



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017
& ANSI/NCSL Z540-1-1994 & ANSI/NCSL Z540.3-2006

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CALIBRATION

Valid To: April 30, 2025

Certificate Number: 2737.02

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations^{1, 6}:

I. Dimensional

Parameter/Equipment	Range	CMC ² (±)	Comments
Hand Tools ³ –			
Calipers	Up to 72 in	17 μin + 4.5 μin/in	Gage blocks, grades 2 & AS-1
Micrometers	Up to 48 in	10 μin + 4.9 μin/in	
Height Gages	Up to 48 in	17 μin + 4.9 μin/in	
Indicators: Dial or Digital	Up to 2 in	8.6 μin + 3 μin/in	
Depth Micrometers	Up to 12 in	17 μin + 6.6 μin/in	
Flatness	Up to 3 in	5.8 μin	Optical flat
Diameter, External (Cylindrical Plug Gages, Thread Wires, Pins)	Up to 3.0 in	120 μin + 1.5 μin/in	GageMaker MicTrac w/ gage blocks, grades 2 & AS-1
Length/Diameter	Up to 12.1 in	120 μin + 3.5 μin/in	GageMaker MicTrac w/ gage blocks, grades 2 & AS-1

Parameter/Equipment	Range	CMC ² (±)	Comments
Tape Measure & Steel Ruler ³ (No Tension)	Up to 36 in	0.0023 in	Gage blocks, grades 2 & AS-1
	(3 to 300) ft	0.0046 in + 6.1 µin/in	Stanley 34-762 tape measure

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 4} (±)	Comments
DC Voltage ³ – Generate	(0 to 220) mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V	6 nV/mV + 0.5 µV 3.5 µV/V + 0.7 µV 2.5 µV/V + 2.9 µV 2.4 µV/V + 6.7 µV 3.4 µV/V + 70 µV 4.2 µV/V + 0.83 mV	Fluke 5720A
DC Voltage ³ – Measure	(0 to 200) mV (0.2 to 2) V (2 to 20) V (20 to 200) V (200 to 1000) V	0.24 µV + 5.0 µV/V 1.1 µV + 3.7 µV/V 10 µV + 3.0 µV/V 0.88 mV + 3.2 µV/V 1.4 mV + 5.0 µV/V	Fluke 8508A
DC High Voltage ³ – Measure/Generate	(1 to 10) kV (10 to 70) kV	0.38 V + 0.36 mV/V 4.9 V + 0.49 mV/V	Vitrek 4700 w/ HVL-70
DC Current ³ – Generate	(0 to 220) µA (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A (1.1 to 2.999 99) A (1.1 to 10.9999) A (11 to 20.5) A	6.1 nA + 35 pA/µA 13 nA + 28 nA/mA 0.18 µA + 25 nA/mA 1.3 µA + 1.0 mA/A 85 µA + 82 µA/A 1.1 mA + 0.30 mA/A 8.2 mA + 0.39 mA/A 17 mA + 0.78 mA/A	Fluke 5720A Fluke 5522A
Clamp-On Only	(10 to 16.5) A (16.5 to 150) A (150 to 1025) A	50 mA + 6.5 mA/A 0.18 A + 3.4 mA/A 0.83 A + 3.3 mA/A	Fluke 5520A w/ 5500A/coil

Parameter/Equipment	Range	CMC ^{2,4,5} (\pm)	Comments
DC Current ³ – Measure	(0 to 100) nA 100 nA to 1 μ A (1 to 10) μ A (10 to 100) μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	46 pA + 30 μ A/A 3.0 pA + 24 μ A/A 0.44 nA + 19 μ A/A 0.26 nA + 16 μ A/A 0.15 μ A + 1.5 mA/A 92 nA + 16 μ A/A 0.92 μ A + 32 μ A/A 2.4 μ A + 0.10 mA/A	Agilent 3458A
	(0 to 2) A (2 to 20) A	26 μ A + 0.18 mA/A 0.56 mA + 0.54 mA/A	Fluke 8508A
	(20 to 100) A (100 to 500) A	0.046 % 0.66 %	3458A & current shunts
DC Resistance ³ – Generate	0 Ω	50 $\mu\Omega$	Fluke 5720A
	1 Ω	96 $\mu\Omega$	
	1.9 Ω	0.18 m Ω	
	10 Ω	0.28 m Ω	
	19 Ω	0.52 m Ω	
	100 Ω	1.3 m Ω	
	190 Ω	2.4 m Ω	
	1 k Ω	9.0 m Ω	
	1.9 k Ω	17 m Ω	
	10 k Ω	90 m Ω	
	19 k Ω	0.17 Ω	
	100 k Ω	1.1 Ω	
	190 k Ω	2.2 Ω	
1 M Ω	20 Ω		
1.9 M Ω	40 Ω		
10 M Ω	0.43 k Ω	Fluke 5522A, 4-wire	
19 M Ω	0.98 k Ω		
100 M Ω	50 k Ω		
(0 to 10.9999) Ω	1.1 m Ω + 24 $\mu\Omega/\Omega$		
(11 to 32.9999) Ω	1.5 m Ω + 24 $\mu\Omega/\Omega$		
(33 to 109.9999) Ω	1.9 m Ω + 23 $\mu\Omega/\Omega$		
(110 to 329.9999) Ω	4.1 m Ω + 22 $\mu\Omega/\Omega$		
330 Ω to 1.099 99 k Ω	9.2 m Ω + 22 $\mu\Omega/\Omega$		
(1.1 to 3.299 999) k Ω	42 m Ω + 22 $\mu\Omega/\Omega$	Fluke 5522A, 2-wire	
(3.3 to 10.999 99) k Ω	93 m Ω + 22 $\mu\Omega/\Omega$		
(11 to 32.999 99) k Ω	0.41 Ω + 22 $\mu\Omega/\Omega$		
(33 to 109.9999) k Ω	0.91 Ω + 23 $\mu\Omega/\Omega$		
(110 to 329.9999) k Ω	8.6 Ω + 26 $\mu\Omega/\Omega$		
330 k Ω to 1.099 999 M Ω	14 Ω + 25 $\mu\Omega/\Omega$		
(1.1 to 3.299 999) M Ω	90 Ω + 47 $\mu\Omega/\Omega$		
(3.3 to 10.999 99) M Ω	0.39 k Ω + 0.10 m Ω/Ω		
(11 to 32.999 99) M Ω	4.2 k Ω + 0.19 m Ω/Ω		

Parameter/Equipment	Range	CMC ^{2, 4, 5} (±)	Comments
DC Resistance ³ – Generate (cont)	(33 to 109.9999) MΩ (110 to 329.9999) MΩ (330 to 1100) MΩ	15 kΩ + 0.39 mΩ/Ω 0.34 MΩ + 2.3 mΩ/Ω 4.2 MΩ + 12 mΩ/Ω	Fluke 5522A, 2- wire
DC Resistance ³ – Generate, Fixed Points, High Voltage			
Up to 20 V	1 kΩ 10 kΩ 100 kΩ	0.0013 % 0.0013 % 0.0013 %	IET VRS-100-11- 1K-BP-10KV
Up to 100 V	1 MΩ	0.0022 %	
Up to 1000 V	10 MΩ	0.004 %	
	100 MΩ	0.012 %	
	1 GΩ	0.062 %	
	10 GΩ	0.24 %	
	100 GΩ	0.36 %	
Up to 5000 V	1 TΩ	0.51 %	
	10 TΩ	1.5 %	
	10 MΩ	0.54 %	
	100 MΩ	0.5 %	
	1 GΩ	0.5 %	
	10 GΩ	0.5 %	
	100 GΩ	0.51 %	
	1 TΩ	0.51 %	
	10 TΩ	2.8 %	
DC Resistance ³ – Measure	(0 to 10) Ω (10 to 100) Ω (0.1 to 1) kΩ (1 to 10) kΩ (10 to 100) kΩ (0.1 to 1) MΩ (1 to 10) MΩ (10 to 100) MΩ (0.1 to 1) GΩ	77 μΩ + 15 μΩ/Ω 0.74 mΩ + 11 μΩ/Ω 2.0 mΩ + 8.0 μΩ/Ω 20 mΩ + 8.0 μΩ/Ω 0.20 Ω + 8.0 μΩ/Ω 4.4 Ω + 14 μΩ/Ω 0.18 kΩ + 54 μΩ/Ω 4.2 kΩ + 0.52 mΩ/Ω 0.31 MΩ + 5.1 mΩ/Ω	HP 3458A
DC Resistance ³ – Measure	10 mΩ 100 mΩ	0.0014 % 0.0028 %	Current shunts & 8508A

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of Thermocouples & Indicators ³ –			
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.34 °C 0.26 °C 0.23 °C 0.26 °C	Fluke 5522A
Type C	(0 to 150) °C (150 to 650) °C (650 to 1000) °C (1000 to 1800) °C (1800 to 2316) °C	0.23 °C 0.2 °C 0.24 °C 0.39 °C 0.65 °C	
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.39 °C 0.13 °C 0.12 °C 0.13 °C 0.17 °C	
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.21 °C 0.13 °C 0.12 °C 0.14 °C 0.18 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.26 °C 0.15 °C 0.13 °C 0.21 °C 0.31 °C	
Type L	(-200 to -100) °C (-100 to 800) °C (800 - 900) °C	0.29 °C 0.20 °C 0.13 °C	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.31 °C 0.18 °C 0.15 °C 0.15 °C 0.21 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.44 °C 0.28 °C 0.26 °C 0.31 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of Thermocouples & Indicators ³ – (cont)			
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.37 °C 0.28 °C 0.29 °C 0.36 °C	Fluke 5522A
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.49 °C 0.21 °C 0.15 °C 0.14 °C	
Type U	(-200 to 0) °C (0 to 600) °C	0.47 °C 0.21 °C	
Electrical Calibration of RTD Indicators ³ –			
Pt 385, 100 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.057 °C 0.056 °C 0.068 °C 0.081 °C 0.088 °C 0.10 °C 0.19 °C	Fluke 5522A
Pt 3926, 100 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.056 °C 0.056 °C 0.068 °C 0.081 °C 0.088 °C 0.10 °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	0.20 °C 0.051 °C 0.056 °C 0.062 °C 0.068 °C 0.074 °C 0.081 °C 0.041 °C 0.18 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of RTD Indicators ³ – (cont)			
Pt 385, 100 Ω	(-200 to -80) °C	0.051 °C	Fluke 5522A
	(-80 to 0) °C	0.051 °C	
	(0 to 100) °C	0.051 °C	
	(100 to 260) °C	0.057 °C	
	(260 to 300) °C	0.10 °C	
	(300 to 400) °C	0.11 °C	
	(400 to 600) °C	0.12 °C	
(600 to 630) °C	0.13 °C		
Pt 385, 500 Ω	(-200 to -80) °C	0.051 °C	
	(-80 to 0) °C	0.056 °C	
	(0 to 100) °C	0.056 °C	
	(100 to 260) °C	0.062 °C	
	(260 to 300) °C	0.074 °C	
	(300 to 400) °C	0.074 °C	
	(400 to 600) °C	0.081 °C	
(600 to 630) °C	0.095 °C		
Pt 385, 1000 Ω	(-200 to -80) °C	0.047 °C	
	(-80 to 0) °C	0.047 °C	
	(0 to 100) °C	0.051 °C	
	(100 to 260) °C	0.057 °C	
	(260 to 300) °C	0.062 °C	
	(300 to 400) °C	0.068 °C	
	(400 to 600) °C	0.068 °C	
(600 to 630) °C	0.18 °C		
PtNi 385, 120 Ω	(-80 to 0) °C	0.062 °C	
	(0 to 100) °C	0.062 °C	
	(100 to 260) °C	0.11 °C	
Cu 427. 10 Ω	(-100 to 260) °C	0.23 °C	

Parameter/Equipment	Range	CMC ^{2, 4, 5} (±)	Comments
Oscilloscope ³ –			
DC into 50 Ω Load	(-6.6 to 6.6) V	33 μV + 2 mV/V	Fluke 5520A-SC1100
DC into 1 MΩ Load	(-130 to 130) V	33 μV + 0.39 mV/V	
Rise Time	≤ 300 ps (Up to 2 MHz) ≤ 350 ps (Above 2 MHz)	82 ps 82 ps	
Bandwidth	50 kHz (reference) 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz	0.33 mV + 17 mV/V 0.4 mV + 31 mV/V 0.43 mV + 36 mV/V 0.53 mV + 57 mV/V 0.58 mV + 67 mV/V	Power meter w/ power sensors
	(1.1 to 16) GHz	3.1 %	
	(16 to 18) GHz	3.3 %	
	(18 to 26.5) GHz	4.1 %	
	(26.5 to 33) GHz	4.3 %	
	(33 to 35) GHz	4.5 %	
	(35 to 40) GHz	4.7 %	
	(40 to 47) GHz	5.1 %	
	(47 to 50) GHz	5.6 %	
Time Markers: Source & Period Into a 50 Ω Load	5 s to 50 ms 50 ms to 1 ns	0.000 63 % + <i>t</i> x 0.1 % 0.000 52 %	Fluke 5520A-SC1100
Amplitude: 1 MΩ, 10 Hz to 1 kHz 1 MΩ, (1 to 10) kHz 50 Ω	1 mV to 130 V _(pk-pk) 1 mV to 130 V _(pk-pk) 1.0 mV to 6.6 V _(pk-pk)	0.2 mV + 0.8 mV/V 0.24 mV + 2 mV/V 91 μV mV + 4.3 mV/V	<i>t</i> = time in seconds
AC Power ³ – Generate (45 to 65) Hz, PF=1	Up to 1020 V: Up to 33 W (33 to 330) W 330 W to 1.1 kW (1.1 to 3) kW (3 to 11) kW (11 to 20.9) kW	0.1 % 0.062 % 0.072 % 0.075 % 0.087 % 0.14 %	Fluke 5522A
DC Power ³ – Generate	Up to 1020 V: Up to 3 W (3 to 30) W (30 to 300) W 300 W to 3 kW (3 to 20.9) kW	0.017 % 0.014 % 0.014 % 0.033 % 0.085 %	Fluke 5522A

Parameter/Equipment	Range	CMC ^{2, 4, 5} (±)	Comments
Duty Cycle ³ – Generate	(1 to 9.99) % (10 to 49.99) % 50 % (50.01 to 90) % (90.01 to 99)	0.32 % 0.02 % 0.013 % 0.02 % 0.31 %	Fluke 5522A

Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
AC Voltage ³ – Generate			
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 (0.5 to 1) MHz	4.7 μV + 0.19 μV/mV 4.4 μV + 79 nV/mV 4.3 μV + 71 nV/mV 4.7 μV + 0.16 μV/mV 6 μV + 0.41 μV/mV 11 μV + 0.82 μV/mV 22 μV + 1.1 μV/mV 23 μV + 2.3 μV/mV	Fluke 5720A
(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 (0.5 to 1) MHz	6.3 μV + 0.41 μV/mV 4.9 μV + 79 nV/mV 4.9 μV + 69 nV/mV 6 μV + 0.16 μV/mV 8.9 μV + 0.4 μV/mV 17 μV + 0.79 μV/mV 29 μV + 1.1 μV/mV 36 μV + 2.2 μV/mV	
(22 to 220) 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 (0.5 to 1) MHz	23 μV + 0.21 μV/mV 12 μV + 80 nV/mV 12 μV + 70 nV/mV 19 μV + 0.17 μV/mV 27 μV + 0.44 μV/mV 62 μV + 0.87 μV/mV 88 μV + 1.1 μV/mV 0.18 mV + 2.2 μV/mV	
(0.22 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 (0.5 to 1) MHz	0.23 mV + 0.21 mV/V 81 μV + 77 μV/V 44 μV + 33 μV/V 88 μV + 58 μV/V 0.14 mV + 86 μV/V 0.43 mV + 0.31 mV/V 0.84 mV + 0.82 mV/V 1.7 mV + 1.2 mV/V	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Voltage ³ – Generate (cont)			
(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 (0.5 to 1) MHz	2.3 mV + 0.21 mV/V 0.81 mV + 76 μV/V 0.20 mV + 40 μV/V 0.65 mV + 64 μV/V 1 mV + 84 μV/V 3.3 mV + 0.25 mV/V 6.7 mV + 0.88 mV/V 10 mV + 1.2 mV/V	Fluke 5720A
(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* (0.5 to 1) MHz*	23 mV + 0.21 mV/V 8.5 mV + 75 μV/V 5.4 mV + 36 μV/V 7.3 mV + 67 μV/V 14 mV + 0.11 mV/V 54 mV + 0.79 mV/V 0.14 V + 4.2 mV/V 0.24 V + 7 mV/V	* Limited to 2.2E7 V-Hz
(220 to 1100) V	(15 to 50) Hz** 50 Hz to 1 kHz	9.1 mV + 0.25 mV/V 78 mV + 57 μV/V	**250V Max
(33 to 330) V	45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	14 mV + 0.15 mV/V 18 mV + 0.16 mV/V 19 mV + 0.20 mV/V 20 mV + 0.25 mV/V 98 mV + 1.6 mV/V	Fluke 5522A
(330 to 1020) V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.11 V + 0.24 mV/V 96 mV + 0.20 mV/V 0.11 V + 0.23 mV/V	
AC Voltage ³ – Measure			
(0 to 10) mV	(1 to 40) Hz (40 to 1000) Hz (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 (4 to 8) MHz	6.1 μV + 0.30 mV/V 4.1 μV + 0.20 mV/V 4.2 μV + 0.30 mV/V 4.9 μV + 1.0 mV/V 9.0 μV + 5.0 mV/V 45 μV + 40 mV/V 20 μV + 12 mV/V 0.44 mV + 70 mV/V 1.1 mV + 0.20 V/V	Agilent 3458A-002

Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
AC Voltage ³ – Measure (cont)			
(10 to 100) mV	(10 to 40) Hz (40 to 1000) Hz (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 4) MHz (4 to 8) MHz (8 to 10) MHz	12 μV + 70 μV/V 10 μV + 70 μV/V 11 μV + 0.14 mV/V 12 μV + 0.30 mV/V 17 μV + 0.80 mV/V 47 μV + 3.0 mV/V 0.12 mV + 10 mV/V 3.8 mV + 15 mV/V 4.1 mV + 40 mV/V 8.9 mV + 40 mV/V 14 mV + 0.15 V/V	Agilent 3458A-002
(0.1 to 1) V	(1 to 40) Hz (40 to 1000) Hz (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 4) MHz (4 to 8) MHz (8 to 10) MHz	0.12 mV + 70 μV/V 0.10 mV + 70 μV/V 0.11 mV + 0.14 mV/V 0.12 mV + 0.30 mV/V 0.17 mV + 0.80 mV/V 0.47 mV + 3.0 mV/V 1.1 mV + 10 mV/V 38 mV + 15 mV/V 41 mV + 40 mV/V 89 mV + 40 mV/V 0.14 V + 0.15 V/V	
(1 to 10) V	(1 to 40) Hz (40 to 1000) Hz (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 4) MHz (4 to 8) MHz (8 to 10) MHz	1.2 mV + 70 μV/V 1.0 mV + 70 μV/V 1.1 mV + 0.14 mV/V 1.2 mV + 0.30 mV/V 1.7 mV + 0.80 mV/V 4.7 mV + 3.0 mV/V 12 mV + 10 mV/V 0.38 V + 15 mV/V 0.41 V + 40 mV/V 0.89 V + 40 mV/V 1.4 V + 0.15 V/V	
(10 to 100) 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	13 mV + 0.20 mV/V 11 mV + 0.20 mV/V 11 mV + 0.20 mV/V 13 mV + 0.35 mV/V 21 mV + 1.2 mV/V 57 mV + 4.0 mV/V 0.17 V + 15 mV/V	
(100 to 1000) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	99 mV + 0.40 mV/V 85 mV + 0.40 mV/V 99 mV + 0.60 mV/V 0.14 V + 1.2 mV/V 0.27 V + 3.0 mV/V	

Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
Capacitance ³ – Measure (1 to 10) pF (10 to 100) pF (100 to 1000) pF (1 to 10) nF (10 to 100) nF (100 to 1000) nF (1 to 10) μF (10 to 100) μF	(0.1 to 10) kHz	48 fF 0.22 pF 1.1 pF 39 pF 60 pF 0.53 nF 9.2 nF 0.14 μF	GR 1689-M CMC is stated at 1 kHz
AC Current ³ – Generate (29 to 329.99) μA (0.33 to 3.2999) mA (3.3 to 32.999) mA (33 to 329.99) mA (0.33 to 1.099 99) A (1.1 to 2.999 99) A (3 to 10.9999) 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 (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 (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 (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (45 to 100) Hz (0.100 to 1) kHz (1 to 5) kHz	0.55 μA + 1.6 mA/A 0.54 μA + 1.2 mA/A 0.53 μA + 0.98 mA/A 1.7 μA + 2.3 mA/A 1.9 μA + 6.2 mA/A 8.8 μA + 12 mA/A 1.8 μA + 1.6 mA/A 1.6 μA + 0.98 mA/A 1.6 μA + 0.78 mA/A 3.0 μA + 1.6 mA/A 5.2 μA + 1.7 mA/A 11 μA + 7.8 mA/A 10 μA + 1.4 mA/A 7.8 μA + 0.71 mA/A 6.5 μA + 0.33 mA/A 8.7 μA + 0.64 mA/A 13 μA + 1.6 mA/A 22 μA + 3.2 mA/A 0.10 mA + 1.4 mA/mA 78 μA + 0.71 mA/A 66 μA + 0.32 mA/A 0.11 mA + 0.79 mA/A 0.17 mA + 1.6 mA/A 0.31 mA + 3.2 mA/A 0.93 mA + 1.4 mA/A 0.60 mA + 0.40 mA/A 2.7 mA + 4.7 mA/A 11 mA + 19 mA/A 2.0 mA + 1.4 mA/A 0.99 mA + 0.56 mA/A 6.3 mA + 4.7 mA/A 26 mA + 19 mA/A 5.4 mA + 0.50 mA/A 6.3 mA + 0.80 mA/A 74 mA + 23 mA/A	Fluke 5522A

Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
AC Current ³ – Generate (cont)			
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	18 mA + 1.6 mA/A 20 mA + 1.7 mA/A 0.26 A + 23 mA/A	Fluke 5522A
Clamp-On Only ³ :			
Toroidal:			
(10 to 16.5) A (16.5 to 150) A (150 to 1025) A	(45 to 65) Hz	26 mA + 2.1 mA/A 50 mA + 1.9 mA/A 0.34 A + 1.9 mA/A	
(10 to 16.5) A (16.5 to 150) A (150 to 1025) A	(65 to 440) Hz	60 mA + 6 mA/A 0.11 A + 5.3 mA/A 0.86 A + 5.3 mA/A	
Non-Toroidal:			
(10 to 16.5) A (16.5 to 150) A (150 to 1025) A	(45 to 65) Hz	60 mA + 3.8 mA/A 0.23 A + 3.7 mA/A 1.2 A + 3.7 mA/A	5520A w/ 5500A/coil
(10 to 16.5) A (16.5 to 150) A (150 to 1025) A	(65 to 440) Hz	90 mA + 7.2 mA/A 0.28 A + 6.7 mA/A 1.6 A + 6.7 mA/A	
AC Current ³ – Measure			
(5 to 100) µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	(10 to 20) Hz	57 nA + 4.0 mA/A 0.43 µA + 4.1 mA/A 2.5 µA + 4.1 mA/A 42 µA + 4.0 mA/A 0.42 mA + 4.1 mA/A	3458A
(5 to 100) µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	(20 to 45) Hz	45 nA + 1.5 mA/A 3.1 µA + 1.6 mA/A 2.3 µA + 1.6 mA/A 30 µA + 1.5 mA/A 0.30 mA + 1.7 mA/A	
(5 to 100) µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	(45 to 100) Hz	41 nA + 0.64 mA/A 0.26 µA + 0.67 mA/A 2.3 µA + 0.67 mA/A 25 µA + 0.60 mA/A 0.26 mA + 0.90 mA/A	
(5 to 100) µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	100 Hz to 1 kHz	41 nA + 0.64 mA/A 0.25 µA + 0.37 mA/A 2.3 µA + 0.37 mA/A 24 µA + 0.30 mA/A 0.27 mA + 1.1 mA/A	

Parameter/Range	Frequency	CMC ^{2, 4, 5} (±)	Comments
AC Current ³ – Measure (cont)			
50 µA to 1 mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	(1 to 5) kHz	0.25 µA + 0.37 mA/A 2.3 µA + 0.37 mA/A 24 µA + 0.30 mA/A 0.27 mA + 1.1 mA/A	3458A
50 µA to 1 mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	(5 to 20) kHz	0.26 µA + 0.67 mA/A 2.3 µA + 0.67 mA/A 25 µA + 0.60 mA/A 0.37 mA + 3.1 mA/A	
50 µA to 1 mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	(20 to 50) kHz	0.63 µA + 4.1 mA/A 4.5 µA + 4.1 mA/A 62 µA + 4.0 mA/A 0.92 mA + 10 mA/A	
50 µA to 1 mA (1 to 10) mA (10 to 100) mA	(50 to 100) kHz	1.8 µA + 5.6 mA/A 16 µA + 5.6 mA/A 0.18 mA + 5.5 mA/A	
(0 to 2) A (0 to 20) A	10 Hz to 2 kHz	0.41 mA + 0.5 mA/A 2.3 mA + 0.72 mA/A	Fluke 8508A
(0 to 2) A (0 to 20) A	(2 to 10) kHz	0.28 mA + 0.67 mA/A 2.4 mA + 1.9 mA/A	
(0 to 2) A	(10 to 30) kHz	0.45 mA + 2.5 mA/A	
Distortion ³ – Measure	20 Hz to 20 kHz (20 to 100) kHz	1.2 dB 2.3 dB	8903A
	100 kHz to 3 GHz (3 to 6.5) GHz (6.5 to 21.9) GHz (21.9 to 50) GHz	0.54 dB 1.8 dB 2.4 dB 3.0 dB	E4448A
Frequency Response ³ – Measure	1 MHz 2 MHz 10 MHz 20 MHz 30 MHz 50 MHz 100 MHz	0.095 % 0.16 % 0.16 % 0.28 % 0.29 % 0.6 % 1.2 %	Ballantine 1395B-1 TVC

III. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ^{2, 4, 5} (±)	Comments
Absolute Power – Measure ³			
(0 to +20) dBm	9 kHz to 16 GHz (16 to 18) GHz	2.6 % 2.8 %	E4418B, E9304A-H18
(-10 to 0) dBm	9 kHz to 16 GHz (16 to 18) GHz	3.1 % 3.3 %	
(-60 to -10) dBm	9 kHz to 2 GHz (2 to 16) GHz (16 to 18) GHz	3.6 % 3.7 % 3.8 %	
(-70 to +20) dBm	(19 to 26.5) GHz (26.5 to 33) GHz	4.1 % 4.3 %	E4418B, E4413A
(-30 to +20) dBm	(33 to 35) GHz (36 to 40) GHz (41 to 47) GHz (48 to 50) GHz	4.5 % 4.7 % 5.1 % 5.6 %	E4418B, 8487A
100 mW to 2 kW	10 kHz to 250 MHz	3.3 %	E4418B, E9304A, couplers & attenuators
100 mW to 500 W	10 kHz to 6 GHz	3.2 %	
Excess Noise Ratio (ENR) – Calibrate Noise Sources Up to 20 dB ENR	10 MHz to 18 GHz (18 to 26.5) GHz	0.52 dB 0.59 dB	346C reference noise source, 8971C noise figure test set, 8970B noise figure meter
Absolute Power ³ – Generate			
100 mW to 500 W	10 kHz to 6 GHz	3.2 %	E4418B, E9304A, couplers & attenuators
Power Reference ³ – Measure	1 mW at 50 MHz 1 mW at 1 GHz	0.68 % 0.71 %	M1110, 1806, 3458A F1109, 1806, 3458A
Power Meter Accuracy	3 μW to 100 mW	0.29 %	11683A
Power Sensor Calibration Factor ³	(10 to 100) MHz 100 MHz to 4.6 GHz (4.8 to 10) GHz (12 to 18) GHz	0.68 % 0.59 % 0.63 % 0.81 %	1806A, M1111, 3458A 1806A, F1109, 3458A
	(18 to 22) GHz (22 to 26.5) GHz	2.4 % 3 %	1806A, 138-641, 3458A

Parameter/Range	Frequency	CMC ^{2,5} (\pm)	Comments
Frequency Modulation ³ – Measure Rate: 20 Hz to 10 kHz Dev.: \leq 40 kHz Peak Rate: 50 Hz to 100 kHz Dev.: \leq 400 kHz Peak Rate: 20 Hz to 200 kHz Dev.: \leq 400 kHz Peak Rate: 50 Hz to 100 kHz Dev.: \leq 400 kHz Peak Rate: 20 Hz to 200 kHz Dev.: \leq 400 kHz Peak	250 kHz to 10 MHz (0.01 to 1.3) GHz (0.01 to 1.3) GHz (1.3 to 26.5) GHz (1.3 to 26.5) GHz	3.5 Hz + 16 Hz/kHz 3.5 Hz + 7.8 Hz/kHz 6.8 Hz + 39 Hz/kHz 6.8 Hz + 7.8 Hz/kHz 6.8 Hz + 39 Hz/kHz	8902A
Phase Modulation ³ – Measure Rate: 200 Hz to 10 kHz (0 to 100) rad Rate: 200 Hz to 20 kHz (0 to 100) rad Rate: 200 Hz to 20 kHz (0 to 100) rad	150 kHz to 10MHz (0.01 to 1.3) GHz (1.3 to 26.5) GHz	36 mrad + 37 mrad/rad 36 mrad + 37 mrad/rad 36 mrad + 37 mrad/rad	8902A
Transmission S ₁₂ /S ₂₁ – Measure (0 to 60) dB	300 kHz to 45 MHz 45 MHz to 2 GHz (2 to 8) GHz (8 to 20) GHz (20 to 26.5) GHz (26.5 to 40) GHz (40 to 50) GHz	0.085 dB 0.078 dB 0.075 dB 0.085 dB 0.092 dB 0.25 dB 0.27 dB	8753E, 8510C & cal/ver kits
Reflection S ₁₂ /S ₂₁ – Measure 1 to ∞	300 kHz to 45 MHz 45 MHz to 2 GHz (2 to 3) GHz (3 to 8) GHz (8 to 20) GHz (20 to 26.5) GHz (26.5 to 50) GHz	0.0061 lin 0.0029 lin 0.003 lin 0.0038 lin 0.0044 lin 0.0056 lin 0.011 lin	8753E, 8510C, cal/ver kits

IV. Optical Quantities

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Fiber Optic ³			
Power – Measuring Equipment & Measure (800 to 1000) nm (1000 to 1650) nm	(-80 to +10) dBm (-90 to +10) dBm	0.15 dB 0.1 dB	81634A power sensor 81624B power sensor
Wavelength – Measuring Equipment & Measure	(600 to 1270) nm	0.59 nm	86142B optical spectrum analyzer
Linearity (1310 to 1550) nm	(1270 to 1650) nm (1310 and 1550) nm (0 to 60) dB	0.093 nm 0.58 nm 0.15 dB	86120C multiwavelength multimeter 81654C laser source 8156A optical attenuator, 81654A laser source

V. Mechanical

Parameter/Equipment	Range	CMC ^{2,5,7} (±)	Comments
Torque Equipment ³	(2 to 200) ozf·in (1 to 10) lbf·in (5 to 50) lbf·in (40 to 400) lbf·in (100 to 1000) lbf·in (25 to 250) lbf·ft (60 to 650) lbf·ft (650 to 2000) lbf·ft	2.3 % 2.3 % 0.3 % 0.3 % 0.31 % 0.3 % 0.29 % 0.65 %	CDI Suretest system
Balances ³			
0.001 g Resolution 0.01 g Resolution 0.1 g Resolution 1 g	(1 to 500) g	2.5 x R 1.5 x R 1.0 x R 0.82 x R	Class 6 weights
Scales ³	Up to 1000 lbs	0.82 x R	Class 6 weights
Force ³ – Measure & Measuring Equipment	(0 to 200) lbf (200 to 1000) lbf (1000 to 10 000) lbf	0.42 lbf 2.9 lbf 22 lbf	Mark-10 load cells

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Pressure Gages, Transducers & Calibrators – Measure & Measuring Equipment ³			
Pneumatic Measure	(-15 to 0) psig (1 to 15) psia (0 to 30) psig (30 to 100) psig (100 to 1000) psig (1000 to 5000) psig (5000 to 10 000) psig	0.013 psi 0.0092 psi 0.017 psi 0.047 psi 0.46 psi 5.8 psi 9.6 psi	Fluke 700PV4 Fluke 700PA4 Fluke 700P05 Fluke 750R06 Fluke 750R08 Fluke 700P30 Fluke 700P31
Pneumatic Measuring Equipment	(-12 to 100) psig	0.041 psi	Fluke 719

VI. Thermodynamics

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Temperature ³ – Measure	(-197 to 660) °C	0.012 °C + 0.000 062 °C/°C	Fluke 5626 PRT, 3458A
Humidity ³ – Measuring Equipment	(10 to 90) % RH	1.1 % RH	Rotronic HP32 w/ HCA2A probe
Temperature Uniformity Survey (TUS) ³	(-200 to -190) °C (-190 to -180) °C (-180 to -150) °C (-150 to -120) °C (-120 to -90) °C (-90 to -70) °C (-70 to -40) °C (-40 to -10) °C (-10 to 0) °C (0 to 1260) °C	2.5 °C 2.4 °C 2.3 °C 2.2 °C 2.1 °C 2.0 °C 1.9 °C 1.8 °C 1.7 °C 1.7 °C + 0.004 °C/°C	AMS 2750F using 1586A SuperDAQ w/1586-2586 high- capacity module, Type-K SLE thermocouple

VII. Time & Frequency

Parameter/Equipment	Range	CMC ^{2, 7} (±)	Comments
Tachometers ³ – Optical	(1 to 100 000) rpm	0.000 78 rpm + 0.000 038 rpm/rpm	Generator locked to GPS
Stopwatches and Timers ³	(0.1 to 86 400) s	32 ms	Counter and Generator locked to GPS
Frequency ³ – Measure	0.1 Hz to 225 MHz 225 MHz to 50 GHz	58 pHz + 12 pHz/Hz 0.12 Hz + 3 pHz/Hz	Counter phase locked to GPS
Frequency ³ – Measuring Equipment	10 MHz 1 μHz to 20 MHz 20 MHz to 50 GHz	58 μHz 0.58 μHz + 29 pHz/Hz 0.58 mHz + 4.5 pHz/Hz	Datum GPS receiver Signal generators, phase locked to GPS

¹ This laboratory offers commercial calibration and field calibration service.

² 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.

³ Field calibration service is available for this calibration. 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.

⁴ The stated measured values are determined using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure or generate the measured value in the ranges indicated. CMC's are expressed as either a specific value that covers the full range or as a percentage or fraction of the reading plus a fixed floor specification.

⁵ In the statement of CMC uncertainty, the value is defined as the percentage of reading unless otherwise indicated; L represents the length of displacement in inches and R represents the resolution of the unit under test.

⁶ This scope meets A2LA's *P112 Flexible Scope Policy*.

⁷ The type of instrument or material being calibrated is defined by the parameter. This indicates the laboratory is capable of calibrating instruments that measure or generate the values in the ranges indicated for the listed measurement parameter.



Accredited Laboratory

A2LA has accredited

TRESCAL, INC.

Elizabeth City, NC

for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and the requirements of ANSI/NCSL Z540.3-2006 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 April 2017*).



Presented this 11th day of July 2023.

A blue ink signature of Mr. Trace McInturff, written in a cursive style.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2737.02
Valid to April 30, 2025

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