CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

E2b Calibration, LLC

521 Fifth Avenue
Chardon, OH 44024

Fulfills the requirements of

ISO/IEC 17025:2017

and national standard

ANSI/NCSL Z540-1-1994 (R2002)

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.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 23 February 2021
Certificate Number: AC-1287

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)

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CALIBRATION

Valid to: **February 23, 2021** Certificate Number: **AC-1287**

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Measure [1,3]	Up to 100 mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 300) V (300 to 500) V (500 to 700) V 700 V to 1 kV	1.5 µV 13 µV 45 µV 1.1 mV 8.7 mV 13 mV 18 mV 24 mV	HP 3458A (Opt 002) Multimeter
DC Voltage – Measure [1,3]	(1 to 10) kV	1.7 V/kV + 0.1 V	Ross VD15 Voltage Divider, HP 34401A Multimeter
	(10 to 60) kV	1.6 V/kV + 0.2 V	Ross VD60 Voltage Divider, HP34401A Multimeter
	(60 to 141) kV	1.8 V/kV + 8.8 V	Ross VMP200 Voltage Divider, Fluke 187 Multimeter
DC Voltage - Source[1,3,5]	Up to 330 mV 330 mV to 3.3 V (3.3 to 33) V (33 to 330) V 330 V to 1.02 kV	12 µV/V + 1 µV 7 µV/V + 2 µV 8 µV/V + 15 µV 12 µV/V + 0.12 mV 11 µV/V + 1.3 mV	Fluke 5522A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current - Measure[1,3]	Up to 100 µA 100 µA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	4.3 nA 39 nA 0.39 µA 5.6 µA 0.15 mA	HP 3458A (Opt 002) Multimeter
DC Current - Measure[1,3]	(1 to 14) A (14 to 30) A	1.5 mA 2.1 mA	HP 3458A (Opt 002) Multimeter with IET DCCS-0.01 and DCCS-0.001 Shunts
DC Current – Source[1,3,5]	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	94 µA/A + 20 nA 62 µA/A + 50 nA 64 µA/A + 0.19 µA 64 µA/A + 1.9 µA 0.13 mA/A + 30 µA 0.24 mA/A + 30 µA 0.31 mA/A + 0.36 mA 0.7 mA/A – 0.18 mA	Fluke 5522A Multiproduct Calibrator
AC Voltage – Measure[1,3]	Up 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 300 kHz to 1 MHz (1 to 4) MHz (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 (2 to 8) MHz (8 to 10) MHz	 9.8 µV 6.6 µV 7.7 µV 17 µV 62 µV 470 µV 160 µV 170 µV 15 µV 13 µV 21 µV 40 µV 97 µV 370 µV 1.2 mV 1.9 mV 4.8 mV 18 mV	HP 3458A (Opt 002) Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure[1,3]	100 mV to 1 V		HP 3458A (Opt 002) Multimeter
	(1 to 40) Hz	150 µV	
	40 Hz to 1 kHz	120 µV	
	(1 to 20) kHz	210 µV	
	(20 to 50) kHz	390 µV	
	(50 to 100) kHz	970 µV	
	(100 to 300) kHz	3.7 mV	
	300 kHz to 1 MHz	12 mV	
	(1 to 2) MHz	19 mV	
	(2 to 8) MHz	48 mV	
	(8 to 10) MHz	180 mV	
	(1 to 10) V		
	(1 to 40) Hz	2.5 mV	
	40 Hz to 1 kHz	1.2 mV	
	(1 to 20) kHz	2.1 mV	
	(20 to 50) kHz	3.9 mV	
	(50 to 100) kHz	9.7 mV	
	(100 to 300) kHz	37 mV	
	300 kHz to 1 MHz	120 mV	
	(1 to 2) MHz	180 mV	
	(2 to 8) MHz	480 mV	
	(8 to 10) MHz	1.8 V	
	(10 to 100) V		
	40 Hz to 20 kHz	28 mV	
	(20 to 50) kHz	45 mV	
	(50 to 100) kHz	150 mV	
	100 V to 1 kHz		
	40 Hz to 1 kHz	0.46 mV/V + 39 mV	
	(1 to 20) kHz	0.73 mV/V + 0.75 mV	
AC Voltage – Measure[1]	(1 to 10) kV 60 Hz	7.2 V/kV + 2.9 V	Ross VD15 Voltage Divider, HP 34401A Multimeter
	(10 to 42) kV 60Hz	6.2 V/kV + 7.9 V	Ross VD60 Voltage Divider, HP34401A Multimeter
	(42 to 106) kV 60 Hz	16 V/kV + 6 V	Ross VMP200 Voltage Divider, Fluke 187 Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage - Source[1,3,5]	Up to 33 mV		Fluke 5522A Multiproduct Calibrator
	(10 to 45) Hz	0.46 mV/V + 5 µV	
	45 Hz to 10 kHz	94 µV/V + 5 µV	
	(10 to 20) kHz	0.13 mV/V + 5 µV	
	(20 to 50) kHz	0.65 mV/V + 5 µV	
	(50 to 100) kHz	2.4 mV/V + 10 µV	
	(100 to 500) kHz	4.9 mV/V + 40 µV	
	(33 to 330) mV		
	(10 to 45) Hz	0.2 mV/V + 7 µV	
	45 Hz to 10 kHz	0.11 mV/V + 7 µV	
	(10 to 20) kHz	0.12 mV/V + 8 µV	
	(20 to 50) kHz	0.23 mV/V + 8 µV	
	(50 to 100) kHz	0.47 mV/V + 25 µV	
	(100 to 500) kHz	1.3 mV/V + 55 µV	
	330 mV to 3.3 V		
	(10 to 45) Hz	0.2 mV/V + 45 µV	
	45 Hz to 10 kHz	0.11 mV/V + 47 µV	
	(10 to 20) kHz	0.13 mV/V + 46 µV	
	(20 to 50) kHz	0.2 mV/V + 45 µV	
	(50 to 100) kHz	0.43 mV/V + 0.11 mV	
	(100 to 500) kHz	1.6 mV/V + 0.48 mV	
	(3.3 to 33) V		
	(10 to 45) Hz	0.2 mV/V + 0.55 mV	
	45 Hz to 10 kHz	0.1 mV/V + 0.47 mV	
	(10 to 20) kHz	0.17 mV/V + 0.53 mV	
	(20 to 50) kHz	0.24 mV/V + 0.51 mV	
	(50 to 100) kHz	0.6 mV/V + 1.3 mV	
	(33 to 330) V		
	45 Hz to 1 kHz	0.12 mV/V + 1.6 mV	
	(1 to 10) kHz	0.13 mV/V + 4.7 mV	
	(10 to 20) kHz	0.17 mV/V + 5.3 mV	
	(20 to 50) kHz	0.19 mV/V + 4.7 mV	
	(50 to 100) kHz	1.3 mV/V + 39 mV	
	330 V to 1.02 kV		
	45 Hz to 1 kHz	0.21 mV/V + 4 mV	
	(1 to 5) kHz	0.17 mV/V + 5 mV	
	(5 to 10) kHz	0.21 mV/V + 4 mV	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current - Source[1,3,5]	(29 to 330) µA		Fluke 5522A Multiproduct Calibrator
	(10 to 20) Hz	0.13 % of reading + 0.09 µA	
	(20 to 45) Hz	0.13 % of reading + 0.08 µA	
	45 Hz to 1 kHz	0.08 % of reading + 0.09 µA	
	(1 to 5) kHz	0.13 % of reading + 0.08 µA	
	(5 to 10) kHz	0.47 % of reading + 0.16 µA	
	(10 to 30) kHz	0.94 % of reading + 0.31 µA	
	330 µA to 3.3 mA		
	(10 to 20) Hz	0.13 % of reading + 0.12 µA	
	(20 to 45) Hz	0.08 % of reading + 0.11 µA	
	45 Hz to 1 kHz	0.07 % of reading + 0.12 µA	
	(1 to 5) kHz	0.13 % of reading + 0.15 µA	
	(5 to 10) kHz	0.33 % of reading + 0.19 µA	
	(10 to 30) kHz	0.63 % of reading + 0.49 µA	
	(3.3 to 33) mA		
	(10 to 20) Hz	0.12 % of reading + 1.6 µA	
	(20 to 45) Hz	0.06 % of reading + 1.6 µA	
	45 Hz to 1 kHz	0.03 % of reading + 1.6 µA	
	(1 to 5) kHz	0.054 % of reading + 1.5 µA	
	(5 to 10) kHz	0.13 % of reading + 2.3 µA	
	(10 to 30) kHz	0.25 % of reading + 3.7 µA	
	(33 to 330) mA		
	(10 to 20) Hz	0.12 % of reading + 16 µA	
	(20 to 45) Hz	0.06 % of reading + 16 µA	
	45 Hz to 1 kHz	0.03 % of reading + 16 µA	
	(1 to 5) kHz	0.065 % of reading + 39 µA	
	(5 to 10) kHz	0.13 % of reading + 78 µA	
	(10 to 30) kHz	0.25 % of reading + 0.16 mA	
	330 mA to 1.1 A		
	(10 to 45) Hz	0.13 % of reading + 70 µA	
	45 Hz to 1 kHz	0.028 % of reading + 90 µA	
	(1 to 5) kHz	0.4 % of reading + 0.76 mA	
	(5 to 10) kHz	1.6 % of reading + 4 mA	
	(1.1 to 3) A		
	(10 to 45) Hz	0.12 % of reading + 0.1 mA	
	45 Hz to 1 kHz	0.042 % of reading + 50 µA	
	(1 to 5) kHz	0.42 % of reading + 0.5 mA	
	(5 to 10) kHz	1.6 % of reading + 4.4 mA	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current - Source[1,3,5]	(3 to 11) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz (11 to 20.5) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	 0.04 % of reading + 1.6 mA 0.062 % of reading + 1.6 mA 2 % of reading 0.071 % of reading + 5.6 mA 0.11 % of reading + 3.3 mA 2 % of reading	Fluke 5522A Multiproduct Calibrator
AC Current - Measure[1,3]	Up to 100 µA (10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz 100 µA to 1 mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (1 to 10) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (10 to 100) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz 100 mA to 1 A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	 0.5 µA 0.21 µA 0.11 µA 4.9 µA 1.8 µA 0.74 µA 0.41 µA 49 µA 18 µA 7.4 µA 4.1 µA 0.49 mA 0.18 mA 73 µA 0.04 mA 4.9 mA 1.9 mA 1 mA 1.3 mA	HP 3458A (Opt 002) Multimeter
AC Current – Measure[1,3]	(1 to 20) A 40 Hz to 1 kHz	 3.1 mA/A + 6.6 mA	HP 3458A (Opt 002) Multimeter with Agilent 34330A Shunt
Inductance - Source[1]	50 µH 1 000 µH 5 H	0.32 µH 2 µH 0.014 H	GenRad Fixed Inductors

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Inductance - Measure[1]	100 µH to 1 mH (1 to 10) mH (10 to 100) mH 100 mH to 1 H (1 to 10) H	0.20 nH 2.4 µH 2.4 µH 0.24 mH 2.4 mH	RLC Bridge GenRad 1689
Capacitance - Measure[1]	Up to 1 nF (1 to 10) nF (10 to 100) nF 100 nF to 1 µF (1 to 1.111) µF	0.2 pF 2.4 pF 24 pF 0.24 nF 0.29 nF	RLC Bridge GenRad 1689
Capacitance – Source[1,3,5] 10 Hz to 10 kHz 10 Hz to 3 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz (10 to 50) Hz (10 to 20) Hz (0 to 6) Hz (0 to 2) Hz (0 to 0.6) Hz (0 to 0.2) Hz	 220 pF to 1.1 nF (1.1 to 3.3) nF (3.3 to 11) nF (11 to 110) pF (110 to 330) nF 330 nF to 1.1 µF (1.1 to 3.3) µF (3.3 to 11) µF (11 to 33) µF (33 to 110) µF (110 to 330) µF 330 µF to 1.1 mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	 0.32 % of reading + 8 pF 0.32 % of reading + 8 pF 0.15 % of reading + 9 pF 0.15 % of reading + 79 pF 0.15 % of reading + 0.24 pF 0.15 % of reading + 0.81 nF 0.15 % of reading + 2.4 nF 0.15 % of reading + 9 nF 0.23 % of reading + 25 nF 0.27 % of reading + 81 nF 0.27 % of reading + 0.24 µF 0.27 % of reading + 0.81 µF 0.27 % of reading + 2.4 µF 0.27 % of reading + 8.1 µF 0.58 % of reading + 20 µF 0.97 % of reading + 44 µF	Fluke 5522A Multiproduct Calibrator
DC Resistance - Source[1,3,5]	Up to 11 Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω 330 Ω to 1.1 kΩ (1.1 to 3.3) kΩ (3.3 to 11) kΩ (11 to 33) kΩ (33 to 110) kΩ (110 to 330) kΩ 330 k Ω to 1.1 MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ	29 µΩ/Ω + 0.8 mΩ 19 µΩ/Ω + 1.2 mΩ 17 µΩ/Ω + 1.2 mΩ 17 µΩ/Ω + 1.6 mΩ 18µΩ/Ω + 1.4 mΩ 18 µΩ/Ω + 16 mΩ 18 µΩ/Ω + 14 mΩ 18 µΩ/Ω + 0.16 Ω 18 µΩ/Ω + 0.14 Ω 20 µΩ/Ω + 1.6 Ω 20 µΩ/Ω + 1.6 Ω 33 µΩ/Ω + 22 Ω 86 µΩ/Ω + 40 Ω 0.16 mΩ/Ω + 2 kΩ	Fluke 5522A Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Resistance - Source[1,3,5]	(33 to 110) MΩ (110 to 330) MΩ 330 MΩ to 1.1 GΩ	0.32 mΩ/Ω + 2.3 kΩ 2 mΩ/Ω + 76 kΩ 9.8 mΩ/Ω + 0.3 MΩ	Fluke 5522A Multiproduct Calibrator
DC Resistance - Measure[1,3]	Up to 10 Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ	0.36 mΩ 2.7 mΩ 19 mΩ 0.19 Ω 2 Ω 30 Ω 0.85 kΩ 64 kΩ	HP 3458A (Opt 002) Multimeter
Oscilloscopes [1,2,3] Amplitude - DC 50 Ω 1 MΩ Amplitude - Square Wave 50 Ω 1 MΩ Amplitude - DC Leveled Sine Wave Relative to 50 kHz Amplitude Flatness Time Marker Rise Time	 (-6.6 to 6.6) V (-130 to 130) V 1 mV to 6.6 V (p-p) 1 mV to 130 V (p-p) 50 kHz reference 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz 600 MHz to 1.1 GHz 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz 600 MHz to 1.1 GHz 5 s to 50 ms 20 ms to 2 ns ≤ 300 ps	 6.5 mV/V + 40 µV 6 mV/V + 40 µV 6.5 mV/V + 40 µV 6.1 mV/V + 40 µV 20 mV/V + 0.3 mV 35 mV/V + 0.3 mV 40 mV/V + 0.3 mV 60 mV/V + 0.3 mV 70 mV/V + 0.3 mV 16 mV/V + 0.1 mV 21 mV/V + 0.1 mV 40 mV/V + 0.1 mV 50 mV/V + 0.1 mV (2 500 + 1 000*t*) µs/s 2.5 ms/s +0/-100 ps	 Fluke 5522A/SC1100 Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicators[1,3,5]	Type B		Fluke 5522A Multiproduct Calibrator
	(600 to 800) °C	0.33 °C	
	(800 to 1 000) °C	0.27 °C	
	(1 000 to 1 550) °C	0.24 °C	
	(1 550 to 1 820) °C	0.18 °C	
	Type C		
	(0 to 150) °C	0.18 °C	
	(150 to 650) °C	0.15 °C	
	(650 to 1 000) °C	0.18 °C	
	(1 000 to 1 800) °C	0.3 °C	
	(1 800 to 2 316) °C	0.49 °C	
	Type E		
	(-250 to -100) °C	0.3 °C	
	(-100 to -25) °C	0.1 °C	
	(-25 to 350) °C	0.08 °C	
	(350 to 650) °C	0.1 °C	
	(650 to 1 000) °C	0.13 °C	
	Type J		
	(-210 to -100) °C	0.16 °C	
	(-100 to -30) °C	0.1 °C	
	(-30 to 150) °C	0.08 °C	
	(150 to 760) °C	0.11 °C	
	(760 to 1 200) °C	0.14 °C	
	Type K		
	(-200 to -100) °C	0.2 °C	
	(-100 to -25) °C	0.11 °C	
	(-25 to 120) °C	0.1 °C	
	(120 to 1 000) °C	0.15 °C	
	(1 000 to 1 372) °C	0.24 °C	
	Type L		
	(-200 to -100) °C	0.29 °C	
	(-100 to 800) °C	0.21 °C	
	(800 to 900) °C	0.14 °C	
	Type N		
	(-200 to -100) °C	0.24 °C	
	(-100 to -25) °C	0.14 °C	
	(-25 to 120) °C	0.12 °C	
	(120 to 410) °C	0.11 °C	
	(410 to 1 300) °C	0.17 °C	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicators[1,3,5]	Type R (0 to 250) °C (250 to 400) °C (400 to 1 000) °C (1 000 to 1 767) °C Type S (0 to 250) °C (250 to 1 000) °C (1 000 to 1 400) °C (1 400 to 1 767) °C Type T (-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C Type U (-200 to 0) °C (0 to 600) °C	 0.38 °C 0.22 °C 0.21 °C 0.24 °C 0.37 °C 0.24 °C 0.22 °C 0.27 °C 0.38 °C 0.14 °C 0.1 °C 0.08 °C 0.44 °C 0.21 °C	Fluke 5522A Multiproduct Calibrator
Phase Angle - Source[1,3,5]	(0 to 360) ° (10 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	 0.08 ° 0.2 ° 0.39 ° 2 ° 3.9 ° 7.8 °	Fluke 5522A Multiproduct Calibrator

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Power - Measure[1,3,4] Up to 18 GHz	(-70 to -30) dBm 50 MHz to 8 GHz (8 to 20) GHz (20 to 26.5) GHz (-30 to +20) dBm 100 kHz to 2.5 GHz (2.5 to 4.2) GHz (4.2 to 13) GHz (13 to 19) GHz (19 to 26.5) GHz	 0.15 dB 0.2 dB 0.25 dB 0.037 dB 0.041 dB 0.082 dB 0.12 dB 0.14 dB	Agilent E4418B Power Meter with Agilent 8485D, 8482A, and 8485A Power Sensors

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Amplitude Modulation[1] - Measure	(5 to 99) %Depth 150 kHz to 10 MHz 10 MHz to 1.3 GHz	 2.4 %Depth 1.2 %Depth	HP 8902A Measuring Receiver
Frequency Modulation[1] - Measure	(5 to 99) %Deviation 150 kHz to 10 MHz 10 MHz to 1.3 GHz	 2.4 % of reading 1.2 % of reading	HP 8902A Measuring Receiver
Phase Modulation[1] - Measure	(5 to 99) % Deviation 150 kHz to 10 MHz 10 MHz to 1.3 GHz	 3.6 % of reading 3.6 % of reading	
Tuned RF Level Attenuation[1,4] - Measure	2.5 MHz to 1.3 GHz (-10 to 0) dBm (-20 to -10) dBm (-30 to -20) dBm (-40 to -30) dBm (-50 to -40) dBm (-60 to -50) dBm (-70 to -60) dBm (-80 to -70) dBm (-90 to -80) dBm (-100 to -90) dBm (-120 to -100) dBm	 0.04 dB 0.052 dB 0.067 dB 0.081 dB 0.095 dB 0.11 dB 0.13 dB 0.15 dB 0.16 dB 0.18 dB 0.19 dB	HP 8902A Measuring Receiver with HP 11722A Power Sensor
Harmonics - Measure[1]	(-80 to 0) dB 30 Hz to 6.5 GHz	 1 dB	HP 8561E Spectrum Analyzer
AM Distortion - Measure[1]	(-80 to 0) dB 20 Hz to 20 kHz (20 to 100) kHz	 1.2 dB 2.4 dB	HP 8903B Audio Analyzer
FM Distortion - Measure[1]	(-80 to 0) dB 20Hz to 20 kHz (20 to 100) kHz	 1.2 dB 2.4 dB	

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Calipers[1,2]	(0 to 6) in (6 to 60) in	(123 + 4.9*L*) µin (457 + 9.6*L*) µin	Gage Blocks
Micrometers[1,2]	(0 to 1) in (1 to 4) in (4 to 40) in	63 µin (78 + 5.3*L*) µin (780 + 5.2*L*) µin	Gage Blocks

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Dial Indicators[1,2] Resolution: 0.000 05 in 0.001 in	 Up to 1 in Up to 4 in	 (66 + 41.7*L*) µin (84 + 1357*L*) µin	Gage Blocks

Mass and Mass-Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pressure Gages & Transducers[1,3]	(0.2 to 50) psi (0.2 to 50) psig	0.001 2 % of reading	Ruska 2465A Piston Gauge
	(29 to 300) psia	0.14 % of reading	Druck DPI-145 Pressure indicator
Pressure Gages & Transducers[1,3]	(50 to 15 000) psi	0.03 % of reading	TD-4000N Deadweight Tester
Vacuum[1,3]	(-15 to 50) psi	0.001 2 % of reading	Ruska 2465A Piston Gauge
Mass Flow[1]	(5 to 500) SCCM (500 to 50 000) SCCM	0.3 % of reading 0.3 % of reading	ML-800-10 Flow Cell ML-800-45 Flow Cell
	(0.7 to 7) SCFM (7 to 35) SCFM (35 to 90) SCFM	0.61 % of reading 0.65 % of reading 0.67 % of reading	Cox 16-064 Sonic Nozzle Cox 16-121 Sonic Nozzle Cox 16-228 Sonic Nozzle
Pipettes[3]	Up to 20 uL (20 to 50) uL (50 to 100) uL (100 to 200) uL (200 to 500) uL (500 to 1 000) uL	0.065 µL 0.066 µL 0.069 µL 0.08 µL 0.14 µL 0.24 µL	A&D 4212B-101 Balance and Software
Torque Transducers[1,3]	(0.5 to 10) lbf·in	0.03 % of reading + 0.000 1 lbf·in	F-Class Weights, 4 in Torque Wheel
	(10 to 1 920) lbf·in	0.018 % of reading + 0.000 1 lbf·in	F-Class Weights, 10 in Torque Wheel
Torque Transducers[1,3]	(160 to 1 000) lbf·ft	0.24 % of reading + 0.01 lbf·ft	F-Class Weights, 4 ft Torque Arm
Torque Tools[1]	(10 to 96) ozf·in	0.6 % of reading	AIMCO UET-0100 Torque Tester
	(6 to 96) lbf·in	0.6 lbf·in	HIOS HP-100 Torque Tester

Mass and Mass-Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Torque Tools[1]	(8 to 295) lbf·ft	0.6 % of reading + 0.03 lbf·ft	Norbar Pro Test 400 (43219)
	(295 to 1 100) lbf·ft	1.2 % of reading	Norbar Pro Test 1500ER (43189)
Force[1,3] - Compression & Tension	(0 to 50) lbf	0.006 lbf	Class F Weights
	(50 to 1 000) lbf	0.31 lbf	1 000 lbf Interface Load Cell
	(1 000 to 10 000) lbf	2.5 lbf	10 000 lbf Interface Load Cell
	(10 000 to 50 000) lbf	13 lbf	50 000 lbf Interface Load Cell
Force[1,3] - Compression & Tension	Up to 20 lb (20 to 50) lb (50 to 100) lb (100 to 200) lb (200 to 400) lb (400 to 600) lb	1.5 g 3.8 g 7.5 g 15 g 30 g 45 g	Class F Weights
Laboratory Balances[1,6]	Up to 2 mg (2 to 10) mg (10 to 20) mg (20 to 100) mg (100 to 200) mg (200 to 500) mg 500 mg to 1 g	0.029 mg 0.035 mg 0.041 mg 0.058 mg 0.07 mg 0.093 mg 0.12 mg	Class 3 Weights
	(1 to 5) g (5 to 10) g (10 to 20) g (20 to 50) g (50 to 100) g (100 to 200) g (200 to 500) g	0.022 mg 0.03 mg 0.044 mg 0.083 mg 0.16 mg 0.3 mg 0.72 mg	Ultra-Class Weights
Scales[1,6]	500 g to 1 kg (1 to 2) kg (2 to 5) kg (5 to 10) kg (10 to 25) kg (25 to 40) kg	2.9 mg 3.1 mg 15 mg 33 mg 74 mg 82 mg	Class 1 Weights

Mass and Mass-Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scales[1,6]	Up to 20 lb (20 to 50) lb (50 to 100) lb (100 to 200) lb (200 to 400) lb (400 to 600) lb	1.1 g 2.7 g 5.4 g 11 g 22 g 32 g	Class F Weights

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Humidity - Measure[1]	(0 to 90) %RH (90 to 100) %RH	1.3 %RH 2.2 %RH	Vaisala HMP-363 Transmitter
Humidity - Source[1]	11.3 %RH 32.9 %RH 75.4 %RH 96.7 %RH	1.3 %RH 1.3 %RH 1.3 %RH 2.2 %RH	Vaisala HMP-363 Transmitter, Saturated Salt Solutions
Temperature - Measure[1]	(-200 to 0) °C (0 to 200) °C (200 to 600) °C	28 mK (0.028 °C) 36 mK (0.036 °C) 56 mK (0.056 °C)	Fluke 5628 SPRT, HP 3457A Multimeter
Temperature - Source[1]	(0 to 125) °C	36 mK (0.036 °C)	Ametek ETC-125 Dryblock, Fluke 5628 SPRT, HP 3457A Multimeter

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency - Source[1,3]	1 µHz to 250 kHz	70 pHz/Hz + 0.58 µHz	Agilent 33220A Signal Generator Locked to Datum LPRO Rubidium Freq Std
	250 kHz to 3 GHz	70 pHz/Hz + 5.8 mHz	HP ESG-D3000A Signal Generator locked to Datum LPRO Rubidium Freq Std

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency - Measure[1,3]	100 mHz to 225 MHz	70 pHz/Hz + 58 mHz	Agilent 53131A Counter locked to Datum LPRO Rubidium Freq Std
Frequency - Measure[1,3]	225 MHz to 26.5 GHz	70 pHz/Hz + 0.58 Hz	HP 5348A Counter locked to Datum LPRO Rubidium Freq Std

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, t = time in seconds.
3. Uncertainties do not include contributors from a "best available" unit under test.
4. The uncertainty does not include the mismatch uncertainty. This will be determined and reported at time of calibration. The reported uncertainty will be higher than listed.
5. These scope uncertainties are based on the 90-day specifications of the Fluke 5522A Multiproduct Calibrator which are not always available. If lower uncertainties based on these 90-day specifications rather than the 1-year specification is required, contact the laboratory for scheduling availability.
6. The uncertainties for scales and balances are highly dependent upon the resolution of the unit under test. The uncertainties presented here do not include the resolution of the unit under test. The resolution will be included in the reported measurement uncertainty at the time of calibration
7. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-1287.