



# CERTIFICATE OF ACCREDITATION

## The ANSI National Accreditation Board

Hereby attests that

**Precision Measurements, Inc.**  
**1630 Zanker Road**  
**San Jose, CA 95112**

Fulfills the requirements of

**ISO/IEC 17025:2017**

and national standards

**ANSI/NCSL Z540-1-1994 (R2002) AND**  
**ANSI/NCSL Z540.3-2006 (R2013)**

In the field of

**CALIBRATION**

This certificate is valid only when accompanied by a current scope of accreditation document.  
The current scope of accreditation can be verified at [www.anab.org](http://www.anab.org).

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 14 March 2023

Certificate Number: AC-1768



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.  
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory  
quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

**SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017**

**AND**

**ANSI/NCSL Z540-1-1994 (R2002) AND  
ANSI/NCSL Z540.3-2006 (R2013)**

**Precision Measurements, Inc.**

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San Jose, CA 95112  
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**CALIBRATION**

Valid to: **March 14, 2023**

Certificate Number: **AC-1768**

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source <sup>1</sup>	Up to 220 mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1 100) V	7.5 $\mu\text{V/V} + 0.4 \mu\text{V}$ 5 $\mu\text{V/V} + 0.7 \mu\text{V}$ 3.5 $\mu\text{V/V} + 2.5 \mu\text{V}$ 3.5 $\mu\text{V/V} + 4 \mu\text{V}$ 5 $\mu\text{V/V} + 40 \mu\text{V}$ 6.5 $\mu\text{V/V} + 0.4 \text{mV}$	Fluke 5720A Multiproduct Calibrator
DC Voltage – Source	Up to 220 mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1 100) V	7.5 $\mu\text{V/V} + 0.4 \mu\text{V}$ 5 $\mu\text{V/V} + 0.7 \mu\text{V}$ 3.5 $\mu\text{V/V} + 2.5 \mu\text{V}$ 3.5 $\mu\text{V/V} + 4 \mu\text{V}$ 5 $\mu\text{V/V} + 40 \mu\text{V}$ 6.5 $\mu\text{V/V} + 0.4 \text{mV}$	Fluke 5730A Multiproduct Calibrator
DC Voltage – Source (Fixed Point)	10 V	2.4 $\mu\text{V/V}$	Fluke 732B DC Reference Standard
DC Voltage – Source <sup>1</sup>	Up to 330 mV 330 mV to 3.3 V (3.3 to 33) V (30 to 330) V (330 to 1 000) V	66 $\mu\text{V/V} + 1 \mu\text{V}$ 33 $\mu\text{V/V} + 2 \mu\text{V}$ 36 $\mu\text{V/V} + 20 \mu\text{V}$ 54 $\mu\text{V/V} + 0.15 \text{mV}$ 54 $\mu\text{V/V} + 1.5 \text{mV}$	Fluke 5520A Multiproduct Calibrator
DC Voltage – Measure	Up to 100 mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1 000) V	17 $\mu\text{V/V} + 3 \mu\text{V}$ 8.6 $\mu\text{V/V} + 0.3 \mu\text{V}$ 11 $\mu\text{V/V} + 0.5 \mu\text{V}$ 11 $\mu\text{V/V} + 36 \mu\text{V}$ 15 $\mu\text{V/V} + 1.1 \text{mV}$	Agilent/HP 3458A Opt 002 8.5 Digit Multimeter



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC High Voltage – Measure	(1 to 10) kV (10 to 20) kV (20 to 30) kV (30 to 40) kV	8.2 mV/V 8.9 mV/V 8.9 mV/V 8.9 mV/V	North Star PVM-1 High Voltage Probe, HP 34401A 6.5 Digit Multimeter
DC Voltage – Measure <sup>1</sup>	Up to 100 mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1 000) V	51 $\mu$ V/V + 10 $\mu$ V 27 $\mu$ V/V + 1 $\mu$ V 24 $\mu$ V/V + 2 $\mu$ V 33 $\mu$ V/V + 30 $\mu$ V 45 $\mu$ V/V + 0.1 mV	Agilent/HP 3458A Opt 002 8.5 Digit Multimeter
DC High Voltage – Measure <sup>1</sup>	(1 to 10) kV (10 to 20) kV (20 to 30) kV (30 to 40) kV	25 mV/V 28 mV/V 28 mV/V 28 mV/V	North Star PVM-1 High Voltage Probe, HP 34401A 6.5 Digit Multimeter
AC Voltage – Source <sup>1</sup>	Up to 2.2 mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz (2.2 to 22) mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.24 mV/V + 4 $\mu$ V 91 $\mu$ V/V + 4 $\mu$ V 81 $\mu$ V/V + 4 $\mu$ V 0.2 mV/V + 4 $\mu$ V 0.5 mV/V + 5 $\mu$ V 1.1 mV/V + 10 $\mu$ V 1.4 mV/V + 20 $\mu$ V 2.7 mV/V + 20 $\mu$ V 2.4 mV/V + 4 $\mu$ V 90 $\mu$ V/V + 4 $\mu$ V 80 $\mu$ V/V + 4 $\mu$ V 0.2 mV/V + 4 $\mu$ V 0.5 mV/V + 5 $\mu$ V 1.1 mV/V + 10 $\mu$ V 1.4 mV/V + 20 $\mu$ V 2.7 mV/V + 20 $\mu$ V	Fluke 5720A Multiproduct Calibrator
AC Voltage – Source <sup>1</sup>	220 mV to 2.2 V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.24 mV/V + 40 $\mu$ V 90 $\mu$ V/V + 15 $\mu$ V 45 $\mu$ V/V + 8 $\mu$ V 75 $\mu$ V/V + 10 $\mu$ V 1.1 mV/V + 30 $\mu$ V 0.42 mV/V + 80 $\mu$ V 1 mV/V + 0.2 mV 1.7 mV/V + 0.3 mV	Fluke 5720A Multiproduct Calibrator



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source <sup>1</sup>	(2.2 to 22) V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz (22 to 220) V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz (220 to 1 100) V (15 to 50) Hz 50 Hz to 1 kHz	0.24 mV/V + 0.4 mV 90 μV/V + 0.15 mV 80 μV/V + 50 μV 0.2 mV/V + 0.1 mV 0.5 mV/V + 0.2 mV 1.1 mV/V + 0.6 mV 1.4 mV/V + 2 mV 2.7 mV/V + 3.2 mV 0.24 mV/V + 0.4 mV 90 μV/V + 0.15 mV 45 μV/V + 50 μV 75 μV/V + 0.1 mV 0.1 mV/V + 0.2 mV 0.28 mV/V + 0.6 mV 1 mV/V + 2 mV 1.5 mV/V + 3.2 mV 0.3 mV/V + 16 mV 70 μV/V + 3.5 mV	Fluke 5720A Multiproduct Calibrator
AC Voltage – Source	Up to 2.2 mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.24 mV/V + 4 μV 91 μV/V + 4 μV 81 μV/V + 4 μV 0.2 mV/V + 4 μV 0.5 mV/V + 5 μV 1.1 mV/V + 10 μV 1.4 mV/V + 20 μV 2.7 mV/V + 20 μV	Fluke 5730A Multiproduct Calibrator
AC Voltage – Source	(2.2 to 22) mV (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	2.4 mV/V + 4 μV 90 μV/V + 4 μV 80 μV/V + 4 μV 0.2 mV/V + 4 μV 0.5 mV/V + 5 μV 1.1 mV/V + 10 μV 1.4 mV/V + 20 μV 2.7 mV/V + 20 μV	Fluke 5730A Multiproduct Calibrator



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source	220 mV to 2.2 V		Fluke 5730A Multiproduct Calibrator
	(10 to 20) Hz	0.24 mV/V + 40 μV	
	(20 to 40) Hz	90 μV/V + 15 μV	
	40 Hz to 20 kHz	45 μV/V + 8 μV	
	(20 to 50) kHz	75 μV/V + 10 μV	
	(50 to 100) kHz	1.1 mV/V + 30 μV	
	(100 to 300) kHz	0.42 mV/V + 80 μV	
	(300 to 500) kHz	1 mV/V + 0.2 mV	
	500 kHz to 1 MHz	1.7 mV/V + 0.3 mV	
	(2.2 to 22) V		
	(10 to 20) Hz	0.24 mV/V + 0.4 mV	
	(20 to 40) Hz	90 μV/V + 0.15 mV	
	40 Hz to 20 kHz	80 μV/V + 50 μV	
	(20 to 50) kHz	0.2 mV/V + 0.1 mV	
	(50 to 100) kHz	0.5 mV/V + 0.2 mV	
	(100 to 300) kHz	1.1 mV/V + 0.6 mV	
	(300 to 500) kHz	1.4 mV/V + 2 mV	
	500 kHz to 1 MHz	2.7 mV/V + 3.2 mV	
	(22 to 220) V		
	(10 to 20) Hz	0.24 mV/V + 0.4 mV	
(20 to 40) Hz	90 μV/V + 0.15 mV		
40 Hz to 20 kHz	45 μV/V + 50 μV		
(20 to 50) kHz	75 μV/V + 0.1 mV		
(50 to 100) kHz	0.1 mV/V + 0.2 V		
(100 to 300) kHz	0.28 mV/V + 0.6 mV		
(300 to 500) kHz	1 mV/V + 2 mV		
500 kHz to 1 MHz	1.5 mV/V + 3.2 mV		
(220 to 1 100) V			
(15 to 50) Hz	0.3 mV/V + 16 mV		
50 Hz to 1 kHz	70 μV/V + 3.5 mV		
AC Voltage – Source <sup>1</sup>	(1 to 33) mV		Fluke 5520A Multiproduct Calibrator
	(10 to 45) Hz	0.8 mV/V + 6 μV	
	(45 Hz to 10) kHz	0.15 mV/V + 6 μV	
	(10 to 20) kHz	0.2 mV/V + 6 μV	
	(20 to 50) kHz	1 mV/V + 6 μV	
	(50 to 100) kHz	3.5 mV/V + 12 μV	
	(100 to 500) kHz	8 mV/V + 50 μV	



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source <sup>1</sup>	(33 to 330) mV		Fluke 5520A Multiproduct Calibrator
	(10 to 45) Hz	0.3 mV/V + 8 μV	
	45 Hz to 10 kHz	0.15 mV/V + 8 μV	
	(10 to 20) kHz	0.16 mV/V + 8 μV	
	(20 to 50) kHz	0.35 mV/V + 8 μV	
	(50 to 100) kHz	0.8 mV/V + 32 μV	
	(100 to 500) kHz	2 mV/V + 70 μV	
	330 mV to 3.3 V		
	(10 to 45) Hz	0.3 mV/V + 50 μV	
	45 Hz to 10 kHz	0.15 mV/V + 60 μV	
	(10 to 20) kHz	0.19 mV/V + 60 μV	
	(20 to 50) kHz	0.3 mV/V + 50 μV	
	(50 to 100) kHz	0.7 mV/V + 0.13 mV	
	(100 to 500) kHz	2.4 mV/V + 0.6 mV	
	(3.3 to 33) V		
	45 Hz to 1 kHz	0.3 mV/V + 0.65 mV	
	(1 to 10) kHz	0.15 mV/V + 0.6 mV	
(10 to 20) kHz	0.24 mV/V + 0.6 mV		
(20 to 50) kHz	0.35 mV/V + 0.6 mV		
(50 to 100) kHz	0.9 mV/V + 1.6 mV		
AC Voltage – Measure	(33 to 330) V		Agilent/HP 3458A Opt 002 8.5 Digit Multimeter (Synchronous AC Mode)
	45 Hz to 1 kHz	0.19 mV/V + 2 mV	
	(1 to 10) kHz	0.2 mV/V + 6 mV	
	(10 to 20) kHz	0.25 mV/V + 6 mV	
	(20 to 50) kHz	0.3 mV/V + 6 mV	
	(50 to 100) kHz	2 mV/V + 50 mV	
	(330 to 1 020) V		
	(15 to 50) Hz	0.3 mV/V + 16 μV	
	50 Hz to 1 kHz	70 mV/V + 3.5 μV	
	(1 to 10) mV		
	(1 to 40) Hz	0.4 mV/V + 3 μV	
40 Hz to 1 kHz	0.24 mV/V + 1 μV		
(1 to 20) kHz	0.4 mV/V + 1 μV		
(20 to 50) kHz	1.2 mV/V + 1 μV		
(50 to 100) kHz	5.8 mV/V + 1 μV		
(100 to 300) kHz	46 mV/V + 2 μV		

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure	(10 to 100) mV		Agilent/HP 3458A Opt 002 8.5 Digit Multimeter (Synchronous AC Mode)
	(1 to 40) Hz	12 $\mu\text{V/V} + 0.4 \mu\text{V}$	
	40 Hz to 1 kHz	9.2 $\mu\text{V/V} + 0.2 \mu\text{V}$	
	(1 to 20) kHz	16 $\mu\text{V/V} + 0.2 \mu\text{V}$	
	(20 to 50) kHz	35 $\mu\text{V/V} + 0.2 \mu\text{V}$	
	(50 to 100) kHz	93 $\mu\text{V/V} + 0.2 \mu\text{V}$	
	(100 to 300) kHz	0.35 mV/V + 1 $\mu\text{V}$	
	300 kHz to 1 MHz	1.2 mV/V + 1 $\mu\text{V}$	
	(1 to 2) MHz	1.7 mV/V + 1 $\mu\text{V}$	
	(0.1 to 1) V		
	(1 to 40) Hz	12 $\mu\text{V/V} + 0.4 \mu\text{V}$	
	40 Hz to 1 kHz	9.2 $\mu\text{V/V} + 0.2 \mu\text{V}$	
	(1 to 20) kHz	16 $\mu\text{V/V} + 0.2 \mu\text{V}$	
	(20 to 50) kHz	35 $\mu\text{V/V} + 0.2 \mu\text{V}$	
	(50 to 100) kHz	93 $\mu\text{V/V} + 0.2 \mu\text{V}$	
	(100 to 300) kHz	0.35 mV/V + 1 $\mu\text{V}$	
	300 kHz to 1 MHz	1.2 mV/V + 1 $\mu\text{V}$	
	(1 to 2) MHz	1.7 mV/V + 1 $\mu\text{V}$	
	(1 to 10) V		
	(1 to 40) Hz	12 $\mu\text{V/V} + 0.4 \mu\text{V}$	
	40 Hz to 1 kHz	9.2 $\mu\text{V/V} + 0.2 \mu\text{V}$	
	(1 to 20) kHz	16 $\mu\text{V/V} + 0.2 \mu\text{V}$	
	(20 to 50) kHz	35 $\mu\text{V/V} + 0.2 \mu\text{V}$	
	(50 to 100) kHz	93 $\mu\text{V/V} + 0.2 \mu\text{V}$	
	(100 to 300) kHz	0.35 mV/V + 1 $\mu\text{V}$	
	300 kHz to 1 MHz	1.2 mV/V + 1 $\mu\text{V}$	
	(1 to 2) MHz	1.7 mV/V + 1 $\mu\text{V}$	
	(10 to 100) V		
	(1 to 40) Hz	25 mV/V + 4 mV	
	40 Hz to 1 kHz	24 mV/V + 2 mV	
(1 to 20) kHz	24 mV/V + 2 mV		
(20 to 50) kHz	41 mV/V + 2 mV		
(50 to 100) kHz	0.14 V/V + 10 mV		
(100 to 300) kHz	0.46 V/V + 10 mV		
300 kHz to 1 MHz	1.7 V/V + 10 mV		
(100 to 1 000) V			
(1 to 40) Hz	55 mV/V + 40 mV		
40 Hz to 1 kHz	46 mV/V + 20 mV		
(1 to 20) kHz	75 mV/V + 20 mV		
(20 to 50) kHz	0.14 V/V + 20 mV		
(50 to 100) kHz	0.35 V/V + 20 mV		



ANSI National Accreditation Board

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC High Voltage – Measure	60 Hz (1 to 7) kV (7 to 14) kV (14 to 21) kV (21 to 28) kV	0.12 % of reading 0.12 % of reading 0.12 % of reading 0.12 % of reading	North Star PVM-1 High Voltage Probe, HP 34401A 6.5 Digit Multimeter
AC Voltage – Measure <sup>1</sup>	(1 to 10) mV (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (10 to 100) mV (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz 100 mV to 1 V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz (1 to 10) V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz	1.2 mV/V + 3 μV 0.72 mV/V + 1 μV 1.2 mV/V + 1 μV 3.6 mV/V + 1 μV 17.4 mV/V + 1 μV 0.14 V/V + 2 μV 36 μV/V + 0.4 μV 28 μV/V + 0.2 μV 48 μV/V + 0.2 μV 0.11 mV/V + 0.2 μV 0.28 mV/V + 0.2 μV 1.1 mV/V + 1 μV 3.6 mV/V + 1 μV 5.1 mV/V + 1 μV 36 μV/V + 0.4 μV 28 μV/V + 0.2 μV 48 μV/V + 0.2 μV 0.11 mV/V + 0.2 μV 0.28 mV/V + 0.2 μV 1.1 mV/V + 1 μV 3.6 mV/V + 1 μV 5.1 mV/V + 1 μV 36 μV/V + 0.4 μV 28 μV/V + 0.2 μV 48 μV/V + 0.2 μV 0.11 mV/V + 0.2 μV 0.28 mV/V + 0.2 μV 1.1 mV/V + 1 μV 3.6 mV/V + 1 μV 5.1 mV/V + 1 μV	Agilent/HP 3458A Opt 002 8.5 Digit Multimeter (Synchronous AC Mode)



**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure <sup>1</sup>	(10 to 100) V (1 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (100 to 1 000) V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	24 mV/V + 2 mV 24 mV/V + 2 mV 41 mV/V + 2 mV 0.14 V/V + 10 mV 0.46 V/V + 10 mV 1.7 V/V + 10 mV 0.6 mV/V + 40 mV 0.5 mV/V + 20 mV 0.8 mV/V + 20 mV 1.4 mV/V + 20 mV 3.5 mV/V + 20 mV	Agilent/HP 3458A Opt 002 8.5 Digit Multimeter (Synchronous AC Mode)
AC High Voltage – Measure <sup>1</sup>	60 Hz (1 to 7) kV (7 to 14) kV (14 to 21) kV (21 to 28) kV	0.36 % of reading 0.36 % of reading 0.36 % of reading 0.36 % of reading	North Star PVM-1 High Voltage Probe, HP 34401A 6.5 Digit Multimeter
DC Current – Source <sup>1</sup>	(10 to 220) $\mu$ A (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A	42 $\mu$ A/A + 6 nA 36 $\mu$ A/A + 7 nA 37 $\mu$ A/A + 40 nA 46 $\mu$ A/A + 0.7 $\mu$ A 82 $\mu$ A/A + 12 $\mu$ A	Fluke 5720A Multiproduct Calibrator
DC Current – Source	Up to 220 $\mu$ A 220 $\mu$ A to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A	40 $\mu$ A/A + 6 nA 35 $\mu$ A/A + 7 nA 35 $\mu$ A/A + 40 nA 45 $\mu$ A/A + 0.7 $\mu$ A 80 $\mu$ A/A + 12 $\mu$ A	Fluke 5730A Multiproduct Calibrator
DC Current – Source <sup>1</sup>	Up to 330 $\mu$ A 330 $\mu$ A to 3.3 mA (3.3 to 33) mA (33 to 330) mA 330 mA to 1.1 A (1.1 to 3) A (3 to 11) A (11 to 20) A	0.015 % of reading + 20 nA 0.01 % of reading + 50 nA 0.01 % of reading + 0.25 $\mu$ A 0.01 % of reading + 2.5 $\mu$ A 0.02 % of reading + 40 $\mu$ A 1.2 mA/A + 40 $\mu$ A 1.5 mA/A + 0.5 mA 3 mA/A + 0.75 mA	Fluke 5520A Multiproduct Calibrator
DC Clamp-on Meters <sup>1</sup> (Current Source)	(20.5 to 30) A (30 to 100) A (100 to 500) A (500 to 1 000) A	0.12 % of reading 0.11 % of reading 0.11 % of reading 0.11 % of reading	Fluke 5520A Multiproduct Calibrator, Fluke 9100-200 Current Coil

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Measure	(10 to 100) $\mu$ A 100 $\mu$ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	48 $\mu$ A/A + 0.8 nA 47 $\mu$ A/A + 5 pA 45 $\mu$ A/A + 50 pA 63 $\mu$ A/A + 0.5 $\mu$ A 0.15 mA/A + 10 $\mu$ A	Agilent/HP 3458A Opt 002 8.5 Digit Multimeter
DC Current – Measure <sup>1</sup>	(10 to 100) $\mu$ A 100 $\mu$ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	0.15 $\mu$ A/A + 0.8 $\mu$ A 0.15 $\mu$ A/A + 5 nA 0.15 $\mu$ A/A + 50 nA 0.19 $\mu$ A/A + 0.5 $\mu$ A 0.45 $\mu$ A/A + 10 $\mu$ A	Agilent/HP 3458A Opt 002 8.5 Digit Multimeter
DC Current – Measure <sup>1</sup>	(1 to 100) A	5 mA/A	Agilent/HP 3458A Opt 002 8.5 Digit Multimeter, Empro 200-50 Shunt
DC Current – Measure <sup>1</sup>	(100 to 500) A	5 mA/A	Agilent/HP 3458A Opt 002 8.5 Digit Multimeter, Empro 1000-1000 Shunt
AC Current – Source <sup>1</sup>	Up to 220 $\mu$ A (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz 220 $\mu$ A to 2.2 mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (2.2 to 22) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (22 to 220) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.3 $\mu$ A/A + 20 nA 0.2 $\mu$ A/A + 12 nA 0.14 $\mu$ A/A + 10 nA 0.35 $\mu$ A/A + 15 nA 1.3 $\mu$ A/A + 80 nA 0.25 mA/A + 40 nA 0.16 mA/A + 35 nA 0.12 mA/A + 35 nA 0.2 mA/A + 0.11 $\mu$ A 1.1 mA/A + 0.65 $\mu$ A 0.25 mA/A + 0.4 $\mu$ A 0.16 mA/A + 0.35 $\mu$ A 0.12 mA/A + 0.35 $\mu$ A 0.2 mA/A + 0.55 $\mu$ A 1.1 mA/A + 5 $\mu$ A 0.25 mA/A + 4 $\mu$ A 0.16 mA/A + 3.5 $\mu$ A 0.12 mA/A + 2.5 $\mu$ A 0.28 mA/A + 3.5 $\mu$ A 1.1 mA/A + 10 $\mu$ A	Fluke 5720A Multiproduct Calibrator

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source <sup>1</sup>	220 mA to 2.2 A 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.26 mA/A + 35 µA 0.45 mA/A + 80 µA 7 mA/A + 0.16 mA	Fluke 5720A Multiproduct Calibrator
AC Current – Source	Up to 220 µA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz 220 µA to 2.2 mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (2.2 to 22) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (22 to 220) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz 220 mA to 2.2 A 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.25 mA/A + 16 nA 0.16 mA/A + 10 nA 0.1 mA/A + 8 nA 0.28 mA/A + 12 nA 0.1 mA/A + 65 nA 0.25 mA/A + 40 nA 0.16 mA/A + 35 nA 0.1 mA/A + 35 nA 0.2 mA/A + 0.11 µA 0.1 mA/A + 0.65 µA 0.25 mA/A + 0.4 µA 0.16 mA/A + 0.35 µA 0.1 mA/A + 0.35 µA 0.2 mA/A + 0.55 µA 1.1 mA/A + 5 µA 0.25 mA/A + 4 µA 0.16 mA/A + 3.5 µA 0.1 mA/A + 2.5 µA 0.2 mA/A + 3.5 µA 0.1 mA/A + 10 µA 0.24 mA/A + 35 µA 0.45 mA/A + 80 µA 7 mA/A + 0.16 mA	Fluke 5730A Multiproduct Calibrator
AC Current – Source <sup>1</sup>	(29 to 330) µA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.2 µA/A + 0.15 µA 0.15 µA/A + 0.15 µA 0.13 µA/A + 0.15 µA 0.3 µA/A + 1.6 µA 0.8 µA/A + 1.7 µA 1.6 µA/A + 10 µA	Fluke 5520A Multiproduct Calibrator



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source <sup>1</sup>	330 $\mu$ A to 3.3 mA		Fluke 5520A Multiproduct Calibrator
	(10 to 20) Hz	0.2 $\mu$ A/A + 0.2 $\mu$ A	
	(20 to 45) Hz	0.13 $\mu$ A/A + 0.2 $\mu$ A	
	45 Hz to 1 kHz	0.1 $\mu$ A/A + 0.2 $\mu$ A	
	(1 to 5) kHz	0.2 $\mu$ A/A + 1.7 $\mu$ A	
	(5 to 10) kHz	0.5 $\mu$ A/A + 1.8 $\mu$ A	
	(10 to 30) kHz	1 $\mu$ A/A + 11 $\mu$ A	
	(3.3 to 33) mA		
	(10 to 20) Hz	5.4 mA/A + 2 $\mu$ A	
	(20 to 40) Hz	2.7 mA/A + 2 $\mu$ A	
	40 Hz to 1 kHz	1.2 mA/A + 2 $\mu$ A	
	(1 to 5) kHz	2.4 mA/A + 2 $\mu$ A	
	(5 to 10) kHz	6 mA/A + 3 $\mu$ A	
	(10 to 30) kHz	12 mA/A + 4 $\mu$ A	
	(33 to 330) mA		
	(10 to 20) Hz	5.4 mA/A + 20 $\mu$ A	
	(20 to 45) Hz	2.7 mA/A + 20 $\mu$ A	
	45 Hz to 1 kHz	1.2 mA/A + 20 $\mu$ A	
	(1 to 5) kHz	3 mA/A + 50 $\mu$ A	
	(5 to 10) kHz	6 mA/A + 0.1 mA	
	(10 to 30) kHz	12 mA/A + 0.2 mA	
	330 mA to 3 A		
	(10 to 45) Hz	5.4 mA/A + 0.1 mA	
45 Hz to 1 kHz	1.8 mA/A + 0.1 mA		
(1 to 5) kHz	18 mA/A + 1 mA		
(5 to 10) kHz	75 mA/A + 5 mA		
(3 to 11) A			
(45 to 100) Hz	1.8 mA/A + 2 mA		
100 Hz to 1 kHz	3 mA/A + 2 mA		
(1 to 5) kHz	90 mA/A + 2 mA		
(11 to 20.5) A			
(45 to 100) Hz	3.6 mA/A + 5 mA		
100 Hz to 1 kHz	4.5 mA/A + 5 mA		
(1 to 5) kHz	90 mA/A + 5 mA		
AC Clamp-on Meters <sup>1</sup> (Current Source)	(50 to 400) Hz	1.2 % of reading	Fluke 5520A Multiproduct Calibrator, Fluke 9100-200 Current Coil
	(20.5 to 30) A	1.2 % of reading	
	(30 to 100) A	1.2 % of reading	
	(100 to 500) A	1.2 % of reading	
	(500 to 1 000) A	1.2 % of reading	



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure	(10 to 100) $\mu$ A		Agilent/HP 3458A Opt 002 8.5 Digit Multimeter
	(10 to 20) Hz	0.46 $\mu$ A/A + 36 nA	
	(20 to 45) Hz	0.17 $\mu$ A/A + 36 nA	
	45 Hz to 5 kHz	0.75 $\mu$ A/A + 36 nA	
	(1 to 100) mA		
	(10 to 20) Hz	0.46 mA/A + 0.24 $\mu$ A	
	(20 to 45) Hz	0.17 mA/A + 0.24 $\mu$ A	
	(45 to 100) Hz	70 $\mu$ A/A + 0.24 $\mu$ A	
	100 Hz to 5 kHz	40 $\mu$ A/A + 0.24 $\mu$ A	
	100 mA to 1 A		
	(10 to 20) Hz	0.46 mA/A + 0.2 mA	
	(20 to 45) Hz	0.17 mA/A + 0.2 mA	
	(45 to 100) Hz	70 $\mu$ A/A + 0.2 mA	
	100 Hz to 5 kHz	40 $\mu$ A/A + 0.2 mA	
	(10 to 100) $\mu$ A		
	(10 to 20) Hz	1.4 $\mu$ A/A + 36 nA	
	(20 to 45) Hz	0.5 $\mu$ A/A + 36 nA	
	45 Hz to 5 kHz	2.3 $\mu$ A/A + 36 nA	
	(1 to 100) mA		
	(10 to 20) Hz	1.4 mA/A + 0.24 $\mu$ A	
	(20 to 45) Hz	0.5 mA/A + 0.24 $\mu$ A	
	(45 to 100) Hz	0.2 mA/A + 0.24 $\mu$ A	
	100 Hz to 5 kHz	0.12 mA/A + 0.24 $\mu$ A	
	100 mA to 1 A		
(10 to 20) Hz	14 mA/A + 0.2 mA		
(20 to 45) Hz	5.7 mA/A + 0.2 mA		
(45 to 100) Hz	2.7 mA/A + 0.2 mA		
100 Hz to 5 kHz	3.6 mA/A + 0.2 mA		
Resistance – Source <sup>1</sup> (Simulated, Fixed Points)	1 $\Omega$	5 $\mu\Omega/\Omega$ + 40 $\mu\Omega$	Fluke 5720A Multiproduct Calibrator
	1.9 $\Omega$	5 $\mu\Omega/\Omega$ + 40 $\mu\Omega$	
	10 $\Omega$	23 $\mu\Omega/\Omega$ + 40 $\mu\Omega$	
	19 $\Omega$	23 $\mu\Omega/\Omega$ + 40 $\mu\Omega$	
	100 $\Omega$	10 $\mu\Omega/\Omega$ + 40 $\mu\Omega$	
	190 $\Omega$	10 $\mu\Omega/\Omega$ + 40 $\mu\Omega$	
	1 k $\Omega$	8.5 $\mu\Omega/\Omega$ + 40 $\mu\Omega$	
	1.9 k $\Omega$	8.5 $\mu\Omega/\Omega$ + 40 $\mu\Omega$	
	10 k $\Omega$	6.5 $\mu\Omega/\Omega$ + 40 $\mu\Omega$	
	19 k $\Omega$	7.5 $\mu\Omega/\Omega$ + 40 $\mu\Omega$	
	100 k $\Omega$	11 $\mu\Omega/\Omega$ + 40 $\mu\Omega$	
	190 k $\Omega$	11 $\mu\Omega/\Omega$ + 40 $\mu\Omega$	
	1 M $\Omega$	20 $\mu\Omega/\Omega$ + 40 $\mu\Omega$	



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Source <sup>1</sup> (Simulated, Fixed Points)	1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	21 μΩ/Ω + 40 μΩ 40 μΩ/Ω + 40 μΩ 47 μΩ/Ω + 40 μΩ 0.1 mΩ/Ω + 40 μΩ	Fluke 5720A Multiproduct Calibrator
Resistance – Source (Simulated, Fixed Points)	1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	95 μΩ/Ω + 40 μΩ 95 μΩ/Ω + 40 μΩ 23 μΩ/Ω + 40 μΩ 23 μΩ/Ω + 40 μΩ 10 μΩ/Ω + 40 μΩ 10 μΩ/Ω + 40 μΩ 6.5 μΩ/Ω + 40 μΩ 6.5 μΩ/Ω + 40 μΩ 6.5 μΩ/Ω + 40 μΩ 6.5 μΩ/Ω + 40 μΩ 8.5 μΩ/Ω + 40 μΩ 8.5 μΩ/Ω + 40 μΩ 13 μΩ/Ω + 40 μΩ 18 μΩ/Ω + 40 μΩ 40 μΩ/Ω + 40 μΩ 47 μΩ/Ω + 40 μΩ 100 μΩ/Ω + 40 μΩ	Fluke 5730A Multiproduct Calibrator
Resistance – Source <sup>1</sup> (Simulation)	Up to 11 Ω (11 to 33) Ω (33 to 110) Ω 110 Ω to 1.1 kΩ (1.1 to 11) kΩ (11 to 110) kΩ 110 kΩ to 1.1 MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ 330 MΩ to 1.1 GΩ	40 μΩ/Ω + 1.4 mΩ 84 μΩ/Ω + 1.5 mΩ 84 μΩ/Ω + 1.4 mΩ 84 μΩ/Ω + 2 mΩ 84 μΩ/Ω + 2 mΩ 87 μΩ/Ω + 0.2 Ω 0.11 mΩ/Ω + 2 Ω 0.18 mΩ/Ω + 30 Ω 0.39 mΩ/Ω + 50 Ω 0.76 mΩ/Ω + 2.5 kΩ 1.5 mΩ/Ω + 3 kΩ 9 mΩ/Ω + 0.1 MΩ 45 mΩ/Ω + 0.5 MΩ	Fluke 5520A Multiproduct Calibrator
Resistance – Measure	Up to 10 Ω (10 to 100) Ω 100 Ω to 10 kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1 GΩ	30 μΩ/Ω + 50 μΩ 18 μΩ/Ω + 0.5 mΩ 15 μΩ/Ω + 5 mΩ 20 μΩ/Ω + 50 mΩ 32 μΩ/Ω + 2 Ω 73 μΩ/Ω + 0.1 kΩ 0.59 mΩ/Ω + 1 kΩ 5.8 mΩ/Ω + 10 kΩ	Agilent/HP 3458A Opt 002 8.5 Digit Multimeter



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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Resistance – Measure <sup>1</sup>	Up to 10 Ω (10 to 100) Ω 100 Ω to 10 kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ 100 MΩ to 1 GΩ	87 μΩ/Ω + 50 μΩ 51 μΩ/Ω + 0.5 mΩ 45 μΩ/Ω + 5 mΩ 55 μΩ/Ω + 50 mΩ 87 μΩ/Ω + 2 Ω 0.21 mΩ/Ω + 0.1 kΩ 1.8 mΩ/Ω + 1 kΩ 15 mΩ/Ω + 10 kΩ	Agilent/HP 3458A Opt 002 8.5 Digit Multimeter
Electrical Simulation of RTD Indicating Devices – Source <sup>1</sup>	Pt 385, 100 Ω (-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C Pt 385, 200 Ω (-200 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C Pt 385, 500 Ω (-200 to -80) °C (-80 to 100) °C (100 to 260) °C (260 to 400) °C (400 to 600) °C (600 to 630) °C Pt 385, 1 000 Ω (-200 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 600) °C (600 to 630) °C	0.06 °C 0.08 °C 0.11 °C 0.12 °C 0.15 °C 0.27 °C 0.06 °C 0.15 °C 0.16 °C 0.18 °C 0.2 °C 0.2 °C 0.05 °C 0.06 °C 0.08 °C 0.1 °C 0.12 °C 0.14 °C 0.04 °C 0.05 °C 0.07 °C 0.08 °C 0.1 °C 0.3 °C	Fluke 5520A Multiproduct Calibrator

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of RTD Indicating Devices – Source <sup>1</sup>	Pt 3916, 100 Ω (-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C Pt 3926, 100 Ω (-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C PtNi 385, 120 Ω (-80 to 100) °C (100 to 260) °C Cu 427, 10 Ω (-100 to 260) °C	0.29 °C 0.05 °C 0.06 °C 0.07 °C 0.09 °C 0.1 °C 0.13 °C 0.11 °C 0.27 °C 0.08 °C 0.08 °C 0.11 °C 0.12 °C 0.15 °C 0.09 °C 0.46 °C 0.36 °C	Fluke 5520A Multiproduct Calibrator
Electrical Simulation of Thermocouple Indicating Devices – Source/Measure <sup>1</sup>	Type B (600 to 800) °C (800 to 1 000) °C (1 000 to 1 550) °C (1 550 to 1 820) °C Type C (0 to 150) °C (150 to 650) °C (650 to 1 000) °C (1 000 to 1 800) °C (1 800 to 2 316) °C Type E (-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1 000) °C	0.51 °C 0.56 °C 0.49 °C 0.54 °C 0.49 °C 0.42 °C 0.51 °C 0.82 °C 1.4 °C 0.82 °C 0.26 °C 0.23 °C 0.26 °C 0.34 °C	Fluke 5520A Multiproduct Calibrator





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Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Source/Measure <sup>1</sup>	Type J		Fluke 5520A Multiproduct Calibrator
	(-210 to -100) °C	0.44 °C	
	(-100 to -30) °C	0.26 °C	
	(-30 to 150) °C	0.23 °C	
	(150 to 760) °C	0.28 °C	
	(760 to 1 200) °C	0.38 °C	
	Type K		
	(-200 to -100) °C	0.38 °C	
	(-100 to -25) °C	0.29 °C	
	(-25 to 120) °C	0.26 °C	
	(120 to 1 000) °C	0.42 °C	
	(1 000 to 1 372) °C	0.65 °C	
	Type L		
	(-200 to -100) °C	0.6 °C	
	(-100 to 800) °C	0.42 °C	
	(800 to 900) °C	0.28 °C	
	Type N		
	(-200 to -100) °C	0.65 °C	
	(-100 to -25) °C	0.36 °C	
	(-25 to 120) °C	0.31 °C	
	(120 to 410) °C	0.29 °C	
	(410 to 1 300) °C	0.44 °C	
	Type R		
	(0 to 250) °C	0.93 °C	
	(250 to 400) °C	0.57 °C	
	(400 to 1 000) °C	0.54 °C	
	(1 000 to 1767) °C	0.65 °C	
	Type S		
(0 to 250) °C	0.77 °C		
(250 to 1 000) °C	0.59 °C		
(1 000 to 1 400) °C	0.60 °C		
(1 400 to 1 767) °C	0.75 °C		
Type T			
(-250 to -150) °C	1.1 °C		
(-150 to 0) °C	0.42 °C		
(0 to 120) °C	0.26 °C		
(120 to 400) °C	0.23 °C		
Type U			
(-200 to 0) °C	0.91 °C		
(0 to 600) °C	0.44 °C		

**Electrical – DC/Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes <sup>1</sup> Leveled Sine Wave/Bandwidth into 50 Ω	5 mVp-p to 5 Vp-p 50 kHz 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1 100) MHz	2.3 % of reading + 0.3 mV 4.1 % of reading + 0.3 mV 4.7 % of reading + 0.3 mV 7 % of reading + 0.3 mV 8.1 % of reading + 0.3 mV	Fluke 5520A/11 Multiproduct Calibrator

**Electrical – RF/Microwave**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes <sup>1,2</sup> Leveled Sine Wave/Bandwidth into 50 Ω load	(1.1 to 12.4) GHz (12.4 to 18) GHz (18 to 26.5) GHz (26.5 to 40) GHz	4.5 % of reading + <i>M</i> 4.7 % of reading + <i>M</i> 5.5 % of reading + <i>M</i> 6.2 % of reading + <i>M</i>	Compared to HP E4418B Power Meter, HP 8485A Power Sensor
Oscilloscopes <sup>1,2</sup> Leveled Sine Wave/Bandwidth into 50 Ω load	(40 to 50) GHz	8.1 % of reading + <i>M</i>	Compared to HP E4418B Power Meter, HP 8487A Power Sensor
RF Power Meter Reference	1 mW, 50 MHz	1.1 % of reading	HP 432A Power Meter, HP 8478B Power Sensor, HP 3458A 8.5 Digit Multimeter
RF Power – Measure <sup>1</sup>	9 kHz to 6 GHz (-60 to -50) dBm (-50 to -40) dBm (-40 to -30) dBm (-30 to -10) dBm (-10 to 20) dBm	7.4 dB 4.2 dB 0.52 dB 0.34 dB 0.31 dB	EPM Power Meter, Keysight E9304A RF Power Sensor
	10 MHz to 18 GHz (-20 to -10) dBm (-10 to 0) dBm (0 to 10) dBm (10 to 20) dBm	0.55 dB 0.16 dB 0.31 dB 0.31 dB	EPM Power Meter, Keysight 8481A Power Sensor

**Electrical – RF/Microwave**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Power – Measure <sup>1</sup>	10 MHz to 18 GHz (-70 to -60) dBm (-60 to -50) dBm (-50 to -40) dBm (-40 to -30) dBm (-30 to -20) dBm	5.4 dB 2.2 dB 0.27 dB 0.16 dB 0.18 dB	EPM Power Meter, Keysight 8481D Power Sensor
	(18 to 26.5) GHz (-30 to -20) dBm (-20 to 0) dBm (0 to 20) dBm	6.1 dB 0.58 dB 0.35 dB	EPM Power Meter, Keysight 8485A Power Sensor
	(18 to 26.5) GHz (-70 to -60) dBm (-60 to -50) dBm (-50 to -40) dBm (-40 to -30) dBm (-30 to -20) dBm	2.2 dB 0.41 dB 0.22 dB 0.28 dB 0.28 dB	EPM Power Meter, Keysight 8485D Power Sensor
	(26.5 to 50) GHz (-30 to -20) dBm (-20 to -10) dBm (-10 to 0) dBm (0 to 10) dBm (10 to 20) dBm	4.1 dB 0.54 dB 0.36 dB 0.36 dB 0.37 dB	EPM Power Meter, Keysight N8487A Power Sensor
	(26.5 to 50) GHz (-70 to -60) dBm (-60 to -50) dBm (-50 to -40) dBm (-40 to -30) dBm (-30 to -20) dBm	5.9 dB 2.7 dB 0.77 dB 0.71 dB 0.71 dB	EPM Power Meter, Keysight 8487D Power Sensor

**Length – Dimensional Metrology**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Micrometers <sup>1,3</sup>	Up to 12 in	$(76 + 5L + 0.6R) \mu\text{in}$	Mitutoyo BE1-81-1F, Mitutoyo BE6-81-2F Gage Block Sets
Calipers <sup>1,3</sup> (Outside Reading Only)	Up to 24 in	$(20 + 5L + 0.6R) \mu\text{in}$	Mitutoyo BE1-81-1F, Mitutoyo BE6-81-2F Gage Block Sets
Cylindrical Ring Gages <sup>3</sup>	Up to 4 in	$(48 + 5L) \mu\text{in}$	Mitutoyo BE1-81-1F Gage Block Set, Federal ID Comparator

**Length – Dimensional Metrology**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Cylindrical Pins <sup>3</sup>	(0.05 to 1) in	61 μin	Mitutoyo BE1-81-1F Gage Block Set, SMM-1 Bench Micrometer
Thickness Gages <sup>3</sup> (Feeler Type)	(0.000 5 to 0.05) in	61 μin	
V-Blocks			Mitutoyo BE1-81-1F Gage Block Set, Starrett Comparator, Master Square
Parallelism	Up to 10 in	100 μin	
Squareness	Up to 10 in	100 μin	
Level <sup>3</sup>	Up to 1 000"	1"	Brunson 470 Calibration Sine Bar

**Mass and Mass Related**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Balances and Scales <sup>1,4</sup>	(1 to 20) mg (20 to 500) mg (0.5 to 5) g (5 to 50) g (50 to 500) g (0.5 to 5) kg (5 to 20) kg	11 μg/g 15 μg/g 26 μg/g 49 μg/g 0.59 mg/g 5.9 mg/g 7.9 mg/g	ASTM E617 Class 1, Class 3, and Class 4 weights and manufacturer's procedure utilized in the calibration of the weighing system.
	Up to 1 000 lb	0.02 lb/lb	
Pneumatic Pressure Gages	Up to 300 psi	0.61 psi	Comparison to Crystal Pressure Gage
	Up to 500 psi	0.06 psi	GE/Druck CM2-B-14G Pressure Controller, Additel Pressure Gages
	Up to 1000 psi	0.37 psi	
	Up to 2000 psi Up to 3000 psi	0.71 psi 3.1 psi	
Hydraulic Pressure Gages	Up to 10 000 psi	3.1 psi	Comparison to Additel Pressure Gages
Differential Pressure Gages	(-10 to 10) inH <sub>2</sub> O	0.005 inH <sub>2</sub> O	Additel Automated Pressure Calibrator
Vacuum Gages	(-14 to 0) psi	0.003 psi	Druck Pressure Calibrator
Barometric Pressure Devices	(800 to 1 030) mbar	0.12 mbar	
Force Gages (Tension and Compression)	(0.1 to 500) lbf	0.087 lbf	Morehouse HADI Indicator, Master Load Cell

### Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Mass Determination	(1 to 100) mg (100 to 500) mg (0.5 to 1) g (1 to 20) kg	0.13 µg 0.69 µg 1.7 µg 2 g	Electronic Balances, ASTM E617 Class 1 Weights
Pipettes	(0.1 to 2) µL (2.1 to 5) µL (5.1 to 10) µL (10.1 to 20) µL	29 nL 39 nL 58 nL 0.1 µL	Gravimetric method utilizing Electronic Balances and Weights.
Pipettes <sup>1</sup>	(20 to 50) µL (50 to 100) µL (100 to 200) µL (200 to 500) µL (500 to 1 000) µL (1 to 2.5) mL (2.5 to 5) mL (5 to 10) mL	0.83 µL 0.96 µL 1.2 µL 1.9 µL 3.1 µL 6.9 µL 13 µL 39 µL	Gravimetric method utilizing Electronic Balances and Weights.
Torque Devices	(0.5 to 215) ozf-in 10 lbf-in to 100 lbf-ft (100 to 1 000) lbf-ft	1.5 % of Reading 1.5 % of Reading 1.5 % of Reading	Torque Testers, Torque Transducers
Volumetric Mass Flow Rate	(0.1 to 100) slm	1.5 % of reading	DHI Flow System

### Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature – Source/Measure	(-95 to -40) °C (-40 to 0) °C (0 to 150) °C (150 to 420) °C (420 to 660) °C	0.04 °C 0.04 °C 0.056 °C 0.057 °C 0.12 °C	Hart 1502 Indicator, Hart 5628 PRT, Fluke 9190A Well, Hart 9173 Dry-block
Temperature – Source/Measure <sup>1</sup>	(-200 to 400) °C	0.1 °C	Hart 1521 Thermometer, Hart 5627-9 PRT, Hart 5623-6 PRT
Infrared Thermometers	(50 to 100) °C (100 to 200) °C (200 to 300) °C (300 to 400) °C (400 to 500) °C	1.6 % of reading + 2.8 °C 1.6 % of reading + 5.5 °C 1.6 % of reading + 8.3 °C 1.6 % of reading + 11 °C 1.6 % of reading + 14 °C	Hart 9132 Blackbody Source (Flat Plate), Hart 1502A Indicator, Hart 5628B PRT $\epsilon = 0.95, \lambda = (8 \text{ to } 14) \mu\text{m}$

**Thermodynamic**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Relative Humidity – Source	(10 to 20) %RH (20 to 40) %RH (40 to 70) %RH (70 to 80) %RH (80 to 95) %RH	0.63 %RH 0.65 %RH 0.67 %RH 0.67 %RH 1.1 %RH	Thunder Scientific 2500 Two-Pressure Humidity Generator
Relative Humidity – Measure <sup>1</sup>	(10 to 95) %RH	1.5 %RH	Rotronic HP23-A HygroPalm/HC2-HK25 Temperature/Humidity Indicator

**Time and Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source <sup>1</sup>	10 mHz to 2 MHz	0.000 25 % of reading + 5 μHz	Fluke 5520A Multiproduct Calibrator
Frequency Oscillator Characterization	10 MHz	3 pHz/Hz	Stanford Research FS740 GPS Time and Frequency System
Digital Stopwatches/Timers <sup>1</sup>	Up to 19.99 s/d	85 ms/d	Helmut-Klein 4500 Timometer per NIST SP 960-12

Calibration and Measurement Capability (CMC) is expressed in terms of the measurement parameter, measurement range, expanded uncertainty of measurement and reference standard, method, and/or equipment. The expanded uncertainty of measurement is expressed as the standard uncertainty of the measurement multiplied by a coverage factor of 2 ( $k=2$ ), corresponding to a confidence level of approximately 95%.

Notes:

1. On-site calibration service is available for this parameter, since on-site conditions are typically more variable than those in the laboratory, larger measurement uncertainties are expected on-site than what is reported on the accredited scope.
2.  $M$  = mismatch uncertainty. The Power Meter and Power Sensor do not include Mismatch Uncertainty, 0 dBm referenced at 1 mW.
3.  $L$  = length in inches;  $R$  = resolution in inches; " = arc-second.
4. The CMC for scales and balances is highly dependent upon the resolution of the unit under test. The CMC presented here does not include the resolution of the unit under test. The resolution will be included in the reported measurement uncertainty at the time of calibration.
5. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-1768.



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