



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: August 31, 2024

Certificate Number: 1797.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations^{1,9}:

I. Device Specific Parameters

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Coupling/Decoupling Networks ³ – Insertion Loss Impedance	150 kHz to 230 MHz 150 kHz to 230 MHz	0.30 dB 3.7 %	IEC 61000-4-6 using HP 8753D VNA
LISN ³ – Insertion Loss Impedance	10 kHz to 1 GHz 10 kHz to 100 MHz	0.30 dB 3.4 %	CISPR 16-1-2 using HP 8753D VNA
ESD Simulators ³ – Air Discharge Voltage (Positive & Negative) (10, 20, 30) kV	(2 to 30) kV	1.3 %	IEC 61000-4-2, ISO 10605 w/ Singer ESV
Peak Current (2 to 16) kV	(2 to 30) kV	2.9 %	Agilent 6 GHz scope (2-ch mode)
Rise Time (10 to 90 %, 1 ns Pulse)	(2 to 30) kV	78 ps	
Fall Time (30 to 60) ns	(2 to 30) kV	82 ps	Schaffner MD103

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
EMI Receivers ³ – Sine Wave Output for CISPR Checks (@ 60 dB/μV) Errors for CISPR (Bands A, B, C & D) Impulse Spectral Amplitude	Bands A, B, C, D Band A (10 to 150) kHz Band B (0.15 to 30) MHz Band C & D (30 to 1000) MHz	0.33 dB 0.42 dB 0.56 dB 0.60 dB	CISPR 16-1-1 w/ IGUU 2916
EFT/Burst Generators ³ – Peak Voltage (±) Rise Time (±) Impulse Duration (±) Burst Duration (±) Burst Period (±) Repetition Rate (±)	10 V to 7 kV (± 10 %) (3.5 to 7) ns (30 to 150) ns (0.75, 15, 30) ms (± 20 %) 300 ms (± 20 %) (2.5, 5, 100) kHz (± 20 %)	1.9 % 1.0 % 1.0 % 1.0 % 1.0 % 1.0 %	IEC 61000-4-4 w/ Tek TDS7104 & Haefely PAT 50/1000
Surge Generators ³ – Front Time (±) Rise Time (±) Duration (±) Peak Voltage (±) Peak Current (±) AC Mains Sync	(0.5 to 13) μs (0.5 to 13) μs (5 to 1500) μs 10 V to 6 kV (± 10 %) 5 A to 3 kA (± 10 %) Up to 360° (± 10°)	1.0 % 1.0 % 1.0 % 1.9 % 1.9 % 1.0 %	IEC 61000-4-5 w/ GR 1089 CORE TIA-968-B Tektronix TDS7104, Schaffner MD-200A high voltage probe, Pearson 110 current coil

Parameter/Equipment	Range	CMC ^{2, 4, 5} (±)	Comments
AC Mains Dip/Surge/Interrupt Generators ³ –			
Line Voltage	(150 to 325) V _{pk} (± 5 %)	1.9 %	IEC 61000-4-11 w/ Tektronix TDS7104, Schaffner MD-200A high voltage probe, Pearson 110 current coil
AC Mains Sync	Up to 360° (± 10°)	1.0 %	
Peak Inrush Current	Up to 500 A	1.9 %	
Dips/Overshoot	Up to 325 V (± 5 %)	1.9 %	
Rise Time	(1 to 5) μs	1.0 %	
Damped Oscillatory Wave Generators/Ring Wave Generators ³ –			
Peak Voltage (±)	250 V to 6 kV (± 10 %)	1.9 %	IEC 61000-4-12, IEC 61000-4-18 w/ Tektronix TDS7104, Schaffner MD-200A high voltage probe, Pearson 110 current coil
Peak Current (±)	(1.25 to 500) A (± 10 %)	1.9 %	
Rise Time (±)	75 ns to 1 μs	1.0 %	
Oscillation Freq. (±)	(0.1, 1) MHz (± 10 %)	1.0 %	
Repetition Rate (±)	40/s for 100 kHz (± 10 %) 400/s for 1 MHz (± 10 %)	1.0 %	
Wave Decay	Up to 110 %	1.9 %	
Harmonic & Flicker Measure ³ –			
Voltage	(100 to 280) V	0.13 V	IEC 61000-3-2, IEC 61000-3-3 w/ Agilent 3458A, Agilent 53132A, Agilent 34330A shunt
Current	(0.1 to 2) A (3 to 16) A	0.026 A 0.067 A	
Perceptibility (Short-Term)	≥ 0.4 P _{st}	0.0042 P _{st}	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Oscilloscopes ³ –			
Bandwidth (Flatness)	0.1 Hz to 300 MHz (300 to 550) MHz 550 MHz to 1.1 GHz (1.1 to 3.3) GHz	2.4 % 3.0 % 4.1 % 4.7 %	Fluke 9500B
Rise Time	150 ps to 100 ms	19 ps	

II. Dimensional

Parameter/Equipment	Range	CMC ² (±)	Comments
Hand Tools ^{3,8} –			
Calipers	Up to 72 in	2.2 μin/in + 15 μin	Gage blocks
Micrometers	Up to 48 in	2.2 μin/in + 13 μin	
Height Gages	Up to 48 in	2.2 μin/in + 9.0 μin	
Drop Indicators	Up to 2 in	2.2 μin/in + 43 μin	
Depth Micrometers	Up to 12 in	2.2 μin/in + 4.8 μin	
End Standards ³	Up to 12 in	2.2 μin/in + 10 μin	Supermic w/ gage blocks
Diameter, External ⁸ – Cylindrical Plug Gages	(0.000 05 to 12) in	2.2 μin/in + 15 μin	Supermic w/ gage blocks
Diameter, Internal ⁸ – Plain Ring Gages	Up to 4.0 in	1.6 μin/in + 4.2 μin	Trimos THV

Parameter/Equipment	Range	CMC ² (±)	Comments
Inside Micrometers, Intrimik, Bore Gages, I.D. Comparators ³	(0.081 to 6.0) in	2.2 μin/in + 10 μin	Gage blocks w/ ring gages
Thickness Gages ³ (Feeler Type)	(0.0005 to 0.0500) in	45 μin	Supermic w/ gage blocks
Precision Levels	Up to 1000" Up to 1000"	0.50" 3.5"	Surface plate, gage blocks Sine bar
Surface Plates Flatness Repeatability	Up to 16 ft diagonal Up to 0.001 in	$\sqrt{D} \times 0.000\ 006\ 5$ in 0.000 029 in	Electronic leveling system <i>D = surface diagonal measured in inches</i>
Line Scales, Rulers, Tape Measures ³	Up to 6 ft (6 to 60) ft	5 μin/in + 280 μin 9 μin/in + 600 μin	Renishaw laser measuring system

III. Dimensional Testing/Calibration

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
1D Length ⁷ (Accessibility Probes)	Up to 3 in	3.7 μin/in + 60 μin	Micrometer
	Up to 8 in	3.7 μin/in + 1200 μin	Caliper
	Up to 8 in	3.7 μin/in + 25 μin	Supermic
	Up to 18 in	3.7 μin/in + 87 μin	Renishaw laser measuring system
Diameter ⁷ – Measure	Up to 3 in	3.7 μin/in + 61 μin	Micrometer

IV. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
DC Voltage – Generate ³	(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	9.2 μV/V + 0.40 μV 5.0 μV/V + 0.70 μV 3.5 μV/V + 2.5 μV 3.5 μV/V + 4.0 μV 5.0 μV/V + 40 μV 6.5 μV/V + 0.4 mV	Fluke 5720A
Fixed Values	1 V 10 V	1.1 part in 10 ⁶ 1.1 part in 10 ⁶	Fluke 732B
DC Voltage – Measure, Fixed Values	0.1 V 1 V 10 V 100 V 1000 V	1.3 μV/V 1.3 μV/V 1.3 μV/V 1.6 μV/V 1.6 μV/V	Fluke 732B, 752B, Agilent 34420A
DC Voltage – Measure ³	(0 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 1050) V	1.3 μV/V + 3 nV 1.4 μV/V + 40 nV 3.4 μV/V + 0.4 μV 4.7 μV + 2.3 μV/V 4.7 μV + 2.3 μV/V 43 μV + 3.5 μV/V 0.57 mV + 10 μV/V	Keysight 34420A Fluke 3458A opt 002
DC High Voltage ³ – Generate Measure	 (0 to 10) kV (1 to 10) kV (10 to 100) kV	 0.012 % 0.01 % 0.70 %	 Fluke 410B monitored with Fluke 80E10 & Agilent 34401A Fluke 80E10 & Agilent 34401A Fluke 410B monitored with Spellman HVD-100- 1 & Agilent 3458A

Parameter/Equipment	Range	CMC ^{2, 4, 5} (±)	Comments
DC Current – Generate ³	(0 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 µA/A + 6.0 nA 37 µA/A + 7.0 nA 36 µA/A + 40 nA 55 µA/A + 0.70 µA 0.013 % + 12 µA	Fluke 5720A
	(2.2 to 11) A (11 to 20.5) A	0.060 % + 0.33 mA 0.1 % + 58 µA	Fluke 5500A Fluke 5520A
	(20.5 to 1000) A	0.34 % + 0.05A	w/ 50 turn coil
DC Current – Measure ³	(0 to 100) nA 100 nA to 1 µA (1 to 10) µA (10 to 100) uA 100 µA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	30 µA/A + 8.0 nA 15 µA/A + 1 nA 15 µA/A + 0.16 nA 15 µA/A + 0.83 nA 15 µA/A + 9.2 nA 15 µA/A + 90 nA 30 µA/A + 0.92 µA 100 µA/A + 13 µA	Agilent 3458A
	(1 to 10) A (10 to 120) A (120 to 500) A	0.030 % 0.051 % 0.011 %	Keysight 34420A w/ Otto Wolf shunt L&N shunt
DC Resistance – Generate, Fixed Points ³	(1, 1.9) Ω	96 µΩ/Ω	Fluke 5720A
	10 Ω	26 µΩ/Ω	
	19 Ω	26 µΩ/Ω	
	100 Ω	16 µΩ/Ω	
	190 Ω	11 µΩ/Ω	
	1 kΩ	9.0 µΩ/Ω	
	(1.9, 10) kΩ	9.0 µΩ/Ω	
	19 kΩ	9.0 µΩ/Ω	
	100 kΩ	12 µΩ/Ω	
	190 kΩ	12 µΩ/Ω	
1 MΩ	21 µΩ/Ω	IET VRS-100-9-1K-BP- 10KV	
1.9 MΩ	22 µΩ/Ω		
10 MΩ	41 µΩ/Ω		
19 MΩ	48 µΩ/Ω	Fluke 742A-1k Fluke 742A-10k ESI SR-1010 L&N 4210-1 Fluke 742A-10M	
100 MΩ	0.011 %		
1 GΩ	(0.5 % + 1 x 10 ⁻⁶ V) Ω		
10 GΩ	(0.51 % + 2 x 10 ⁻⁶ V) Ω		
100 GΩ	(1.1 % + 5 x 10 ⁻⁶ V) Ω		
1 kΩ	0.000 82 Ω		
10 kΩ	0.012 kΩ		
100 Ω	0.0023 Ω		
1 Ω	0.000 023 Ω		
10 MΩ	32 Ω		

Parameter/Equipment	Range	CMC ^{2, 4, 5} (±)	Comments
DC Resistance – Generate ³	(0 to 10.9999) Ω (11 to 32.9999) Ω (33 to 109.9999) Ω (110 to 329.9999) Ω 330 Ω to 1.099 99 kΩ (1.1 to 3.299 999) kΩ (3.3 to 10.99 999) kΩ (11 to 32.99 999) kΩ (33 to 109.9999) kΩ	40 μΩ/Ω + 1.0 mΩ 30 μΩ /Ω + 1.5 mΩ 28 μΩ /Ω + 1.4 mΩ 28 μΩ /Ω + 2.0 mΩ 28 μΩ /Ω + 6.8 mΩ 28 μΩ /Ω + 21 mΩ 28 μΩ /Ω + 25 mΩ 28 μΩ /Ω + 0.2 Ω 28 μΩ /Ω + 0.22 Ω	Fluke 5520A, 4-wire
	(110 to 329.9999) kΩ 330 kΩ to 1.099 999 MΩ (1.1 to 3.299 999) MΩ (3.3 to 10.99 999) MΩ (11 to 32.99 999) MΩ (33 to 109.9999) MΩ (110 to 329.9999) MΩ (330 to 1100) MΩ	32 μΩ /Ω + 2.0 Ω 32 μΩ /Ω + 2.6 Ω 60 μΩ /Ω + 42 Ω 0.013 % + 61 Ω 0.025 % + 2.7 kΩ 0.05 % + 5.4 kΩ 0.3 % + 0.12 MΩ 1.5 % + 0.56 MΩ	Fluke 5520A, 2-wire
DC Resistance – Measure ³	(0.9 to 100) mΩ (0.1 to 1) Ω (1 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	0.013 % 4.7 μΩ/Ω 6.6 μΩ/Ω 7.9 μΩ/Ω 5.1 μΩ/Ω 8.6 μΩ/Ω 8.6 μΩ/Ω 8.6 μΩ/Ω 15 μΩ/Ω 17 μΩ/Ω	Agilent 3458A

Parameter/Range	Frequency	CMC ^{2, 5} (±)	Comments
AC Voltage – Generate ³ (0 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	0.024 % + 4.0 μV 90 μV/V + 4.0 μV 80 μV/V + 4.0 μV 0.020 % + 4.0 μV 0.050 % + 5.0 μV 0.11 % + 10 μV 0.14 % + 20 μV 0.27 % + 20 μV	Fluke 5720A

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
AC Voltage – Generate ³ (cont)			
(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	0.024 % + 4.0 μV 90 μV/V + 4.0 μV 80 μV/V + 4.0 μV 0.020 % + 4.0 μV 0.050 % + 5.0 μV 0.11 % + 10 μV 0.14 % + 20 μV 0.27 % + 20 μV	Fluke 5720A
(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	0.024 % + 12 μV 90 μV/V + 7.0 μV 80 μV/V + 7.0 μV 0.020 % + 7.0 μV 0.046 % + 17 μV 0.090 % + 20 μV 0.14 % + 25 μV 0.27 % + 45 μV	
220 mV to 2.2 V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.024 % + 40 μV 90 μV/V + 15 μV 50 μV/V + 8.0 μV 80 μV/V + 10 μV 0.011 % + 30 μV 0.042 % + 80 μV 0.10 % + 0.20 mV 0.17 % + 0.30 mV	
(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	0.024 % + 400 μV 90 μV/V + 150 μV 50 μV/V + 51 μV 80 μV/V + 0.10 mV 0.010 % + 0.20 mV 0.028 % + 0.60 mV 0.1 % + 2.0 mV 0.15 % + 3.2 mV	

Parameter/Range	Frequency	CMC ^{2, 5} (±)	Comments
AC Voltage – Generate ³ (cont)			
(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*	0.024 % + 4.0 μV 90 μV/V + 2.0 μV 50 μV/V + 1.0 μV 80 μV/V + 1.0 μV 0.015 % + 3.0 μV 0.090 % + 16 μV 0.44 % + 40 μV 0.80 % + 80 μV	Fluke 5720A *Limited to 2.2 × 10 ⁷ V-Hz
(220 to 1100) V	(15 to 50) Hz 50 Hz to 1 kHz	0.030 % + 16 μV 0.0070 % + 4.0 μV	
AC Voltage – Measure ³			
(0 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	0.17 % + 1.6 μV 0.074 % + 1.6 μV 0.042 % + 1.6 μV 0.081 % + 2.3 μV 0.12 % + 2.8 μV 0.23 % + 4.3 μV 0.24 % + 8.3 μV 0.35 % + 8.3 μV	Fluke 5790A
(2.2 to 7) 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	0.085 % + 1.6 μV 0.037 % + 1.6 μV 0.021 % + 1.6 μV 0.040 % + 2.3 μV 0.060 % + 2.8 μV 0.12 % + 4.3 μV 0.13 % + 8.3 μV 0.23 % + 8.3 μV	
(7 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	0.029 % + 1.6 μV 0.019 % + 1.6 μV 0.011 % + 1.6 μV 0.021 % + 2.3 μV 0.031 % + 2.8 μV 0.081 % + 4.3 μV 0.089 % + 8.3 μV 0.17 % + 8.3 μV	

Parameter/Range	Frequency	CMC ^{2,4,5} (±)	Comments
AC Voltage – Measure ³ (cont)			
(22 to 70) 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	0.024 % + 1.8 μV 0.012 % + 1.8 μV 65 μV/V + 1.8 μV 0.013 % + 2.3 μV 0.026 % + 2.8 μV 0.051 % + 4.3 μV 0.067 % + 8.3 μV 0.11 % + 8.3 μV	Fluke 5790A
(70 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	0.021 % + 1.8 μV 85 μV/V + 1.8 μV 38 μV/V + 1.8 μV 69 μV/V + 2.3 μV 0.016 % + 2.8 μV 0.025 % + 4.3 μV 0.038 % + 8.3 μV 0.10 % + 8.3 μV	
(220 to 700) 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	0.021 % + 1.8 μV 76 μV/V + 1.8 μV 33 μV/V + 1.8 μV 51 μV/V + 2.3 μV 79 μV/V + 2.8 μV 0.018 % + 4.3 μV 0.030 % + 8.3 μV 0.096 % + 8.3 μV	
700 mV to 2.2 V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.020 % 66 μV/V 24 μV/V 46 μV/V 71 μV/V 0.016 % 0.026 % 0.090 %	
(2.2 to 7) 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	0.020 % 67 μV/V 24 μV/V 48 μV/V 81 μV/V 0.019 % 0.040 % 0.12 %	

Parameter/Range	Frequency	CMC ^{2,4,5} (±)	Comments
AC Voltage – Measure ³ (cont)			
(7 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	0.020 % 67 μV/V 27 μV/V 48 μV/V 81 μV/V 0.019 % 0.040 % 0.12 %	Fluke 5790A
(22 to 70) 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	0.020 % 68 μV/V 32 μV/V 57 μV/V 94 μV/V 0.020 % 0.041 % 0.12 %	
(70 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	0.020 % 68 μV/V 31 μV/V 69 μV/V 98 μV/V 0.021 % 0.050 %	
(220 to 700) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.020 % 99 μV/V 41 μV/V 0.013 % 0.050 %	
(700 to 1000) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	0.020 % 99 μV/V 38 μV/V 0.013 % 0.050 %	

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
AC Voltage – Wide Band Input – Measure ³			
(0 to 2.2) mV	(1 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.070 % + 1.3 μV 0.17 % + 1.3 μV 0.30 % + 1.3 μV 0.70 % + 2.3 μV	Fluke 5790A
(2.2 to 7) mV	(1 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.070 % + 1.3 μV 0.10 % + 1.3 μV 0.17 % + 1.3 μV 0.37 % + 1.3 μV	
(7 to 22) mV	(1 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.070 % + 0.30 μV 0.10 % + 0.30 μV 0.17 % + 0.30 μV 0.37 % + 0.30 μV	
22 mV to 7 V	(1 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	0.05 % + 2.1 μV 0.10 % + 2.1 μV 0.15 % + 2.1 μV 0.35 % + 2.1 μV	
AC Current – Generate ³			
(0 to 220) μA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.025 % + 16 nA 0.016 % + 10 nA 0.012 % + 8.0 nA 0.028 % + 12 nA 0.11 % + 65 nA	Fluke 5720A
220 μA to 2.2 mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.025 % + 41 nA 0.016 % + 36 nA 0.012 % + 36 nA 0.02 % + 0.11 μA 0.11 % + 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	0.025 % + 0.41 μA 0.016 % + 0.36 μA 0.012 % + 0.36 μA 0.02 % + 0.56 μA 0.11 % + 5.0 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	0.025 % + 4.0 μA 0.016 % + 4.0 μA 0.012 % + 3.0 μA 0.02 % + 4.0 μA 0.11 % + 10 μA	
220 mA to 2.2 A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.026 % + 35 μA 0.045 % + 80 μA 0.70 % + 0.16 mA	

Parameter/Range	Frequency	CMC ^{2, 5} (±)	Comments
AC Current – Generate ³ (cont)			
(1.1 to 2.999 99) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.18 % + 0.10 mA 0.06 % + 0.10 mA 0.60 % + 1.0 mA 2.5 % + 5.0 mA	Fluke 5720A
(3 to 10.9999) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz (45 to 100) Hz	0.06 % + 2.0 mA 0.10 % + 2.0 mA 3.0 % + 2.0 mA 0.12 % + 5.0 mA	Fluke 5520A
(11 to 550) A	50 Hz to 440 Hz	0.42 % + 0.5 A	w/ 50-turn coil
AC Current – Measure ³			
(5 to 100) µA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 5 kHz	57 nA + 4 mA/A 45 nA + 1.5 mA/A 40 nA + 0.64 mA/A	HP 3458A
(0.1 to 1) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.43 µA + 0.0041 mA/mA 0.31 µA + 0.0016 mA/mA 0.26 µA + 0.000 67 mA/mA 0.25 µA + 0.000 37 mA/mA 0.26 µA + 0.000 67 mA/mA 0.63 µA + 0.0042 mA/mA 1.8 µA + 0.0056 mA/mA	
(1 to 10) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	2.4 µA + 0.0041 mA/mA 2.3 µA + 0.0016 mA/mA 2.3 µA + 0.000 67 mA/mA 2.3 µA + 0.000 37 mA/mA 2.3 µA + 0.000 67 mA/mA 4.5 µA + 0.0041 mA/mA 16 µA + 0.0056 mA/mA	
(10 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	42 µA + 0.004 mA/mA 30 µA + 0.0015 mA/mA 25 µA + 0.0006 mA/mA 24 µA + 0.0003 mA/mA 25 µA + 0.0006 mA/mA 62 µA + 0.004 mA/mA 0.18 mA + 0.0055 mA/mA	
(0.2 to 1) A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz (5 to 20) kHz (20 to 50) kHz	0.42 mA + 0.0041 A/A 0.3 mA + 0.0017 A/A 0.26 mA + 0.0009 A/A 0.27 mA + 0.0011 A/A 0.37 mA + 0.0031 A/A 0.92 mA + 0.01 A/A	
(10 to 120) A	(50 to 400) Hz	0.15 %	L&N shunt, Fluke 5790A

Parameter/Range	Frequency	CMC ^{2,4,5} (±)	Comments
Capacitance – Generate ³ (0.19 to 0.3999) nF (0.4 to 1.0999) nF (1.1 to 3.2999) nF (3.3 to 10.9999) nF (11 to 32.9999) nF (33 to 109.999) nF (110 to 329.999) nF (0.33 to 1.099 99) μF (1.1 to 3.299 99) μF (3.3 to 10.9999) μF (11 to 32.9999) μF (33 to 109.999) μF (110 to 329.999) μF (0.33 to 1.099 99) mF (1.1 to 3.299 99) mF (3.3 to 10.9999) mF (11 to 32.9999) mF (33 to 110) mF	10 Hz to 10 kHz 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 Hz to 1 kHz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz (0 to 50) Hz (0 to 20) Hz (0 to 6) Hz (0 to 2) Hz (0 to 0.6) Hz (0 to 0.2) Hz	0.40 % + 0.013 nF 0.42 % + 0.014 nF 0.44 % + 0.017 nF 0.21 % + 0.021 nF 0.22 % + 0.14 nF 0.21 % + 0.21 nF 0.22 % + 0.62 nF 0.22 % + 0.002 μF 0.22 % + 0.01 μF 0.23 % + 0.02 μF 0.35 % + 0.08 μF 0.40 % + 0.26 μF 0.40 % + 0.83 μF 0.38 % + 0.0026 mF 0.38 % + 0.01 mF 0.39 % + 0.025 mF 0.77 % + 0.14 mF 0.9 % + 0.76 mF	Fluke 5520A
Capacitance – Generate ³ , Fixed Values 1 pF 10 pF	1 kHz 1 MHz 2 MHz 3 MHz 4 MHz 5 MHz 10 MHz 13 MHz 1 kHz 1 MHz 2 MHz 3 MHz 4 MHz 5 MHz 10 MHz 13 MHz	0.019 % 0.021 % 0.030 % 0.046 % 0.067 % 0.092 % 0.26 % 0.38 % 0.012 % 0.012 % 0.012 % 0.013 % 0.012 % 0.011 % 0.018 % 0.042 %	HP 16380 series

Parameter/Range	Frequency	CMC ^{2, 4, 5} (±)	Comments
Capacitance – Generate ³ , Fixed Values (cont)			
100 pF	1 kHz	0.0085 %	HP 16380 series
	1 MHz	0.0086 %	
	2 MHz	0.009 %	
	3 MHz	0.011 %	
	4 MHz	0.012 %	
	5 MHz	0.016 %	
	10 MHz	0.034 %	
13 MHz	0.050 %		
1 nF	1 kHz	0.010 %	
	1 MHz	0.011 %	
	2 MHz	0.018 %	
	3 MHz	0.030 %	
	4 MHz	0.046 %	
	5 MHz	0.067 %	
	10 MHz	0.19 %	
13 MHz	0.29 %		
10 nF	120 Hz	0.0081 %	
	1 kHz	0.0081 %	
	10 kHz	0.0083 %	
	100 kHz	0.0088 %	
100 nF	120 Hz	0.0066 %	
	1 kHz	0.0070 %	
	10 kHz	0.0069 %	
	100 kHz	0.012 %	
1 μF	120 Hz	0.011 %	
	1 kHz	0.012 %	
	10 kHz	0.011 %	
	100 kHz	0.014 %	
Inductance – Generate ³ , Fixed Points			
20 μH 50 μH 10 mH 50 mH	(0.1 to 10) kHz	0.10 %	QuadTech 1482
		0.086 %	
		0.025 %	
		0.031 %	
500 mH 5 H	(0.1 to 1) kHz	0.028 %	
		0.045 %	

Parameter/Range	Frequency	CMC ^{2,4,5} (\pm)	Comments
Distortion – Measure ³ (0 to -80) dB (0 to -65) dB	20 Hz to 20 kHz (20 to 100) kHz	1.2 dB 2.3 dB	HP 8903B
AC Resistance – Generate ³ 0.1 Ω 1 Ω 10 Ω (0.1, 1, 10, 100) k Ω	DC to 13 MHz	1.2 % + 0.6R 0.12 % + 0.6R 0.11 % + 0.6R 0.032 % + 0.6R	Agilent 16074A AC

Parameter/Equipment	Range	CMC ² (\pm)	Comments
Thermocouple Simulation ³ – Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.58 °C 0.19 °C 0.16 °C 0.19 °C 0.24 °C	Fluke 5500A
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.31 °C 0.19 °C 0.16 °C 0.20 °C 0.27 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.38 °C 0.21 °C 0.19 °C 0.30 °C 0.46 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.73 °C 0.28 °C 0.19 °C 0.16 °C	

V. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ^{2, 4, 5} (±)	Comments
RF Microwave – Power ³			
Power Reference at 1 mW	50 MHz	0.36 %	HP 432A w/ 478-H55
Calibration Factor	0.1 MHz 0.3 MHz to 4 GHz (4 to 18) GHz (18 to 40) GHz (40 to 50) GHz	0.71 % 1.0 % 1.2 % 2.7 % 2.8 %	E4419B w/ 8481A, 8482A, 8487A, 11722A, 11792A
RF Microwave – Absolute Power – Measure ³			Power meter w/:
(-60 to -30) dBm	9 kHz to 18 GHz	2.0 %	E9304A, N-type
(-30 to 10) dBm	100 kHz to 4.2 GHz (4.2 to 18) GHz (18 to 30) GHz (30 to 40) GHz (40 to 50) GHz	1.4 % 1.9 % 2.7 % 3.5 % 5.3 %	8482A, N-type 8481A, N-type 8487A, N-type
(10 to 20) dBm	100 kHz to 4.2 GHz (4.2 to 18) GHz (18 to 30) GHz (30 to 40) GHz (40 to 50) GHz	3.3 % 3.5 % 3.9 % 4.1 % 5.0 %	8482A, N-type 8481A, N-type 8487A, N-type
Harmonic Measurements ³			
(-10 to -20) dBm ≤ -20 dBm	3 Hz to 50 GHz	0.083 dB 0.15 dB	HP E4448A HP33120A
(0 to -50) dBc (0 to -60) dBc (0 to -70) dBc	20 Hz to 40 MHz	1.1 dB 1.5 dB 1.9 dB	HP 3585A
Single Sideband Phase Noise (SSB) – Measure ³			
CW Frequency: 10 MHz to 50 GHz	Markers: 100 Hz to 1 MHz	0.5 dB	HP E4448A

Parameter/Equipment	Range	CMC ^{2, 4, 5} (±)	Comments
Tuned RF Power Relative – Measure ³			
10 MHz to 50 GHz	(0 to -10) dB (-10 to -20) dB (-20 to -30) dB (-30 to -40) dB (-40 to -50) dB (-50 to -60) dB (-60 to -70) dB (-70 to -80) dB (-80 to -90) dB (-90 to -95) dB (-95 to -100) dB (-100 to -110) dB (-110 to -120) dB (-120 to -127) dB	0.022 dB 0.022 dB 0.032 dB 0.064 dB 0.044 dB 0.053 dB 0.069 dB 0.15 dB 0.14 dB 0.13 dB 0.14 dB 0.18 dB 0.18 dB 0.19 dB	HP E4448A
Amplitude Modulation – Measure ³			
(5 to 99) % Depth, 50 Hz to 10 kHz	100 kHz to 10 MHz	0.87 %	HP E4448A
(20 to 99) % Depth, 50 Hz to 100 kHz	10 MHz to 3 GHz	0.58 %	
(5 to 20) % Depth, 50 Hz to 100 kHz	10 MHz to 3 GHz	2.9 %	
(20 to 99) % Depth, 50 Hz to 100 kHz	(3 to 26.5) GHz	1.7 %	
(5 to 20) % Depth, 50 Hz to 100 kHz	(3 to 26.5) GHz	5.2 %	
(20 to 99) % Depth, 50 Hz to 100 kHz	(26.5 to 31.15) GHz	2.2 %	
(5 to 20) % Depth, 50 Hz to 100 kHz	(26.5 to 31.15) GHz	7.9 %	
(20 to 99) % Depth, 50 Hz to 100 kHz	(31.15 to 50) GHz	6.9 %	
(5 to 20) % Depth, 50 Hz to 100 kHz	(31.15 to 50) GHz	30 %	

Parameter/Equipment	Range	CMC ^{2,4,5} (±)	Comments
Frequency Modulation – Measure ³			
Rate: 20 Hz to 10 kHz Peak Dev ≤ 40 kHz, β > 0.2	250 kHz to 10 MHz	1.7 %	HP E4448A
Rate: 20 Hz to 10 kHz Peak Dev ≤ 40 kHz, β > 1.2	250 kHz to 10 MHz	1.2 %	
Rate: 50 Hz to 200 kHz Peak Dev ≤ 400 kHz, β > 0.2	10 MHz to 6.6 GHz	1.7 %	
Rate: 50 Hz to 200 kHz Peak Dev ≤ 400 kHz, β > 0.45	10 MHz to 6.6 GHz	1.2 %	
Rate: 50 Hz to 200 kHz Peak Dev ≤ 400 kHz, β > 0.2	(6.6 to 13.2) GHz	2.9 %	
Rate: 50 Hz to 200 kHz Peak Dev ≤ 400 kHz, β > 8	(6.6 to 13.2) GHz	1.2 %	
Rate: 50 Hz to 200 kHz Peak Dev ≤ 400 kHz, β > 0.2	(13.2 to 31.15) GHz	4.4 %	
Rate: 50 Hz to 200 kHz Peak Dev ≤ 400 kHz, β > 16	(13.2 to 31.15) GHz	1.2 %	
Rate: 50 Hz to 200 kHz Peak Dev ≤ 400 kHz, β > 0.2	(31.15 to 50) GHz	9.8 %	
Rate: 50 Hz to 200 kHz Peak Dev ≤ 400 kHz, β > 32	(31.15 to 50) GHz	1.2 %	
Phase Modulation ³ – Measure			
Rate: 200 Hz to 20 kHz	100 kHz to 6.6 GHz > 0.7 rad > 0.3 rad	1.2 % 3.5 %	HP E4448A
	(6.6 to 13.2) GHz > 2.0 rad > 0.6 rad	1.2 % 3.5 %	
	(13.2 to 26.5) GHz > 4.0 rad > 1.2 rad	1.2 % 3.5 %	
	(26.5 to 31.5) GHz > 4.0 rad > 1.3 rad	1.2 % 3.5 %	
	(31.5 to 50) GHz > 4.0 rad > 2.4 rad	1.2 % 3.5 %	

Parameter/Equipment	Range	CMC ^{2, 4} (\pm)	Comments
RF Microwave ³ – Parameters S ₁₁ & S ₁₂			
Type N Connectors			
Reflection Coefficient ρ S ₁₁ : (0 to 1)	10 kHz to 2 GHz (2 to 8) GHz (8 to 18) GHz	(0.0070 to 0.017) ρ (0.013 to 0.028) ρ (0.017 to 0.033) ρ	Vector Network analyzer w/ calibration kit; ρ is the reflection coefficient
Phase: Arg (S ₁₁) 0 < S ₁₁ < 1 -180° to + 180°	10 kHz to 45 MHz (45 to 2000) MHz (2 to 8) GHz (8 to 18) GHz	(13 to 180)° (30 to 180)° (30 to 180)° (14 to 180)°	
Attenuation: S ₁₂ : (0 to 60) dB	10 kHz to 45 MHz (45 to 2000) MHz (2 to 8) GHz (8 to 18) GHz	(0.056 to 0.23) dB (0.057 to 0.25) dB (0.07 to 0.26) dB (0.12 to 0.43) dB	
7 mm Connectors			
Reflection Coefficient ρ S ₁₁ : (0 to 1)	10 kHz to 45 MHz (45 to 2000) MHz (2 to 8) GHz (8 to 18) GHz	(0.0040 to 0.011) ρ (0.0040 to 0.017) ρ (0.0060 to 0.028) ρ (0.0080 to 0.031) ρ	Agilent VNA/PNA w/ 85057B
Phase: Arg (S ₁₁) 0 < S ₁₁ < 1 -180° to + 180°	10 kHz to 45 MHz (45 to 2000) MHz (2 to 8) GHz (8 to 18) GHz	(3.8 to 180)° (20 to 180)° (6.3 to 180)° (6.6 to 180)°	
Attenuation: S ₁₂ : (0 to 60) dB	10 kHz to 45 MHz (45 to 2000) MHz (2 to 8) GHz (8 to 18) GHz	(0.035 to 0.21) dB (0.035 to 0.23) dB (0.048 to 0.23) dB (0.047 to 0.41) dB	
3.5 mm Connectors			
Reflection Coefficient ρ S ₁₁ : (0 to 1)	10 kHz to 45 MHz (45 to 2000) MHz (2 to 8) GHz (8 to 20) GHz (20 to 26.5) GHz	(0.010 to 0.018) ρ (0.007 to 0.023) ρ (0.007 to 0.013) ρ (0.010 to 0.016) ρ (0.013 to 0.019) ρ	Agilent VNA/PNA w/ 85057B
Phase: Arg (S ₁₁) 0 < S ₁₁ < 1 -180° to + 180°	10 kHz to 45 MHz (45 to 2000) MHz (2 to 8) GHz (8 to 20) GHz (20 to 26.5) GHz	(3.6 to 180)° (2.2 to 180)° (22 to 180)° (16 to 180)° (20 to 180)°	
Attenuation: S ₁₂ : (0 to 60) dB	10 kHz to 45 MHz (45 to 2000) MHz (2 to 8) GHz (8 to 20) GHz (20 to 26.5) GHz	(0.041 to 0.31) dB (0.035 to 0.17) dB (0.060 to 0.22) dB (0.075 to 0.51) dB (0.10 to 2.0) dB	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
RF Microwave ³ – Parameters S ₁₁ & S ₁₂ (cont)			
2.4 mm Connectors			
Reflection Coefficient ρ S ₁₁ : (0 to 1)	45 MHz to 2.0 GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	(0.028 to 0.032) ρ (0.030 to 0.036) ρ (0.047 to 0.053) ρ (0.057 to 0.070) ρ	Agilent VNA/PNA w/ 85057B; ρ is the reflection coefficient
Attenuation: S ₁₂ : (0 to 60) dB	45 MHz to 2.0 GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	(0.07 to 0.22) dB (0.12 to 0.32) dB (0.25 to 0.54) dB (0.33 to 0.69) dB	
Phase: Arg (S ₁₁) 0 < S ₁₁ < 1 -180° to + 180°	45 MHz to 2.0 GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	(0.92 to 1.6)° (4.1 to 5.0)° (8.0 to 9.6)° (10.1 to 12.4)°	

VI. Mechanical

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Mass	(10 to 100) mg 100 mg to 1 g (1 to 20) g (20 to 200) g 200 g to 2 kg (2 to 5) kg (5 to 23) kg	0.0078 mg 0.016 mg 0.028 mg 0.16 mg 1.5 mg 6.2 mg 58 mg	NIST SOP 4 w/ Class 1 weights
Torque Transducers	2 ozf-in to 10 lbf-in 10 lbf-in to 1000 lbf-ft	0.12 % 0.19 %	Calibrated weights & moment arms
Torque Tools ³	2 ozf-in to 4 lbf-in 4 lbf-in to 600 lbf-ft	1.3 % 0.31%	Torque transducers

Parameter/Equipment	Range	CMC ^{2,4,6} (±)	Comments
Pressure – Measuring Equipment			
Hydraulic	Up to 10 000 psig	3.2 psig	Additel ADT672-02-GP10K-PSI-N
Pneumatic ³	(8 to 17) psia (-15 to 15) psig	0.01 % 0.003 psi	Mensor CPC6050 w/ sensor range: (8 to 17) psia (-15 to +15) psig
	(-15 to 50) psig (> 50 to 150) psig	0.0044 psi 0.008 %	(-15 to 150) psig
	(-15 to 100) psig (> 100 to 300) psig	0.0083 psi 0.008 %	(-15 to 300) psig
	(-15 to 330) psig (> 300 to 1000) psig	0.027 psi 0.008 %	(-15 to 1000) psig
Force Gages – Tension & Compression ³	(1 to 16) ozf (1.0 to 100) lbf	0.023 % + 0.6R 0.012 % + 0.6R	Class F weights
Force – Measure, Tension & Compression	(10 to 1000) lbf (1000 to 50 000) lbf	0.044 % + 0.2 lbf 0.072 % + 2.2 lbf	Load cells
Acceleration –			
Sensitivity (mV/g, pC/g)	100 Hz	0.83 %	National Instruments USB-4431 System
Frequency Response	10 Hz to 10 kHz	1.5 %	
Optical Tachometers	(5 to 500 000) rpm	0.0021 rpm + 0.6R	Stroboscope & frequency counter phase locked to GPS receiver
Scales & Balances ^{3,8}	(20 to 500) mg 500 mg to 10 g (10 to 100) g 100 g to 10 kg	0.023 mg 0.005 % 0.000 58 % 0.000 29 %	Class 1 weights
	(5 to 1000) lb	0.012 %	Class F weights

VII. Optical Quantities

Parameter/Equipment	Range	CMC ^{2, 6} (\pm)	Comments
Fiber Optic Power – Relative Measuring Equipment ³	(-50 to -40) dB (-40 to -30) dB (-30 to -20) dB (-20 to -10) dB (-10 to 0) dB (0 to 10) dB	0.026 dB 0.021 dB 0.024 dB 0.022 dB 0.02 dB 0.02 dB	Agilent 81623B
Fiber Optic Power – Measure ³ (1000 to 1650) nm	(-50 to +10) dBm	0.095 dB	Agilent 81623B
Fiber Optic Wavelength – Measuring Equipment ³	(1510 to 1540) nm	0.7 pm	NIST SRM 2517A

VIII. Thermodynamics

Parameter/Equipment	Range	CMC ^{2, 4, 6} (\pm)	Comments
Temperature – Measure ³	(-200 to 420) °C	0.074 °C	PRT & meter
Temperature – Measuring Equipment ³	(-55 to 420) °C	0.14 °C	Hart dry cells with PRT & meter
Relative Humidity – Measuring Equipment ³	(10 to 95) % RH	0.63 % RH	Thunder Scientific
Relative Humidity – Measure ³ Humidity: (+15 to +25) °C (+15 to +25) °C (-20 to +40) °C (-40 to +180) °C Temperature: (0 to 40) °C (-40 to 100) °C (-70 to 140) °C (140 to 180) °C	(0 to 90) % RH (90 to 100) % RH (0 to 100) % RH (0 to 100) % RH	1.3 % RH 2.0 % RH 1.3 % RH + 0.0092 % 1.8 % RH + 0.017 % 0.71 °C 0.79 °C 0.87 °C 0.95 °C	Vaisala humidity meter/probe

IX. Time & Frequency

Parameter/Equipment	Range	CMC ^{2, 6} (\pm)	Comments
Frequency – Measuring Equipment ³	1 Hz to 10 MHz 10 MHz to 50 GHz	0.11 nHz/Hz 10 pHz/Hz	GPS receiver, signal generators
Frequency – Measure ^{3, 8}	1 Hz to 10 MHz 10 MHz to 50 GHz	0.11 nHz/Hz 10 pHz/Hz	GPS receiver, frequency counters
Timers – Stopwatch ³	\pm (0 to 19.99) sec/day	0.037 sec/day	Timometer

¹ This laboratory offers commercial and field calibration services.

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 In the statement of CMC, L is the numerical value of the nominal length of the device measured in inches; R is the numerical value of the resolution of the device and percentages are to be read as percent of reading unless otherwise noted.

⁵ 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. CMCs are expressed as either a specific value that covers the full range or as a percent or fraction of the reading plus a fixed floor specification.

⁶ 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.

⁷ This laboratory meets R205 – Specific Requirements: Calibration Laboratory Accreditation Program for the types of dimensional tests listed above and is considered equivalent to that of a calibration.

⁸ Uncertainty components that can be reasonably attributed to the Unit Under Test have not been utilized in the calculation of the CMC value for this measurement parameter.

⁹ This scope meets A2LA's P112 *Flexible Scope Policy*.



Accredited Laboratory

A2LA has accredited

TRESCAL, INC.

Santa Clara, CA

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/NC SL Z540-1-1994 and the requirements of ANSI/NC SL 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 6th day of April 2023.

A blue ink signature of Mr. Trace McInturff, written over a horizontal line.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1797.01
Valid to August 31, 2024

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