



CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board

500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that

Precision Measurements, Inc.

1630 Zanker Road

San Jose, CA 95112

has been assessed by ANAB
and meets the requirements of international standard

ISO/IEC 17025:2005

and national standard

ANSI/NCSL Z540-1-1994 (R2002)

while demonstrating technical competence in the field of

CALIBRATION

Refer to the accompanying Scope of Accreditation for information regarding the types of calibrations to which this accreditation applies.

AC-1768

Certificate Number


ANAB Approval

Certificate Valid: 02/28/2018-03/14/2019
Version No. 004 Issued: 02/28/2018



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. 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 17025:2005
AND ANSI/NCSL Z540-1-1994 (R2002)**

Precision Measurements, Inc.

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CALIBRATION

Valid to: **March 14, 2019**

Certificate Number: **AC-1768**

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
DC Voltage - Source	Up to 220 mV	12 $\mu\text{V/V} + 0.4 \mu\text{V}$	Fluke 5720A Multiproduct Calibrator
	220 mV to 2.2 V	5 $\mu\text{V/V} + 0.7 \mu\text{V}$	
	(2.2 to 11) V	3.5 $\mu\text{V/V} + 2.5 \mu\text{V}$	
	(11 to 22) V	3.5 $\mu\text{V/V} + 4 \mu\text{V}$	
	(22 to 220) V	5 $\mu\text{V/V} + 40 \mu\text{V}$	
	220 V to 1.1 kV	6.7 $\mu\text{V/V} + 0.40 \text{ mV}$	
DC Voltage – Source Fixed Points	10 V	2.4 $\mu\text{V/V}$	Fluke 732B DC Reference Standard
DC Voltage - Source ¹	Up to 330 mV	66 $\mu\text{V/V} + 1 \mu\text{V}$	Fluke 5520A Multiproduct Calibrator
	330 mV to 3.3 V	33 $\mu\text{V/V} + 2 \mu\text{V}$	
	(3.3 to 33) V	36 $\mu\text{V/V} + 20 \mu\text{V}$	
	(30 to 330) V	54 $\mu\text{V/V} + 0.15 \text{ mV}$	
	100 V to 1 kV	54 $\mu\text{V/V} + 1.5 \text{ mV}$	
DC Voltage - Measure	Up to 100 mV	17 $\mu\text{V/V} + 3 \mu\text{V}$	HP/Agilent 3458A Opt 002 Multimeter
	100 mV to 1 V	8.6 $\mu\text{V/V} + 0.3 \mu\text{V}$	
	(1 to 10) V	7.8 $\mu\text{V/V} + 0.05 \mu\text{V}$	
	(10 to 100) V	11 $\mu\text{V/V} + 0.3 \mu\text{V}$	
	100 V to 1 kV	15 $\mu\text{V/V} + 0.1 \mu\text{V}$	
	(1 to 40) kV	16 mV/V	Fluke 80K40 High Voltage Probe, HP 34401A Multimeter



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
DC Voltage – Measure ¹	Up to 100 mV 100 mV to 1 V (1 to 10) V (10 to 100) V 100 to 1 kV	51 $\mu\text{V}/\text{V} + 10 \mu\text{V}$ 27 $\mu\text{V}/\text{V} + 1 \mu\text{V}$ 24 $\mu\text{V}/\text{V} + 2 \mu\text{V}$ 33 $\mu\text{V}/\text{V} + 30 \mu\text{V}$ 45 $\mu\text{V}/\text{V} + 0.1 \text{ mV}$	HP/Agilent 3458A Opt 002 Multimeter
	(1 to 40) kV	20 mV/V	Fluke 80K40 High Voltage Probe HP 34401A Multimeter
DC Current - Source	(10 to 220) μA 220 μA to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A	42 $\mu\text{A}/\text{A} + 6 \text{ nA}$ 36 $\mu\text{A}/\text{A} + 7 \text{ nA}$ 37 $\mu\text{A}/\text{A} + 40 \text{ nA}$ 46 $\mu\text{A}/\text{A} + 0.7 \mu\text{A}$ 82 $\mu\text{A}/\text{A} + 12 \mu\text{A}$	Fluke 5720A Multiproduct Calibrator
DC Current – Source ¹	Up to 330 μA 330 μA 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 20.5) A	45 $\mu\text{A}/\text{A} + 0.02 \mu\text{A}$ 45 $\mu\text{A}/\text{A} + 0.05 \mu\text{A}$ 30 $\mu\text{A}/\text{A} + 0.25 \mu\text{A}$ 30 $\mu\text{A}/\text{A} + 2.5 \mu\text{A}$ 60 $\mu\text{A}/\text{A} + 40 \mu\text{A}$ 1.2 mA/A + 40 μA 1.5 mA/A + 0.5 mA 3 mA/A + 0.75 mA	Fluke 5520A Multiproduct Calibrator
DC Current - Measure	(10 to 100) μA 100 μA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	48 $\mu\text{A}/\text{A} + 0.80 \text{ nA}$ 47 $\mu\text{A}/\text{A} + 5 \text{ pA}$ 45 $\mu\text{A}/\text{A} + 50 \text{ pA}$ 63 $\mu\text{A}/\text{A} + 0.5 \text{ pA}$ 0.15 mA/A + 10 μA	HP/Agilent 3458A Opt 002 Multimeter
DC Current – Measure ¹	(10 to 100) μA 100 μA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	0.15 mA/A + 800 pA 0.15 $\mu\text{A}/\text{A} + 5 \text{ nA}$ 0.15 $\mu\text{A}/\text{A} + 50 \text{ nA}$ 0.19 $\mu\text{A}/\text{A} + 0.5 \mu\text{A}$ 0.45 $\mu\text{A}/\text{A} + 10 \mu\text{A}$	HP/Agilent 3458A Opt 002 Multimeter
Resistance - Source Fixed Points	(1, 1.9) Ω (10, 19) Ω (100, 190) Ω (1, 19) k Ω (100, 190) k Ω 1 M Ω 1.9 M Ω	95 $\mu\Omega/\Omega$ 25 $\mu\Omega/\Omega$ 11 $\mu\Omega/\Omega$ 9 $\mu\Omega/\Omega$ 14 $\mu\Omega/\Omega$ 24 $\mu\Omega/\Omega$ 25 $\mu\Omega/\Omega$	Fluke 5720A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Resistance - Source Fixed Points	10 MΩ 19 MΩ 100 MΩ	43 μΩ/Ω 52 μΩ/Ω 0.12 mΩ/Ω	Fluke 5720A Multiproduct Calibrator
Resistance – Source ¹	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 111) kΩ 111 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	12 μΩ/Ω + 1 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 μΩ/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 (0.1 to 1) GΩ	30 μΩ/Ω + 50 μΩ 18 μΩ/Ω + 0.50 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 MΩ	HP/Agilent 3458A Opt 002 Multimeter
Resistance – Measure ¹	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 (0.1 to 1) GΩ	87 μΩ/Ω + 50 μΩ 51 μΩ/Ω + 500 μΩ 45 μΩ/Ω + 5 mΩ 55 μΩ/Ω + 50 mΩ 87 μΩ/Ω + 2 Ω 0.21 mΩ/Ω + 100 Ω 1.8 mΩ/Ω + 1 kΩ 15 mΩ/Ω + 10 kΩ	HP/Agilent 3458A Opt 002 Multimeter



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage - Source	Up to 2.2 mV		Fluke 5720A Multiproduct Calibrator
	(10 to 20) Hz	0.24 mV/V + 4 μV	
	(20 to 40) Hz	91 μV/V + 4 μV	
	40 Hz to 20 kHz	81 μV/V + 4 μV	
	(20 to 50) kHz	0.20 mV/V + 4 μV	
	(50 to 100) kHz	0.50 mV/V + 5 μV	
	(100 to 300) kHz	1.1 mV/V + 10 μV	
	(300 to 500) kHz	1.4 mV/V + 20 μV	
	500 kHz to 1 MHz	2.7 mV/V + 20 μV	
	(2.2 to 22) mV		
	(10 to 20) Hz	2.4 mV/V + 4 μV	
	(20 to 40) Hz	90 μV/V + 4 μV	
	40 Hz to 20 kHz	80 μV/V + 4 μV	
	(20 to 50) kHz	0.2 mV/V + 4 μV	
	(50 to 100) kHz	0.5 mV/V + 5 μV	
	(100 to 300) kHz	1.1 mV/V + 10 μV	
	(300 to 500) kHz	1.4 mV/V + 20 μV	
	500 kHz to 1 MHz	2.7 mV/V + 20 μV	
	(22 to 220) mV		
	(10 to 20) Hz	0.24 mV/V + 12 μV	
	(20 to 40) Hz	90 μV/V + 7 μV	
	40 Hz to 20 kHz	80 μV/V + 7 μV	
	(20 to 50) kHz	0.20 mV/V + 7 μV	
	(50 to 100) kHz	0.46 mV/V + 17 μV	
(100 to 300) kHz	0.9 mV/V + 20 μV		
(300 to 500) kHz	1.4 mV/V + 25 μV		
500 kHz to 1 MHz	2.7 mV/V + 45 μV		
220 mV to 2.2 V			
(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		



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage - Source	(2.2 to 22) V		Fluke 5720A Multiproduct Calibrator
	(10 to 20) Hz	0.24 mV/V + 0.4 mV	
	(20 to 40) Hz	90 μ V/V + 0.15 mV	
	40 Hz to 20 kHz	80 μ V/V + 50 μ V	
	(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 μ V/V + 0.15 mV	
	40 Hz to 20 kHz	45 μ V/V + 50 μ V	
	(20 to 50) kHz	75 μ V/V + 1.2 V	
(50 to 100) kHz	0.1 mV/V + 0.2 mV		
(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	5 mV/V + 3.2 mV		
AC Voltage – Source ¹	220 V to 1.1 kV		Fluke 5520A Multiproduct Calibrator
	(15 to 50) Hz	0.3 mV/V + 16 mV	
	50 Hz to 1 kHz	70 μ V/V + 3.5 mV	
	(1 to 33) mV		
	(10 to 45) Hz	0.24 mV/V + 6 μ V	
	45 Hz to 10 kHz	60 μ V/V + 6 μ V	
	(10 to 20) kHz	70 μ V/V + 6 μ V	
	(20 to 50) kHz	0.3 mV/V + 6 μ V	
	(50 to 100) kHz	1.1 mV/V + 12 μ V	
	(100 to 500) kHz	2.4 mV/V + 50 μ V	
AC Voltage – Source ¹	(33 to 330) mV		Fluke 5520A Multiproduct Calibrator
	(10 to 45) Hz	90 μ V/V + 8 μ V	
	45 Hz to 10 kHz	50 μ V/V + 8 μ V	
	(10 to 20) kHz	50 μ V/V + 8 μ V	
	(20 to 50) kHz	0.11 mV/V + 8 μ V	
	(50 to 100) kHz	0.24 mV/V + 32 μ V	
	(100 to 500) kHz	0.6 mV/V + 70 μ V	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage – Source ¹	330 mV to 3.3 V		Fluke 5520A Multiproduct Calibrator
	(10 to 45) Hz	90 μ V/V + 50 μ V	
	45 Hz to 10 kHz	50 μ V/V + 60 μ V	
	(10 to 20) kHz	60 μ V/V + 60 μ V	
	(20 to 50) kHz	90 μ V/V + 50 μ V	
	(50 to 100) kHz	0.24 mV/V + 0.13 mV	
	(100 to 500) kHz	0.72 mV/V + 0.6 mV	
	(3.3 to 33) V		
	45 Hz to 1 kHz	90 μ V/V + 0.65 mV	
	(1 to 10) kHz	50 μ V/V + 0.6 mV	
	(10 to 20) kHz	70 μ V/V + 0.6 mV	
	(20 to 50) kHz	0.11 mV/V + 0.6 mV	
	(50 to 100) kHz	0.27 mV/V + 1.6 mV	
	(33 to 330) V		
	45 Hz to 1 kHz	60 μ V/V + 2 mV	
(1 to 10) kHz	60 μ V/V + 6 mV		
(10 to 20) kHz	80 μ V/V + 6 mV		
(20 to 50) kHz	90 μ V/V + 6 mV		
(50 to 100) kHz	0.6 mV/V + 50 mV		
AC Voltage - Measure	330 V to 1.02 kV		HP/Agilent 3458A Opt 002 Multimeter in Synchronous AC Mode
	45 Hz to 1 kHz	90 μ V/V + 10 mV	
	(1 to 5) kHz	80 μ V/V + 10 mV	
	(5 to 10) kHz	0.1 mV/V + 10 mV	
	(1 to 10) mV		
	(1 to 40) Hz	0.4 mV/V + 3 μ V	
	40 Hz to 1 kHz	0.24 mV/V + 1 μ V	
	(1 to 20) kHz	0.4 mV/V + 1 μ V	
	(20 to 50) kHz	1.2 mV/V + 1 μ V	
	(50 to 100) kHz	5.8 mV/V + 1 μ V	
	(100 to 300) kHz	46 mV/V + 2 μ V	
	(10 to 100) mV		
	(1 to 40) Hz	0.1 mV/V + 0.4 μ V	
	40 Hz to 1 kHz	0.1 mV/V + 0.2 μ V	
	(1 to 20) kHz	0.2 mV/V + 0.2 μ V	
(20 to 50) kHz	0.4 mV/V + 0.2 μ V		
(50 to 100) kHz	0.9 mV/V + 0.2 μ V		
(100 to 300) kHz	3.5 mV/V + 1 μ V		
300 kHz to 1 MHz	12 mV/V + 1 μ V		
(1 to 2) MHz	17 mV/V + 1 μ V		



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage - Measure	100 mV to 1 V		HP/Agilent 3458A Opt 002 Multimeter in Synchronous AC Mode
	(1 to 40) Hz	0.1 mV/V + 4 μV	
	40 Hz to 1 kHz	0.1 mV/V + 2 μV	
	(1 to 20) kHz	0.2 mV/V + 2 μV	
	(20 to 50) kHz	0.4 mV/V + 2 μV	
	(50 to 100) kHz	0.9 mV/V + 2 μV	
	(100 to 300) kHz	3.5 mV/V + 1 μV	
	300 kHz to 1 MHz	12 mV/V + 1 μV	
	(1 to 2) MHz	17 mV/V + 1 μV	
	(1 to 10) V		
	(1 to 40) Hz	0.12 mV/V + 40 μV	
	40 Hz to 1 kHz	0.1 mV/V + 20 μV	
	(1 to 20) kHz	0.2 mV/V + 20 μV	
	(20 to 50) kHz	0.4 mV/V + 20 μV	
	(50 to 100) kHz	0.9 mV/V + 20 μV	
	(100 to 300) kHz	3.5 mV/V + 10 μV	
	300 kHz to 1 MHz	12 mV/V + 10 μV	
	(1 to 2) MHz	17 mV/V + 10 μV	
	(10 to 100) V		
	(1 to 40) Hz	0.3 mV/V + 2 mV	
40 Hz to 20 kHz	0.2 mV/V + 2 mV		
(20 to 50) kHz	0.4 mV/V + 2 mV		
(50 to 100) kHz	1.4 mV/V + 2 mV		
(100 to 300) kHz	4.6 mV/V + 10 mV		
300 kHz to 1 MHz	17 mV/V + 10 mV		
100 V to 1 kV			
(1 to 40) Hz	0.6 mV/V + 40 mV		
40 Hz to 1 kHz	0.5 mV/V + 20 mV		
(1 to 20) kHz	0.8 mV/V + 20 mV		
(20 to 50) kHz	1.4 mV/V + 20 mV		
(50 to 100) kHz	3.5 mV/V + 20 mV		
AC Voltage - Measure	(1 to 28) kV 60Hz	77 mV/V	Fluke 87 Multimeter and Fluke 80K40 High Voltage Probe



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage – Measure ¹	(1 to 10) mV		HP/Agilent 3458A Opt 002 Multimeter in Synchronous AC Mode
	(1 to 40) Hz	1.2 mV/V + 3 μV	
	40 Hz to 1 kHz	0.72 mV/V + 1 μV	
	(1 to 20) kHz	1.2 mV/V + 1 μV	
	(20 to 50) kHz	3.6 mV/V + 1 μV	
	(50 to 100) kHz	18 mV/V + 1 μV	
	(100 to 300) kHz	0.14 mV/V + 2 μV	
	(10 to 100) mV		
	(1 to 40) Hz	0.3 mV/V + 0.4 pV	
	40 Hz to 1 kHz	0.3 mV/V + 0.2 pV	
	(1 to 20) kHz	0.6 mV/V + 0.2 pV	
	(20 to 50) kHz	1.2 mV/V + 0.2 pV	
	(50 to 100) kHz	2.7 mV/V + 0.2 pV	
	(100 to 300) kHz	11 mV/V + 1 μV	
	300 kHz to 1 MHz	36 mV/V + 1 μV	
	(1 to 2) MHz	54 mV/V + 1 μV	
	100 mV to 1 V		
	(1 to 40) Hz	0.3 mV/V + 0.4 μV	
	40 Hz to 1 kHz	0.3 mV/V + 0.2 μV	
	(1 to 20) kHz	0.6 mV/V + 0.2 μV	
	(20 to 50) kHz	1.2 mV/V + 0.2 μV	
	(50 to 100) kHz	2.7 mV/V + 0.2 μV	
	(100 to 300) kHz	11 mV/V + 1 μV	
	300 kHz to 1 MHz	36 mV/V + 1 μV	
	(1 to 2) MHz	54 mV/V + 1 μV	
	(1 to 10) V		
	(1 to 40) Hz	0.36 mV/V + 0.4 μV	
	40 Hz to 1 kHz	0.3 mV/V + 0.2 μV	
(1 to 20) kHz	0.6 mV/V + 0.2 μV		
(20 to 50) kHz	1.2 mV/V + 0.2 μV		
(50 to 100) kHz	2.7 mV/V + 0.2 μV		
(100 to 300) kHz	11 mV/V + 1 μV		
300 kHz to 1 MHz	36 mV/V + 1 μV		
(1 to 2) MHz	54 mV/V + 1 μV		



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Voltage – Measure ¹	(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	0.9 mV/V + 2 mV 0.6 mV/V + 2 mV 1.2 mV/V + 2 mV 4.2 mV/V + 2 mV 14 mV/V + 10 mV 51 mV/V + 10 mV	HP/Agilent 3458A Opt 002 Multimeter in Synchronous AC Mode
	100 V to 1 kV (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	1.8 mV/V + 40 mV 1.5 mV/V + 20 mV 2.4 mV/V + 20 mV 4.2 mV/V + 20 mV 11 mV/V + 20 mV	
	(1 to 28) kV 60 Hz	77 mV/V	Fluke 87 Multimeter and Fluke 80K40
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	0.25 mA/A + 16 nA 0.16 mA/A + 10 nA 0.12 mA/A + 8 nA 0.28 mA/A + 12 nA 1.1 mA/A + 65 nA	Fluke 5720A Multiproduct Calibrator
	(0.22 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	0.25 mA/A + 40 nA 0.16 mA/A + 35 nA 0.12 mA/A + 35 nA 0.2 mA/A + 0.11 μA 1.1 mA/A + 0.65 μA	
	(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	0.25 mA/A + 0.4 μA 0.16 mA/A + 0.35 μA 0.12 mA/A + 0.35 μA 0.2 mA/A + 0.55 μA 1.1 mA/A + 5 μA	
	(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	0.25 mA/A + 4 μA 0.16 mA/A + 3.5 μA 0.12 mA/A + 2.5 μA 0.28 mA/A + 3.5 μA 1.1 mA/A + 10 μA	



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Current - Source	(0.22 to 2.2) A 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.26 mA/A + 35 μ A 0.45 mA/A + 80 μ A 7 mA/A + 0.16 mA	Fluke 5720A Multiproduct Calibrator
AC Current – Source ¹	(29 to 330) μ A (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 (0.33 to 3.3) mA (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 (3.3 to 33) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz (33 to 330) mA (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 (0.33 to 3) A (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	6 mA/A + 0.1 μ A 4.5 mA/A + 0.1 μ A 3.8 mA/A + 0.1 μ A 9 mA/A + 0.15 μ A 24 mA/A + 0.2 μ A 48 mA/A + 0.4 μ A 6 mA/A + 0.15 μ A 3.8 mA/A + 0.15 μ A 3 mA/A + 0.15 μ A 6 mA/A + 0.2 μ A 15 mA/A + 0.3 μ A 30 mA/A + 0.6 μ A 5.4 mA/A + 2 μ A 2.7 mA/A + 2 μ A 1.2 mA/A + 2 μ A 2.4 mA/A + 2 μ A 6 mA/A + 3 μ A 12 mA/A + 4 μ A 5.4 mA/A + 20 μ A 2.7 mA/A + 20 μ A 1.2 mA/A + 20 μ A 3 mA/A + 50 μ A 6 mA/A + 0.1 mA 12 mA/A + 0.2 mA 5.4 mA/A + 0.1 mA 1.8 mA/A + 0.1 mA 18 mA/A + 1 mA 75 mA/A + 5 mA	Fluke 5520A Multiproduct Calibrator



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
AC Current – Source ¹	(3 to 11) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz (11 to 20.5) A 45 Hz to 100 Hz 100 Hz to 1 kHz (1 to 5) kHz	1.8 mA/A + 2 mA 3 mA/A + 2 mA 90 mA/A + 2 mA 3.6 mA/A + 5 mA 4.5 mA/A + 5 mA 90 mA/A + 5 mA	Fluke 5520A Multiproduct Calibrator
AC Current - Measure	(10 to 100) μ A (10 to 20) Hz (20 to 45) Hz 45 Hz to 5 kHz (1 to 100) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (0.1 to 1) A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	4.6 mA/A + 20 nA 1.7 mA/A + 20 nA 0.75 mA/A + 20 nA 4.6 mA/A + 0.2 μ A 1.7 mA/A + 0.2 μ A 0.7 mA/A + 0.2 μ A 0.4 mA/A + 0.2 μ A 4.6 mA/A + 0.2 mA 1.9 mA/A + 0.2 mA 0.9 mA/A + 0.2 μ A 1.2 mA/A + 0.2 μ A	HP/Agilent 3458A Opt 002 Multimeter
AC Current - Measure ¹	(10 to 100) μ A (10 to 20) Hz (20 to 45) Hz 45 Hz to 5 kHz (1 to 100) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (0.1 to 1) A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	14 mA/A + 20 nA 5.1 mA/A + 20 nA 2.1 mA/A + 20 nA 14 mA/A + 0.2 μ A 5.1 mA/A + 0.2 μ A 2.1 mA/A + 0.2 μ A 1.2 mA/A + 0.2 μ A 14 mA/A + 0.2 mA 5.7 mA/A + 0.2 mA 2.7 mA/A + 0.2 mA 3.6 mA/A + 0.2 mA	HP/Agilent 3458A Opt 002 Multimeter



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Oscilloscope – Bandwidth ¹	At 50 kHz reference:	2.3 % of Reading + 300 μ V	Fluke 5520A SC1100 Multiproduct Calibrator
	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz 600 MHz to 1.1 GHz	4.1 % of Reading + 300 μ V 4.7 % of Reading + 300 μ V 7 % of Reading + 300 μ V 8.1 % of Reading + 300 μ V	
	(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 +M 4.7% of Reading +M 5.5% of Reading +M 6.2% of Reading +M	
	(40 to 50) GHz	8.1% of Reading +M	E4418B Power Meter with 8487A Power Sensor
Electrical Calibration of RTD Indicators ¹	Pt 385, 100 Ω		Fluke 5520A Multiproduct Calibrator
	(-200 to 0) $^{\circ}$ C	0.06 $^{\circ}$ C	
	(0 to 100) $^{\circ}$ C	0.08 $^{\circ}$ C	
	(100 to 300) $^{\circ}$ C	0.11 $^{\circ}$ C	
	(300 to 400) $^{\circ}$ C	0.12 $^{\circ}$ C	
	(400 to 630) $^{\circ}$ C	0.15 $^{\circ}$ C	
	(630 to 800) $^{\circ}$ C	0.13 $^{\circ}$ C	
	Pt 385, 200 Ω		
	(-200 to 100) $^{\circ}$ C	0.05 $^{\circ}$ C	
	(100 to 260) $^{\circ}$ C	0.06 $^{\circ}$ C	
	(260 to 300) $^{\circ}$ C	0.15 $^{\circ}$ C	
	(300 to 400) $^{\circ}$ C	0.16 $^{\circ}$ C	
	(400 to 600) $^{\circ}$ C	0.18 $^{\circ}$ C	
	(600 to 630) $^{\circ}$ C	0.2 $^{\circ}$ C	
	Pt 385, 500 Ω		
	(-200 to -80) $^{\circ}$ C	0.05 $^{\circ}$ C	
	(-80 to 100) $^{\circ}$ C	0.06 $^{\circ}$ C	
	(100 to 260) $^{\circ}$ C	0.08 $^{\circ}$ C	
(260 to 400) $^{\circ}$ C	0.1 $^{\circ}$ C		
(400 to 600) $^{\circ}$ C	0.12 $^{\circ}$ C		
(600 to 630) $^{\circ}$ C	0.14 $^{\circ}$ C		

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Electrical Calibration of RTD Indicators ¹	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 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	0.04 °C 0.05 °C 0.07 °C 0.08 °C 0.1 °C 0.3 °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 Calibration of Thermocouple Indicating Systems ¹	Type B (600 to 800) °C (800 to 1 000) °C (1 000 to 1 550) °C (1 550 to 1 820) °C	0.51 °C 0.56 °C 0.49 °C 0.54 °C	Fluke 5520A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Electrical Calibration of Thermocouple Indicating Systems ¹	Type C		Fluke 5520A Multiproduct Calibrator
	(0 to 150) °C	0.49 °C	
	(150 to 650) °C	0.42 °C	
	(650 to 1 000) °C	0.51 °C	
	(1 000 to 1 800) °C	0.82 °C	
	(1 800 to 2 316) °C	1.4 °C	
	Type E		
	(-250 to -100) °C	0.82 °C	
	(-100 to -25) °C	0.26 °C	
	(-25 to 350) °C	0.23 °C	
	(350 to 650) °C	0.26 °C	
	(650 to 1 000) °C	0.34 °C	
	Type J		
	(-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 1200) °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 1000) °C	0.42 °C	
	(1000 to 1372) °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		

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Electrical Calibration of Thermocouple Indicating Systems ¹	Type R (0 to 250) °C	0.93 °C	Fluke 5520A Multiproduct Calibrator
	(250 to 400) °C	0.57 °C	
	(400 to 1 000) °C	0.54 °C	
	(1000 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	0.6 °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 - RF/Microwave

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
RF Power – Power Meter Reference	1 mW @ 50 MHz	0.4 % of Reading	HP 432A Power Meter and HP 8478B Power Sensor with HP 3458A Multimeter
RF Power – Measure ^{1,3}	(-20 to +20) dBm (10 to 30) MHz	2.4 % of Reading	E4418B Power Meter with 8481A Power Sensor
	30 MHz to 7 GHz	2.8 % of Reading	
	(7 to 18) GHz	3.7 % of Reading	
RF Power – Measure ^{1,3}	(-20 to +20) dBm (18 to 26.5) GHz	4 % of Reading +M	E4418B Power Meter with 8485A Power Sensor
	(-20 to +20) dBm (26.5 to 40) GHz (40 to 50) GHz	5 % of Reading +M 7.2 % of Reading +M	E4418B Power Meter with 8487A Power Sensor



Length – Dimensional Metrology

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Micrometers ^{1,2}	(0 to 12) in	(75 + 5L) μin	Gage Blocks Mitutoyo BE1-81-1F, Mitutoyo BE6-81-2F
Calipers ^{1,2}	(0 to 24) in	(170 + 5L) μin	
Indicators ^{1,2}	(0 to 2) in	(140 + 5L) μin	
Height and Depth Gages ²	(0 to 12) in	(140 + 5L) μin	
Height and Depth Gages ^{1,2}	(12 to 24) in	(180 + 5L) μin	
Pins ²	(0.05 to 1) in	(35 + 5L) μin	Gage Blocks Mitutoyo BE1-81-1F, SMM-1
Plain Ring Gauges ²	(0 to 4) in	(48 + 5L) μin	Gage Blocks Mitutoyo BE1-81-1F, Federal ID Comparator
V-Blocks Parallelism Squareness	Up to 10 in Up to 10 in	100 μin 100 μin	Gage Blocks Mitutoyo BE1-81-1F, Starrett Comparator Master Square
Thickness Gage (Feeler Type)	(0.000 5 to 0.05) in	51 μin	Gage Blocks Mitutoyo BE1-81-1F, SMM-1
Radius Gage	Up to 1 in	0.000 5 in	Optical Comparator, GM4
Clinometer/Protractor	Up to 45 °	0.08 °	Brunson 470 Calibration Sine Bar , Gage Blocks, Sine Bars
Micrometer Heads ²	(0 to 2) in	(75 + 5L) μin	Gage Blocks Mitutoyo BE1-81-1F, Mitutoyo BE6-81-2F
Master Height Gage ²	(0 to 18) in	(40 + 5L) μin	
Level	Up to 1 000 arc sec	1 arc sec	Brunson 470 Calibration Sine Bar
Angle	(0 to 90) °	0.08 °	Optical Comparator



Mass and Mass-Related

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Pressure Gages	(2 to 25) psi (25 to 100) psi (100 to 500) psi (500 to 10 000) psi	0.3 % of Setting 0.05 % of Setting 0.02 % of Setting 0.15 % of Setting	Druck DPI 515 Pressure Controller, Pneumatic Deadweight Tester T2300/3, Ashcroft 1305B Deadweight Tester
Scales and Balances ^{1,2}	Up to 20 mg (20 to 500) mg (0.5 to 5) g	6 mg/g + 0.6R 60 µg/g + 0.6R 20 µg/g + 0.6R	Class 1, 3 and 4 Weights Mettler UMT2 Balance
	(5 to 50) g (50 to 500) g	32 µg/g + 0.6R 2 µg/g + 0.6R	Class 1, 3 and 4 Weights Mettler AE240 Balance
	(0.5 to 5) kg (5 to 15) kg (15 to 30) kg	0.4 mg/g + 0.6R 40 µg/g + 0.6R 13 µg/g + 0.6R	Class 1, 3 and 4 Weights Sartorius CP 34001S Balance
	Up to 1 000 lbs	0.5 µg/g + 0.6R	Class F Weights
Torque	(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, Mass, Torque Arms
Force Gages Tension/Compression	(0.1 to 500) lbf	1 % of Reading	Class F Weights
Mass Measurement	1 mg to 2.1 g (2.1 to 210) g 211 g to 4.1 kg (4.1 to 34) kg	0.01 mg 0.1 mg 0.1 g 1 g	Balances and ASTM Class 1 Weight Set
Mass Flow Rate	(0.1 to 100) SLM	1.5 % of Setting	DHI Flow System
Pipettes	(0.1 to 2.0) µL (2.1 to 5.0) µL (5.1 to 10.0) µL (10.1 to 20.0) µL	0.029 µL 0.039 µL 0.058 µL 0.1 µL	Gravimetric Method using Balances and Weights
Pipettes ¹	(20.1 to 50.0) µL (50.1 to 100.0) µL (100.1 to 200.0) µL (200.1 to 500.0) µL (500.1 to 1 000.0) µL (1 000.1 to 2 500.0) µL (2 500.1 to 5 000.0) µL (5 000.1 to 10 000) µL	0.83 µL 0.96 µL 1.2 µL 1.9 µL 3.1 µL 6.9 µL 13 µL 39 µL	



Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature - Source and Measure	(-95 to 660) °C	0.08 °C	Hart 1502 Indicator and 5628 PRT Fluke 9190A Well and Hart 9173 Dryblock
Temperature – Source and Measure ²	(-200 to 400) °C	0.1 °C	Hart 1521 Thermometer and 5627-6 or 5623A-6 PRT Hart 9141 Drywell
Infrared Measure	(50 to 100) °C (100 to 200) °C (200 to 300) °C (300 to 400) °C (400 to 500) °C	1.4 °C 2.4 °C 3.5 °C 4.7 °C 5.5 °C	Hart 9132 Blackbody and Hart 1502A Indicator with 5618B PRT
Relative Humidity - Source	(11 to 20) %RH (20 to 40) %RH (40 to 70) %RH (70 to 80) %RH (80 to 90) %RH	0.65 %RH 0.7 %RH 0.73 %RH 0.75 %RH 1.1 %RH	Thunder Scientific 2500 Temperature/Humidity Chamber
Relative Humidity - Measure ¹	(10 to 90) %RH	1.6 %RH	Rotronic HP23-A HydroPalm/HC2-HK25 Temperature/Humidity Indicator

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency - Oscillator Characterization	10 MHz	5 parts in 10 ¹¹ MHz	Symmetricom Xli GPS Receiver
Frequency – Measure ¹	10 MHz to 26.5 GHz (26.5 to 46) GHz	(0.19 to 70) µHz/Hz of reading (40 to 70) µHz/Hz of reading	HP 5345A Counter, HP 5355A Converter, HP 5356A Converter HP 53149A Counter



Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Digital Stopwatch/Timer	(0 to 86 400) seconds/day	0.085 seconds/day	Helmut-Klein 4500 Timometer, NIST 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. L = length in inches, R = resolution of the device under test, % = percent of reading unless otherwise indicated.
3. Mismatch uncertainty is denoted by M . E4418B and 8481A do not include the mismatch uncertainty, 0 dBm referenced at 1 mW.
4. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-1768.



Vice President