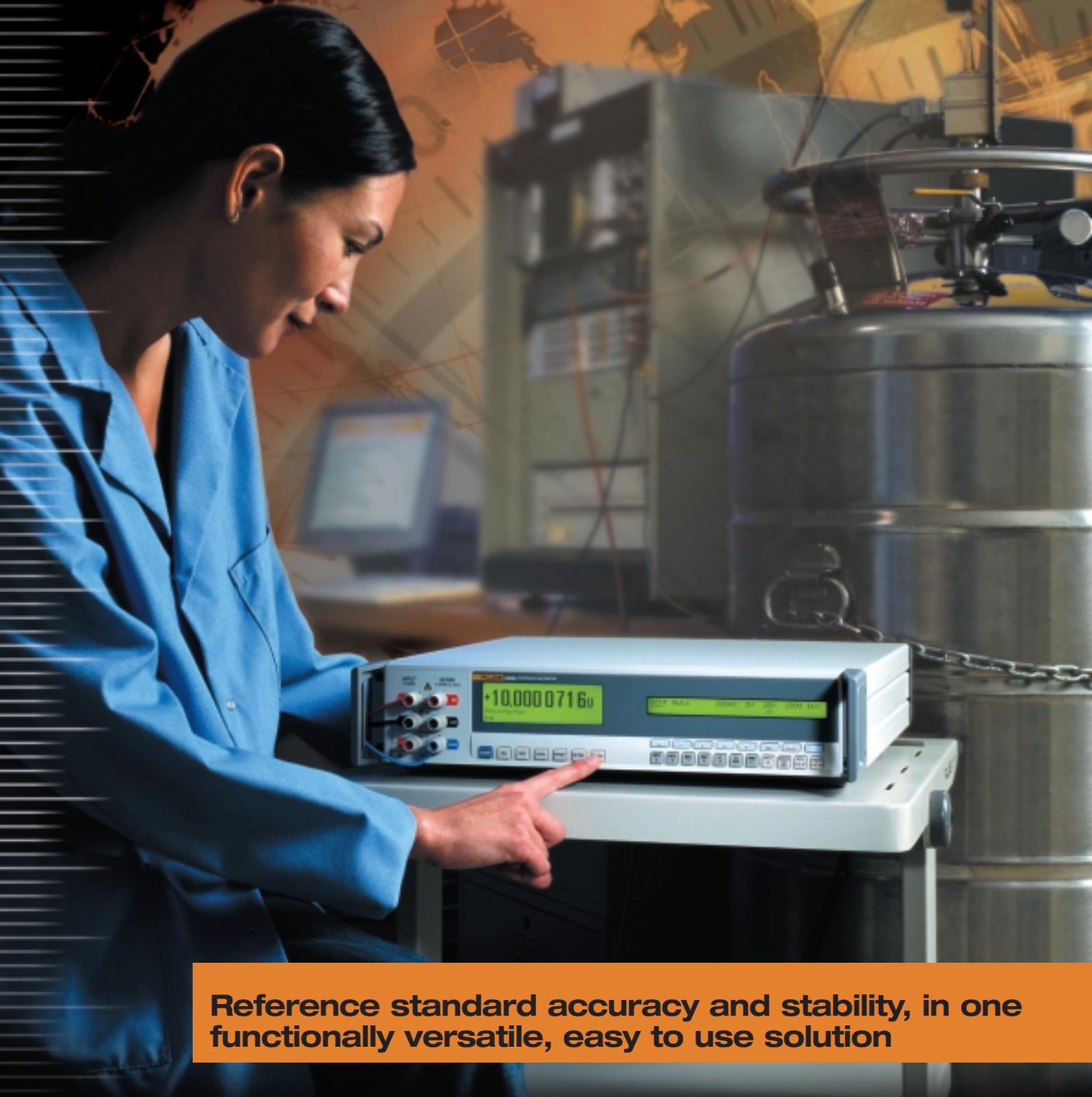


FLUKE

The Fluke 8508A

Reference Multimeter



Reference standard accuracy and stability, in one functionally versatile, easy to use solution

Three mainstays of performance

Engineers know that three sided objects are the most solid shape possible. We know that a three legged stool is the most secure device on which to sit on virtually any surface. It seems clear then that a base of three elements is a highly effective platform. Design of the 8508A followed this principle and addressed three key areas of

performance: Accuracy and Stability; Functionality and Versatility and Ease of Use.

In focusing on these three vital issues, like the triangle or the three legged stool, the 8508A provides the most solid, dependable and reliable measurement instrument available today.

Accuracy and stability

The 8508A features 8.5 digit resolution, exceptional linearity and extraordinarily low noise and stability, producing what are arguably the most accurate measurements to be had from any commercially available product today.

But that's only part of the story.

Measurements must be repeatable today, tomorrow, next week, even next year. That's why stability must be treated with the same priority as accuracy. The 8508A demonstrates 365 day stability as low as 2.7 ppm, with a 24-hour stability of 0.5 ppm, ensuring that confidence in today's measurement can be the same as it was yesterday or last year.

Full analog design

In these days of digital everything, the temptation is to digitize as soon as possible, then correct, adjust, or otherwise massage data digitally to correct for problems and produce the "right" answer. The 8508A disregards this approach entirely, and focuses on good analog design and correct measurement practice to achieve measurements in which you can have total confidence, and the stability you need to rely on day in, day out.

Importantly, this stability is achieved without the need for any kind of auto-cal or self calibration routines. While this technique may produce specifications which on paper demonstrate good stability, it means that measurement traceability and history are compromised. While this may be acceptable within some environments, it does not fulfil the exacting needs of the metrologist.

Understanding specifications

An important part of understanding what accuracy and stability numbers really mean with respect to real measurements, is to understand how those accuracy and stability numbers are stated. It is common practice to publish specifications which are absolute in nature. This provides the user with uncertainty information of product performance at the time of manufacture. Further down the line, those uncertainty figures are no longer true, but depend

substantially on uncertainties available from the laboratory that calibrated the instrument, as well as the instrument itself.

To ensure that total uncertainties of measurements are fully understood, 8508A uncertainties are published in both relative terms and 365 day absolute terms inside this brochure, and in more detail, separately on the World Wide Web.

Metrology definitions

Error

Deviation from the true or nominal value. Different types of error include offset, linearity, random, retrace, reversal, scale, systematic and transfer error.

Measurement Uncertainty

An estimate of the range of values within which the true value of a measurand lies, usually centered on the nominal value.

Stability

The ability of an instrument to have a response or output that is constant with time.

Test Uncertainty Ratio (TUR)

The Test Uncertainty Ratio (TUR) for a measurand is the specified uncertainty of the instrument under test divided by the specified uncertainty of the calibrator or standard used to test it. The specifications for the instruments must have the same coverage factor.

Uncertainty

An estimate of the possible error in a measurement. More precisely, an estimate of the range of values which contains the true value of a measured quantity. Uncertainty is usually reported in the terms of probability that the true value lies within a stated range of values.

Extraordinary measurement capabilities

“Relative” versus “Absolute” specifications

Uncertainty specifications must be evaluated as ‘relative’ or ‘absolute’. Relative uncertainty does not include the additional uncertainty of the reference standards used to calibrate the instrument. For example, when a digital multimeter’s uncertainty is specified as ‘relative’ to calibration standards, this covers only the uncertainty in the digital multimeter. This is an incomplete statement regarding the instrument’s total uncertainty. ‘Absolute’ (or total) uncertainty includes all uncertainties in the traceability chain: the ‘relative’ uncertainty of the unit, plus the uncertainty of the equipment used to calibrate it. This is the true specification of available instrument performance.

A standards laboratory can provide the uncertainties in their calibration standards. These uncertainties must be combined with the specifications ‘relative’ to calibration standards to determine the performance which is actually achieved.

Functionality and versatility

Metrologists need to make many diverse measurements as part of their complex duties. To achieve this frequently requires a complex array of instruments. The Fluke 8508A provides an extraordinarily broad range of measurement

capability. This means you can undertake a wider range of applications, and perform most of your measurement requirements with a single instrument, providing real economies in time and money.

Voltage measurement

With DC and AC ranges from 200 mV to 1 kV, the 8508A covers all your voltage measurement needs. Full 8.5 digit resolution is available on all ranges to provide resolution down to 1 nV. Bandwidth for AC measurements extends to 1 MHz.

Excellent linearity, coupled with Ratio measurement capability, means that the 8508A can replace Kelvin Varley dividers and AC/DC voltage transfer standards, improving your measurement efficiency in one simple, single box solution.

Current measurements

The 8508A features a remarkable new current measurement system. For the first time, resistance at the input is virtually zero. This means that measurements can be much less invasive, and present virtually zero burden to the measurement points. It also offers the advantage that complex guarding schemes are now largely unnecessary, and measurements can be made more

reliably, more repeatably and with greater confidence.

Ranges from 200 μ A to 20 A and frequencies from 1 Hz to 100 kHz, again ensure that all of your measurement needs are covered including the high currents encountered when calibrating multi-function calibrators.

Resistance measurement

With ranges from 2 Ω to 20 G Ω and resolution as low as 10 n Ω the 8508A can truly be described as the ultimate resistance measurement system. Add to that a high compliance of 200 V and a high measurement current of 100 mA and you can begin to understand how the 8508A can help extend the range of your resistance measurements.

But performance of the resistance measurement system doesn’t end with just specifications. Attention to measurement technique helps further improve your results. When making ratio measurements, the same current is forced through both resistances, and only the measurement is switched. Measurement current is reversible to eliminate errors due to thermal effects.

Temperature measurement

To further extend your range of measurements, the 8508A offers temperature measurement through 2, 3, or 4-wire PRT’s or SPRT’s, with a temperature range from -200 $^{\circ}$ C to 660 $^{\circ}$ C. With simultaneous temperature and resistance readout, ITS-90 and Callendar van Dusen Linearization’s the 8508A is an ideal tool for both temperature measurement and PRT calibration applications. As with resistance,

current reversal is used to remove thermal emf errors.

This greater flexibility provides the means to increase the overall range of your scope of precision measurements, and to realize better uncertainty on many of the measurements you might already perform with less than ideal equipment.

Performance highlights

DC Volts

- Ranges: 5, From 200 mV to 1000 V
- Maximum Measurement: 1050 V
- Resolution: user selectable from 5.5 to 8.5 digits
- Maximum Sensitivity: 1 nV

DC Current

- Ranges: 6, From 200 μ A to 20 A
- Maximum Measurement: 19.999999 A
- Resolution: user selectable from 5.5 to 7.5 digits
- Maximum Sensitivity: 10 pA

AC Volts

- Ranges: 5, from 200 mV to 1000 V
- Resolution: user selectable from 5.5 to 6.5 digits
- Maximum Bandwidth: 1 MHz
- Maximum Sensitivity: 100 nV

AC Current

- Ranges: 6, from 200 μ A to 20 A
- Resolution: user selectable from 5.5 to 6.5 digits
- Maximum Bandwidth: 100 kHz
- Maximum Sensitivity: 100 pA

Ohms

- Ranges: 10, 2 Ω to 20 G Ω
- Resolution: user selectable from 5.5 to 8.5 digits
- Maximum Sensitivity: 10 n Ω
- Maximum Compliance Voltage: 200 V
- Maximum Measurement Current: 100 mA

Temperature

- Two-wire, three-wire and four-wire Ohms with current reversal
- Range: From -200 $^{\circ}$ C to 660 $^{\circ}$ C
- Resolution user selectable from 5.5 to 8.5 digits
- ITS-90 linearization
- Readout: $^{\circ}$ C, $^{\circ}$ F, K or Ω



8508A specifications

DC Voltage ^{[1] [2] [3]}

Range	Full Scale	Uncertainty Relative to Cal Stds			Absolute Uncertainties	Temp Coefficient 15 °C-30 °C (ppm/°C)
		± (ppm Reading + ppm Range) TCal ±1 °C ^[4]			365 day	
		24 hour	90 day	365 day		
200 mV	199.999 999	0.7 + 0.5	1.4 + 0.5	2.7 + 0.5	4.5 + 0.5	0.4
2 V	1.999 999 99	0.5 + 0.2	1.4 + 0.2	2.7 + 0.2	3.0 + 0.2	0.3
20 V	19.999 999 9	0.5 + 0.2	1.4 + 0.2	2.7 + 0.2	3.0 + 0.2	0.3
200 V	199.999 999	1.0 + 0.2	2.6 + 0.2	4.0 + 0.2	4.5 + 0.2	0.7
1000 V	1050.000 00	1.0 + 0.5	2.6 + 0.5	4.0 + 0.5	4.5 + 0.5	0.7

Type	Multi-slope, multi-cycle A-D Converter
CMRR (1 kΩ unbalance) ^[5]	140 dB at DC and 1 - 60 Hz
NMRR ^[5]	60 dB at 50/60 Hz ±0.09 %
Filter Out	110 dB at 50/60 Hz ±0.09 %
Filter In	
Protection (All ranges)	1 kV rms
Input Impedance	
200 mV to 20 V Ranges	>100 GΩ
200 V & 1000 V Ranges	10.1 MΩ ± 1 %
Max Input Current	50 pA
Ratio Accuracy	±(Net Front Input Accuracy + Net Rear Input Accuracy)
Settling Time (to 10 ppm step size)	
Filter Out	<50 ms
Filter In	<1 s

DC Current ^{[1] [2] [3]}

Range	Full Scale	Uncertainty Relative to Cal Stds			Absolute Uncertainties	Temp Coefficient 15 °C-30 °C (ppm/°C)
		± (ppm Reading + ppm Range) TCal ±1 °C ^[4]			365 day	
		24 hour	90 day	365 day		
200 μA	199.999 99	5.5 + 2.0	6.0 + 2.0	6.5 + 2.0	12 + 2.0	0.4
2 mA	1.999 999 9	5.5 + 2.0	6.0 + 2.0	6.5 + 2.0	12 + 2.0	0.4
20 mA	19.999 999	6.5 + 2.0	7.0 + 2.0	8.0 + 2.0	13 + 2.0	1.2
200 mA	199.999 99	28 + 4.0	30 + 4.0	33 + 4.0	36 + 4.0	6.0
2 A	1.999 999 9	80 + 8.0	125 + 8.0	170 + 8.0	170 + 8.0	8.0
20 A	19.999 999	200 + 20	290 + 20	380 + 20	380 + 20	8.0

Type	Multi-slope, multi-cycle A-D Converter
Protection	
Front Input	20 A rms
Rear Input	2 A rms, Rear Panel Fuse
Settling Time	
	Up to 2 A range as DCV,
	20 A range <30 s to 100 ppm step size

8508A specifications

AC Voltage ^{[1] [2] [6] [7]}

Range	Full Scale	Frequency (Hz)	Uncertainty Relative to Cal Stds			Absolute Uncertainties	Temp Coefficient
			± (ppm Reading + ppm Range) TCal ±1 °C ^[4]			365 day	15 °C-30 °C (ppm/°C)
			24 hour	90 day	365 day		
200 mV	199.999 9	1 - 10	80 + 70	120 + 70	120 + 70		5
		10 - 40	80 + 20	120 + 20	120 + 20	130 + 20	5
		40 - 100	60 + 20	100 + 20	100 + 20	110 + 20	5
		100 - 2k	40 + 10	100 + 10	100 + 10	105 + 10	5
		2k - 10k	60 + 20	100 + 20	100 + 20	105 + 20	12
		10k - 30k	250 + 30	300 + 40	300 + 40	305 + 40	15
		30k - 100k	400 + 100	700 + 100	700 + 100	705 + 100	40
2 V, 20 V & 200 V	1.999 999	1 - 10	70 + 60	100 + 60	100 + 60		5
	19.999 99	10 - 40	70 + 10	100 + 10	100 + 10	105 + 10	5
	199.999 9	40 - 100	50 + 10	80 + 10	80 + 10	85 + 10	5
		100 - 2k	30 + 10	60 + 10	60 + 10	65 + 10	5
		2k - 10k	50 + 10	80 + 10	80 + 10	85 + 10	10
		10k - 30k	100 + 20	200 + 20	200 + 20	205 + 20	12
		30k - 100k	250 + 100	500 + 100	500 + 100	505 + 100	40
		100k - 300k	0.15 % + 0.1 %	0.3 % + 0.1 %	0.3 % + 0.1 %	0.3 + 0.1 %	60
1000 V ^[8]	1050.000	1 - 10	70 + 70	100 + 70	100 + 70		5
		10 - 40	70 + 20	100 + 20	100 + 20	110 + 20	5
		40 - 10k	50 + 20	80 + 20	80 + 20	95 + 20	10
		10k - 30k	100 + 40	200 + 40	200 + 40	205 + 40	12
		30k - 100k	250 + 200	500 + 200	500 + 200	510 + 200	40

Type	True RMS, AC coupled measures AC component with up to 1000 V DC bias on any range. DC coupled gives $\sqrt{(AC^2 + DC^2)}$
CMRR (1 kΩ unbalance) ^[5]	>90 dB DC - 60 Hz
Crest Factor 200 mV to 200 V ranges	10:1 at 12 % of range, 5:1 at 50 % of range, 2.5:1 at full range
1000 V range	10:1 at 25 % of range, 5:1 at full range
Protection (All ranges)	1 kV rms
Input Impedance	1 MΩ in parallel with 150 pF
DC Accuracy (DC Coupled) ^[15]	Add ±(50 ppm Reading + 50 ppm Range + 20 μV)
Ratio Accuracy	±(Net Front Input Accuracy + Net Rear Input Accuracy)
Settling Time (to 100 ppm step size)	
100 Hz	<0.5 s
40 Hz	<1.25 s
10 Hz	<5 s
1 Hz	<50 s
Frequency Measurement Signal Amplitude Range	5 % of range to limit set by maximum V.Hz
Normal Gate Mode:	
Resolution	6.5 digits
Frequency Range	10 Hz - 1 MHz
Accuracy (1 year, 13 °C - 33 °C)	± (10 ppm of Reading + 2 digits)
Sample Interval	1 s
Fast Gate Mode:	
Resolution	4.5 digits
Frequency Range	200 Hz - 1 MHz
Accuracy (1 year, 13 °C - 33 °C)	± 2 digits
Sample Interval	50 ms

8508A specifications

AC Current ^{[1] [2] [9]}

Range	Full Scale	Frequency (Hz)	Uncertainty Relative to Cal Stds			Absolute Uncertainties	Temp Coefficient 15 °C-30 °C (ppm/°C)
			± (ppm Reading + ppm Range)			TCal ±1 °C ^[4]	
			24 hour	90 day	365 day	365 day	
200 µA, 2 mA & 20 mA	199.999 9	1 - 10	200 + 100	250 + 100	250 + 100		10
	1.999 999	10 - 10k	200 + 100	250 + 100	250 + 100	280 + 100	10
	19.999 99	10k - 30k	500 + 100	600 + 100	600 + 100	650 + 100	12
		30k - 100k	0.35 % + 100	0.4 % + 100	0.4 % + 100	0.4 % + 100	40
200 mA	199.999 9	1 - 10	200 + 100	250 + 100	250 + 100		10
		10 - 10k	200 + 100	250 + 100	250 + 100	250 + 100	15
		10k - 30k	500 + 100	600 + 100	600 + 100	600 + 100	15
2 A	1.999 999	10 - 2k	500 + 100	600 + 100	600 + 100	600 + 100	10
		2k - 10k	600 + 100	700 + 100	700 + 100	700 + 100	15
		10k - 30k	0.25 % + 100	0.3 % + 100	0.3 % + 100	0.3 % + 100	20
20 A	19.999 99	10 - 2k	700 + 100	800 + 100	800 + 100	800 + 100	10
		2k - 10k	0.2 % + 100	0.25 % + 100	0.25 % + 100	0.25 % + 100	15

Type True RMS, AC coupled. DC coupled gives $\sqrt{(AC^2 + DC^2)}$

Crest Factor 3:1 at 50 % of range, 1.5:1 at full range

Protection
Front Input 20 A rms
Rear Input 2 A rms, Rear Panel Fuse

Settling Time Up to 2 A range as ACV. 20 A range, 40 Hz filter and above, <30 s to 100 ppm step size

Resistance ^{[1] [2] [3] [10]}

Range ^[9]	Full Scale	Uncertainty Relative to Cal Stds			Absolute Uncertainties	Temp Coefficient 15 °C-30 °C (ppm/°C)
		± (ppm Reading + ppm Range)			TCal ±1 °C ^[4]	
		24 hour	90 day	365 day	365 day	
2 Ω ^[11]	1.999 999 99	5.0 + 2.0	8.0 + 2.0	10 + 2.0	15 + 2.0	1.5
20 Ω ^[11]	19.999 999 9	2.5 + 0.7	4.5 + 0.7	7.0 + 0.7	9.0 + 0.7	0.6
200 Ω ^[11]	199.999 999	1.5 + 0.25	4.0 + 0.25	7.0 + 0.25	7.5 + 0.25	0.5
2 kΩ ^[11]	1.999 999 99	1 + 0.25	3.5 + 0.25	7.0 + 0.25	7.5 + 0.25	0.5
20 kΩ ^[11]	19.999 999 9	1 + 0.25	3.5 + 0.25	7.0 + 0.25	7.5 + 0.25	0.5
200 kΩ ^[11]	199.999 999	1 + 0.25	3.5 + 0.25	7.0 + 0.25	7.5 + 0.25	0.5
2 MΩ ^[11]	1.999 999 99	2 + 0.5	4.0 + 0.5	7.0 + 0.5	8.5 + 0.5	0.6
20 MΩ ^[12]	19.999 999 9	2 + 0.5	4.0 + 0.5	7.0 + 0.5	15 + 0.5	0.6
200 MΩ ^[12]	199.999 999	3.5 + 5.0	6.0 + 5.0	9.0 + 5.0	60 + 5.0	2.0
2 GΩ ^[12]	1.999 999 99	20 + 50	25 + 50	30 + 50	150 + 50	20
20 GΩ ^[12]	19.999 999 9	250 + 500	350 + 500	500 + 500	525 + 500	200

Type True 4-wire with Ohms guard. 2 wire selectable

Max Lead Resistance 10 Ω in any or all leads, 1 Ω on 2 Ω range

Protection (All ranges) 250 V rms, 360 V pk

Ratio Accuracy ±(Net Front Input Accuracy + Net Rear Input Accuracy)

Settling Time Up to 200 kΩ range generally the same as DCV Filter In but depends on external connections

8508A specifications

Temperature Readout ^[1] ^[2] ^[3]

Resistance Range	Absolute Resistance Measurement Uncertainty ^[13] 365 day TCal ± 1 °C ^[4] \pm (ppm Reading + m Ω)	Typical Equivalent Temperature Measurement Uncertainty ^[14]			
		Probe Type	Nominal Temp (°C)	Resistance (Ω)	Accuracy \pm (°C)
0 - 199.999 999 Ω	7.5 + 0.14	25 Ω PRT/SPRT	-200	5	0.0085
		25 Ω PRT/SPRT	0	25	0.0035
		25 Ω PRT/SPRT	660	84	0.0025
		100 Ω PRT/SPRT	-200	20	0.0035
		100 Ω PRT/SPRT	0	100	0.0025
		100 Ω PRT/SPRT	232	185	0.0020
200 - 1999.999 99 Ω	7.5 + 0.5	100 Ω PRT/SPRT	400	250	0.0025

Type	4-wire current reversal resistance measurement with readout of equivalent temperature. 2-wire and 3-wire selectable without current reversal. Refer to resistance specifications for additional details
Temperature Range	-200 °C to 660 °C, readout also available in °F or K
Linearization	ITS-90 or Callendar van Dusen. Entry and storage of coefficients and nominal resistance for up to 100 probes
Current Source	1 mA

Read Rate and Additional Uncertainty Specifications

Function	Resolution	Filter Frequency (Hz)	Read Rate (readings/second)		Additional Errors ^[15] \pm (ppm Reading + ppm Full Scale)	
			Normal	Fast	Normal	Fast
DCV, DCI & Ohms ^[10]	8		1/25	1/6	0 + 0	0 + 0.1
	7		1/6	1/2	0 + 0.1	0 + 0.5
	6		2	35	0 + 0.5	0 + 2.5
	5		35	150	0 + 5	0 + 25
ACV & ACI ^[6]	6	1	1/50		0 + 0	
		10	1/5		0 + 0	
		40	1/2		0 + 0	
		100	1		0 + 0	
	5	1	1/50		0 + 5	
		10	1/5		0 + 5	
		40	1/2		0 + 5	
		100	2		0 + 5	
PRT & Tru Ohms	8		1/90		0 + 0	
	7		1/30		0 + 0.1	
	6		1/4		0 + 0.5	
	5		1/3		0 + 5	

8508A specifications

General Specifications	
Power	
Voltage Frequency Consumption	100 V to 120 V $\pm 10\%$ or 200 V to 240 V $\pm 10\%$ 47 Hz to 63 Hz 80 VA
Dimensions	
Height Width Depth Weight	88 mm (3.5 inches) 427 mm (16.8 inches) 487 mm (19.2 inches) 11.5 kg (25.5 lbs)
Environment Temperature	
Operating Storage	0 °C to +50 °C, performance specified 5 °C to 40 °C -20 °C to +70 °C
Relative Humidity Operating Storage Warm Up	(non condensing) <90 % (5 °C to 40 °C) <95 % (0 °C to 70 °C) 4 hours to full uncertainty specification
Safety	Designed and tested to EN61010-1-2001, UL 61010-1A1, CAN/CSA 22.2 no. 61010.1 CE and ETL marked.
EMC	EN50081-1 Class B, EN55011/22, EN61326-1:1998, EN50082-1, EN55011:1991 Class B, EN61000-6-1:2001, FCC Rules part 15 sub-part J class B.
Warranty	1 Year

- ^[1] Specifications apply for max resolution in each function, normal read mode. Uncertainties stated at coverage factor k=2, equivalent to 95 % confidence level, in accordance with accepted metrology practices.
- ^[2] Assumes 4 hour warm-up period.
- ^[3] Input zero or offset null required whenever the temperature moves more than ± 1 °C from the temperature at which the previous null/zero was performed.
- ^[4] TCal = Ambient calibration temperature. Factory calibration temperature 23 °C.
- ^[5] Integration time > 1 Power Line cycle.
- ^[6] Valid for signals >1 % Full Scale, Transfer mode on. Signal must be DC coupled <40 Hz.
- ^[7] Maximum Volt.Hertz 3×10^7 .
- ^[8] >300 V, <10 kHz add $\pm 0.0004 (R-300)^2$ ppm.
>300 V, 10 kHz - 30 kHz add $\pm (0.0004 + (F-10000) \times 10^{-7}) (R-300)^2$ ppm.
>300 V, >30 kHz add $\pm 0.0024 (R-300)^2$ ppm.
- ^[9] Typical above 10 kHz for ACI and above 2 G Ω for resistance.
- ^[10] Tru Ohms mode available on 2 Ω to 20 k Ω ranges. Read rate reduced in Tru Ohms mode. Specifications for Tru Ohms same as corresponding normal Ohms range.
- ^[11] Normal Ohms mode.
- ^[12] High Voltage Ohms mode.
- ^[13] Valid for 4-wire sensor.
- ^[14] Not including sensor uncertainty.
- ^[15] Assume Range and Full Scale = 2000 V when calculating for 1000 V Range. For DCI additional errors only apply in 5 digit resolution.

Ordering information

Model

8508A	Reference Multimeter
8508A/01	Reference Multimeter with front and rear binding posts and ratio measurement package

Accessories

NVLAP	NVLAP Accredited Calibration
UKAS	UKAS Accredited Calibration
8508A-PRT	Hart 5626 Platinum Resistance Thermometer
8508A-SPRT	Hart 5699 Standard Platinum Resistance Thermometer
8508A-LEAD	Comprehensive Measurement Lead Kit
Y8508	Rack Mount Kit
Y8508S	Rack Mount Kit Slides
8508-7000K	Calibration

2002 - Fluke introduces the ALL NEW 8508A Digital Multimeter, providing reference standard accuracy and stability, in one functionally versatile, easy to use solution

8508A Reference Multimeter

Other precision instruments in the range

5720A Multifunction Calibrator



The lowest uncertainties of any multifunction calibrator

5520A Multi-Product Calibrator



High performance multi-product calibrator suitable for calibrating current to 20 A and pressure measurement as well as 5½ and 6½ digit digital multimeters

Model 9500B Oscilloscope Calibrator



High accuracy calibration of analog and digital-storage oscilloscopes up to 3.2 and 6 GHz

525A Temperature/Pressure Calibrator



Superior accuracy and functionality in an economical benchtop package

Fluke. *Keeping your world up and running.*

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