

**FLUKE**®

Calibration

# 8558A

8 1/2 Digit Multimeter

## Product Specifications

**4TECT**

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## General Specifications

### Power

Voltage .....	100 V to 120 V, 200 V to 240 V
Frequency .....	47 Hz to 63 Hz
Fuse .....	T1.25AH 250V
Consumption .....	80 VA max
Power cord .....	IEC 60320-C13 receptacle, NEMA-5-15 plug, cable 3 core 18AWG to SVT

### Dimensions

Height .....	88 mm (3.5 in)
Width (excluding handles) .....	431 mm (17 in)
Width (including handles) .....	440 mm (17.3 in)
Depth (excluding handles) .....	475 mm (18.7 in)
Depth (including handles) .....	510 mm (20.1 in)
Weight .....	9.8 kg (21.5 lb)

### Environment

#### Temperature

Operating .....	0 °C to 50 °C
Specified operation .....	5 °C to 40 °C
Storage .....	-20 °C to 70 °C
Calibration (Tcal) .....	20 °C to 25 °C
Warm up .....	3 hours to full specification

#### Relative Humidity (non-condensing)

Operating .....	<90 % (5 °C to 40 °C)
Storage .....	<95 % (0 °C to 70 °C)

#### Altitude

Operating .....	3000 m
Storage .....	12 000 m

Vibration and Shock ..... Complies with MIL-PRF-28800F Class 3

#### EMC

IEC61326-1 .....	(Controlled EM Environment); CISPR 11, Group 1, Class A
FCC .....	47 CFR 15 subpart B, this product is considered an exempt device per clause 15.103
Korea (KCC) .....	Class A equipment (Industrial Broadcasting & Communication Equipment)

**Safety Compliance**

Mains ..... IEC 61010-1: Overvoltage Category II, Pollution Degree 2  
Measurement..... IEC 61010-2-030: Not Category rated, 1485 Vpk Maximum, 1050 Vrms Maximum

**Measurement Isolation**

Guard to Safety ground .... <700 pF, >10 GΩ

**Lo to Guard**

External Guard ON ..... <1700 pF, >10 GΩ (not in Resistance function)  
External Guard OFF ..... Lo and Guard terminals internally shorted (<1700 pF, >10 GΩ in Resistance)  
Remote Interfaces ..... GPIB IEEE 488.2, USBTMC, Ethernet

**Electrical Specifications**

**Maximum Voltage and Current Inputs**

**Notes**

To avoid potential damage:

- This product must not be used to measure Category rated Mains Voltages.
- The maximum current available from voltage sources being measured must not exceed 200 mA.
- The maximum voltage from current sources being measured must not exceed 5 V.
- Do not permit transient voltages beyond the limits in the tables below.

Maximum dc input equal to maximum RMS input. Maximum peak input is RMS x 1.414.

Specifications apply equally to front and rear input terminals except where noted below.

Front to rear isolation allows opposing polarity of maximum terminal voltage on each input.

Digital I/O Ground (DigGnd) is internally connected to Safety Ground (Ground).

Maximum Common Mode voltage with respect to Safety Ground is  $1.7 \times 10^5$  VHz.

**DCV, ACV, Voltage Digitizing, and Thermocouple**

Maximum rms terminal voltages

						Hi	SENSE HI
							250 V
					SENSE LO	1050 V	1050 V
			LO	250 V	250 V	1050 V	1050 V
		A	250 V	250 V	250 V	1050 V	1050 V
	Guard	250 V	250 V	250 V	250 V	1050 V	1050 V
	DigGnd	650 V	650 V	650 V	650 V	1050 V	1050 V
Ground	0 V	650 V	650 V	650 V	650 V	1050 V	1050 V

The A terminal is open circuit in these functions.

**DCI, ACI, and Current Digitizing**

Maximum rms terminal voltages

						Hi	SENSE HI
							250 V
					SENSE LO	1050 V	1050 V
			LO	5 V	250 V	1050 V	1050 V
		A	250 V	250 V	250 V	1050 V	1050 V
	Guard	250 V	250 V	250 V	250 V	1050 V	1050 V
	DigGnd	650 V	650 V	650 V	650 V	1050 V	1050 V
Ground	0 V	650 V	650 V	650 V	650 V	1050 V	1050 V

**DCI, ACI, and Current Digitizing**

Maximum rms terminal Currents

	Guard	A	LO	SENSE LO	Hi	SENSE HI
Front Input	N/A	30.2 A	30.2 A	N/A	N/A	N/A
Rear Input	N/A	2.02 A	2.02 A	N/A	N/A	N/A

The SENSE LO, SENSE HI, and HI terminals are open circuit in these functions. The front input A terminal protection is automatic and self-resetting, and does not interrupt current flow.

**⚠ Caution**

**Damage will occur if >30 A is applied to the front current terminals and the current source maximum compliance is >5 V.**

The rear input A terminal is protected by a fuse on the rear panel.

**Resistance and PRT**

Maximum rms terminal voltages

						SENSE HI
					HI	250 V
				SENSE LO	1050 V	1050 V
			LO	250 V	1050 V	1050 V
		A	250 V	250 V	250 V	250 V
	Guard	250 V	250 V	250 V	1050 V	1050 V
	DigGnd	650 V	650 V	650 V	650 V	1050 V
Ground	0 V	650 V	650 V	650 V	650 V	1050 V

The A terminal is open circuit in these functions.

## Performance Specifications

The product specifications describe the Absolute Instrumental Uncertainty of the Product. The product specifications include stability, temperature, and humidity; within specified limits, linearity, line and load regulation, and the reference standard measurement uncertainty. The product specifications are provided at a 99 %, k=2.58, normally distributed and a 95 %, k=2, normally distributed level of confidence. Fluke Calibration guarantees product performance to the 99 % level of confidence.

### DC Voltage <sup>[1][2][3][4]</sup>

DC Voltage maximum resolution is 8 digits

Aperture  $\geq 100 \mu\text{s}$

95 % Confidence			Relative Accuracy					Absolute Accuracy			
			$\pm(\mu\text{V/V of reading} + \mu\text{V/V of range})$								
Range	Zin	Full Scale	Transfer, 20 min <sup>[15]</sup>	24 Hour Tcal $\pm 1^\circ\text{C}$	90 day Tcal $\pm 1^\circ\text{C}$	365 day Tcal $\pm 1^\circ\text{C}$	2 years Tcal $\pm 1^\circ\text{C}$	365 day Tcal $\pm 1^\circ\text{C}$	365 day Tcal $\pm 5^\circ\text{C}$	2 year Tcal $\pm 5^\circ\text{C}$	
100 mV	Auto, 10 M $\Omega$ , 1 M $\Omega$	202 mv	0.2 + 2.0	1.0 + 2.0	2.0 + 2.0	4.0 + 2.0	8.0 + 2.0	5.9 + 2.0	8.3 + 2.0	17 + 2.0	
1 V	Auto, 10 M $\Omega$ , 1 M $\Omega$	2.02 V	0.06 + 0.3	1.0 + 0.35	2.0 + 0.4	4.0 + 0.4	8.0 + 0.4	4.1 + 0.4	5.3 + 0.4	11 + 0.4	
10 V	Auto, 10 M $\Omega$ , 1 M $\Omega$	20.2 V	0.05 + 0.05	0.5 + 0.06	2.0 + 0.06	4.0 + 0.06	8.0 + 0.06	4.1 + 0.06	5.3 + 0.06	11 + 0.06	
100 V	Auto, 10 M $\Omega$	202 V	0.4 + 0.3	1.5 + 0.35	3.0 + 0.4	6.0 + 0.4	12 + 0.4	6.1 + 0.4	8.5 + 0.4	17 + 0.4	
100 V	1 M $\Omega$	202 V	2.0 + 5.0	2.0 + 5.0	5.0 + 5.0	10 + 5.0	20 + 5.0	10 + 5.0	16 + 5.0	32 + 5.0	
1000 V	Auto, 10 M $\Omega$	1050 V	0.4 + 0.5	1.5 + 1.3	3.0 + 1.3	6.0 + 1.3	12 + 1.3	6.2 + 1.3	8.6 + 1.3	17 + 1.3	
1000 V	1 M $\Omega$	1050 V	4.0 + 25	4.0 + 25	5.0 + 25	10 + 25	20 + 25	10 + 25	16 + 25	32 + 25	

99 % Confidence			Relative Accuracy					Absolute Accuracy			
			$\pm(\mu\text{V/V of reading} + \mu\text{V/V of range})$								
Range	Zin	Full Scale	Transfer, 20 min <sup>[15]</sup>	24 Hour Tcal $\pm 1^\circ\text{C}$	90 day Tcal $\pm 1^\circ\text{C}$	365 day Tcal $\pm 1^\circ\text{C}$	2 years Tcal $\pm 1^\circ\text{C}$	365 day Tcal $\pm 1^\circ\text{C}$	365 day Tcal $\pm 5^\circ\text{C}$	2 year Tcal $\pm 5^\circ\text{C}$	
100 mV	Auto, 10 M $\Omega$ , 1 M $\Omega$	202 mv	0.26 + 2.6	1.29 + 2.6	2.6 + 2.6	5.2 + 2.6	10.3 + 2.6	7.6 + 2.6	10.7 + 2.6	21 + 2.6	
1 V	Auto, 10 M $\Omega$ , 1 M $\Omega$	2.02 V	0.08 + 0.39	1.29 + 0.45	2.6 + 0.45	5.2 + 0.45	10.3 + 0.45	5.3 + 0.45	6.8 + 0.45	14 + 0.45	
10 V	Auto, 10 M $\Omega$ , 1 M $\Omega$	20.2 V	0.06 + 0.06	0.65 + 0.08	2.6 + 0.08	5.2 + 0.08	10.3 + 0.08	5.3 + 0.08	6.8 + 0.08	14 + 0.08	
100 V	Auto, 10 M $\Omega$	202 V	0.52 + 0.39	1.9 + 0.45	3.9 + 0.45	7.7 + 0.45	15 + 0.45	7.8 + 0.45	10.9 + 0.45	22 + 0.45	
100 V	1 M $\Omega$	202 V	2.6 + 6.5	2.6 + 6.5	6.5 + 6.5	13 + 6.5	26 + 6.5	13 + 6.5	21 + 6.5	41 + 6.5	
1000 V	Auto, 10 M $\Omega$	1050 V	0.52 + 0.65	1.9 + 1.68	3.9 + 1.68	7.7 + 1.68	15 + 1.68	8.0 + 1.68	11.1 + 1.68	22 + 1.68	
1000 V	1 M $\Omega$	1050 V	5.2 + 32	5.2 + 32	6.5 + 32	13 + 32	26 + 32	13 + 32	21 + 32	42 + 32	

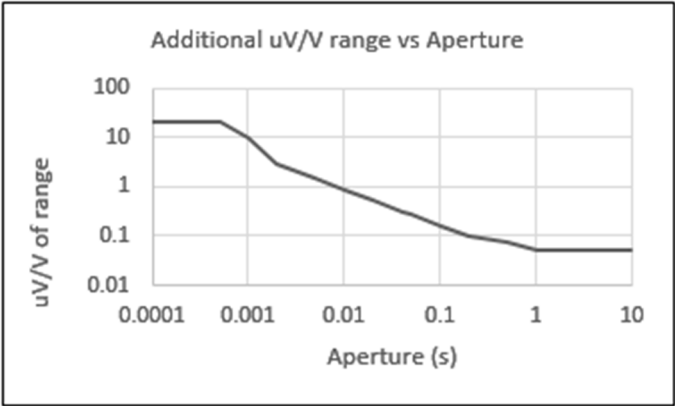
**Temperature Coefficient** (not applicable if within Tcal ± 1 °C)

Aperture ≥ 100 μs		± (μV/V of reading/°C + μV/V of range/°C)
Range	Zin	5 °C to 40 °C [13]
100 mV	Auto, 10 MΩ, 1 MΩ	0.6 + 0.5
1 V	Auto, 10 MΩ, 1 MΩ	0.3 + 0.25
10 V	Auto, 10 MΩ, 1 MΩ	0.3 + 0.2
100 V	Auto, 10 MΩ	0.6 + 0.25
100 V	1 MΩ	1.5 + 0.25
1000 V	Auto, 10 MΩ	0.6 + 0.2
1000 V	1 MΩ	1.5 + 0.2

Aperture Range ..... 100 μs to 2 s in 200 ns increments, >2 s to 10 s in 1 ms increments.

Minimum trigger interval is the aperture plus 170 μs. For example at 50 Hz line frequency, 0.1plc, the minimum interval is 0.002 + 0.00011 seconds = 0.00211 seconds (read rate 474 Hz).

Additional errors (aperture ≥ 100 μs):	
Aperture	μV/V of Reading
1 s to 10 s	0
100 ms to <1 s	0.05
10 ms to 100 ms	0.50
10 ms to 50 ms	1.00
2 ms	2.00
1 ms	10.00
<500 μs	20.00



Aperture  $\geq 100 \mu\text{s}$ ; additional uncertainty with read rate: (Period = aperture + delay between readings)

Read Period	$\pm (\mu\text{V/V of reading} + \mu\text{V/V of range})$
<20 ms	0.2 + 0.0
<10 ms	0.5 + 0.2
<6 ms	5.0 + 0.5
<3 ms	20 + 2.0
<2 ms	40 + 5.0

Maximum Trigger Rate (Aperture = 100  $\mu\text{s}$ )...(Ascii format - for faster sampling rates see Digitizing)

4700 readings/s

(Maximum Block size of 10 000 000 samples)

**Aperture <100  $\mu\text{s}$**

95 % Confidence			Relative Accuracy				Absolute Accuracy		
			$\pm (\mu\text{V/V of reading} + \mu\text{V/V of range})$						
Range	Zin	Full Scale	24 Hour Tcal $\pm 1 \text{ }^\circ\text{C}$	90 day Tcal $\pm 1 \text{ }^\circ\text{C}$	365 day Tcal $\pm 1 \text{ }^\circ\text{C}$	2 years Tcal $\pm 1 \text{ }^\circ\text{C}$	365 day Tcal $\pm 1 \text{ }^\circ\text{C}$	365 day Tcal $\pm 5 \text{ }^\circ\text{C}$	2 year Tcal $\pm 5 \text{ }^\circ\text{C}$
100 mV	Auto, 10 M $\Omega$ , 1 M $\Omega$	202 mv	3.3 + 15	20 + 15	44 + 15	62 + 15	45 + 15	63 + 15	80 + 15
1 V	Auto, 10 M $\Omega$ , 1 M $\Omega$	2.02 V	3.3 + 15	20 + 15	44 + 15	62 + 15	45 + 15	59 + 15	76 + 15
10 V	Auto, 10 M $\Omega$ , 1 M $\Omega$	20.2 V	3.3 + 15	20 + 15	44 + 15	62 + 15	45 + 15	59 + 15	76 + 15
100 V	Auto, 10 M $\Omega$	202 V	3.3 + 15	20 + 15	44 + 15	62 + 15	45 + 15	59 + 15	76 + 15
100 V	1 M $\Omega$	202 V	3.3 + 15	20 + 15	44 + 15	62 + 15	45 + 15	59 + 15	76 + 15
1000 V	Auto, 10 M $\Omega$	1050 V	3.3 + 15	20 + 15	44 + 15	62 + 15	45 + 15	63 + 15	80 + 15
1000 V	1 M $\Omega$	1050 V	4.0 + 15	20 + 15	44 + 15	62 + 15	45 + 15	63 + 15	80 + 15



99 % Confidence			Relative Accuracy				Absolute Accuracy			
			± (μV/V of reading + μV/V of range)							
Range	Zin	Full Scale	24 Hour Tcal ± 1 °C	90 day Tcal ± 1 °C	365 day Tcal ± 1 °C	2 years Tcal ± 1 °C	365 day Tcal ± 1 °C	365 day Tcal ± 5 °C	2 year Tcal ± 5 °C	
100 mV	Auto, 10 MΩ, 1 MΩ	202 mv	4.3 + 19	26 + 19	57 + 19	80 + 19	58 + 19	81 + 19	103 + 19	
1 V	Auto, 10 MΩ, 1 MΩ	2.02 V	4.3 + 19	26 + 19	57 + 19	80 + 19	58 + 19	76 + 19	98 + 19	
10 V	Auto, 10 MΩ, 1 MΩ	20.2 V	4.3 + 19	26 + 19	57 + 19	80 + 19	58 + 19	76 + 19	98 + 19	
100 V	Auto, 10 MΩ	202 V	4.3 + 19	26 + 19	57 + 19	80 + 19	58 + 19	76 + 19	98 + 19	
100 V	1 MΩ	202 V	4.3 + 19	26 + 19	57 + 19	80 + 19	58 + 19	76 + 19	98 + 19	
1000 V	Auto, 10 MΩ	1050 V	4.3 + 19	26 + 19	57 + 19	80 + 19	58 + 19	81 + 19	103 + 19	
1000 V	1 MΩ	1050 V	5.2 + 19	26 + 19	57 + 19	80 + 19	58 + 19	81 + 19	103 + 19	

**Temperature Coefficient** (not applicable if within Tcal ±1 °C)

Aperture < 100 μs		± (μV/V of reading/°C + μV/V of range/°C)
Range	Zin	5 °C to 40 °C <sup>[13]</sup>
100 mV	Auto, 10 MΩ, 1 MΩ	4.5 + 12
1 V	Auto, 10 MΩ, 1 MΩ	3.3 + 9.3
10 V	Auto, 10 MΩ, 1 MΩ	3.3 + 9.3
100 V	Auto, 10 MΩ	3.3 + 9.3
100 V	1 MΩ	3.3 + 9.3
1000 V	Auto, 10 MΩ	4.5 + 9.3
1000 V	1 MΩ	4.5 + 9.3

Aperture <100 μs "0" to 99.8 μs in 200 ns increments

Minimum trigger interval is the aperture plus 30 μs. For example with aperture = 50 μs, the minimum interval is 50 μs + 30 μs = 80 μs (read rate 12.5 kHz). Note maximum read rate is limited to 20 kHz by other factors; see the System Speed specifications.

(There is an additional 30 μs on each conversion).

**All Apertures**CMRR [5]..... 140 dB at dc and 1 Hz - 60 Hz (1 k $\Omega$  unbalance)NMRR [5]..... 70 dB at 50/60 Hz  $\pm$ 0.1 %

Protection ..... All Ranges 1 kV RM

## Input Impedance

Auto ..... 100 mV to 10 V Ranges ..... >1 T $\Omega$ 100 V and 1000 V Range ..... 10 M $\Omega$   $\pm$ 1 %10 M $\Omega$  ..... All Ranges ..... 10 M $\Omega$   $\pm$ 1 %1 M $\Omega$  ..... All Ranges ..... 1.01 M $\Omega$   $\pm$ 1 %Input Current ..... 100 mV to 10 V Ranges (Auto Zin): ...  $\pm$ 20 pA  $\pm$ 1 pA/ $^{\circ}$ CSettling Time ..... to 10  $\mu$ V/V of step size: ..... <50 ms

## Ratio Accuracy

Range to Range ..... Apply a Root Sum of Squares combination of Net Front Input Accuracy and Net rear Input Accuracy

Within Range ..... Using the 24 hour or 20 minute Transfer Uncertainty specifications as appropriate, apply a Root Sum of Squares combination of specified accuracy of the Front Input signal and the specified accuracy of the Rear Input signal.

**DC Current** <sup>[1][2][3][4]</sup>

DC Current maximum resolution is 7 digits

Aperture  $\geq 100 \mu\text{s}$

95 % Confidence

Range	Full Scale	Relative Accuracy					Absolute Accuracy		
		Transfer, 20 min <sup>[15]</sup>	24 Hour Tcal $\pm 1^\circ\text{C}$	90 day Tcal $\pm 1^\circ\text{C}$	365 day Tcal $\pm 1^\circ\text{C}$	2 years Tcal $\pm 1^\circ\text{C}$	$\pm (\mu\text{A/A of reading} + \mu\text{A/A of range)}$		
10 $\mu\text{A}$	20.2 $\mu\text{A}$	5.0 + 20	11 + 40	18 + 40	25 + 40	38 + 40	29 + 40	31 + 40	47 + 40
100 $\mu\text{A}$	202 $\mu\text{A}$	0.25 + 1	8.00 + 5	8.5 + 5	9.0 + 5	14 + 5	10 + 5	12 + 5	18 + 5
1 mA	2.02 mA	0.25 + 1	8.00 + 5	8.5 + 5	9.0 + 5	14 + 5	9.8 + 5	11 + 5	17 + 5
10 mA	20.2 mA	0.25 + 1	9.00 + 5	9.5 + 5	10 + 5	15 + 5	11 + 5	15 + 5	23 + 5
100 mA	202 mA	1.0 + 4	30 + 15	33 + 15	35 + 15	53 + 15	35 + 15	59 + 15	89 + 15
1 A	2.02 A	2.0 + 25	80 + 150	100 + 150	120 + 150	180 + 150	120 + 150	152 + 150	229 + 150

99 % Confidence

Range	Full Scale	Relative Accuracy					Absolute Accuracy		
		Transfer, 20 min <sup>[15]</sup>	24 Hour Tcal $\pm 1^\circ\text{C}$	90 day Tcal $\pm 1^\circ\text{C}$	365 day Tcal $\pm 1^\circ\text{C}$	2 years Tcal $\pm 1^\circ\text{C}$	$\pm (\mu\text{A/A of reading} + \mu\text{A/A of range)}$		
10 $\mu\text{A}$	20.2 $\mu\text{A}$	6.45 + 26	14 + 52	23 + 52	32 + 52	48 + 52	37 + 52	40 + 52	60 + 52
100 $\mu\text{A}$	202 $\mu\text{A}$	0.32 + 1	10 + 6	11 + 6	12 + 6	17 + 6	13 + 6	15 + 6	23 + 6
1 mA	2.02 mA	0.32 + 1	10 + 6	11 + 6	12 + 6	17 + 6	13 + 6	15 + 6	22 + 6
10 mA	20.2 mA	0.32 + 1	12 + 6	12 + 6	13 + 6	19 + 6	14 + 6	20 + 6	30 + 6
100 mA	202 mA	1.3 + 5	39 + 19	42 + 19	45 + 19	68 + 19	45 + 19	76 + 19	115 + 19
1 A	2.02 A	2.6 + 32	103 + 194	129 + 194	155 + 194	232 + 194	155 + 194	197 + 194	295 + 194

**Temperature Coefficient** (not applicable if within Tcal  $\pm 1$  °C)

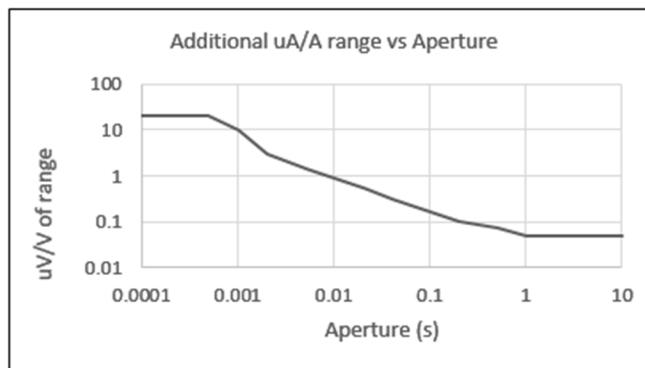
Aperture  $\geq 100$   $\mu$ s

Range	$\pm \mu\text{A/A}$ of reading/ $^{\circ}\text{C}$	
	15 °C to 30 °C	5 °C to 40 °C <sup>[13]</sup>
10 $\mu\text{A}$	0.6 or	0.9 + 5
100 $\mu\text{A}$	0.4 or	0.6 + 1
1 mA	0.4 or	0.6 + 0.5
10 mA	1.2 or	1.8 + 0.5
100 mA	6.0 or	9 + 0.5
1 A	8.0 or	12 + 0.5

Aperture range ..... 100  $\mu$ s to 2 s in 200 ns increments, >2 s to 10 s in 1 ms increments.

Maximum trigger interval is the aperture plus 170  $\mu$ s. For example at 50 Hz line frequency, 0.1plc, the maximum interval is 0.002 seconds + 0.00011 seconds = 0.00211 seconds (read rate 474 Hz).

Additional errors (aperture $\geq 100$ $\mu$ s)	
Aperture	$\mu\text{A/A}$ of reading
1 s to 10 s	0
100 ms to <1 s	0.05
10 ms to 100 ms	0.50
10 ms to 50 ms	1.00
2 ms	2.00
1 ms	10.00
< 500 $\mu$ s	20.00



**Additional uncertainty with read rate**

Read Rate	$\mu\text{A/A}$ of reading + $\mu\text{A/A}$ of range
>1ms <5ms	20 + 0.5
<1 ms <4 ms	45 + 5

**Aperture <100 μs**

		Relative Accuracy				Absolute Accuracy		
95 % Confidence		±(μA/A of reading + μA/A of range)						
Range	Full Scale	24 Hour Tcal ± 1 °C	90 day Tcal ± 1 °C	365 day Tcal ± 1 °C	2 years Tcal ± 1 °C	365 day Tcal ± 1 °C	365 day Tcal ± 5 °C	2 year Tcal ± 5 °C
10 μA	20.2 μA	35 + 80	40 + 80	44 + 80	66 + 80	46 + 80	58 + 80	87 + 80
100 μA	202 μA	5.5 + 70	22 + 70	44 + 70	66 + 70	44 + 70	56 + 70	84 + 70
1 mA	2.02 mA	5.5 + 70	22 + 70	44 + 70	66 + 70	44 + 70	56 + 70	84 + 70
10 mA	20.2 mA	6.5 + 70	22 + 70	44 + 70	66 + 70	44 + 70	56 + 70	84 + 70
100 mA	202 mA	18 + 70	22 + 70	44 + 70	66 + 70	44 + 70	76 + 70	114 + 70
1 A	2.02 A	22 + 125	55 + 125	110 + 125	165 + 125	110 + 125	142 + 125	214 + 125

		Relative Accuracy				Absolute Accuracy		
99 % Confidence		±(μA/A of reading + μA/A of range)						
Range	Full Scale	24 Hour Tcal ± 1 °C	90 day Tcal ± 1 °C	365 day Tcal ± 1 °C	2 years Tcal ± 1 °C	365 day Tcal ± 1 °C	365 day Tcal ± 5 °C	2 year Tcal ± 5 °C
10 μA	20.2 μA	45 + 103	52 + 103	57 + 103	85 + 103	60 + 103	75 + 103	113 + 103
100 μA	202 μA	7.1 + 90	28 + 90	57 + 90	85 + 90	57 + 90	73 + 90	109 + 90
1 mA	2.02 mA	7.1 + 90	28 + 90	57 + 90	85 + 90	57 + 90	72 + 90	109 + 90
10 mA	20.2 mA	8.4 + 90	28 + 90	57 + 90	85 + 90	57 + 90	72 + 90	109 + 90
100 mA	202 mA	23 + 90	28 + 90	57 + 90	85 + 90	57 + 90	98 + 90	147 + 90
1 A	2.02 A	28 + 161	71 + 161	142 + 161	213 + 161	142 + 161	184 + 161	276 + 161

Temperature Coefficient (not applicable if within Tcal ± 1 °C)

Aperture <100 μs

Range	± μA/A reading/°C		± (μV/V of reading/°C + μV/V of range/°C)	
	15 °C to 30 °C		5 °C to 40 °C [13]	
10 μA	3.0	or	5 +	5
100 μA	3.0	or	5 +	1
1 mA	3.0	or	5 +	0.5
mA	3.0	or	5 +	0.5
100 mA	8.0	or	12 +	0.5
1 A	8.0	or	12 +	0.5

Aperture <100 μs "0" to 99.8 μs in 200 ns increments (there is an additional 30 μs on each conversion).

Maximum trigger interval is the aperture plus 30 μs. For example with aperture = 50 μs, the maximum interval is 50 μs + 30 μs = 80 μs (read rate 12.5 kHz). Note maximum read rate is limited to 20 kHz by other factors; see the System Speed specifications

**All Apertures**

**Settling time**

10 μA to 100 mA Ranges to 20 μA/A of step size..... <1 s  
 1 A Range to 100 μA/A of step size..... <1 s

**Current shunt self-heating time to settle to within specification**

1 A Range cold to final value..... 20 μA/A in 2 minutes

**Input Impedance**

Range	Front	Rear
10 μA	100 Ω	100 Ω
100 μA	100 Ω	100 Ω
1 mA	10.5 Ω	10.8 Ω
10 mA	1.5 Ω	1.8 Ω
100 mA	0.8 Ω	1.1 Ω
1 A	0.4 Ω	0.6 Ω

Maximum burden voltage = 2.02 x Range x input Impedance

Measurement voltage burden = input current x Input impedance

**Protection**

Front Input .....30 A rms, self-resettling  
 Rear Input.....2 A rms, Rear Panel Fuse

**AC Voltage** <sup>[1][2][4][6][7]</sup>

**AC Voltage - Wideband/Extended HF**

AC Voltage maximum resolution is 7 digits

			Relative Accuracy					Absolute Accuracy		
95 % Confidence			± (μV/V of reading + μV/V of range)							
Range	Full Scale (rms)	Frequency (Hz)	Transfer, 20 min <sup>[16]</sup>	24 Hour Tcal ± 1 °C	90 day Tcal ± 1 °C	365 day Tcal ± 1 °C	2 year Tcal ± 1 °C	365 day Tcal ± 1 °C	365 day Tcal ± 5 °C	2 year Tcal ± 5 °C
10 mV (Auto, 10 MΩ, 1 MΩ)	12.12 mv	1 - 2k	100 + 100	300 + 200	378 + 200	550 + 200	970 + 200	570 + 200	610 + 200	0.10% + 0.02%
		2k - 10k	100 + 100	380 + 200	390 + 200	400 + 200	455 + 200	421 + 200	461 + 200	510 + 200
		10k - 30k	100 + 100	230 + 200	390 + 200	400 + 200	455 + 200	431 + 200	471 + 200	520 + 200
		30k - 100k	200 + 100	0.40% + 0.02%	0.41% + 0.02%	0.42% + 0.02%	0.47% + 0.02%	0.42% + 0.02%	0.43% + 0.02%	0.48% + 0.02%
		100k - 300k	300 + 100	1.30% + 0.06%	1.38% + 0.06%	1.60% + 0.06%	2.27% + 0.06%	1.60% + 0.06%	1.61% + 0.06%	2.28% + 0.06%
		300k - 1M	500 + 100	1.93% + 0.06%	2.09% + 0.06%	2.50% + 0.06%	3.72% + 0.06%	2.50% + 0.06%	2.51% + 0.06%	3.73% + 0.06%
100 mV (Auto, 10 MΩ, 1 MΩ)	121.2 mv	1 - 2k	10 + 5	50 + 10	59 + 10	80 + 10	135 + 10	90 + 10	110 + 10	160 + 10
		2k - 10k	10 + 5	80 + 10	92 + 10	120 + 10	196 + 10	130 + 10	150 + 10	220 + 10
		10k - 30k	10 + 10	120 + 20	151 + 10	220 + 20	388 + 20	230 + 20	250 + 20	410 + 20
		30k - 100k	10 + 15	300 + 200	378 + 200	550 + 200	970 + 200	560 + 200	580 + 200	990 + 200
		100k - 300k	15 + 20	0.13% + 0.05%	0.17% + 0.05%	0.26% + 0.05%	0.47% + 0.05%	0.26% + 0.05%	0.27% + 0.05%	0.48% + 0.05%
		300k - 1M	60 + 50	1.30% + 0.20%	1.33% + 0.20%	1.40% + 0.20%	1.66% + 0.20%	1.40% + 0.20%	1.41% + 0.20%	1.68% + 0.20%
		1M - 2M	100 + 200	1.40% + 0.50%	1.45% + 0.70%	1.60% + 0.70%	2.1% + 0.70%	1.61% + 0.70%	1.63% + 0.70%	2.11% + 0.70%
<sup>[17]</sup> 2M - 4M	200 + 400	4.10% + 1.20%	4.23% + 1.20%	4.6% + 1.20%	5.8% + 1.20%	4.6% + 1.20%	4.7% + 1.20%	6.0% + 1.20%		
<sup>[17]</sup> 4M - 8M	800 + 800	8.5% + 1.20%	8.6% + 1.20%	9.0% + 1.20%	10% + 1.20%	9.0% + 1.20%	9.4% + 1.20%	11% + 1.20%		
<sup>[17]</sup> 8M - 10M	0.10% + 0.10%	16% + 1.20%	17% + 1.20%	18% + 1.20%	20% + 1.20%	18% + 1.20%	18% + 1.20%	21% + 1.20%		

95 % Confidence			Relative Accuracy					Absolute Accuracy		
			± (μV/V of reading + μV/V of range)							
Range	Full Scale (rms)	Frequency (Hz)	Transfer, 20 min <sup>[16]</sup>	24 Hour Tcal ± 1 °C	90 day Tcal ± 1 °C	365 day Tcal ± 1 °C	2 year Tcal ± 1 °C	365 day Tcal ± 1 °C	365 day Tcal ± 5 °C	2 year Tcal ± 5 °C
1 V 10 V (Auto, 10 MΩ, 1 MΩ)	1.212 V 12.12 V	1 - 2k	5 + 2	50 + 10	59 + 10	80 + 10	135 + 10	90 + 10	102 + 10	150 + 10
		2k - 10k	5 + 2	80 + 10	92 + 10	120 + 10	196 + 10	130 + 10	142 + 10	210 + 10
		10k - 30k	5 + 2	120 + 20	151 + 20	220 + 20	388 + 20	230 + 20	250 + 20	410 + 20
		30k - 100k	10 + 15	300 + 200	378 + 200	550 + 200	970 + 200	560 + 200	580 + 200	990 + 200
		100k - 300k	15 + 20	0.13% + 0.05%	0.17% + 0.05%	0.26% + 0.05%	0.47% + 0.05%	0.26% + 0.05%	0.27% + 0.05%	0.48% + 0.05%
		300k - 1M	60 + 50	1.30% + 0.20%	1.33% + 0.20%	1.40% + 0.20%	1.66% + 0.20%	1.40% + 0.20%	1.41% + 0.20%	1.68% + 0.20%
		1M - 2M	100 + 200	1.40% + 0.50%	1.45% + 0.70%	1.60% + 0.70%	2.1% + 0.70%	1.61% + 0.70%	1.63% + 0.70%	2.11% + 0.70%
[17]	2M - 4M	200 + 400	3.40% + 1.00%	3.74% + 1.20%	4.60% + 1.20%	7.1% + 1.20%	4.6% + 1.20%	4.6% + 1.20%	7.11% + 1.20%	
[17]	4M - 8M	800 + 800	7.5% + 1.00%	7.9% + 1.20%	9.00% + 1.20%	12% + 1.20%	9.0% + 1.20%	9.2% + 1.20%	13% + 1.20%	
[17]	8M - 10M	0.10% + 0.100%	14% + 1.00%	15% + 1.20%	18% + 1.20%	25% + 1.20%	18% + 1.20%	18% + 1.20%	25% + 1.20%	
100 V (10 MΩ)	121.2 V	1 - 1k	20 + 5	200 + 10	205 + 10	220 + 10	271 + 10	230 + 10	250 + 10	290 + 10
		1k - 2k	20 + 5	950 + 10	963 + 10	0.10% + 0.001%	0.11% + 0.001%	0.10% + 0.001%	0.10% + 0.001%	0.12% + 0.001%
		2k - 10k	100 + 5	1.90% + 0.002%	1.93% + 0.002%	2.00% + 0.002%	2.3% + 0.002%	2.00% + 0.002%	2.01% + 0.002%	2.29% + 0.002%
100 V (Auto, 1 MΩ)	121.2 V	1 - 2k	5 + 5	50 + 10	59 + 10	80 + 10	135 + 10	90 + 10	110 + 10	160 + 10
		2k - 10k	5 + 5	5 + 5	80 + 10	92 + 10	120 + 10	196 + 10	130 + 10	150 + 10
		10k - 30k	5 + 5	120 + 20	151 + 20	220 + 20	388 + 20	230 + 20	250 + 20	410 + 20
		30k - 100k	15 + 20	300 + 200	378 + 200	550 + 200	970 + 200	560 + 200	640 + 200	0.11% + 0.02%
		100k - 300k	20 + 25	0.40% + 0.10%	0.41% + 0.10%	0.42% + 0.10%	0.47% + 0.10%	0.42% + 0.10%	0.44% + 0.10%	0.49% + 0.10%
		300k - 1M	70 + 50	1.30% + 0.70%	1.35% + 0.50%	1.50% + 0.70%	1.98% + 0.50%	1.50% + 0.50%	1.53% + 0.50%	2.02% + 0.50%
1000 V (10 MΩ)	1050 V	1 - 1k	20 + 7	200 + 10	205 + 10	220 + 10	271 + 10	230 + 10	250 + 10	290 + 10
		1k - 2k	20 + 7	950 + 10	963 + 10	0.10% + 0.001%	0.11% + 0.001%	0.10% + 0.001%	0.10% + 0.001%	0.12% + 0.001%
		2k - 10k	100 + 7	1.90% + 0.001%	1.93% + 0.001%	2.00% + 0.001%	2.27% + 0.001%	2.00% + 0.001%	2.01% + 0.001%	2.29% + 0.001%
1000 V (Auto, 1 MΩ)	1050 V	1 - 2k	15 + 7	90 + 25	101 + 30	130 + 30	208 + 30	140 + 30	160 + 30	230 + 30
		2k - 10k	15 + 7	120 + 25	128 + 30	150 + 30	216 + 30	160 + 30	180 + 30	240 + 30
		10k - 30k	15 + 7	180 + 25	216 + 30	300 + 30	513 + 30	310 + 30	330 + 30	530 + 30
		30k - 100k	20 + 20	300 + 100	378 + 200	550 + 200	970 + 200	560 + 200	640 + 200	0.11% + 0.02%



99 % Confidence			Relative Accuracy					Absolute Accuracy		
			± (μV/V of reading + μV/V of range)							
Range	Full Scale (rms)	Frequency (Hz)	Transfer, 20 min <sup>[16]</sup>	24 Hour Tcal ± 1 °C	90 day Tcal ± 1 °C	365 day Tcal ± 1 °C	2 year Tcal ± 1 °C	365 day Tcal ± 1 °C	365 day Tcal ± 5 °C	2 year Tcal ± 5 °C
10 mV (Auto, 10 MΩ, 1 MΩ)	12.12 mv	1 - 2k	100 + 100	387 + 258	488 + 258	710 + 258	0.13% + 0.026%	735 + 258	787 + 258	0.13% + 0.026%
		2k - 10k	100 + 100	490 + 260	503 + 260	516 + 260	587 + 260	543 + 260	594 + 260	658 + 260
		10k - 30k	100 + 100	490 + 260	503 + 260	516 + 260	587 + 260	556 + 260	607 + 260	671 + 260
		30k - 100k	200 + 100	0.52% + 0.026%	0.52% + 0.026%	0.54% + 0.026%	0.61% + 0.026%	0.54% + 0.026%	0.55% + 0.026%	0.62% + 0.026%
		100k - 300k	300 + 100	1.68% + 0.077%	1.78% + 0.077%	2.06% + 0.077%	2.93% + 0.077%	2.07% + 0.077%	2.07% + 0.077%	2.94% + 0.077%
		300k - 1M	500 + 100	2.49% + 0.077%	2.69% + 0.077%	3.23% + 0.077%	4.80% + 0.077%	3.23% + 0.077%	3.24% + 0.077%	4.81% + 0.077%
100 mV (Auto, 10 MΩ, 1 MΩ)	121.2 mv	1 - 2k	10 + 5	65 + 13	76 + 13	103 + 13	174 + 13	116 + 13	142 + 13	206 + 13
		2k - 10k	10 + 5	103 + 13	118 + 13	155 + 13	253 + 13	168 + 13	194 + 13	284 + 13
		10k - 30k	10 + 10	155 + 26	195 + 26	284 + 26	500 + 26	297 + 26	323 + 26	529 + 26
		30k - 100k	10 + 15	387 + 258	488 + 258	710 + 258	0.13% + 0.026%	722 + 258	748 + 258	0.13% + 0.026%
		100k - 300k	15 + 20	0.17% + 0.065%	0.22% + 0.065%	0.34% + 0.065%	0.60% + 0.065%	0.34% + 0.065%	0.34% + 0.065%	0.61% + 0.065%
		300k - 1M	60 + 50	1.68% + 0.26%	1.71% + 0.26%	1.81% + 0.26%	2.15% + 0.26%	1.81% + 0.26%	1.82% + 0.26%	2.16% + 0.26%
		1M - 2M	100 + 200	1.94% + 0.90%	1.97% + 0.90%	2.06% + 0.90%	2.41% + 0.90%	2.07% + 0.90%	2.12% + 0.90%	2.47% + 0.90%
		<sup>[17]</sup> 2M - 4M	200 + 400	5.29% + 1.55%	5.46% + 1.55%	5.93% + 1.55%	7.55% + 1.55%	5.94% + 1.55%	6.07% + 1.55%	7.68% + 1.55%
		<sup>[17]</sup> 4M - 8M	800 + 800	11.0% + 1.55%	11.1% + 1.55%	11.6% + 1.55%	13.4% + 1.55%	11.6% + 1.55%	12.1% + 1.55%	13.9% + 1.55%
		<sup>[17]</sup> 8M - 10M	0.10% + 0.10%	21.2% + 1.55%	21.5% + 1.55%	22.6% + 1.55%	26.4% + 1.55%	22.6% + 1.55%	23.3% + 1.55%	27.1% + 1.55%

99 % Confidence			Relative Accuracy					Absolute Accuracy		
			± (μV/V of reading + μV/V of range)							
Range	Full Scale (rms)	Frequency (Hz)	Transfer, 20 min <sup>[16]</sup>	24 Hour Tcal ± 1 °C	90 day Tcal ± 1 °C	365 day Tcal ± 1 °C	2 year Tcal ± 1 °C	365 day Tcal ± 1 °C	365 day Tcal ± 5 °C	2 year Tcal ± 5 °C
1 V 10 V (Auto, 10 MΩ, 1 MΩ)	1.212 V 12.12 V	1 - 2k	5 + 2	65 + 13	76 + 13	103 + 13	174 + 13	116 + 13	132 + 13	194 + 13
		2k - 10k	5 + 2	103 + 13	118 + 13	155 + 13	253 + 13	168 + 13	183 + 13	271 + 13
		10k - 30k	5 + 2	155 + 26	195 + 26	284 + 26	500 + 26	297 + 26	323 + 26	529 + 26
		30k - 100k	10 + 15	387 + 258	488 + 258	710 + 258	0.13% + 0.026%	722 + 258	748 + 258	0.13% + 0.026%
		100k - 300k	15 + 20	0.17% + 0.065%	0.22% + 0.065%	0.34% + 0.065%	0.60% + 0.065%	0.34% + 0.065%	0.34% + 0.065%	0.61% + 0.065%
		300k - 1M	60 + 50	1.68% + 0.26%	1.71% + 0.26%	1.81% + 0.26%	2.15% + 0.26%	1.81% + 0.26%	1.82% + 0.26%	2.16% + 0.26%
		1M - 2M	100 + 200	1.81% + 0.65%	1.87% + 0.90%	2.06% + 0.90%	2.69% + 0.90%	2.07% + 0.90%	2.10% + 0.90%	2.73% + 0.90%
	<sup>[17]</sup>	2M - 4M	200 + 400	4.39% + 1.29%	4.82% + 1.55%	5.93% + 1.55%	9.12% + 1.55%	5.94% + 1.55%	5.99% + 1.55%	9.17% + 1.55%
	<sup>[17]</sup>	4M - 8M	800 + 800	9.7% + 1.29%	10.2% + 1.55%	11.6% + 1.55%	16.1% + 1.55%	11.6% + 1.55%	11.9% + 1.55%	16.3% + 1.55%
	<sup>[17]</sup>	8M - 10M	0.10% + 0.100%	18.6% + 1.29%	19.7% + 1.55%	22.6% + 1.55%	31.7% + 1.55%	22.6% + 1.55%	23.1% + 1.55%	32.2% + 1.55%
100 V (10 MΩ)	121.2 V	1 - 1k	20 + 5	258 + 13	265 + 13	284 + 13	350 + 13	297 + 13	323 + 13	374 + 13
		1k - 2k	20 + 5	0.12% + 0.001%	0.12% + 0.001%	0.13% + 0.001%	0.15% + 0.001%	0.13% + 0.001%	0.13% + 0.001%	0.15% + 0.001%
		2k - 10k	100 + 5	2.45% + 0.003%	2.48% + 0.003%	2.58% + 0.003%	2.93% + 0.003%	2.58% + 0.003%	2.60% + 0.003%	2.95% + 0.003%
100 V (Auto, 1 MΩ)	121.2 V	1 - 2k	5 + 5	65 + 13	76 + 13	103 + 13	174 + 13	116 + 13	142 + 13	206 + 13
		2k - 10k	5 + 5	103 + 13	118 + 13	155 + 13	253 + 13	168 + 13	194 + 13	284 + 13
		10k - 30k	5 + 5	155 + 26	195 + 26	284 + 26	500 + 26	297 + 26	323 + 26	529 + 26
		30k - 100k	15 + 20	387 + 258	488 + 258	710 + 258	0.13% + 0.026%	722 + 258	826 + 258	0.14% + 0.026%
		100k - 300k	20 + 25	0.52% + 0.13%	0.52% + 0.13%	0.54% + 0.13%	0.61% + 0.13%	0.54% + 0.13%	0.56% + 0.13%	0.63% + 0.13%
		300k - 1M	70 + 50	1.68% + 0.90%	1.75% + 0.90%	1.94% + 0.90%	2.56% + 0.90%	1.94% + 0.90%	1.98% + 0.90%	2.60% + 0.90%
1000 V (10 MΩ)	1050 V	1 - 1k	20 + 7	258 + 13	265 + 13	284 + 13	350 + 13	297 + 13	323 + 13	374 + 13
		1k - 2k	20 + 7	0.12% + 0.001%	0.12% + 0.001%	0.13% + 0.001%	0.15% + 0.001%	0.13% + 0.001%	0.13% + 0.001%	0.15% + 0.001%
		2k - 10k	100 + 7	2.45% + 0.001%	2.48% + 0.001%	2.58% + 0.001%	2.93% + 0.001%	2.58% + 0.001%	2.60% + 0.001%	2.95% + 0.001%
1000 V (Auto, 1 MΩ)	1050 V	1 - 2k	15 + 7	116 + 32	131 + 39	168 + 39	268 + 39	181 + 39	206 + 39	297 + 39
		2k - 10k	15 + 7	155 + 32	165 + 39	194 + 39	279 + 39	206 + 39	232 + 39	310 + 39
		10k - 30k	15 + 7	232 + 32	279 + 39	387 + 39	661 + 39	400 + 39	426 + 39	684 + 39
		30k - 100k	20 + 20	387 + 129	488 + 258	710 + 258	0.13% + 0.026%	722 + 258	826 + 258	0.14% + 0.026%

**Temperature Coefficient** (not applicable if within Tcal  $\pm 1$  °C)

Range	Frequency (Hz)	$\pm \mu V/V$ of reading / °C	
		15 °C to 30 °C	5 °C to 15 °C, 30 °C to 40 °C
10 mV (Auto, 10 M $\Omega$ , 1 M $\Omega$ )	1 - 2k	10	15
	2k - 10k	10	15
	10k - 30k	10	15
	30k - 100k	10	15
	100k - 300k	15	20
	300k - 1M	30	50
100 mV (Auto, 10 M $\Omega$ , 1 M $\Omega$ )	1 - 2k	5	8
	2k - 10k	5	8
	10k - 30k	5	8
	30k - 100k	5	8
	100k - 300k	15	20
	300k - 1M	30	50
	1M - 2M	100	150
	2M - 4M [17]	250	400
1 V 10 V (Auto, 10 M $\Omega$ , 1 M $\Omega$ )	1 - 2k	3	5
	2k - 10k	3	5
	10k - 30k	5	8
	30k - 100k	5	8
	100k - 300k	15	20
	300k - 1M	30	50
	1M - 2M	50	80
	2M - 4M [17]	100	150
	4M - 8M [17]	500	800
	8M - 10M [17]	1000	1500

Range	Frequency (Hz)	$\pm \mu V/V$ of reading / °C	
		15 °C to 30 °C	5 °C to 15 °C, 30 °C to 40 °C
100 V (10 M $\Omega$ )	1 - 1k	5	8
	1k - 2k	5	8
	2k - 10k	30	50
100 V (Auto, 1 M $\Omega$ )	1 - 2k	5	8
	2k - 10k	5	8
	10k - 30k	5	8
	30k - 100k	20	30
	100k - 300k	40	60
	300k - 1M	80	120
1000 V (10 M $\Omega$ )	1 - 1k	5	8
	1k - 2k	5	8
	2k - 10k	30	50
1000 V (Auto, 1 M $\Omega$ )	1 - 2k	5	8
	2k - 10k	5	8
	10k - 30k	5	8
	30k - 100k	20	30

Reading rate		
RMS Filter	Acquisition time (seconds)	Read rate (Hz)
0.1 Hz	62	0.016
1 Hz	6.2	0.16
10 Hz	0.62	1.6
40 Hz	0.156	6.4
100 Hz	0.063	16
1000 Hz	0.015	67

Read rate 3x slower for Extended HF.

Auto Counter Gate setting will not affect the read-rate.. Setting Gate time manually may reduce the read rate.

Type ..... True RMS, AC Coupled measures AC component with up to 1000 V DC bias on any range  
 DC Coupling produces the root sum of squares of the AC and DC components  $\sqrt{(ac^2 + dc^2)}$

**Specified Range**

10 mV Range ..... From 10 % of range to full range  
 100 mV to 1 kV Ranges ..... From 1 % of range to full range

CMRR..... >90 dB DC to 60 Hz (1kΩ unbalance)

Peak Input (RMS not to exceed full scale value)

10 mV to 100V Ranges ..... 2 x Range  
 1000 V Range ..... 1050V \* 1.414

Protection on all ranges ..... 1050 V RMS

**Input Impedance**

Auto ..... 10 mV to 10V Ranges.....>1 TΩ in parallel with 80 pF ±5 pF  
 100 V and 1000 V Range..... 1.01 MΩ ±1 % in parallel with 50 pF ±5 pF  
 10 MΩ..... 10 mV to 10V Ranges..... 10 MΩ ±1 % in parallel with 80 pF ±5 pF  
 100 V and 1000 V Range..... 10 MΩ ±1 % in parallel with 50 pF ±5 pF  
 1 MΩ..... 10 mV to 10V Ranges..... 1.01 MΩ ±1 % in parallel with 80 pF ±5 pF  
 100 V and 1000 V Range..... 1.01 MΩ ±1 % in parallel with 50 pF ±5 pF

DC Accuracy (DC Coupled) .....Add ± (50 μV/V of Reading + 50 μV/V of Range + 20 μV)

AC Coupling .....330 nF into 1.01 MΩ or 10 MΩ

Volt.Hertz limit .....3 x 10<sup>7</sup> (allows 3 V at 10 MHz)

Frequency Secondary Measurement: see frequency counter specification

Other secondary reading values are not specified.

**AC Current** <sup>[1][2][4][6]</sup>

**AC Current- Wideband**

AC Current maximum resolution is 7 digits

95 % Confidence			Relative Accuracy					Absolute Accuracy		
			$\pm(\mu\text{A}/\text{A of reading} + \mu\text{A}/\text{A of range})$							
Range	Full Scale (rms)	Frequency (Hz)	Transfer, 20 min <sup>[16]</sup>	24 Hour Tcal $\pm 1^\circ\text{C}$	90 day Tcal $\pm 1^\circ\text{C}$	365 day Tcal $\pm 1^\circ\text{C}$	2 year Tcal $\pm 1^\circ\text{C}$	365 day Tcal $\pm 1^\circ\text{C}$	365 day Tcal $\pm 5^\circ\text{C}$	2 year Tcal $\pm 5^\circ\text{C}$
10 $\mu\text{A}$	20.2 $\mu\text{A}$	1 - 2k	150.0 + 3	2000 + 300	2136 + 300	2500 + 300	3606 + 300	2510 + 300	3910 + 300	3630 + 300
		2k - 10k	150.0 + 3	2000 + 300	2136 + 300	2500 + 300	3606 + 300	2510 + 300	3910 + 300	3630 + 300
		10k - 30k	150.0 + 10	2000 + 300	2136 + 300	2500 + 300	3606 + 300	2510 + 300	3910 + 300	3650 + 300
100 $\mu\text{A}$ 1 mA 10 mA	202 $\mu\text{A}$ 2.02 mA 20.2 mA	1 - 2k	20.0 + 10	250 + 100	263 + 100	300 + 100	415 + 100	310 + 100	450 + 100	440 + 100
		2k - 10k	20.0 + 7	500 + 100	527 + 100	600 + 100	831 + 100	610 + 100	890 + 100	850 + 100
		10k - 30k	20.0 + 10	700 + 100	726 + 100	800 + 100	1044 + 100	820 + 100	1110 + 100	1080 + 100
		30k - 100k	50.0 + 20	4500 + 150	4630 + 150	5000 + 150	6265 + 150	5010 + 150	6630 + 150	6310 + 150
100 mA	202 mA	1 - 2k	10.0 + 7	250 + 100	263 + 100	300 + 100	415 + 100	300 + 100	450 + 100	440 + 100
		2k - 10k	10.0 + 7	500 + 100	527 + 100	600 + 100	831 + 100	600 + 100	890 + 100	850 + 100
		10k - 30k	10.0 + 15	700 + 100	726 + 100	800 + 100	1044 + 100	800 + 100	1110 + 100	1090 + 100
1 A	2.02 A	1 - 2k	10.0 + 10	250 + 150	263 + 150	300 + 150	415 + 150	300 + 150	450 + 150	460 + 150
		2k - 10k	10.0 + 10	550 + 150	563 + 150	600 + 150	730 + 150	610 + 150	770 + 150	780 + 150
		10k - 30k	10.0 + 20	650 + 150	691 + 150	800 + 150	1137 + 150	810 + 150	1230 + 150	1220 + 150

99 % Confidence			Relative Accuracy					Absolute Accuracy			
			$\pm(\mu\text{A/A of reading} + \mu\text{A/A of range})$								
Range	Full Scale (rms)	Frequency (Hz)	Transfer, 20 min <sup>[16]</sup>	24 Hour Tcal $\pm 1^\circ\text{C}$	90 day Tcal $\pm 1^\circ\text{C}$	365 day Tcal $\pm 1^\circ\text{C}$	2 year Tcal $\pm 1^\circ\text{C}$	365 day Tcal $\pm 1^\circ\text{C}$	365 day Tcal $\pm 5^\circ\text{C}$	2 year Tcal $\pm 5^\circ\text{C}$	
10 $\mu\text{A}$	20.2 $\mu\text{A}$	1 - 2k	194 + 4	2580 + 387	2755 + 387	3225 + 387	4651 + 387	3238 + 387	5044 + 387	4683 + 387	
		2k - 10k	194 + 4	2580 + 387	2755 + 387	3225 + 387	4651 + 387	3238 + 387	5044 + 387	4683 + 387	
		10k - 30k	194 + 13	2580 + 387	2755 + 387	3225 + 387	4651 + 387	3238 + 387	5044 + 387	4709 + 387	
100 $\mu\text{A}$ 1 mA 10 mA	202 $\mu\text{A}$ 2.02 mA 20.2 mA	1 - 2k	26 + 13	323 + 129	340 + 129	387 + 129	536 + 129	400 + 129	581 + 129	568 + 129	
		2k - 10k	26 + 9	645 + 129	680 + 129	774 + 129	1072 + 129	787 + 129	1148 + 129	1097 + 129	
		10k - 30k	26 + 13	903 + 129	937 + 129	1032 + 129	1347 + 129	1058 + 129	1432 + 129	1393 + 129	
		30k - 100k	65 + 26	5805 + 194	5973 + 194	6450 + 194	8082 + 194	6463 + 194	8553 + 194	8140 + 194	
100 mA	202 mA	1 - 2k	13 + 9	323 + 129	340 + 129	387 + 129	536 + 129	387 + 129	581 + 129	568 + 129	
		2k - 10k	13 + 9	645 + 129	680 + 129	774 + 129	1072 + 129	774 + 129	1148 + 129	1097 + 129	
		10k - 30k	13 + 19	903 + 129	937 + 129	1032 + 129	1347 + 129	1032 + 129	1432 + 129	1406 + 129	
1 A	2.02 A	1 - 2k	13 + 13	323 + 194	340 + 194	387 + 194	536 + 194	387 + 194	581 + 194	593 + 194	
		2k - 10k	13 + 13	710 + 194	726 + 194	774 + 194	941 + 194	787 + 194	993 + 194	1006 + 194	
		10k - 30k	13 + 26	839 + 194	891 + 194	1032 + 194	1467 + 194	1045 + 194	1587 + 194	1574 + 194	

**AC Current Temperature Coefficient** (not applicable if within Tcal  $\pm 1$  °C)

Range	Frequency (Hz)	$\pm \mu\text{A/A}$ of reading/°C	
		15 °C to 30 °C	5 °C to 15 °C, 30 °C to 40 °C
10 $\mu\text{A}$	1 - 10	5	8
	10 - 10k	5	8
	10k - 30k	10	15
100 $\mu\text{A}$	1 - 10	5	8
1 mA	10 - 10k	5	8
10 mA	10k - 30k	5	8
	30k - 100k	10	15
100 mA	1 - 10	5	8
	10 - 10k	5	8
	10k - 30k	10	15
1 A	1 - 10	10	15
	10 - 10k	10	15
	10k - 30k	20	30

**Settling time**

10  $\mu\text{A}$  to 100 mA Ranges to  
20  $\mu\text{A/A}$  of step size..... <1 s

**Current shunt self-heating time to settle to within specification**

1 A Range cold to final value..... 20  $\mu\text{A/A}$  in 2 minutes

DC Accuracy (DC Coupled)..... Add  $\pm(100 \mu\text{A/A}$  Reading + 50  $\mu\text{A/A}$  Range + 20 nA)

**Input Impedance**

Range	Front	Rear
10 $\mu\text{A}$	100 $\Omega$	100 $\Omega$
100 $\mu\text{A}$	100 $\Omega$	100 $\Omega$
1 mA	10.5 $\Omega$	10.8 $\Omega$
10 mA	1.5 $\Omega$	1.8 $\Omega$
100 mA	0.8 $\Omega$	1.1 $\Omega$
1 A	0.4 $\Omega$	0.6 $\Omega$

Maximum burden voltage = 2.02 x Range x input Impedance  
Measurement voltage burden = input current x Input impedance

Protection  
Front Input.....30 A rms, self-resetting  
Rear Input .....2 A rms, Rear Panel Fuse  
Peak Input (RMS not to exceed full scale value): 2 x Range

**Reading rate**

RMS Filter	Acquisition time (seconds)	Read rate (Hz)
0.1 Hz	62	0.016
1 Hz	6.2	0.16
10 Hz	0.62	1.6
40 Hz	0.156	6.4
100 Hz	0.063	16
1000 Hz	0.015	67

Auto Counter Gate setting will not affect the read-rate.  
Setting Gate time manually may reduce the read rate.  
Frequency as Secondary Measurement - see frequency counter specifications

**Resistance** <sup>[1][2][3][4][10]</sup>**Resistance 4 Wire**

Resistance maximum resolution is 8 digits

95 % Confidence			Relative Accuracy					Absolute Accuracy			
			± (μΩ/Ω of reading + μΩ/Ω of range)								
Range	Full Scale	"Mode"	Transfer, 20 min <sup>[15]</sup>	24 Hour Tcal ± 1 °C	90 day Tcal ± 1 °C	365 day Tcal ± 1 °C	2 year Tcal ± 1 °C	365 day Tcal ± 1 °C	365 day Tcal ± 5 °C	2 year Tcal ± 5 °C	
1 Ω	2.02 Ω	Normal	2.0 + 4.5	6.0 + 4.5	11 + 4.5	15 + 4.5	30 + 4.5	15 + 4.5	21 + 4.5	32 + 4.5	
10 Ω	20.2 Ω	Normal	0.8 + 2.0	4.0 + 2.0	8.0 + 2.0	12 + 2.0	24 + 2.0	12 + 2.0	15 + 2.0	22 + 2.0	
100 Ω	202 Ω	Normal	0.2 + 0.6	3.0 + 0.6	6.5 + 0.6	10 + 0.6	20 + 0.5	10 + 0.5	12 + 0.5	18 + 0.5	
1 kΩ	2.02 kΩ	Normal	0.2 + 0.6	2.0 + 0.6	6.0 + 0.6	10 + 0.6	20 + 0.5	10 + 0.5	12 + 0.5	18 + 0.5	
10 kΩ	20.2 kΩ	Normal	0.2 + 0.6	2.0 + 0.6	6.0 + 0.6	10 + 0.6	20 + 0.5	10 + 0.5	12 + 0.5	18 + 0.5	
100 kΩ	202 kΩ	Normal	0.2 + 0.6	2.0 + 0.6	6.0 + 0.6	10 + 0.6	20 + 0.5	10 + 0.5	12 + 0.5	18 + 0.5	
1 MΩ	2.02 MΩ	Normal	0.5 + 1.5	1.0 + 1.5	5.5 + 1.5	10 + 1.5	20 + 1.0	11 + 1.0	13 + 1.0	20 + 1.0	
10 MΩ	20.2 MΩ	Normal	2.5 + 15	4.0 + 15	12 + 15	20 + 15	40 + 10	21 + 10	29 + 10	43 + 10	
100 MΩ	202 MΩ	Normal	15 + 150	40 + 150	43 + 150	45 + 150	90 + 100	51 + 100	131 + 100	197 + 100	
1 GΩ	2.02 GΩ	Normal	200 + 1500	300 + 1500	450 + 1500	600 + 1500	1200 + 1500	600 + 1500	1410 + 1500	2110 + 1500	
1 Ω	2.02 Ω	Lo Current	2.0 + 4.0	6.0 + 4.5	11 + 4.5	15 + 4.5	30 + 4.5	15 + 4.5	21 + 4.5	32 + 4.5	
10 Ω	20.2 Ω	Lo Current	0.8 + 1.4	4.0 + 2.0	8 + 2.0	12 + 2.0	24 + 2.0	12 + 2.0	15 + 2.0	22 + 2.0	
100 Ω	202 Ω	Lo Current	2.5 + 2.0	8.7 + 2.0	11.2 + 2.0	14 + 2.0	21 + 2.0	14.4 + 2.0	17 + 2.0	25 + 2.0	
1 kΩ	2.02 kΩ	Lo Current	2.5 + 2.0	9.3 + 2.0	11.8 + 2.0	15 + 2.0	22 + 2.0	16 + 2.0	18 + 2.0	27 + 2.0	
10 kΩ	20.2 kΩ	Lo Current	2.5 + 2.0	12.9 + 2.0	15.4 + 2.0	19 + 2.0	26 + 2.0	19 + 2.0	21 + 2.0	32 + 2.0	
100 kΩ	202 kΩ	Lo Current	5.0 + 0.6	12.9 + 0.6	15.4 + 0.6	19 + 0.6	26 + 0.6	19 + 0.6	21 + 0.6	32 + 0.6	
1 MΩ	2.02 MΩ	Lo Current	7.0 + 1.0	11.6 + 1.0	13.6 + 1.0	17 + 1.0	24 + 1.0	17 + 1.0	25 + 1.0	38 + 1.0	
10 MΩ	20.2 MΩ	Lo Current	20 + 10	40 + 10	43 + 10	46 + 10	55 + 10	46 + 10	126 + 10	190 + 10	
100 MΩ	202 MΩ	Lo Current	250 + 100	250 + 100	350 + 100	500 + 100	1000 + 100	515 + 100	1320 + 100	1970 + 100	
1 GΩ	2.02 GΩ	Lo Current	250 + 1500	300 + 1	450 + 1500	600 + 1500	1200 + 1500	600 + 1500	1410 + 1500	2110 + 1500	
10 MΩ	20.2 MΩ	HV	2.0 + 1	5.8 + 1	6.5 + 1	7.0 + 1	14 + 1	15 + 1	17 + 1	26 + 1	
100 MΩ	202 MΩ	HV	3.5 + 10	7.4 + 10	8.0 + 10	9.0 + 10	18.0 + 10	60 + 10	68 + 10	102 + 10	
1 GΩ	2.02 GΩ	HV	20 + 100	27 + 100	28 + 100	30 + 100	60.0 + 100	150 + 100	230 + 100	345 + 100	
10 GΩ <sup>[14]</sup>	20.2 GΩ	HV	250 + 1000	250 + 1000	350 + 1000	500 + 1000	1000 + 1000	525 + 1000	1330 + 1000	1990 + 1000	



99 % Confidence			Relative Accuracy					Absolute Accuracy		
			$\pm(\mu\Omega/\Omega \text{ of reading} + \mu\Omega/\Omega \text{ of range})$							
Range	Full Scale	"Mode"	Transfer, 20 min <sup>[15]</sup>	24 Hour Tcal $\pm 1^\circ\text{C}$	90 day Tcal $\pm 1^\circ\text{C}$	365 day Tcal $\pm 1^\circ\text{C}$	2 year Tcal $\pm 1^\circ\text{C}$	365 day Tcal $\pm 1^\circ\text{C}$	365 day Tcal $\pm 5^\circ\text{C}$	2 year Tcal $\pm 5^\circ\text{C}$
1 $\Omega$	2.02 $\Omega$	Normal	2.6 + 5.8	7.7 + 5.8	14 + 5.8	19 + 5.8	39 + 5.8	20 + 5.8	28 + 5.8	41 + 5.8
10 $\Omega$	20.2 $\Omega$	Normal	1.0 + 2.6	5.2 + 2.6	10 + 2.6	15 + 2.6	31 + 2.6	16 + 2.6	19 + 2.6	29 + 2.6
100 $\Omega$	202 $\Omega$	Normal	0.3 + 0.7	3.9 + 0.7	8.4 + 0.7	13 + 0.7	26 + 0.7	13 + 0.7	16 + 0.7	23 + 0.7
1 k $\Omega$	2.02 k $\Omega$	Normal	0.3 + 0.7	2.6 + 0.7	7.7 + 0.7	13 + 0.7	26 + 0.7	13 + 0.7	16 + 0.7	23 + 0.7
10 k $\Omega$	20.2 k $\Omega$	Normal	0.3 + 0.7	2.6 + 0.7	7.7 + 0.7	13 + 0.7	26 + 0.7	13 + 0.7	16 + 0.7	23 + 0.7
100 k $\Omega$	202 k $\Omega$	Normal	0.3 + 0.7	2.6 + 0.7	7.7 + 0.7	13 + 0.7	26 + 0.7	13 + 0.7	16 + 0.7	24 + 0.7
1 M $\Omega$	2.02 M $\Omega$	Normal	0.6 + 1.9	1.3 + 1.9	7.1 + 1.9	13 + 1.9	26 + 1.9	14 + 1.9	17 + 1.9	26 + 1.9
10 M $\Omega$	20.2 M $\Omega$	Normal	3.2 + 19	5.2 + 19	15 + 19	26 + 19	52 + 19	27 + 19	37 + 19	56 + 19
100 M $\Omega$	202 M $\Omega$	Normal	19 + 194	52 + 194	55 + 194	58 + 194	116 + 194	66 + 194	170 + 194	254 + 194
1 G $\Omega$	2.02 G $\Omega$	Normal	260 + 1940	390 + 1940	580 + 1940	775 + 1940	1550 + 1940	780 + 1940	1820 + 1940	2530 + 1940
1 $\Omega$	2.02 $\Omega$	Lo Current	2.6 + 5.8	7.7 + 5.8	14 + 5.8	19 + 5.8	39 + 5.8	20 + 5.8	28 + 5.8	41 + 5.8
10 $\Omega$	20.2 $\Omega$	Lo Current	1.0 + 2.6	5.2 + 2.6	5.8 + 2.6	15 + 2.6	31 + 2.6	16 + 2.6	19 + 2.6	29 + 2.6
100 $\Omega$	202 $\Omega$	Lo Current	3.2 + 2.6	11.2 + 2.6	14.4 + 2.6	18 + 2.6	27 + 2.6	18.6 + 2.6	22 + 2.6	33 + 2.6
1 k $\Omega$	2.02 k $\Omega$	Lo Current	3.2 + 2.6	12.0 + 2.6	15.2 + 2.6	20 + 2.6	29 + 2.6	20 + 2.6	23 + 2.6	35 + 2.6
10 k $\Omega$	20.2 k $\Omega$	Lo Current	3.2 + 2.6	16.6 + 2.6	19.9 + 2.6	24 + 2.6	33 + 2.6	25 + 2.6	28 + 2.6	41 + 2.6
100 k $\Omega$	202 k $\Omega$	Lo Current	6.5 + 0.8	16.6 + 0.8	19.9 + 0.8	24 + 0.8	33 + 0.8	25 + 0.8	28 + 0.8	41 + 0.8
1 M $\Omega$	2.02 M $\Omega$	Lo Current	9.0 + 1.3	14.9 + 1.3	17.5 + 1.3	21 + 1.3	30 + 1.3	22 + 1.3	33 + 1.3	49 + 1.3
10 M $\Omega$	20.2 M $\Omega$	Lo Current	26 + 13	52 + 13	55 + 13	59 + 13	71 + 13	60 + 13	163 + 13	245 + 13
100 M $\Omega$	202 M $\Omega$	Lo Current	323 + 129	323 + 129	580 + 129	645 + 129	1290 + 129	664 + 129	1700 + 129	2540 + 129
1 G $\Omega$	2.02 G $\Omega$	Lo Current	323 + 1940	390 + 1940	580 + 1940	775 + 1940	1550 + 1940	780 + 1940	1820 + 1940	2530 + 1940
10 M $\Omega$	20.2 M $\Omega$	HV	2.6 + 1.29	7.5 + 1.29	8.4 + 1.29	9.0 + 1.29	18 + 1.29	19 + 1.29	22 + 1.29	34 + 1.29
100 M $\Omega$	202 M $\Omega$	HV	4.5 + 12.9	9.5 + 12.9	10.3 + 12.9	11.6 + 12.9	23.2 + 12.9	77 + 12.9	88 + 12.9	132 + 12.9
1 G $\Omega$	2.02 G $\Omega$	HV	26 + 129	35 + 129	36 + 129	39 + 129	77.4 + 129	194 + 129	297 + 129	445 + 129
10 G $\Omega$ <sup>[14]</sup>	20.2 G $\Omega$	HV	323 + 1290	323 + 1290	452 + 1290	645 + 1290	1290 + 1290	677 + 1290	1720 + 1290	2570 + 1290

Temperature Coefficient (not applicable if within Tcal  $\pm 1$  °C)

Range	"Mode"	$\pm \mu\Omega/\Omega$ of reading/°C 15 °C to 30 °C		$\pm (\mu\Omega/\Omega$ of reading/°C + $\Omega/^\circ\text{C})$ 5 °C to 40 °C [13]
1 $\Omega$	Normal	1.5	or	2.5 + 1.5 $\mu$
10 $\Omega$	Normal	0.6	or	1.0 + 15 $\mu$
100 $\Omega$	Normal	0.5	or	0.8 + 20 $\mu$
1 k $\Omega$	Normal	0.5	or	0.8 + 200 $\mu$
10 k $\Omega$	Normal	0.5	or	0.8 + 2 m
100 k $\Omega$	Normal	0.5	or	0.8 + 20 m
1 M $\Omega$	Normal	0.6	or	1.0 + 200 m
10 M $\Omega$	Normal	2	or	3.0 + 2
100 M $\Omega$	Normal	20	or	30 + 20
1 G $\Omega$	Normal	200	or	300 + 200
1 $\Omega$	Lo Current	1.5	or	2.5 + 1.5 $\mu$
10 $\Omega$	Lo Current	0.6	or	1.0 + 15 $\mu$
100 $\Omega$	Lo Current	0.6	or	1.0 + 150 $\mu$
1 k $\Omega$	Lo Current	0.6	or	1.0 + 1.5 m
10 k $\Omega$	Lo Current	0.6	or	1.0 + 15 m
100 k $\Omega$	Lo Current	0.6	or	1.0 + 20 m
1 M $\Omega$	Lo Current	2	or	3.0 + 200 m
10 M $\Omega$	Lo Current	20	or	30 + 2
100 M $\Omega$	Lo Current	200	or	300 + 20
1 G $\Omega$	Lo Current	200	or	300 + 100
10 M $\Omega$	HV	0.6	or	1.0 + 2.5
100 M $\Omega$	HV	2	or	3.0 + 25
1 G $\Omega$	HV	20	or	30 + 250
10 G $\Omega$ <sup>[14]</sup>	HV	200	or	300 + 2.5 k

## Voltage and Current Parameters

Range	"Mode"	Measurement Current	Measurement Voltage at Full Scale
1 $\Omega$	Normal	100 mA	200 mV
10 $\Omega$	Normal	10 mA	200 mV
100 $\Omega$	Normal	10 mA	2 V
1 k $\Omega$	Normal	1 mA	2 V
10 k $\Omega$	Normal	100 $\mu$ A	2 V
100 k $\Omega$	Normal	100 $\mu$ A	20 V
1 M $\Omega$	Normal	10 $\mu$ A	20 V
10 M $\Omega$	Normal	1 $\mu$ A	20 V
100 M $\Omega$	Normal	100 nA	20 V
1 G $\Omega$	Normal	10 nA	20 V
1 $\Omega$	Lo Current	100 mA	200 mV
10 $\Omega$	Lo Current	10 mA	200 mV
100 $\Omega$	Lo Current	1 mA	200 mV
1 k $\Omega$	Lo Current	100 $\mu$ A	200 mV
10 k $\Omega$	Lo Current	10 $\mu$ A	200 mV
100 k $\Omega$	Lo Current	10 $\mu$ A	2 V
1 M $\Omega$	Lo Current	1 $\mu$ A	2 V
10 M $\Omega$	Lo Current	100 nA	2 V
100 M $\Omega$	Lo Current	10 nA	2 V
1 G $\Omega$	Lo Current	10 nA	20 V
10 M $\Omega$	HV	10 $\mu$ A	200 V
100 M $\Omega$	HV	1 $\mu$ A	200 V
1 G $\Omega$	HV	100 nA	200 V
10 G $\Omega$ <sup>[14]</sup>	HV	10 nA	200 V

Aperture ..... 100 μs to 2 s in 200 ns increments, >2 s to 10 s in 1 ms increments

Additional errors with aperture

Aperture	μΩ/Ω of reading + μΩ/Ω of range
<10 ms	0 + 0.5
<4 ms	1 + 2
<2 ms	10 + 10
<1ms	20 + 20

Additional errors with read rate:

Read Rate	μΩ/Ω of reading + μΩ/Ω of range
>1ms <5ms	20 + 0.5
<1 ms	45 + 5

Maximum Trigger Rate (Aperture ≤ 100 μs) ..... 4700 readings/s (Ascii format - for faster sampling rates see Digitizing).

(Maximum Block size of 10 000 000 samples)

Minimum trigger interval is the aperture plus 170 μs. For example at 50 Hz line frequency, 0.1plc, the minimum interval is 0.002 + 0.00011 seconds = 0.00211 seconds (read rate 474 Hz).

Tru Ohms mode available on 1 Ω to 10 kΩ ranges. Read Rate reduced in Tru Ohms Mode. Specification for Tru Ohms same as corresponding Normal or Lo Current ranges.

2 Wire Adder ..... ± (10 pA/Ir) x 10<sup>6</sup> μΩ/Ω of Reading ±50 mΩ ±3 mΩ/°C),

where Ir is the measurement current, where the temperature related factor is based on the temperature difference between the present operating temperature and the temperature where the instrument was last zeroed.

Maximum 4 wire Lead Resistance ..... 10 Ω in any or all leads, 1 Ω on the 1 Ω Range

Ω Guarding

Range ..... Minimum Parallel Guard Resistance .....  $R_x = R_d \times (1 + (R_d \times R_g)/(R_a \times R_b))$  where  $R_x$  = Resistor being measured

1 Ω, 10 Ω ..... 200 Ω .....  $R_d$  = displayed value

100 Ω ..... 2 kΩ .....  $R_a$  = parallel resistor from Hi to Guard

1 kΩ, 10 kΩ, 100 kΩ, 1 MΩ ..... 20 kΩ .....  $R_b$  = parallel resistor from Lo to Guard

10 MΩ, 100 MΩ, 1 GΩ, 10 GΩ ..... 200 kΩ .....  $R_g$  = Ω Guard lead resistance (<1 Ω)

## Full Scale Measurement Voltage

Normal Mode.....	200 mV / 2 V / 20 V
Lo Current Mode .....	20mV/200 mV / 2 V / 20 V
High Voltage Mode.....	200 V

Protection (All Ranges) ..... 1050 V RMS

## Ratio Accuracy

Range to Range .....	Combine total Front Input accuracy and total Rear Input accuracy by Root Sum of Squares
Within Range.....	Using the 24 hour or 20 minute Transfer Uncertainty specifications as appropriate, apply a Root Sum of Squares combination of the specified accuracy of the Front Input signal and the specified accuracy of the Rear Input signal

## Settling Time

Filter Off.....	Up to 100 k $\Omega$ Range <0.05 s to 10 $\mu\Omega/\Omega$
Filter On.....	Up to 100 k $\Omega$ Range <1 s to 10 $\mu\Omega/\Omega$

**Digitizing** <sup>[2][3][4][9][18][19]</sup>**Digitize DC Voltage**18-bit resolution for aperture 0 to  $\leq 3$  ms

95 % Confidence			Relative Accuracy				Absolute Accuracy			
			$\pm(\mu\text{V}/\text{V of reading} + \mu\text{V}/\text{V of range})$							
Range	Zin	Full Scale	24 Hour Tcal $\pm 1^\circ\text{C}$	90 day Tcal $\pm 1^\circ\text{C}$	365 day Tcal $\pm 1^\circ\text{C}$	2 years Tcal $\pm 1^\circ\text{C}$	365 day Tcal $\pm 1^\circ\text{C}$	365 day Tcal $\pm 5^\circ\text{C}$	2 year Tcal $\pm 5^\circ\text{C}$	
100 mV	Auto, 10 M $\Omega$ , 1 M $\Omega$	202 mV	3.3 + 15	20 + 15	44 + 15	62 + 15	49 + 15	67 + 15	80 + 15	
1 V	Auto, 10 M $\Omega$ , 1 M $\Omega$	2.02 V	3.3 + 15	20 + 15	44 + 15	62 + 15	49 + 15	63 + 15	76 + 15	
10 V	Auto, 10 M $\Omega$ , 1 M $\Omega$	20.2 V	3.3 + 15	20 + 15	44 + 15	62 + 15	49 + 15	63 + 15	76 + 15	
100 V	Auto, 10 M $\Omega$	202 V	3.3 + 15	20 + 15	44 + 15	62 + 15	49 + 15	63 + 15	76 + 15	
100 V	1 M $\Omega$	202 V	3.3 + 15	20 + 15	44 + 15	62 + 15	49 + 15	63 + 15	76 + 15	
1000 V	Auto, 10 M $\Omega$	1050 V	3.3 + 15	20 + 15	44 + 15	62 + 15	49 + 15	67 + 15	80 + 15	
1000 V	1 M $\Omega$	1050 V	4.0 + 15	20 + 15	44 + 15	62 + 15	49 + 15	67 + 15	80 + 15	

99 % Confidence			Relative Accuracy				Absolute Accuracy			
			±(μV/V of reading + μV/V of range)							
Range	Zin	Full Scale	24 Hour Tcal ± 1 °C	90 day Tcal ± 1 °C	365 day Tcal ± 1 °C	2 years Tcal ± 1 °C	365 day Tcal ± 1 °C	365 day Tcal ± 5 °C	2 year Tcal ± 5 °C	
100 mV	Auto, 10 MΩ, 1 MΩ	202 mV	4.3 + 19	26 + 19	57 + 19	80 + 19	63 + 19	86 + 19	103 + 19	
1 V	Auto, 10 MΩ, 1 MΩ	2.02 V	4.3 + 19	26 + 19	57 + 19	80 + 19	63 + 19	81 + 19	98 + 19	
10 V	Auto, 10 MΩ, 1 MΩ	20.2 V	4.3 + 19	26 + 19	57 + 19	80 + 19	63 + 19	81 + 19	98 + 19	
100 V	Auto, 10 MΩ	202 V	4.3 + 19	26 + 19	57 + 19	80 + 19	63 + 19	81 + 19	98 + 19	
100 V	1 MΩ	202 V	4.3 + 19	26 + 19	57 + 19	80 + 19	63 + 19	81 + 19	98 + 19	
1000 V	Auto, 10 MΩ	1050 V	4.3 + 19	26 + 19	57 + 19	80 + 19	63 + 19	86 + 19	103 + 19	
1000 V	1 MΩ	1050 V	5.2 + 19	26 + 19	57 + 19	80 + 19	63 + 19	86 + 19	103 + 19	

If Filter Off is selected, add 40 μV/V of reading + 35 μV/V of range

**Temperature Coefficient (not applicable if within Tcal ± 1 °C)**

Range	Zin	± (μV/V of reading / °C + μV/V of Range/°C)
		5 °C to 40 °C <sup>[13]</sup>
100 mV	Auto, 10 MΩ, 1 MΩ	4.5 + 12.0
1 V	Auto, 10 MΩ, 1 MΩ	3.3 + 9.30
10 V	Auto, 10 MΩ, 1 MΩ	3.3 + 9.30
100 V	Auto, 10 MΩ	3.3 + 9.30
100 V	1 MΩ	3.3 + 9.30
1000 V	Auto, 10 MΩ	4.5 + 9.30
1000 V	1 MΩ	4.5 + 9.30

**Low Pass Filter Bandwidths**

Filter	Bandwidth
Off	10 mV to 10 V ranges are approximately 15 MHz-20 MHz BW.
100 kHz	Approximates to single pole RC up to 10 MHz
3 MHz	4-pole at 3MHz

18-bit Resolution for Aperture 0 to  $\leq 3$  ms

		Relative Accuracy				Absolute Accuracy			
95 % Confidence		$\pm(\mu\text{A/A of reading} + \mu\text{A/A of range})$							
Range	Full Scale	24 Hour Tcal $\pm 1$ °C	90 day Tcal $\pm 1$ °C	365 day Tcal $\pm 1$ °C	2 years Tcal $\pm 1$ °C	365 day Tcal $\pm 1$ °C	365 day Tcal $\pm 5$ °C	2 year Tcal $\pm 5$ °C	
10 $\mu\text{A}$	20.2 $\mu\text{A}$	35 + 80	40 + 80	44 + 80	66 + 80	48 + 80	60 + 80	78 + 80	
100 $\mu\text{A}$	202 $\mu\text{A}$	6 + 70	22 + 70	44 + 70	66 + 70	48 + 70	60 + 70	78 + 70	
1 mA	2.02 mA	6 + 70	22 + 70	44 + 70	66 + 70	48 + 70	60 + 70	78 + 70	
10 mA	20.2 mA	7 + 70	22 + 70	44 + 70	66 + 70	48 + 70	60 + 70	78 + 70	
100 mA	202 mA	18 + 70	22 + 70	44 + 70	66 + 70	48 + 70	80 + 70	98 + 70	
1 A	2.02 A	22 + 125	55 + 125	110 + 125	165 + 125	112 + 125	144 + 125	197 + 125	

		Relative Accuracy				Absolute Accuracy			
99 % Confidence		$\pm(\mu\text{A/A of reading} + \mu\text{A/A of range})$							
Range	Full Scale	24 Hour Tcal $\pm 1$ °C	90 day Tcal $\pm 1$ °C	365 day Tcal $\pm 1$ °C	2 years Tcal $\pm 1$ °C	365 day Tcal $\pm 1$ °C	365 day Tcal $\pm 5$ °C	2 year Tcal $\pm 5$ °C	
10 $\mu\text{A}$	20.2 $\mu\text{A}$	45 + 103	52 + 103	57 + 103	85 + 103	62 + 103	78 + 103	101 + 103	
100 $\mu\text{A}$	202 $\mu\text{A}$	7 + 90	28 + 90	57 + 90	85 + 90	62 + 90	78 + 90	101 + 90	
1 mA	2.02 mA	7 + 90	28 + 90	57 + 90	85 + 90	62 + 90	78 + 90	101 + 90	
10 mA	20.2 mA	8 + 90	28 + 90	57 + 90	85 + 90	62 + 90	78 + 90	101 + 90	
100 mA	202 mA	23 + 90	28 + 90	57 + 90	85 + 90	62 + 90	104 + 90	126 + 90	
1 A	2.02 A	28 + 161	71 + 161	142 + 161	213 + 161	144 + 161	186 + 161	254 + 161	

If Filter Off is selected, add 40  $\mu\text{A/A}$  of reading + 70  $\mu\text{A/A}$  of range.

**Temperature Coefficient (not applicable if within Tcal ± 1 °C)**

Range	± μA/A reading/°C	
	15 °C to 30 °C	5 °C to 40 °C <sup>[13]</sup>
10 μA	3.0 or	5.0 + 5
100 μA	3.0 or	5.0 + 1
1 mA	3.0 or	5.0 + 0.5
10 mA	3.0 or	5.0 + 0.5
100 mA	8.0 or	12 + 0.5
1 A	8.0 or	12 + 0.5

**Low Pass Filter bandwidths**

Range	Bandwidth with Filter Setting		
	100 kHz	3 MHz	Off
10μA	100 kHz	500kHz	500kHz
100μA	100 kHz	500kHz	500kHz
1mA	100 kHz	2MHz	2MHz
10mA	100 kHz	4MHz	4MHz
100mA	100 kHz	2MHz	2MHz
1A	100 kHz	500kHz	500kHz

**Digitizing: Voltage and Current**

Digitizing internal buffer capacity:

Non-time-stamped	10 000 000
Time-stamped	5 000 000

Maximum Digitizing Sample rate:

Internal trigger	5 MHz
External trigger	5 MHz

**Dynamic Performance (for 2xFull Scale pk-pk signal)**

RMS Signal to noise ratio (Aperture = 0 ns)

Filter	100kHz	3MHz	Full
Range			
100mV	76 dB	70 dB	60 dB
1V	80 dB	80 dB	80 dB
10V	80 dB	80 dB	80 dB
100V	80 dB	80 dB	80 dB
1000V	80 dB	80 dB	80 dB

**Dynamic Performance (for 2xFull Scale pk-pk signal)**

FFT harmonics and spuri at 1kHz (Aperture = 0 ns)

Filter	100kHz	3MHz	Full
Range			
100mV	-100 dB	-80 dB	-74 dB
1V	-100 dB	-100 dB	-90 dB
10V	-100 dB	-100 dB	-100 dB
100V	-94 dB	-94 dB	-94 dB
1000V	-100 dB	-100 dB	-100 dB

**Dynamic Performance (for 2xFull Scale pk-pk signal)**

RMS Signal to noise ratio (Aperture = 0 ns)

Filter	100kHz	3MHz	Full
Range			
10 $\mu$ A	60 dB	51 dB	50 dB
100 $\mu$ A	76 dB	70 dB	70 dB
1 mA	80 dB	74 dB	74 dB
10 mA	80 dB	77 dB	76 dB
100 mA	70 dB	66 dB	60 dB
1 A	70 dB	66 dB	60 dB
10 A	67 dB	62 dB	62 dB
30 A	77 dB	72 dB	72 dB

**Dynamic Performance (for 2xFull Scale pk-pk signal)**

FFT harmonics and spuri at 1 kHz (Aperture = 0 ns)

Filter	100kHz	3MHz	Full
Range			
10 $\mu$ A	-74 dB	-62 dB	-62 dB
100 $\mu$ A	-90 dB	-80 dB	-80 dB
1 mA	-94 dB	-80 dB	-80 dB
10 mA	-94 dB	-92 dB	-90 dB
100 mA	-92 dB	-76 dB	-76 dB
1 A	-90 dB	-80 dB	-76 dB
10 A	-80 dB	-78 dB	-76 dB
30 A	-90 dB	-88 dB	-86 dB

**PRT Temperature [2][12]****PRT Temperature readout accuracy (99 % Confidence)**Secondary resistance reading accuracy (99 %):  $\pm 0.5$  m $\Omega$ 

Temperature readout values are calculated using the IEC 60751 industrial PRT (385 curve) conversion algorithm

Temperature readout accuracy ( $R_o = 100$ ):  $\pm 5$  mKTemperature readout accuracy ( $R_o = 25$ ):  $\pm 10$  mK**Thermocouple [2][12]****Thermocouple temperature readout accuracy 99 %**Secondary voltage reading accuracy (99 %):  $\pm 5$   $\mu$ V

Temperature readout values are calculated:

Types K, S, J, E, B, R:  $\pm 5$  mK

(NIST Monograph 175 conversion algorithm)

Type T:  $\geq 120$  K (-123  $^{\circ}$ C):  $\pm 5$  mK<120 K (-123  $^{\circ}$ C):  $\pm 15$  mK

(NIST Monograph 175 conversion algorithm)

Type N:  $\geq 120$  K (-153  $^{\circ}$ C):  $\pm 5$  mK $\geq 100$  K, < 120 K ( $\geq -173$   $^{\circ}$ C < -153  $^{\circ}$ C):  $\pm 25$  mK<100 K (< -173  $^{\circ}$ C):  $\pm 50$  mK

(NIST Monograph 175 conversion algorithm)

Types L, U:  $\pm 5$  mK

(ITS 90 algorithm)

Type C:  $\pm 5$  mK

(IEC 60584-1: 2013 algorithm)



**Notes to Performance Specifications**

1. Specifications apply for default configuration for aperture and resolution.
2. Assumes 3 hour warm-up period.
3. Input zero or offset null required whenever the temperature moves more than  $\pm 1$  °C from the temperature at which the previous Zero operation was performed. Or NULL using Math.
4. For all specification tables, TCal = Ambient calibration temperature.
5. Integration time >1 Power Line cycle.
6. Valid for signals >1 % Full Scale. Signals must be DC coupled <40 Hz.
7. Maximum Volt.Hertz  $3 \times 10^7$ .
8. Maximum input to front and rear terminals is 2 A.
9. DCV Digitizing and DCV aperture <100  $\mu$ s : for inputs > 160 % of range add 20  $\mu$ V/V of range.
10. Tru Ohms mode available on 2  $\Omega$  to 20 k $\Omega$  ranges. Read Rate reduced in Tru Ohms Mode. Specification for Tru Ohms same as corresponding Normal or Lo Current range.
11. Valid for 4-wire sensor.
12. Not including sensor uncertainty.
13. The zero TC specification only needs to be applied if an input zero has not been performed within  $\pm 1$  °C of the current operating temperature.
14. >2 G $\Omega$  Relative Humidity Operating <80 % to 30 °C <70 % to 40 °C.
15. Transfer specification for DCV, DCI, and Ohms applies to measurement made between 10 % and 120 % of range for deviations of up to 10 % of the initial measurement made using the same configuration for range, filter, aperture, delay etc. Specification accounts for linearity and noise but excludes temperature coefficient which should be calculated from the data provided according to the environment in which the instrument is used.
16. Transfer specification for ACV and ACI applies to measurements made between 10 % of range and full scale and accounts for deviations of up to 1 % of frequency and 10 % of amplitude of the initial measurement. Measurement must be made using the same configuration for range, filter, aperture, delay etc. The quoted transfer specification accounts for linearity, flatness and noise but excludes temperature coefficient which should be calculated from the data provided according to the environment in which the instrument is used.
17. Extended HF mode must be selected.
18. Differential non-linearity is included in the specification.
19. For AC signals refer to the ACV/ACI specification.



**System Speed**

Change configuration and take one reading in remote control	GPIB	USB	Ethernet		
DCV ≤10 V range to/from DCV ≤10 V range	125/s	150/s	130/s		
DCV to DCV > 10 V range	75/s	80/s	75/s		
Other function to DCV	50/s	50/s	55/s		
Reading Speed	To Volatile memory		To GPIB	To USB	To Ethernet
DCV, DCI readings	20 000/s		-	-	-
DCV, DCI readings	100 000/s	[F]	-	-	-
Normal Ohms, DCI Ext Shunt, Thermocouple, and PRT 2W	4 700/s		-	-	-
ACV, ACI, ACI Ext Shunt (1 kHz filter)	66/s		-	-	-
Capacitance	13/s		-	-	-
Digitize capture rate into volatile buffer	5 000 000/s		-	-	-
Digitize captured data transfer to volatile memory	500 000/s		-	-	-
DCV, DCI single "READ?"s	-	[e]	230/s	500/s	230/s
DCV, DCI SYNC triggered TALK? to GPIB	-	[e]	1500/s	n/a	n/a
DCV, DCI SYNC triggered TALK? to GPIB	-	[b]	2000/s	n/a	n/a
DCV, DCI SYNC triggered TALK? to GPIB	-	[B]	2000/s	n/a	n/a
DCV, DCI continuous FNOW?	-	[b][F]	200 000/s	500 000/s	75 000/s
DCV, DCI continuous FNOW?	-	[B][F]	100 000/s	300 000/s	75 000/s
Bus Transfer Speed					
Readings from volatile memory	-	[e]	4000/s	30 000/s	50 000/s
Readings from volatile memory	-	[b]	8000/s	100 000/s	180 000/s
Readings from volatile memory	-	[B]	7000/s	90 000/s	180 000/s
Readings from volatile memory	-	[b][F]	200 000/s	500 000/s	200 000/s
Readings from volatile memory	-	[B][F]	100 000/s	400 000/s	200 000/s
Notes:					
[e] = engineering format rounded to 4.5 digits for display					
[b] = 2 byte binary format					
[B] = 4 byte binary format					
[F] = 2-byte or 4-bite binary captured with DISP OFF, STATS OFF, and PRESET FAST mode. PRESET FAST selects 2 byte binary, 4 byte can be set if required.					

**Tru Ohms, Scan, and auto-range front/rear settling delay times**

Range of setting ..... 0 s to 65 000 s

Resolution of setting ..... 1 ms

Accuracy of setting ..... 0.5 ms

### External Frequency Reference Clock

Frequency Ref In BNC	Maximum input	±5 Vpk
	Minimum input	0.2 Vpp
	Impedance	50 Ω
	Frequency – user selectable	1 MHz / 10 MHz
	Frequency lock range	±5 μHz/Hz

### Triggering

UI Delay Resolution Settings		
Time (seconds)		
From	Up to	Setting Resolution
0	0	N/A
0.000 000 030	40.000 000 00	10 ns
40.000 000 00	400.000 000 0	100 ns
400.000 000 0	4000.000 000	1 μs
4000.000 000	40 000.000 00	10 μs
40 000.000 00	400 000.000 0	100 μs
400 000.000 0	4 000 000.000	1 ms

Note setting resolution is also pkpk jitter for delays (but not timers)

Timer resolution settings		
Time (seconds)		
From	Up to	Setting Resolution
0.000 000 02	40.000 000 00	10 ns
40.000 000 00	400.000 000 0	100 ns
400.000 000 0	4000.000 000	1 μs
4000.000 000	40 000.000 00	10 μs
40 000.000 00	400 000.000 0	100 μs
400 000.000 0	4 000 000.000	1 ms

### Trigger Latency

Digitizing and AC functions	
Ext Trigger edge at rear BNC to ADC conversion begin .....	60 ns to 100 ns
Jitter .....	10 ns pkpk
Maximum input frequency .....	25 MHz
DC functions, Ohms; Capacitance; PRT; Thermocouple	
Ext Trigger edge at rear BNC to ADC conversion begin .....	2.8 μs
Jitter .....	0.2 μs
DC functions, aperture ≥100 μs: aperture closed to reading complete .....	<170 μs
Conversion time overhead (additional to aperture setting)	
Digitize .....	200 ns .....
DC functions, aperture <100 μs.....	30 μs .....
Trigger source INTERNAL (signal level)	
Setting resolution.....	1 % of range .....
Accuracy .....	5 % of range .....
Range .....	±200 % .....
Trig In BNC	
Maximum input .....	±5 Vpk
Threshold selectable .....	TTL or ±0.1 V
Impedance .....	10 kΩ
Trig Out BNC	
Output levels.....	3.3 V / 0 V
Source selectable from:	
	Off
	Signal acquired - 1 μs pulse
	Aperture open - level
	Reading count complete - 1 μs pulse
	On event - 1 μs pulse when an enabled event occurs in operation status register or questionable status registers
	Reading complete - 1 μs pulse
Output polarity .....	Negative or positive pulse or level