	10 MΩ ±1 %	110 + 75	120 + 75	130 + 75	15 + 20
1000.00 V ⁶⁰	10 mV	10 MΩ ±1 %	110 + 75	120 + 75	130 + 75	10 + 20

⁵⁴ For DC coupling, 20 % overrange for 100 mV to 100 V. For AC coupling, 500 % overrange 100 mV to 100 V. 1 % for 1000 V range DC and AC coupling.

⁵⁵ Accuracy with sample rate 1 k per second, aperture auto, and 100 reading buffer average.

⁵⁶ Power up default is 4½ digits.

⁵⁷ User-selectable.

⁵⁸ Add per degree from T_{CAL} ± 5 %.

⁵⁹ For 100 V range, input impedance auto and without A_{CAL}, add 100 ppm of range additional uncertainty and 15 ppm/°C additional uncertainty for "of range" temperature coefficient for operation outside of T_{CAL} ±5 °C.

⁶⁰ For signal levels greater than 500 V, add 0.02 ppm/V to the ppm of the readings specification for measurements exceeding 500 V.

Specifications and characteristics are subject to change without notice.

SIGNAL CHARACTERISTICS^{61,62,63}**TYPICAL AC AND DC COUPLED**

Range	Analog bandwidth (-3 dB)	Maximum flatness error 3 Hz to 20 kHz ⁶⁴	THD 20 kHz signal (-1 dB FS) ⁶⁵	DC-coupled settling time (0.5 %)	AC-coupled filter fast settling time (0.5 %)	AC-coupled filter slow settling time (0.5 %)	AC coupling low frequency (-3 dB) point ⁶⁶
100.000 mV	600 kHz	0.015 dB	0.04 %	5 μ s	80 ms	2.3 s	1 Hz
1.00000 V	600 kHz	0.01 dB	0.03 %	6 μ s	80 ms	2.5 s	1 Hz
10.0000 V	600 kHz	0.01 dB	0.01 %	4 μ s	80 ms	2.5 s	1 Hz

TYPICAL DC COUPLED

Range	Analog bandwidth (-3 dB)	Maximum flatness error 3 Hz to 1 kHz ⁶⁴	Total harmonic distortion (THD) 1 kHz signal (-1 dB FS) ⁶⁵	Settling time (0.5 %)
100.000 V	20 kHz ⁶⁷	0.1 dB	1.3 %	160 μ s
1000.00 V	20 kHz	0.1 dB	1.8 %	80 μ s

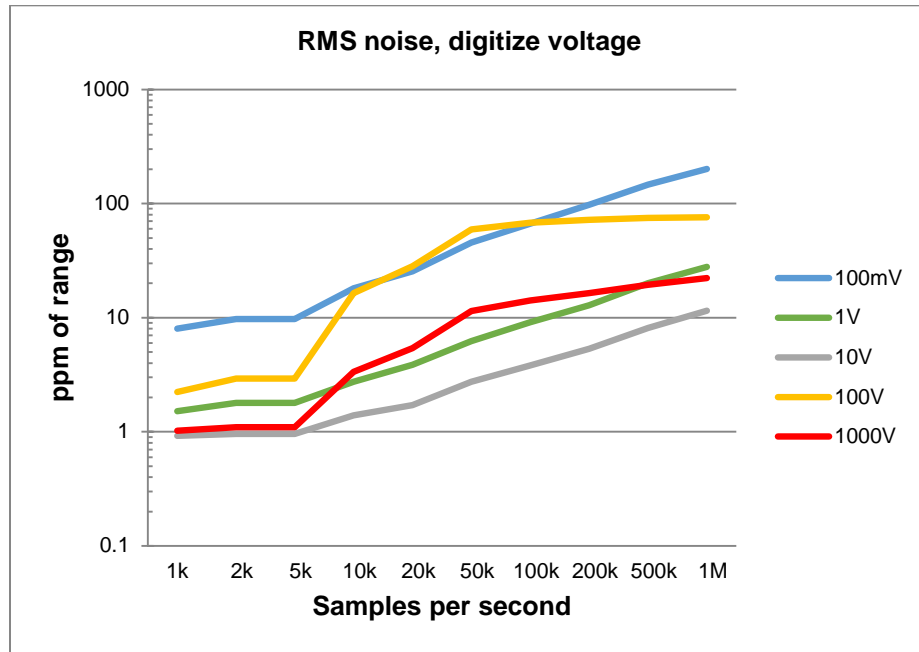
TYPICAL AC COUPLED

Range	Analog bandwidth (-3 dB)	Maximum flatness error 3 Hz to 20 kHz ⁶⁴	Filter Fast settling time (0.5 %)	Filter Slow settling time (0.5 %)	Low frequency coupling point ⁶⁶ (-3 dB)
100.000 V	600 kHz	0.1 dB	80 ms	2.3 s	1 Hz
1000.00 V	600 kHz	0.1 dB	80 ms	2.3 s	1 Hz

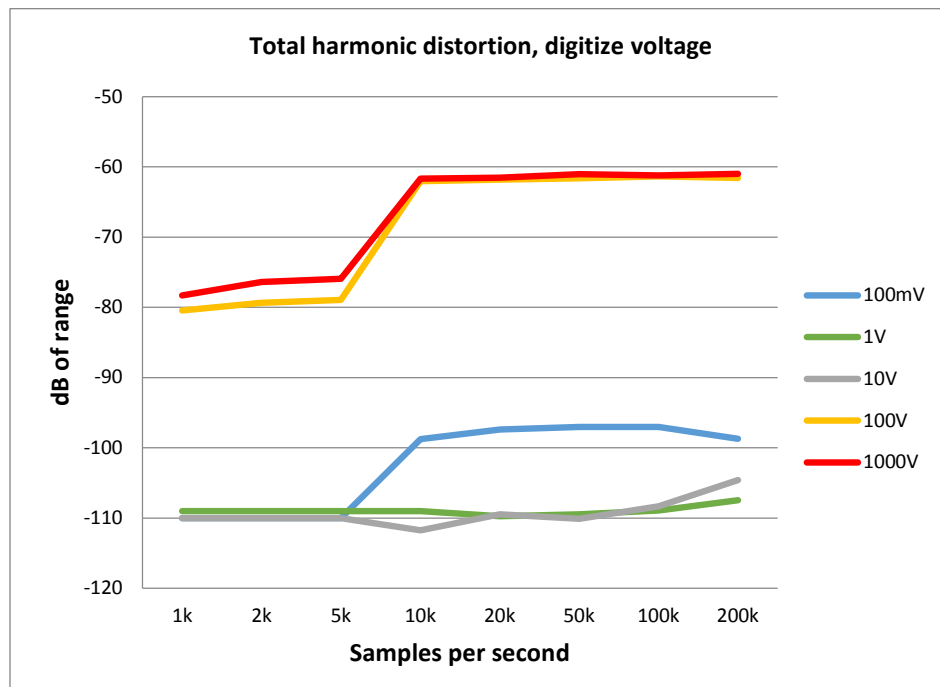
⁶¹ Accuracy with sample rate 1 M per second and aperture 1 μ s.⁶² Verified with sine wave input and DC content \leq 3 % of range.⁶³ For AC coupling, maximum crest factor of 5.⁶⁴ For DC coupled, 0 dB reference frequency is 3 Hz. For AC coupled, 0 dB reference frequency is 1 kHz. For AC coupled operation below 1 kHz, add 0.1 dB.⁶⁵ Exclusive of source input noise.⁶⁶ With AC coupling frequency = 3 Hz and AC coupling filter = Slow.⁶⁷ For input impedance auto, bandwidth is 6 kHz.

Specifications are subject to change without notice.

DC-COUPLED ADDITIONAL NOISE UNCERTAINTY, TYPICAL⁶⁸



DC-COUPLED TOTAL HARMONIC DISTORTION (THD), TYPICAL⁶⁹

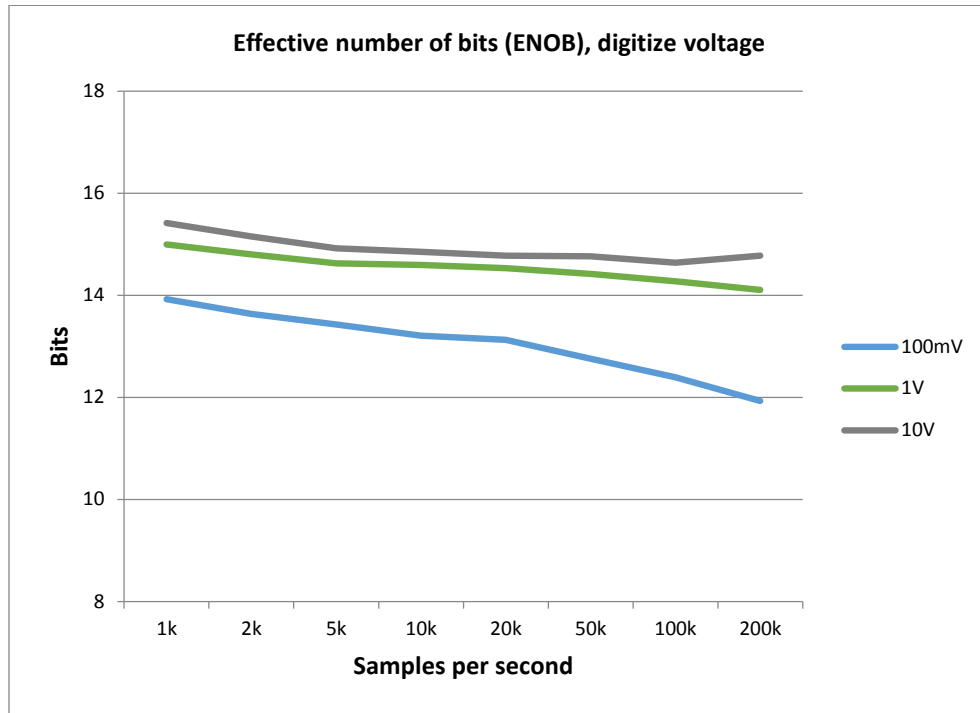


⁶⁸ Specified with aperture Auto and 4-wire short on input terminals. For 100 V range, input impedance 10 MΩ, multiply by 2.5. For all ranges and sample rate > 1 k, add an additional 3× RMS noise uncertainty to ppm of range.

⁶⁹ Specified with aperture Auto, 100 Hz sine wave for sample rate ≤ 5 k, and 1 kHz sine wave for sample rate ≥ 10 k. Distortion is calculated using first five harmonics.

Specifications and characteristics are subject to change without notice.

DC-COUPLED EFFECTIVE NUMBER OF BITS (ENOB), TYPICAL⁷⁰



⁷⁰ Specified with aperture Auto, 100 Hz sine wave for sample rate ≤ 5 k, and 1 kHz sine wave for sample rate ≥ 10 k. For the 100 V and 1000 V ranges, use the 1 V and 10 V range ENOB, respectively; guaranteed by design.

Specifications are subject to change without notice.

DIGITIZE CURRENT

DC ACCURACY⁷¹

Range ⁷²	Resolution ⁷³	Burden voltage	Accuracy ± [ppm of reading + ppm of range]			
			90 day T _{CAL} ±5 °C	1 year T _{CAL} ±5 °C	2 year T _{CAL} ±5 °C	Temperature coefficient ⁷⁴
10.0000 µA	0.1 nA	15 mV	150 + 75	160 + 75	170 + 75	30 + 15
100.000 µA	1 nA	15 mV	150 + 75	160 + 75	170 + 75	30 + 15
1.00000 mA	10 nA	15 mV	150 + 75	160 + 75	170 + 75	30 + 15
10.0000 mA	100 nA	20 mV	150 + 75	160 + 75	170 + 75	30 + 15
100.000 mA	1 µA	200 mV	340 + 100	450 + 100	560 + 100	50 + 20
1.00000 A	10 µA	400 mV	400 + 110	500 + 110	600 + 110	50 + 25
3.00000 A	100 µA	1300 mV	650 + 150	900 + 150	900 + 150	50 + 25
10.0000 A ⁷⁵	100 µA	650 mV	950 + 350	1500 + 350	2000 + 350	50 + 25

SIGNAL CHARACTERISTICS, TYPICAL⁷⁶

Range ⁷²	Maximum flatness error 3 Hz to 20 kHz	Analog bandwidth (-3 dB)	Total harmonic distortion (THD) 20 kHz signal (-1 dB FS)	DC-coupled settling time (0.5 %)
10.0000 µA	0.15 dB	100 kHz	0.02 %	8 µs
100.000 µA	0.15 dB	100 kHz	0.01 %	7 µs
1.00000 mA	0.1 dB	100 kHz	0.01 %	3 µs
10.0000 mA	0.1 dB	100 kHz	0.01 %	8 µs
100.000 mA	0.1 dB	100 kHz	0.02 %	5 µs
1.00000 A ⁷⁷	0.1 dB	100 kHz	0.02 %	6 µs
3.0000 A ⁷⁷	0.1 dB	100 kHz	0.02 %	6 µs
10.0000 A ^{75,77,78}	0.1 dB	100 kHz	0.02 %	6 µs

⁷¹ Accuracy with sample rate 1 k per second, aperture auto, and 100 reading buffer average.

⁷² 20 % overrange on all ranges except 3.3 % for 3 A and 10 A ranges.

⁷³ Power up default is 4½ digits.

⁷⁴ Add per degree from T_{CAL} ±5 °C.

⁷⁵ Rear input terminals only.

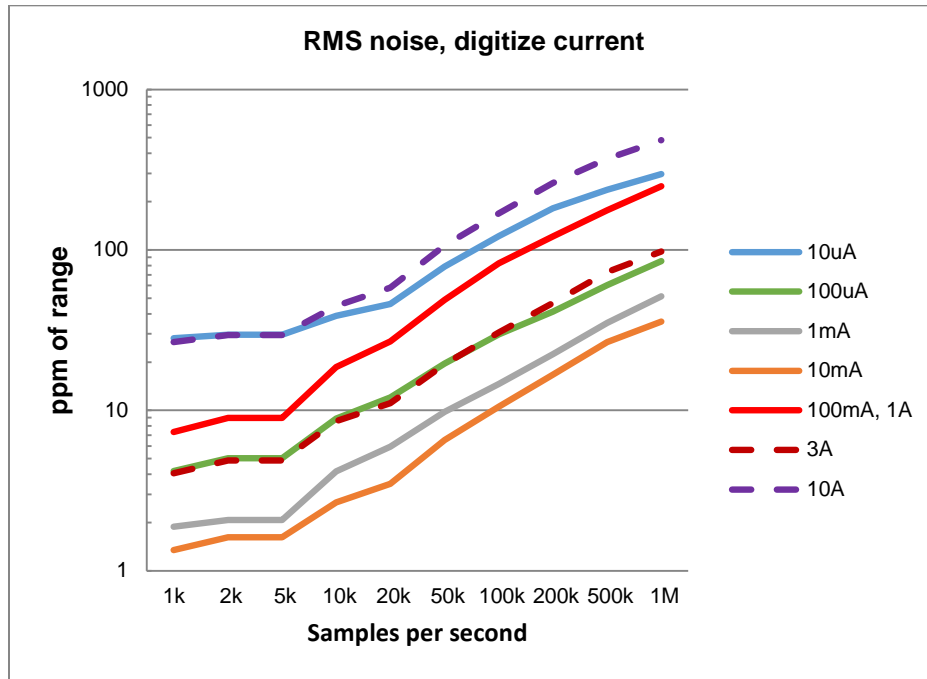
⁷⁶ Verified with sine wave input and DC content ≤ 3 % of range. For flatness error, 0 dB reference frequency is 3 Hz.

⁷⁷ For the 1 A, 3 A, and 10 A ranges, use the 100 mA range accuracy; guaranteed by design.

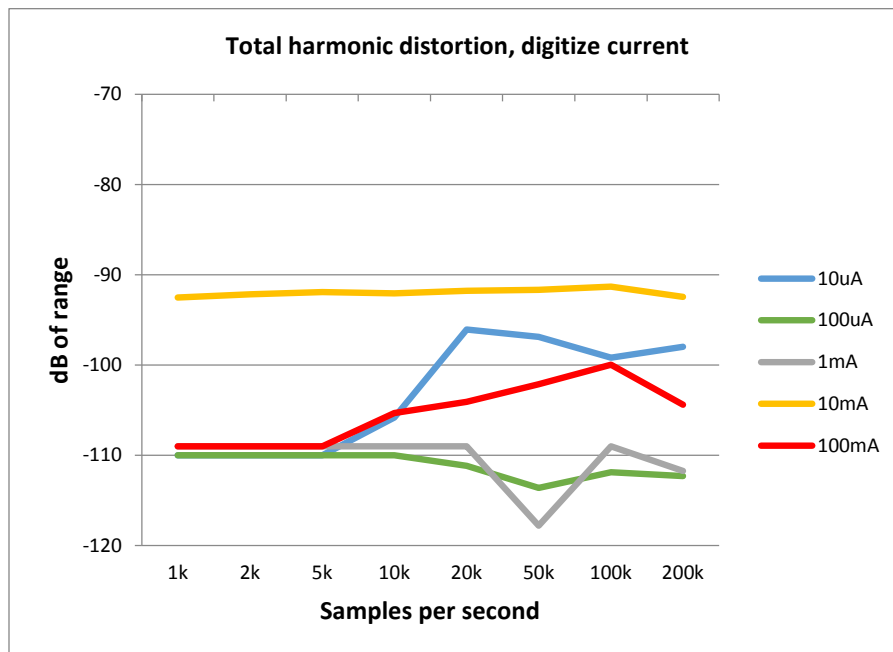
⁷⁸ 10 A flatness verified to 10 kHz; 100 kHz guaranteed by design.

Specifications and characteristics are subject to change without notice.

ADDITIONAL NOISE UNCERTAINTY, TYPICAL⁷⁹



TOTAL HARMONIC DISTORTION (THD), TYPICAL⁸⁰

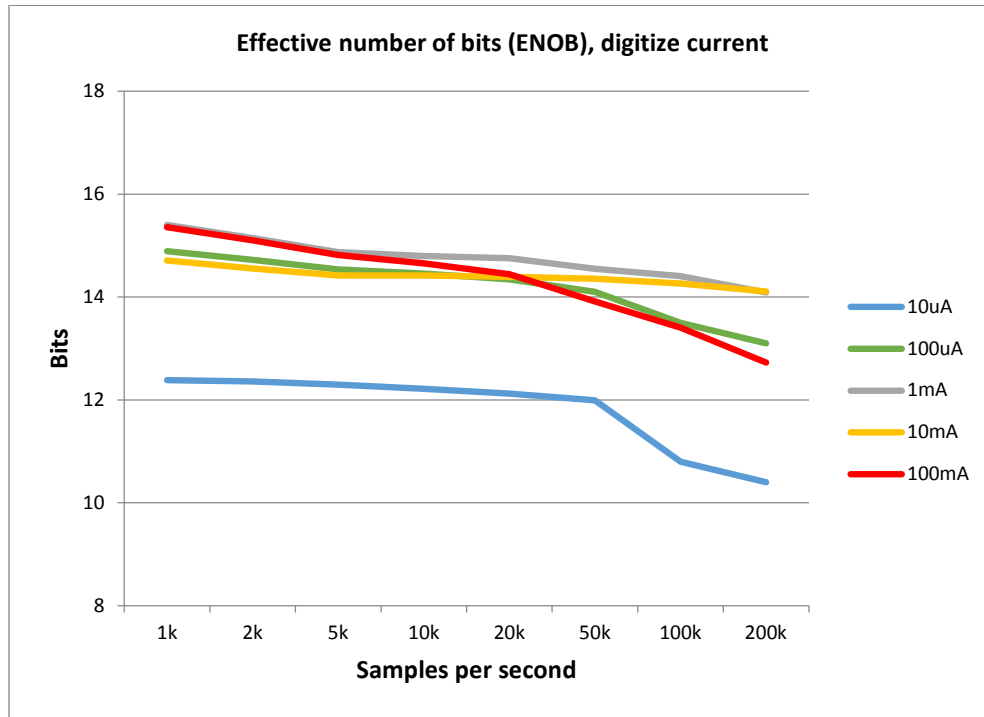


⁷⁹ Specified with aperture Auto and open input terminals. For all ranges and for ≥ 1 k sample rate, add an additional $3 \times$ RMS noise uncertainty to ppm of range.

⁸⁰ Specified with aperture Auto, 100 Hz sine wave for sample rate ≤ 5 k, and 1 kHz sine wave for sample rate ≥ 10 k. Distortion is calculated using first five harmonics. For the 1 A, 3 A, and 10 A ranges, use the 100 mA range accuracy; guaranteed by design.

Specifications are subject to change without notice.

EFFECTIVE NUMBER OF BITS (ENOB), TYPICAL⁸¹



DIGITIZER CHARACTERISTICS

Maximum resolution	18 bits
Measurement input coupling	DC or AC (voltage only)
Sampling rate ⁸²	Programmable 1 k through 1 million
Volatile sample memory with timestamp	27.5 million
Minimum record time	1 μs
Timestamp resolution	1 ns with standard or full buffer style 1 μs with compact buffer style
Timestamp accuracy	With standard or full buffer style, 20 ns between adjacent readings, with total buffer time < 2 s With compact buffer style, 2 μs adjacent readings, with total buffer buffer time < 2 s
Maximum record length	8 million

⁸¹ Specified with aperture Auto, 100 Hz sine wave for sample rate ≤5 k, and 1 kHz sine wave for sample rate ≥10 k. For the 1 A, 3 A, and 10 A ranges, use the 100 mA ENOB; guaranteed by design.

⁸² Sample rate is not continuously adjustable. For valid discrete settings, see the Model DMM7510 Reference Manual.

Specifications and characteristics are subject to change without notice.

TRUE RMS AC VOLTAGE AND AC CURRENT

Function	Range ⁸³	Resolution	1 year accuracy: ± (% of reading + % of range) T _{CAL} ± 5 °C					
			3 Hz to 5 Hz	5 Hz to 10 Hz	10 Hz to 20 kHz	20 kHz to 50 kHz	50 kHz to 100 kHz	100 kHz to 300 kHz
Voltage ⁸⁴	100.0000 mV	0.1 μV	1.0 + 0.03	0.30 + 0.03	0.06 + 0.03	0.14 + 0.05	0.6 + 0.08	4.0 + 0.5
	1.000000 V	1 μV	1.0 + 0.03	0.30 + 0.03	0.06 + 0.03	0.14 + 0.05	0.6 + 0.08	4.0 + 0.5
	10.00000 V	10 μV	1.0 + 0.03	0.30 + 0.03	0.06 + 0.03	0.14 + 0.05	0.6 + 0.08	4.0 + 0.5
	100.0000 V	100 μV	1.0 + 0.03	0.30 + 0.03	0.06 + 0.03	0.14 + 0.05	0.6 + 0.08	4.0 + 0.5
	700.000 V	1 mV	1.0 + 0.03	0.30 + 0.03	0.06 + 0.03	0.14 + 0.05	0.6 + 0.08	4.0 + 0.5
Temperature coefficient / °C (all ranges)	–	–	0.01 + 0.003	0.03 + 0.003	0.005 + 0.003	0.006 + 0.005	0.01 + 0.006	0.03 + 0.01

Function	Range ⁸³	Resolution	1 year accuracy: ± (% of reading + % of range) T _{CAL} ± 5 °C				
			3 Hz to 5 Hz	5 Hz to 10 Hz	10 Hz to 2 kHz	2 kHz to 5 kHz	5 kHz to 10 kHz
Current ⁸⁴	1.000000 mA	1 nA	1.0 + 0.04	0.30 + 0.04	0.08 + 0.03	0.09 + 0.03	0.09 + 0.03
	10.00000 mA	10 nA	1.0 + 0.04	0.30 + 0.04	0.08 + 0.03	0.09 + 0.03	0.09 + 0.03
	100.0000 mA	100 nA	1.0 + 0.04	0.30 + 0.04	0.08 + 0.03	0.09 + 0.03	0.09 + 0.03
	1.000000 A	1 μA	1.0 + 0.04	0.30 + 0.04	0.20 + 0.04	0.88 + 0.04	2.0 + 0.04
	3.000000 A	1 μA	1.0 + 0.05	0.30 + 0.05	0.20 + 0.05	0.88 + 0.05	2.0 + 0.05
	10.00000 A ⁸⁵	10 μA	1.0 + 0.05	0.40 + 0.05	0.40 + 0.05	0.88 + 0.05	2.0 + 0.05
Temperature coefficient / °C (all ranges)	–	–	0.10 + 0.004	0.030 + 0.004	0.005 + 0.003	0.006 + 0.005	0.006 + 0.005

ADDITIONAL AC UNCERTAINTIES – LOW FREQUENCY UNCERTAINTY

Additional uncertainty ±(% of reading), lower frequency uncertainty	Detector bandwidth (BW)		
	3 BW (3 Hz to 300 kHz)	30 BW (30 Hz to 300 kHz)	300 BW (300 Hz to 300 kHz)
20 Hz to 30 Hz	0	0.3	—
30 Hz to 50 Hz	0	0	—
50 Hz to 100 Hz	0	0	4.0
100 Hz to 200 Hz	0	0	0.72
200 Hz to 300 Hz	0	0	0.18
300 Hz to 500 Hz	0	0	0.07
> 500 Hz	0	0	0

⁸³ 20 % overrange on AC functions except 1 % on 700 V, 3.33 % on 3 A and 1 % on 10 A. Default resolution is 6½ digits.

⁸⁴ Specifications are for detector bandwidth of 3 Hz and sine wave inputs > 5 % of range. Detector bandwidth of 3 Hz and 30 Hz are multisample A/D conversions. Detector bandwidth of 300 Hz is a single A/D conversion, programmable from 0.0005 PLC to 15 PLC (60 Hz), 12 PLC (50 Hz). Default condition set to 1 PLC.

⁸⁵ Rear input terminals only.

Specifications are subject to change without notice.

ADDITIONAL AC VOLTAGE CREST FACTOR UNCERTAINTIES⁸⁶

Additional uncertainty ± (% of reading)

Input signal frequency	Detector bandwidth	Crest factor Maximum crest factor: 5 at range full scale			
		1 to 2	2 to 3	3 to 4	4 to 5
3 Hz to 5 Hz	3 Hz	1.00	4.00	4.80	5.00
5 Hz to 10 Hz	3 Hz	0.50	1.20	1.30	1.40
10 Hz to 30 Hz	3 Hz	0.20	0.30	0.60	0.90
5 Hz to 100 Hz	30 Hz	0.20	0.30	0.60	0.90
100 Hz to 300 Hz	30 Hz	0.05	0.15	0.30	0.40
100 Hz to 300 Hz	300 Hz	0.50	1.20	1.30	1.50
500 Hz to 10 kHz	300 Hz	0.05	0.15	0.30	1.20

AC VOLTAGE CHARACTERISTICS

Measurement method	AC-coupled, true RMS
Input impedance	1 MΩ ± 2 % < 150 pF
Volt*Hertz product	< 2.1 x 10 ⁷ V*Hz verified; input frequency verified for < 300 kHz

AC CURRENT CHARACTERISTICS

Measurement method	AC-coupled, true RMS
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Range	1 mA	10 mA	100 mA	1 A	3 A	10 A ⁸⁷
Burden voltage (RMS)	< 16 mV	< 20 mV	< 0.2 V	< 0.4 V	< 1.3 V	< 0.65 V
Overload recovery: For each additional sustained ampere beyond ±1.5 A, add the following initial % of range error until thermally settled after overload recovery	0.006	0.006	0.12	0.05	—	—

⁸⁶ Applies for non-sine wave inputs, DC content ≤ 3 % of range, maximum crest factor ≤ 5.0.

⁸⁷ Rear input terminals only.

FREQUENCY AND PERIOD

MEASUREMENT ACCURACY⁸⁸

Aperture	Measurement resolution	Accuracy ±[ppm of reading + ppm of aperture time] Frequency: 3 Hz to 500 kHz Period: 333 ms to 2 μs	
		1 year T _{CAL} ±5 °C	2 year T _{CAL} ±5 °C
250 ms	0.1 ppm	80 + 0.333	160 + 0.333
100 ms	0.1 ppm	80 + 3.33	160 + 3.33
10 ms	0.1 ppm	80 + 33.3	160 + 33.3

THRESHOLD LEVEL ACCURACY⁸⁹

Threshold range	Threshold resolution	Accuracy ±[% of reading]
		2 year T _{CAL} ±5 °C
100 mV to 700 V	0.05 %	1.0 %

FREQUENCY AND PERIOD CHARACTERISTICS

Measurement method	Reciprocal counting technique
Aperture	10 ms to 273 ms; default is 10 ms

⁸⁸ Specified for square wave inputs. Input signal must be >10 % of ACV range. If input is <20 mV on the 100 mV range, then the frequency must be >10 Hz. For sine wave inputs, frequency must be >100 Hz. For frequencies ≤100 Hz, threshold level ≤50 % of input signal and ≤7 Hz, threshold level ≤3 % of range.

⁸⁹ Threshold range is voltage RMS and threshold level voltage peak. Specified with 1 KHz square wave. 100 V and 700 V threshold ranges guaranteed by design.

Specifications are subject to change without notice.

TYPICAL READING RATES, 60 Hz (50 Hz) OPERATION^{90,91,92,93}

NPLC	Digits	Functions: DC voltage (10 V) 2-wire ohms ($\leq 10\text{ k}\Omega$), DC current (1 mA)		Functions: 4-wire ohms ($\leq 1\text{ k}\Omega$) 4-wire / 3-wire RTD		Functions: Thermistor		Functions: Dry circuit ($\leq 1\text{ k}\Omega$)	
		Measurements into buffer	Measurements into computer	Measurements into buffer	Measurements into computer	Measurements into buffer	Measurements into computer	Measurements into buffer	Measurements into computer
1	7½	59.8 (49.8)	58 (48)	29 (24)	28 (24)	57 (48)	57 (48)	27 (23)	26 (22)
0.2	6½	295 (240)	250 (210)	128 (109)	119 (100)	230 (200)	230 (200)	100 (89)	96 (85)
0.06	5½	965 (810)	950 (800)	310 (280)	315 (280)	900 (750)	900 (750)	190 (180)	190 (180)
0.006	4½	7500 (6700)	7300 (6500)	750 (730)	740 (720)	6800 (6000)	6800 (6000)	295 (290)	295 (290)
0.0005	3½	26000 (26000)	24000 (24000)	860 (860)	860 (860)	18000 (18000)	18000 (18000)	310 (310)	310 (310)

Detector bandwidth (Hz)	Digits	Functions: AC voltage, AC current	
		Measurements into buffer	Measurements into computer
3	6½	0.5 (0.5)	0.5 (0.5)
30	6½	3.3 (3.3)	3.3 (3.3)
300 ⁹⁴	6½	59.8 (49.8)	55 (46)
300 ⁹⁴	3½	26200 (26200)	24500 (24500)

DIGITIZE, TYPICAL

Sampling rate	Digits	Resolution	Measurements into computer ⁹³
10 kS/s	5½	18	9700
20 kS/s	4½	16	19000
50 kS/s	4½	16	44400
100 kS/s	4½	15	80000
1 MS/s	3½	12	108000

⁹⁰ Reading speeds for autozero off, fixed range, autodelay off. Offset compensation off and open lead detector off where applicable.

⁹¹ Buffer measurements: For < 0.2 PLC, multisample, single buffer transfer binary reading only.

⁹² PC measurements: For 1 and 0.2 PLC single reading and single transfer to computer (USB).

⁹³ Reading rates using factory default operating conditions and autorange off, autodelay off. Speeds include measurement and data transfer out of the USB. ≥ 1000 readings with binary transfer over USB.

⁹⁴ For bandwidth 300 Hz, autozero off, 6½ digits at 1 PLC, 3½ digits at 0.0005 PLC.

Specifications and characteristics are subject to change without notice.

SYSTEM PERFORMANCE, TYPICAL

- Mode: 3½ digit, autozero off, 0.0005 PLC, excludes measurement time
- Time includes function change from DC voltage or 2-wire ohms to listed function

Function	Function change (ms)	Range change (ms)
DC voltage or 2-wire ohms (< 10 kΩ)	6	1.3
4-wire ohms (< 10 kΩ)	7	1.3
DC current	7	1.3
Frequency or period ⁹⁵	7	1.3
AC voltage or AC current	7	1.3
Digitize voltage or current	7	1.3

RANGES FOR FUNCTION CHANGE TIMES

Function change times apply to the ranges listed in the table below.

Function	Range
DC voltage	10 V
2-wire or 4-wire ohms	1 kΩ
DC current	1 mA
Dry-circuit ohms	10 Ω
Thermocouple	Use DC voltage rates
Thermistor	Use 2-wire ohms rates
AC current	1 mA
AC voltage	1 V

Buffer transfer speed (binary)	Measurements into computer (per second)		
	USB	LAN	GPIB
Average for 1000 readings	280000	270000	190000
Average for 1000 readings with timestamp	170000	140000	100000

⁹⁵ For DC voltage or 2-wire ohms to frequency or period, 10 ms aperture. For AC current or AC voltage, detector bandwidth is 300 Hz.

TRIGGERING

Time base accuracy	25 ppm
Trigger source	Analog DC voltage, DC current, or any system trigger
Trigger coupling	DC or AC (DC voltage function only)
Input trigger latency ^{96,97,98}	< 225 ns
Input trigger jitter ^{96,97}	< 50 ns
Sample period jitter ^{96,97}	< 1 ns

DMM REAR-PANEL TRIGGERS

EXT TRIG IN and OUT	0 V to 5 V logic signal input and output, TTL-compatible
EXT trigger latency (IN and OUT)	< 400 ns
EXT trigger latency (IN or OUT)	< 200 ns (guaranteed by design)

ANALOG TRIGGERING⁹⁹

ANALOG LEVEL, EDGE, OR WINDOW TRIGGER TYPES¹⁰⁰

Trigger characteristics	Voltage input	Current input
Input range	100 mV to 1000 V	10 µA to 10 A
Resolution	0.05 %	0.05 %
Basic accuracy ($T_{ACAL} \pm 5 \text{ }^\circ\text{C}$) ^{101,102}	1 %	1 %

ANALOG TRIGGER LATENCIES

	Digital I/O	External
Positive logic	800 ns + 40 ns jitter	930 ns + 40 ns jitter
Negative logic	800 ns + 40 ns jitter	840 ns + 40 ns jitter

WINDOW FILTER AND MEMORY (BUFFER)

Window filter size	0 to 10 % of reading, where 0 averages all readings
Memory	Up to 27.5 million timestamped readings with the compact buffer style, with additional memory available using an external USB flash drive
Maximum Internal memory (buffer)	27.5 million readings with the compact buffer style (6½-digit without formatting); 11 million readings with the standard or full buffer styles

⁹⁶ Guaranteed by design; for digital I/O only.

⁹⁷ Stimulus command required to meet specifications.

⁹⁸ If using trigger model, add 200 ns uncertainty.

⁹⁹ For DC or AC coupled, the trigger level can be set up to 100 % of measure range.

¹⁰⁰ Rising or falling edge triggering supported. Window trigger requires setting two independent levels.

¹⁰¹ Trigger event occurs after the threshold crossing at a time determined by total trigger latencies.

¹⁰² Accuracy specifications require user A_{CAL} and are verified with level trigger amplitude set to 50 % of range with a 100 Hz sine wave at 100 % full scale of range. High frequency rejection is off. NPLC 0.0005 (DC voltage/DC current) or aperture 1 µs for digitize voltage or digitize current. Specified for fixed range, autozero off. For digitized DC voltage AC coupled, add 0.5 %. For DC current and digitized DC current 3 A or 10 A ranges, add an additional 2 %.

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GENERAL INSTRUMENT SPECIFICATIONS

SPECIFICATION CONDITIONS

This document contains specifications and supplemental information for the Model DMM7510 Precision Sampling Digital Multimeter instrument. Specifications are the standards against which the Model DMM7510 is tested. Upon leaving the factory, the Model DMM7510 meets these specifications. Supplemental, typical, and characteristic values are non-warranted, apply at 23 °C, and are provided solely as useful information. All specifications apply to front or rear terminal inputs, except 10 A specifications (rear-terminals only).

Input protection	1010 V DC (715 V _{RMS} V AC) all ranges and functions on HI and LO terminals; 350 V all ranges and functions on sense HI, sense LO terminals; 250 V rated current input terminal; fused 3 A and 10 A ranges; current input terminals protected to 1 kV
3 A input fuse protection	3.5 A, 1 kV fast blow type; Keithley part number DMM7510-FUSE-3A
10 A input fuse protection	11 A, 1 kV fast blow type; Keithley part number DMM7510-FUSE-10A
AC voltage input	Maximum DC voltage: 1000 V on any AC voltage range
Common mode isolation	500 V DC or AC V _{peak} LO to chassis All terminals > 10 GΩ, < 350 pF any terminal to chassis
Power line	Universal input, 100 V to 240 V
Line frequency	50 Hz or 60 Hz, automatically sensed at power-up
Power consumption	60 VA
Operating environment	Specified for 0 °C to 50 °C, ≤ 80 % relative humidity at 35 °C, altitude up to 2000 meters
Storage environment	-30 °C to 70 °C
Real time clock	Lithium battery backup (3+ years battery life)
EMC	Conforms to European Union EMC Directive
Safety	NRTL listed to UL61010-1, and CSA C22.2 No 61010-1; conforms with European Union Low Voltage Directive
Vibration	MIL-PRF-28800F Class 3, Random
Warm-up	90 minutes to rated accuracy
Input signal connections	Front and rear safety banana jacks
Cooling	Forced air, fixed speed
Dimensions	Without handle and bumpers: 88 mm high × 213 mm wide × 410 mm deep (3.46 in. × 8.39 in. × 16.13 in.) With handle and bumpers (bench configuration): 106 mm high × 255 mm wide × 425 mm deep (4.18 in. × 10.05 in. × 16.75 in.)
Shipping weight (with bumpers and handle)	4.08 kg (9.0 lb)
Shipping weight (without bumpers and handle)	3.63 kg (8.0 lb)

Digital I/O	Connector	9-pin female D
	5 V power supply pin	Limited to 500 mA at > 4 V (solid-state fuse protected)
	Lines	Six input/output, user-defined, for digital I/O or triggering
	Input signal levels	0.7 V (maximum logic low) 3.7 V (minimum logic high)
	Input voltage limits	-0.25 V (absolute minimum) +5.25 V (absolute maximum)
	Maximum source current	+2.0 mA at > 2.7 V (per pin)
	Maximum sink current	-50 mA at 0.7 V (per pin, solid-state fuse protected)
	Handler	User-defined start of test, end of test, four category bits
Math functions	Rel, dB, Limit Test, Percentage, 1/x, and mX + b	
Remote interface	LAN: RJ-45 connector, 10/100BT; Virtual Front Panel GPIB: IEEE-488.1 compliant. Supports IEEE-488.2 common commands and status model topology USB device (rear panel, type B): 2.0 full speed, USBTMC compliant USB host (front panel, type A): USB 2.0, support for flash drives, FAT 32	
LXI compliance	LXI version 1.4 Core 2011	
Language	Embedded Test Script Processor (TSP) accessible from any host interface; responds to high-speed test scripts comprised of remote commands and statements (for example, branching, looping, math); able to execute high-speed test scripts stored in memory without host intervention; also SCPI (default command set)	
Accessories supplied	Product Information CD-ROM, Model DMM7510 Quick Start Guide, Kickstart Software Quick Start Guide, power cord, 1 m USB cable (type A to type B), 3 m LAN cable, and Model 1756 Standard Test Lead Kit	
Accessories available	(Calibration / Data / ISO 17025), software IVI/VISA drivers for Microsoft® Visual Basic®, Visual C/C++®, National Instruments (NI™) LabVIEW™, Keithley Test Script Builder, Keithley KickStart, and NI LabWindows™/CVI	
Display	Five-inch capacitive touch, color thin-film-transistor (TFT) WVGA (800 x 480) with LED backlight	
Password protection	30 characters	
Expansion interface	The TSP-Link® expansion interface allows TSP-enabled instruments to trigger and communicate with each other	
IP configuration	Static or DHCP (manual or automatic)	