



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005  
& ANSI/NCSL Z540-1-1994

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CALIBRATION

Valid To: March 31, 2020

Certificate Number: 2147.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1</sup>:

I. Acoustical Quantities

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Sound Pressure <sup>3</sup>	94 dB 114 dB	0.28 dB 0.28 dB	Sound calibrator

II. Chemical

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
pH <sup>3</sup>	4 pH 7 pH 10 pH	0.017 pH 0.012 pH 0.019 pH	pH solution
Conductivity <sup>3</sup>	10 µS/cm 1413 µS/cm 10 mS/cm 100.9 mS/cm	4.4 µS/cm 9.8 µS/cm 0.15 mS/cm 2.2 mS/cm	Conductivity solutions

### III. Dimensional

Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
Bore Gages <sup>3</sup>	Up to 4 in (4 to 8) in	85 µin 140 µin	Master ring gauges
Calipers <sup>3</sup> – Dial, Digital, Vernier	Up to 6 in (6 to 12) in (12 to 48) in	480 µin 710 µin 950 µin	Gage blocks
Depth Gage <sup>3</sup> – Dial, Digital, Vernier	(0.001 to 6) in	59 µin	Gage blocks
Dimensional Measurement			Vision System
Linear	Up to 10) mm (10 to 100) mm (100 to 300) mm	0.0021 mm 0.0025 mm 0.0035 mm	
Volumetric	(300 200 150) mm	0.0041 mm	
Gage Blocks	Up to 1.0 in (1 to 12) in	4.1 µin (4.1 + 1.3L) µin	P&W Labmaster™, gage blocks
Height Gages <sup>3</sup>	Up to 12 in (12 to 24) in	790 µin 900 µin	Gage blocks
Indicator <sup>3</sup>	(0.000 01 to 2) in	35 µin	Gage blocks, surface plate
Length Standards	Up to 4 in (4 to 24) in (24 to 48) in (48 to 96) in	41 µin 62 µin 120 µin 590 µin	P&W Labmaster™, gage blocks
Length Standards <sup>3</sup>	Up to 4 in (4 to 24) in (24 to 48) in (48 to 96) in	130 µin 160 µin 230 µin 620 µin	Micrometer Head, gage blocks
Measuring Rule <sup>3</sup>	Up to 36 in (76.2 to 1000) mm	0.002 in 0.063 mm	Master rule



Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Bore Gages <sup>3</sup>	Up to 4 in (4 to 8) in	85 μin 140 μin	Master ring gages
Micrometers <sup>3</sup> –			Gage blocks
OD	Up to 6 in (6 to 12) in	83 μin 190 μin	
ID	Up to 12 in	930 μin	
Optical Comparators <sup>3</sup>			
Angularity	0° to 180°	0.81 arcmin	Sine plate, gage blocks
Linear	Up to 6 in (6 to 12) in	200 μin 220 μin	Glass scales
Magnification	Up to 50X	730 μin	Magnification scale
Plain Gage –			P&W Labmaster™, gage blocks
Pin & Plug	(0.01 to 1) in (1 to 4) in	7.1 μin 9.6 μin	
Ring	Up to 1 in (1 to 4) in (4 to 8) in	8.4 μin 18 μin 26 μin	
Plain Gage <sup>3</sup> –	(0.01 to 1) in (1 to 4) in	150 μin 190 μin	Micrometer
Pin & Plug			
Protractor <sup>3</sup>	Up to 180°	0.010°	Surface plate, sine bar, gage blocks
Sine Bar	(5 to 10) in	44 μin	Surface plate, gage blocks
Surface Plate <sup>3</sup>			
Flatness	Up to 48 in (48 to 72) in	44 μin 55 μin	Electronic level
Repeatability	Up to 72 in	34 μin	Repeat-o-meter



Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
Thickness Gage <sup>3</sup> – Hard Ultrasonic	Up to 4 in (4 to 8) in (0.001 to 8) in	68 µin 77 µin 210 µin + 0.6R	P&W Labmaster™, gage blocks
Thread Gage – Thread Ring <sup>3</sup> Thread Plug <sup>3</sup> Major Diameter Pitch Diameter Thread Wire	Up to 4 in Up to 1 in Up to 1 in (80 to 6) TPI	210 µin 79 µin 120 µin 15 µin	Master thread plugs P&W Lab Master™, gage blocks
Vision System <sup>3</sup> – Linear	Up to 100 mm	0.000 74 mm	Glass scale

#### IV. Electrical DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2,7</sup> (±)	Comments
DC Voltage <sup>3</sup> – Fixed Measure	10 V 0 V Short Up to 1 µV (1 to 10) µV (10 to 100) µV (0.1 to 1) mV (1 to 10) mV (10 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V (1 to 15) kV (15 to 90) kV	0.5 µV/V 0.61 µV/V 0.17 µV 0.17 µV 0.63 µV 0.63 µV 0.78 µV 1.6 µV 7.2 µV 0.54 mV 0.74 mV 8.9 mV 7.9 V 0.015 kV	Direct voltage standard DMM



Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
DC Voltage <sup>3</sup> –			
Generate	(0 to 100) $\mu$ V (0.1 to 1) mV (1 to 10) mV (10 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	0.5 $\mu$ V 0.52 $\mu$ V 0.64 $\mu$ V 1.3 $\mu$ V 6.1 $\mu$ V 0.034 mV 0.56 mV 7.6 mV	Multifunction calibrator
Transfer	0 to 100 mV (0.1 to 1) V 1 to 10) V 10 to 100) V 100 to 1000) V	1.0 $\mu$ V 4.3 $\mu$ V 0.037 mV 0.55 mV 5.5 mV	Transfer standard
DC Current <sup>3</sup> –			
Measure	(0 to 110) $\mu$ A (0.1 to 1.1) mA (1 to 11) mA (10 to 110) mA (0.1 to 1) A	0.041 $\mu$ A 0.072 $\mu$ A 0.6 $\mu$ A 6.6 $\mu$ A 0.18 mA	DMM
Current Shunt	Up to 1000 A 10 $\mu$ A 100 $\mu$ A 1 mA 10 mA 100 mA 1 A 1.9 A	1.2 A 7.1 nA 2.3 nA 0.023 $\mu$ A 0.23 $\mu$ A 1.7 $\mu$ A 0.22 $\mu$ A 0.045 $\mu$ A	High voltage DMM Voltmeter, current shunt
Generate	(0 to 1) $\mu$ A (1 to 10) $\mu$ A (10 to 110) $\mu$ A (0.1 to 1.1) mA (1 to 11) mA (10 to 110) mA (0.1 to 1) A (1 to 1.9) A (1.9 to 11) A (11 to 20) A	2.3 nA 3.2 nA 0.012 $\mu$ A 0.051 $\mu$ A 0.51 $\mu$ A 5.2 $\mu$ A 0.13 mA 0.21 mA 6.4 mA 0.022 A	Multifunction calibrator



Parameter/Equipment	Range	CMC <sup>2, 8</sup> (±)	Comments
DC Current <sup>3</sup> – Transfer	(0 to 100) $\mu$ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	2.3 nA 0.017 $\mu$ A 0.18 $\mu$ A 2.0 $\mu$ A 0.031 mA	Transfer standard
Resistance <sup>3</sup> –			
Fixed	10 m $\Omega$ 100 m $\Omega$ 1 $\Omega$ 10 k $\Omega$ 10 M $\Omega$ 1 G $\Omega$ 10 G $\Omega$ 100 G $\Omega$ 1 T $\Omega$	0.31 $\mu\Omega$ 2.8 $\mu\Omega$ 2.0 $\mu\Omega$ 7.9 m $\Omega$ 0.32 k $\Omega$ 0.56 M $\Omega$ 5.1 M $\Omega$ 0.13 G $\Omega$ 2.6 G $\Omega$	Reference resistors
Measure	(10 to 100) m $\Omega$ (0.1 to 1) $\Omega$ (1 to 10) $\Omega$ (10 to 100) $\Omega$ (0.1 to 1) k $\Omega$ (1 to 10) k $\Omega$ (10 to 100) k $\Omega$ (0.1 to 1) M $\Omega$ (0.32 to 10) M $\Omega$ (10 to 100) M $\Omega$	0.053 m $\Omega$ 0.076 m $\Omega$ 5.5 m $\Omega$ 0.017 $\Omega$ 0.011 $\Omega$ 2 $\Omega$ 2.2 $\Omega$ 0.017 k $\Omega$ 0.76 k $\Omega$ 0.059 M $\Omega$	DMM
Current Shunt	(0.8 to 80) $\Omega$ (0.08 to 8) k $\Omega$ (8 to 80) k $\Omega$	90 $\mu\Omega/\Omega$ 0.018 % 0.027 %	Voltmeter, current shunt
Generate	(1 to 10) $\Omega$ (10 to 100) $\Omega$ (0.1 to 1) k $\Omega$ (1 to 10) k $\Omega$ (10 to 100) k $\Omega$ (0.1 to 1) M $\Omega$ (1 to 10) M $\Omega$ (10 to 100) M $\Omega$ (0.1 to 1) G $\Omega$	1.1 m $\Omega$ 1.9 m $\Omega$ 0.023 $\Omega$ 0.051 $\Omega$ 0.049 $\Omega$ 5.2 $\Omega$ 0.19 k $\Omega$ 8 k $\Omega$ 9.9 M $\Omega$	Multifunction calibrator



Parameter/Equipment	Range	CMC <sup>2,7</sup> (±)	Comments
Resistance <sup>3</sup> – Transfer (cont)	Up to 1 Ω (1 to 10) Ω (0.01 to 190) kΩ (0.19 to 1.9) MΩ (1.9 to 19) MΩ (19 to 100) MΩ	74 μΩ/Ω 27 μΩ/Ω 7.9 μΩ/Ω 13 μΩ/Ω 21 μΩ/Ω 0.023 %	Transfer standard

Parameter/Range	Frequency	CMC <sup>2,7</sup> (±)	Comments
AC Voltage <sup>3</sup> – Measure			DMM
3 mV	(10 to 40) Hz (0.04 to 30) kHz (30 to 200) kHz (200 to 500) kHz 500 kHz to 1 MHz	0.3 μV 0.25 μV 0.57 μV 1.2 μV 3.3 μV	
10 mV	(10 to 40) Hz (0.04 to 30) kHz (30 to 200) kHz (200 to 500) kHz (0.5 to 1) MHz	0.3 μV 0.25 μV 0.57 μV 1.2 μV 1.2 μV	
30 mV	(10 to 40) Hz (0.04 to 30) kHz (30 to 200) kHz (200 to 500) kHz (0.5 to 1) MHz	0.4 μV 0.35 μV 1.9 μV 3.7 μV 9.0 μV	
100 mV	(10 to 40) Hz (0.04 to 30) kHz (30 to 200) kHz (200 to 500) kHz (0.5 to 1) MHz	4.0 μV 3.3 μV 0.019 mV 0.037 mV 0.09 mV	
300 mV	(1 to 2) Hz (2 to 10) Hz (10 to 40) Hz (0.04 to 30) kHz (30 to 200) kHz (200 to 500) kHz (0.5 to 1) MHz	0.11 mV 0.049 mV 9.9 μV 9.9 μV 0.057 mV 0.11 mV 0.27 mV	



Parameter/Range	Frequency	CMC <sup>2</sup> (±)	Comments
AC Voltage <sup>3</sup> – Measure (cont)			
1 V	(1 to 2) Hz (2 to 10) Hz (10 to 40) Hz (0.04 to 30) kHz (30 to 200) kHz (200 to 500) kHz (0.5 to 1) MHz	0.36 mV 0.17 mV 0.033 mV 0.032 mV 0.09 mV 0.34 mV 0.89 mV	DMM
3 V	(1 to 2) Hz (2 to 10) Hz (10 to 40) Hz (0.04 to 30) kHz (30 to 200) kHz (200 to 500) kHz (0.5 to 1) MHz	1.1 mV 0.4 mV 0.099 mV 0.099 mV 0.24 mV 1.1 mV 2.7 mV	
10 V	(1 to 2) Hz (2 to 10) Hz (10 to 40) Hz (0.04 to 30) kHz (30 to 200) kHz (200 to 500) kHz (0.5 to 1) MHz	3.6 mV 1.7 mV 0.33 mV 0.33 mV 0.9 mV 3.4 mV 8.9 mV	High voltage meter
30 V	(1 to 2) Hz (2 to 10) Hz (10 to 40) Hz (0.04 to 30) kHz (30 to 200) kHz (200 to 500) kHz (0.5 to 1) MHz	0.11 V 4.9 mV 1.2 mV 1.0 mV 2.7 mV 6.8 mV 0.018 V	
100 V	(1 to 2) Hz (2 to 10) Hz (10 to 40) Hz (0.04 to 30) kHz (30 to 200) kHz	0.036 V 0.017 V 4.0 mV 3.4 mV 9.5 mV	
300 V	(0.04 to 20) kHz (20 to 100) kHz	0.013 V 0.035 V	
1000 V	(0.04 to 20) kHz (20 to 30) kHz (30 to 100) kHz	0.05 V 0.12 V 0.085 V	
(1 to 10) kV	(0.01 to 600) Hz	12 V	
(10 to 70) kV	(0.01 to 600) Hz	74 V	





Parameter/Range	Frequency	CMC <sup>2</sup> (±)	Comments
AC Voltage <sup>3</sup> – Generate			
1 mV	(10 to 31) Hz	5.4 μV	Multifunction calibrator
	(32 to 320) Hz	5.4 μV	
	(0.3 to 10) kHz	5.3 μV	
	(10 to 33) kHz	5.3 μV	
	(30 to 100) kHz	6.1 μV	
	(100 to 330) kHz	7.9 μV	
	(0.3 to 1.0) MHz	0.012 mV	
10 mV	(10 to 31) Hz	6.9 μV	
	(32 to 320) Hz	6.4 μV	
	(0.3 to 10) kHz	6.3 μV	
	(10 to 33) kHz	6.1 μV	
	(30 to 100) kHz	9.3 μV	
	(100 to 330) kHz	0.016 mV	
	(0.3 to 1.0) MHz	0.04 mV	
100 mV	(10 to 31) Hz	0.022 mV	
	(32 to 320) Hz	0.017 mV	
	(0.3 to 10) kHz	0.016 mV	
	(10 to 33) kHz	0.017 mV	
	(30 to 100) kHz	0.042 mV	
1 V	(100 to 330) kHz	0.025 mV	
	(0.3 to 1.0) MHz	0.32 mV	
	(10 to 31) Hz	0.13 mV	
	(32 to 330) Hz	0.083 mV	
	(0.3 to 33) kHz	0.073 mV	
10 V	(30 to 100) kHz	0.13 mV	
	(100 to 330) kHz	0.31 mV	
	(0.3 to 1.0) MHz	2.1 mV	
	(10 to 31) Hz	1.3 mV	
	(32 to 330) Hz	0.83 mV	
100 V	(0.3 to 33) kHz	0.74 mV	
	(30 to 100) kHz	1.3 mV	
	(100 to 330) kHz	3.2 mV	
	(0.3 to 1.0) MHz	0.022 V	
	(10 to 31) Hz	0.14 V	
1000 V	(32 to 320) Hz	8.4 mV	
	(0.3 to 33) kHz	6.5 mV	
	(30 to 100) kHz	0.017 V	
	(100 to 330) kHz	0.11 V	
	(10 to 31) Hz	0.17 V	
	(32 to 320) Hz	0.13 V	
	(0.3 to 3.3) kHz	0.13 V	
	(3 to 33) kHz	0.17 V	



Parameter/Range	Frequency	CMC <sup>2,7</sup> (±)	Comments
AC Voltage <sup>3</sup> – Transfer			
1 mV	10 Hz to 30 kHz	2.1 μV	Transfer standard
	30 kHz to 50 kHz	2.3 μV	
	50 kHz to 100 kHz	3.3 μV	
	300 kHz to 1 MHz	6.0 μV	
10 mV	10 Hz to 30 kHz	2.6 μV	
	30 kHz to 50 kHz	3.8 μV	
	50 kHz to 100 kHz	4.7 μV	
	300 kHz to 1 MHz	0.014 mV	
100 mV	10 Hz to 30 kHz	5.7 μV	
	30 kHz to 50 kHz	0.012 mV	
	50 kHz to 100 kHz	0.013 mV	
	300 kHz to 500 kHz	0.067 mV	
	500 kHz to 1 MHz	0.072 mV	
1 V	10 Hz to 40 Hz	0.023 mV	
	40 Hz to 30 kHz	0.016 mV	
	30 kHz to 50 kHz	0.038 mV	
	50 kHz to 100 kHz	0.044 mV	
	300 kHz to 1 MHz	0.38 mV	
10 V	10 Hz to 40 Hz	0.23 mV	
	40 Hz to 30 kHz	0.16 mV	
	30 kHz to 50 kHz	0.38 mV	
	50 kHz to 100 kHz	0.44 mV	
	300 kHz to 1 MHz	3.9 mV	
19 V	200 kHz	0.46 mV	
100 V	10 Hz to 40 Hz	2.4 mV	
	40 Hz to 30 kHz	1.9 mV	
	30 kHz to 50 kHz	4.4 mV	
	50 kHz to 100 kHz	3.9 mV	
	100 kHz to 200 kHz	7.0 mV	
1000 V	55 Hz to 400 Hz	0.030 V	
	400 Hz to 1 kHz	0.026 V	



Parameter/Range	Frequency	CMC <sup>2, 7</sup> (±)	Comments
AC Current <sup>3</sup> – Measure			
(0 to 10) µA	(0.01 to 1) kHz (1 to 5) kHz	2.5 nA 3.5 nA	DMM
(10 to 100) µA	(0.01 to 1) kHz (1 to 5) kHz	0.025 µA 0.035 µA	
(0.1 to 1) mA	(0.01 to 1) kHz (1 to 5) kHz	0.25 µA 0.35 µA	
(1 to 10) mA	(0.01 to 1) kHz (1 to 5) kHz	2.5 µA 3.5 µA	
(10 to 100) mA	(0.01 to 1) kHz (1 to 5) kHz	0.025 mA 0.035 mA	
(0.1 to 1) A	(0.01 to 1) kHz (1 to 5) kHz	0.25 mA 0.35 mA	
(1 to 1.9) A	(0.01 to 1) kHz (1 to 5) kHz	0.48 mA 0.67 A	
(0 to 1000) A	(45 to 445) Hz	2.2 A	Calibrator, current clamp, coil
AC Current <sup>3</sup> – Current Shunts			
1 kHz	10 µA 100 µA 1 mA 10 mA 100 mA 1 A 1.9 A	7.1 nA 2.3 nA 0.023 µA 0.23 µA 1.7 µA 0.022 mA 0.045 mA	Voltmeter, current shunts
AC Current <sup>3</sup> – Generate			
(0 to 10) µA	(0.01 to 1) kHz (1 to 5) kHz	7.6 nA 0.011 µA	Multifunction calibrator
(10 to 100) µA	(0.01 to 1) kHz (1 to 5) kHz	0.021 µA 0.038 µA	
(0.1 to 1) mA	(0.01 to 1) kHz (1 to 5) kHz	0.16 µA 0.26 µA	



Parameter/Range	Frequency	CMC <sup>2,7</sup> (±)	Comments
AC Current <sup>3</sup> - Generate (cont)			
(1 to 10) mA	(0.01 to 1) kHz (1 to 5) kHz	1.6 µA 2.6 µA	Multifunction calibrator
(10 to 100) mA	(0.01 to 1) kHz (1 to 5) kHz	0.016 mA 0.026 mA	
(0.1 to 1) A	(0.01 to 1) kHz (1 to 5) kHz	0.36 mA 0.53 mA	
(1 to 1.9) A	(0.01 to 1) kHz (1 to 5) kHz	0.63 mA 0.93 mA	
(1.9 to 11) A	45 to 100 Hz 100 Hz to 1 kHz 1 kHz to 5 kHz	9.1 mA 0.014 A 0.34 A	
(11 to 20) A	45 to 100 Hz 100 Hz to 1 kHz 1 kHz to 5 kHz	0.03 A 0.036 A 0.61 A	
AC Current <sup>3</sup> – Transfer			
Up to 100 µA	10 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	0.013 µA 0.022 µA 0.044 µA	Transfer standard
100 µA to 1 mA	10 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	0.12 µA 0.17 µA 0.46 µA	
1 mA to 10 mA	10 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	1.2 µA 2.0 µA 6.3 µA	
10 mA to 100 mA	10 Hz to 60 Hz 60 Hz to 400 Hz 400 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	0.012 mA 0.014 mA 0.013 mA 0.020 mA 0.063 mA	
100 mA to 1 A	10 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	0.15 mA 0.27 mA 0.99 mA	



Parameter/Equipment	Range	CMC <sup>2,7</sup> (±)	Comments
Phase Angle <sup>3</sup> –  Measure  0° to 359.9999°  Generate  0° to 999.999°	10 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 200 kHz  1 Hz to 1 kHz 1 kHz to 50 kHz 50 kHz to 200 kHz	0.013° 0.027° 0.053° 0.11°  0.0072° 0.017° 0.042°	Phase angle voltmeter    Phase standard
Inductance <sup>3</sup> –  Fixed  Measure  Generate	20 mH 100 mH 200 mH 2 H  (0.1 to 10) µH (0.01 to 10) mH 0.01 to 100) mH (0.1 to 10) kH (10 to 100) kH  (1 to 10) mH (10 to 100) mH (0.1 to 1) H (1 to 10) H	3.1 µH 0.018 mH 0.048 mH 0.84 mH  0.022 µH 0.21 µH 0.02 H 6.4 H 0.61 kH  9.5 µH 0.071 H 0.01 H 0.2 H	Standard inductors   LCR meter  Multifunction calibrator
Capacitance <sup>3</sup> – Fixed	1 nF 2 nF 10 nF 100 nF 200 nF 1 µF	0.51 pF 0.84 pF 5.4 pF 0.012 nF 0.11 nF 0.30 nF	Standard capacitors



Parameter/Equipment	Range	CMC <sup>2,6</sup> (±)	Comments
Capacitance <sup>3</sup> –			
Measure	(0 to 1) nF (0.001 to 10) µF (0.001 to 10) mF (0.01 to 110) mF	1.1 pF 5.4 nF 0.011 mF 0.28 mF	LCR Meter
Generate	(0 to 0.3) nF (0 to 1) nF (1 to 3) nF (3 to 10) nF (10 to 30) nF (30 to 100) nF (100 to 300) nF (0.3 to 1) µF (1 to 3) µF (3 to 10) µF (10 to 30) µF (30 to 100) µF (100 to 300) µF (0.3 to 1) mF (1 to 3) mF (3 to 10) mF (10 to 30) mF (30 to 110) mF	0.012 nF 0.015 nF 0.025 nF 0.036 nF 0.18 nF 0.36 nF 1.1 nF 2.7 nF 0.011 µF 0.036 µF 0.16 µF 0.56 µF 1.7 µF 5.6 µF 0.017 mF 0.056 mF 0.26 mF 1.4 mF	Multifunction calibrator
Thermocouple Simulation <sup>3</sup> –			
Type E	(-250 to -200) °C (-200 to -100) °C (-100 to 850) °C (850 to 1000) °C	0.41 °C 0.21 °C 0.12 °C 0.21 °C	Multifunction calibrator, thermocouple calibrator
Type J	(-210 to -30) °C (-30 to 50) °C (50 to 500) °C (500 to 1200) °C	0.28 °C 0.17 °C 0.15 °C 0.23 °C	
Type K	(-200 to -100) °C (-100 to -30) °C (-30 to 120) °C (120 to 1050) °C (1050 to 1371.1) °C	0.34 °C 0.19 °C 0.17 °C 0.14 °C 0.22 °C	



Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Thermocouple Simulation <sup>3</sup> –			
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.41 °C 0.23 °C 0.2 °C 0.19 °C 0.28 °C	Multifunction calibrator, thermocouple calibrator
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.57 °C 0.35 °C 0.33 °C 0.40 °C	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.47 °C 0.36 °C 0.37 °C 0.46 °C	
Type T	(-250 to -150) °C (-250 to -100) °C (-100 to 0) °C (0 to 400) °C	0.64 °C 0.25 °C 0.18 °C 0.15 °C	
RTD Simulation <sup>3</sup> –			
Cu427	100 to 260°C	0.31°C	Multifunction calibrator
Ni120	(-80 to 100) °C (100 to 260) °C	0.11°C 0.16°C	
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	0.071 °C 0.1 °C 0.13 °C 0.15 °C 0.17 °C 0.33 °C	



Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
RTD Simulation <sup>3</sup> –			
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	0.08 °C 0.085 °C 0.14 °C 0.15 °C 0.16 °C 0.18 °C	Multifunction calibrator
Pt 385, 500 Ω	(-200 to -80) °C (-80 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.08 °C 0.085 °C 0.091 °C 0.11 °C 0.12 °C 0.13 °C	
Pt 385, 1000 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	0.075 °C 0.08 °C 0.085 °C 0.091 °C 0.098 °C 0.24 °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	0.26 °C 0.08 °C 0.085 °C 0.091 °C 0.098 °C 0.11 °C 0.12 °C 0.13 °C 0.24 °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	0.085 °C 0.098 °C 0.12 °C 0.13 °C 0.14 °C	





IV. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC <sup>2</sup> (±)	Comments
RF Power <sup>3</sup> – Generate / Measure			
(-35 to +20) dB	DC to 100 MHz 100 MHz to 8 GHz (8 to 26.5) GHz (26.5 to 50) GHz	0.051 dB 0.074 dB 0.11 dB 0.26 dB	RF reference source, power sensor, power meter
Leveled Sine Wave -			
(-130 to -94) dBm	(10 to 128) MHz 128 MHz to 3 GHz	0.72 dB 1.6 dB	
(-94 to -84) dBm	100 kHz to 10 MHz (10 to 128) MHz (128 to 300) MHz 300 MHz to 3 GHz	0.52 dB 0.35 dB 0.51 dB 1.1 dB	
(-84 to -74) dBm	100 kHz to 10 MHz (10 to 128) MHz (128 to 300) MHz 300 MHz to 1.4 GHz (1.4 to 4) GHz	0.51 dB 0.13 dB 0.33 dB 0.55 dB 1.1 dB	
(-74 to -48) dBm	100 kHz to 10 MHz (10 to 128) MHz (128 to 300) MHz 300 MHz to 1.4 GHz (1.4 to 4) GHz	0.21 dB 0.11 dB 0.12 dB 0.41 dB 0.56 dB	
(-48 to -17) dBm	(10 to 100) kHz 100 kHz to 128 MHz (128 to 300) MHz 300 MHz to 1.4 GHz (1.4 to 3) GHz (3 to 4) GHz	0.041 dB 0.062 dB 0.088 dB 0.22 dB 0.38 dB 0.53 dB	
(-17 to +14) dBm	(10 to 100) kHz 100 kHz to 128 MHz (128 to 300) MHz 300 MHz to 1.4 GHz (1.4 to 4) GHz	0.035 dB 0.070 dB 0.093 dB 0.22 dB 0.33 dB	



Parameter/Range	Frequency	CMC <sup>2</sup> (±)	Comments
RF Power <sup>3</sup> – Leveled Sine Wave (cont)  +14 to +20 dBm  +20 to +24 dBm	10 kHz to 100 kHz 100 kHz to 128 MHz 128 MHz to 300 MHz 300 MHz to 1.4 GHz  10 kHz to 100 kHz 100 kHz to 128 MHz	0.051 dB 0.058 dB 0.11 dB 0.26 dB  0.038 dB 0.051 dB	RF reference source, power sensor, power meter
Attenuation <sup>3,5</sup> 10 Hz to 128 MHz	0 to 55 dB 55 to 64 dB 64 to 100 dB 100 to 116 dB	0.044 dB 0.057 dB 0.17 dB 0.23 dB	RF reference source, spectrum analyzer
Amplitude Modulation <sup>3</sup> – Measure  Carrier: 150 kHz to 10 MHz Rate: 50 Hz to 10 kHz  Rate: 20 Hz to 10 kHz  Carrier: 10 MHz to 1.3 GHz Rate: 50 Hz to 50 kHz  Rate: 20 Hz to 100 kHz	Depth: 20% Depth: 50% Depth: 80%  Depth: 20% Depth: 50% Depth: 80%  Depth: 20% Depth: 50% Depth: 80%  Depth: 20% Depth: 50% Depth: 80%	0.72 % 1.7 % 2.7 %  0.87 % 2.1 % 3.2 %  0.59 % 1.4 % 2.2 %  0.87 % 2.1 % 3.2 %	Modulation analyzer



Parameter/Range	Frequency	CMC <sup>2,8</sup> (±)	Comments	
Amplitude Modulation <sup>3</sup> – Generate				
Carrier: 150 kHz to 10 MHz Rate: 50 Hz to 10 kHz	Depth: 20 % Depth: 50 % Depth: 80 %	1.3 % 2.2 % 3.2 %	RF reference source, modulation analyzer	
Rate: 20 Hz to 10 kHz	Depth: 20 % Depth: 50 % Depth: 80 %	1.4 % 2.5 % 3.7 %		
Carrier: 10 MHz to 1.3 GHz Rate: 50 Hz to 10 kHz	Depth: 20 % Depth: 50 % Depth: 80 %	0.98 % 1.9 % 2.8 %		
Rate: 20 Hz to 10 kHz	Depth: 20 % Depth: 50 % Depth: 80 %	1.2 % 2.4 % 3.6 %		
Frequency Modulation <sup>3</sup> – Measure				
Carrier: 150 kHz to 10 MHz Rate: 20 Hz to 10 kHz	Deviation: 100 Hz	4.4 Hz		Modulation analyzer
Carrier: 10 MHz to 1.3 GHz Rate: 50 Hz to 100 kHz	Deviation: 400 Hz	6.3 Hz		
Carrier: 10 MHz to 1.3 GHz Rate: 20 kHz to 200 kHz	Deviation: 400 Hz	21 kHz		



Parameter/Range	Frequency	CMC <sup>2, 7, 9</sup> ( $\pm$ )	Comments
Frequency Modulation <sup>3</sup> – Generate  Carrier: Up to 10 MHz Rate: Up to 10 kHz  Carrier: Up to 100 MHz Rate: Up to 100 kHz  Carrier: Up to 1 GHz Rate: Up to 100 kHz  Carrier: Up to 10 MHz Rate: Up to 10 kHz	Deviation: 100 Hz  Deviation: 500 Hz  Deviation: 1 kHz  Deviation: 100 kHz	4.3 Hz  17 Hz  34 Hz  3.9 kHz	RF reference source, modulation analyzer
Phase Modulation <sup>3</sup> - Measure  Carrier: 150 kHz to 10 MHz  Rate: 4 kHz to 10 kHz  Rate: 100 Hz to 10 kHz  Rate: 100 Hz to 2 kHz  Carrier: 10 MHz to 1.3 GHz  Rate: 10 kHz to 20 kHz  Rate: 2 kHz to 20 kHz  Rate: 100 Hz to 1 kHz	Deviation: 0.1 rad  Deviation: 4 rad  Deviation: 20 rad  Deviation: 0.1 rad Deviation: 4 rad  Deviation: 20 rad  Deviation: 400 rad	0.055 rad  0.18 rad  0.86 rad  0.055 rad 0.24 rad  0.67 rad  14 rad	Modulation analyzer
Amplitude Modulation <sup>3</sup> – Sine Distortion  10.0 % to 89.0 %	50 kHz to 125 MHz	-40 dBc	Fluke 9640A



Parameter/Range	Frequency	CMC <sup>2, 7, 8</sup> (±)	Comments
Phase Modulation <sup>3</sup> – Generate			RF reference source
Carrier: 150 kHz to 10 MHz			
Rate: 4 kHz to 10 kHz	Deviation: 0.1 rad	0.0064 rad	
Rate: 100 Hz to 10 kHz	Deviation: 4 rad	0.14 rad	
Rate: 100 Hz to 2 kHz	Deviation: 20 rad	0.66 rad	
Carrier: 10 MHz to 1.3 GHz			
Rate: 10 to 20 kHz	Deviation: 0.1 rad Deviation: 4 rad	0.054 rad 0.15 rad	
Rate: 2 kHz to 20 kHz	Deviation 20 rad	0.66 rad	
Rate: 100 Hz to 1 kHz	Deviation: 400 rad	13 rad	
Total Harmonic Distortion	47 Hz to 100 kHz	1.2 %	Phase angle voltmeter

## VI. Mechanical

Parameter/Equipment	Range	CMC <sup>2, 8</sup> (±)	Comments
Accelerometers <sup>3</sup>			Shaker, DMM, signal conditioner
100 Hz to 2 kHz	Up to 5G	3.5 %	
2 kHz to 10 kHz	Up to 5G	5.1 %	
Balance <sup>3</sup>	(1 to 500) mg (0.5 to 5) g (5 to 50) g (50 to 100) g (100 to 200) g (200 to 2000) g (2000 to 6000) g	0.018 mg + 0.6R 0.044 mg + 0.6R 0.10 mg + 0.6R 0.040 mg + 0.6R 0.17 mg + 0.6R 0.80 mg + 0.6R 0.15 g + 0.6R	Standard weights



Parameter/Equipment	Range	CMC <sup>2, 8</sup> (±)	Comments
Flow – Air <sup>3</sup>	Up to 150 LPM	1.1 %	Mass flow meters
Force <sup>3</sup>	Up to 100 lb (0.1 to 5) klb (5 to 100) klb	0.22 % 0.078 % 0.028 %	Load cell
Pressure/Vacuum <sup>3</sup>	(-15 to 0) PSI  Up to 25 PSI  (25 to 100) PSI  Up to 625 PSI (625 to 2500) PSI  Up to 3000 PSI (3000 to 10 000) PSI	0.0059 PSI  0.004% + 0.0012 PSI  0.0083% + 0.00066 PSI  0.049 PSI 0.69 PSI  0.33 PSI 1.1 PSI	Pressure calibrator    Pressure indicator
Tachometers <sup>3</sup>	5 rpm 25 rpm 250 rpm 2500 rpm 25 000 rpm 250 000 rpm	0.0062 rpm 0.021 rpm 0.20 rpm 1.7 rpm 8.6 rpm 53 rpm	Master tachometer
Torque <sup>3</sup>	(1 to 150) in·lbf (10 to 150) ft·lbf	1.4 % 1.2 %	Torque analyzer

#### V. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Humidity <sup>3</sup> – Measure	Up to 100 % RH	0.84 % RH	Humidity meter, Humidity probe
Temperature <sup>3</sup> – Measure			
Thermometer	(-20 to 375) °C (375 to 600) °C	0.058 °C 0.31 °C	PRTD
Infrared	Up to 500°C	0.19 °C	

## VI. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Frequency <sup>3</sup> –			
Measure	Up to 20 GHz	0.022 μHz/Hz	Counter
Generate	Up to 10 kHz 10 kHz to 4 GHz (4 to 26) GHz	0.091 μHz/Hz 0.060 μHz/Hz 0.078 μHz/Hz	RF reference source
GPS Clock	10 MHz	0.12 mHz	GPS disciplined clock
Timers/Stopwatches <sup>3</sup>	0 s to 60 hr	0.0017 s	Counter

<sup>1</sup> This laboratory offers commercial calibration service and field calibration service.

<sup>2</sup> Calibration and Measurement Capability Uncertainty (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. CMCs represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of  $k = 2$ . The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

<sup>3</sup> Field calibration service is available for this calibration and this laboratory meets A2LA R104 – *General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the actual uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.

<sup>4</sup> Specifications are typical below 10 MHz.

<sup>5</sup> Relative to +16 dBm output.

<sup>6</sup> In the statement of CMC,  $L$  is the numerical value of the nominal length of the device measured in inches and  $R$  is the resolution of the unit under test.

<sup>7</sup> The measurands stated are generated using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure the measurand in the ranges indicated. CMC are expressed as either a specific value that covers the full range or as a fraction of the reading plus a fixed floor specification.

<sup>8</sup> In the statement of CMC, percentages are percentage of reading, unless otherwise indicated.



## Accredited Laboratory

A2LA has accredited

**ENI LABS**

*Fort Wayne, IN*

for technical competence in the field of

**Calibration**

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSLI Z540-1-1994 2006 and R205 – Specific Requirements: Calibration Laboratory Accreditation Program. 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 8 January 2009).



Presented this 12<sup>th</sup> day of April 2018.

A handwritten signature in black ink, written over a horizontal line.

President and CEO  
For the Accreditation Council  
Certificate Number 2147.01  
Valid to March 31, 2020  
Revised July 23, 2018

*For the calibrations to which this accreditation applies, please refer to the laboratory's Calibration Scope of Accreditation.*