



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

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CALIBRATION

Valid To: September 30, 2024

Certificate Number: 1395.12

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. Dimensional

Parameter/Equipment	Range	CMC ^{2,7} ($\pm$)	Comments
Micrometers – OD ID Depth Anvil Flatness Anvil Parallelism	Up to 36 in Up to 4 in Up to 12 in Up to 1 in Up to 0.001 in	(55 + 7.4L) μ in (55 + 7.4L) μ in (55 + 7.4L) μ in 8.5 μ in 13 μ in	Gage block set, optical flat, optical parallel
Calipers ³	Up to 72 in 1 in	230 μ in 220 μ in	Gage blocks, pin gages Ring gage
Dial & Test Indicators ³ (Analog & Digital)	Up to 1 in: 0.001 resolution 0.0001 resolution 0.000 05 resolution	(64 + 4.6L) μ in (22 + 4.8L) μ in (21 + 4.8L) μ in	Pratt & Whitney Supermicrometer™
Cylindrical Ring Gages – Diameter Roundness/Taper	(0.3 to 4) in (0.3 to 4) in	(16 + 3.2L) μ in 4.7 μ in	Pratt & Whitney Supermicrometer™, gage block set

Parameter/Equipment	Range	CMC ^{2, 7} ($\pm$)	Comments
Cylindrical Pin & Plugs – Diameter Roundness/Taper	Up to 1 in (> 1 to 4) in -----	(12 + 3.2L) μ in (15 + 3.2L) μ in 8.1 μ in	Pratt & Whitney Supermicrometer™, gage block set
Threaded Plug Gages – Major Diameter Pitch Diameter	Up to 12 in (6 to 80) TPI	(17 + 3.2L) μ in (70 + 4.1L) μ in	Gage blocks w/ thread wires & Pratt & Whitney Supermicrometer™
Adjustable Threaded Ring Gages	Up to 5 in	W (Set Plug Tolerance)	Set using master plug gages ASME/ANSI B1.2-1983 & ASME/ANSI B1.3- 2007
Rulers & Measuring Tapes	Up to 5 in (> 5 to 18) in (> 18 to 36) in (> 36 to 38) in	16 μ in/in + 0.0014 in 11 μ in/in + 0.0014 in 11 μ in/in + 0.0019 in 11 μ in/in + 0.0024 in	SIMCO SNS-V2 Custom ruler calibrator

II. Dimensional Testing/Calibration¹

Parameter/Equipment	Range	CMC ² ($\pm$)	Comments
Length – 3 Dimensional ¹¹ X, Y, Z	(28 x 39.8 x 26.8) in	30 μ in/in + 200 μ in	Hexagon Metrology 7.10.7 CMM

III. Electrical – DC / Low Frequency

Parameter/Equipment	Range	CMC ^{2, 4, 5, 6} ($\pm$)	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	9.0 μ V/V + 1.3 μ V 7.1 μ V/V + 1.6 μ V 7.1 μ V/V + 4.2 μ V 7.1 μ V/V + 7.6 μ V 8.1 μ V/V + 84 μ V 9.3 μ V/V + 0.52 mV	Fluke 5700A
DC Voltage – Measure ³	(0 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100 V (100 to 1000) V*	6.9 μ V/V + 0.45 μ V 5.4 μ V/V + 0.47 μ V 5.4 μ V/V + 0.95 μ V 8.0 μ V/V + 44 μ V 8.0 μ V/V + 0.26 mV*	HP 3458A opt-2 *add 12 μ V/V ($V_{in}/1000$) ² to all $V_{in} > 100$
DC Current – Generate ³	(0 to 220) μ A (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A (2.2 to 11) A (11 to 20.5) A	50 μ A/A + 8 nA 51 μ A/A + 8 nA 50 μ A/A + 80 nA 79 μ A/A + 0.8 μ A 83 μ A/A + 25 μ A 0.036 % + 480 μ A 0.079 % + 0.59 mA	Fluke 5700A/5725A Fluke 5520A/SC1100
DC Current – Clamp-On Meters ³	(20 to 150) A (150 to 1000) A	0.58 % + 160 mA 0.58 % + 720 mA	Fluke 5520A/SC1100 Fluke 5500A/coil
DC High Voltage – Generate	(1 to 25) kV	0.067 % + 1.1 mV	Hipotronics HD100 monitored with HP 34401A & Ross Engineering VD60-6.2
DC High Voltage – Measure ³	(1 to 60) kV	0.067 % + 1.1 mV	HP 34401A & Ross Engineering VD60-6.2

Parameter/Equipment	Range	CMC ^{2, 4, 5, 6} ($\pm$)	Comments
DC Current – Measure ³	(0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A (> 1 to 10) A (> 10 to 120) A	27 μ A/A + 7.5 nA 29 μ A/A + 75 nA 44 μ A/A + 0.75 μ A 0.013 % + 16 μ A 12 μ A/A + 6.6 μ A 4.8 μ A/A + 3.3 mA	HP 3458A opt-2 HP 3458A opt-2 w/ Guildline 9230-300
Resistance – Generate ³	1 m Ω 10 m Ω 100 m Ω 1 Ω 10 Ω 100 Ω 1 k Ω 10 k Ω 100 k Ω 1 M Ω (0 to 11) Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω (0.33 to 1.1) k Ω (1.1 to 3.3) k Ω (3.3 to 11) k Ω (11 to 33) k Ω (33 to 110) k Ω (110 to 330) k Ω (0.33 to 1.1) M Ω (1.1 to 3.3) M Ω (3.3 to 11) M Ω (11 to 33) M Ω (33 to 110) M Ω (0.11 to 0.33) G Ω (0.33 to 1.1) G Ω	0.14 $\mu\Omega$ 2.2 $\mu\Omega$ 4.9 $\mu\Omega$ 0.12 m Ω 0.16 m Ω 1.1 m Ω 12 m Ω 94 m Ω 3.3 Ω 21 Ω 32 $\mu\Omega/\Omega$ + 0.78 m Ω 24 $\mu\Omega/\Omega$ + 1.2 m Ω 22 $\mu\Omega/\Omega$ + 1.1 m Ω 22 $\mu\Omega/\Omega$ + 1.6 m Ω 22 $\mu\Omega/\Omega$ + 1.6 m Ω 22 $\mu\Omega/\Omega$ + 16 m Ω 22 $\mu\Omega/\Omega$ + 16 m Ω 22 $\mu\Omega/\Omega$ + 0.16 Ω 22 $\mu\Omega/\Omega$ + 0.16 Ω 28 $\mu\Omega/\Omega$ + 1.6 Ω 28 $\mu\Omega/\Omega$ + 1.6 Ω 52 $\mu\Omega/\Omega$ + 24 Ω 0.011 % + 40 Ω 0.021 % + 2.0 k Ω 0.041 % + 2.7 k Ω 0.24 % + 80 k Ω 1.2 % + 0.39 M Ω	Standard resistors Fluke 5520A/SC1100 CMCs shown are based on 4-wire compensation only; for 2-wire & 2- wire compensation add 5 μ V per ampere stimulus current ($R_{\text{floor}} = E/I$)

Parameter/Equipment	Range	CMC ^{2, 4, 6, 7} ($\pm$)	Comments
Resistance – Measure ³	Up to 10 Ω (10 to 100) Ω (0.1 to 1) k Ω (1 to 10) k Ω (10 to 100) k Ω (0.1 to 1) M Ω (1 to 10) M Ω (10 to 100) M Ω (0.1 to 1) G Ω	19 $\mu\Omega/\Omega$ + 85 $\mu\Omega$ 16 $\mu\Omega/\Omega$ + 0.82 m Ω 14 $\mu\Omega/\Omega$ + 0.82 m Ω 14 $\mu\Omega/\Omega$ + 8.2 m Ω 14 $\mu\Omega/\Omega$ + 83 m Ω 20 $\mu\Omega/\Omega$ + 2.7 Ω 62 $\mu\Omega/\Omega$ + 0.12 k Ω 0.059 % + 3.7 k Ω 0.58 % + 0.26 M Ω	HP 3458A opt-2
Oscilloscopes ³ – Level Sine Amp: 50 kHz to 10 MHz Ref Level Sine Flatness: 4.44 mV to 5.56 V Relative to 50 kHz to 10 MHz Reference Square Wave: 10 Hz to 10 kHz 50 Ω Impedance (Peak to Peak) 1 M Ω Impedance (Peak to Peak) Time Marker Output Edge Transition: 4.44 mV _(p-p) to 3.1 V _(p-p) 10 Hz to 2 MHz Rate	4.4 mV to 5.6 V _(p-p) 100 mHz to 100 MHz (100 to 550) MHz (550 to 1100) MHz (35.52 to 999.90) μ V (1.0 to 21.0) mV (21.001 to 556.0) mV 556.01 mV to 5.56 V (35.52 to 999.90) μ V (1.0 to 21.0) mV (21.001 to 556.0) mV 556.01 mV to 210.0 V 450.50 ps to < 1 ms 1 ms to 55.00 s 150 ps 500 ps	1.7 % 2.2 % 4 % 4.8 % 1.2 % + 12 μ V 0.13 % + 17 μ V 0.13 % + 1.2 μ V 0.075 % + 1.2 μ V 1.2 % + 12 μ V 0.12 % + 17 μ V 0.12 % + 1.2 μ V 0.058 % + 1.2 μ V 0.29 μ s/s 0.36 μ s/s 12 ps 28 ps	Fluke/Wavetek 9500 scope calibrator w/ 9530 active head

Parameter/Equipment	Range	CMC ^{2, 4, 5} (±)	Comments
Phase Angle – Generate ³ (0 to 360)°	(10 to 65) Hz (65 to 500) Hz (0.5 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.14° 0.30° 0.59° 2.9° 5.8°	Fluke 5520A/SC1100
Electrical Simulation of Thermocouple – Generate ³ Type E Type J Type K Type T	(-270 to 1000) °C (-210 to 1200) °C (-270 to 1373) °C (-270 to 400) °C	0.082 °C 0.071 °C 0.084 °C 0.076 °C	Fluke 5700A mV(dc) output with external thermocouple reference probe & ice point reference
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 0.11 °C 0.13 °C 0.16 °C	Fluke 5520A/SC1100
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 0.11 °C 0.13 °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 0.14 °C 0.13 °C 0.20 °C 0.31 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.49 °C 0.19 °C 0.13 °C 0.11 °C	

Parameter/Equipment	Range	CMC ^{2, 5} (±)	Comments
Electrical Simulation of Thermocouple – Measure ³			
Type E	(-270 to 1000) °C	0.076 °C	Keysight 3458A DMM w/ external thermocouple reference probe & ice point reference
Type J	(-210 to 1200) °C	0.061 °C	
Type K	(-270 to 1373) °C	0.074 °C	
Type T	(-270 to 400) °C	0.070 °C	
Type E	(-250 to -100) °C	0.39 °C	Fluke 5522A/SC1100
	(-100 to -25) °C	0.13 °C	
	(-25 to 350) °C	0.11 °C	
	(350 to 600) °C	0.13 °C	
	(600 to 1000) °C	0.16 °C	
Type J	(-210 to -100) °C	0.21 °C	
	(-100 to -30) °C	0.13 °C	
	(-30 to 150) °C	0.11 °C	
	(150 to 760) °C	0.13 °C	
	(760 to 1200) °C	0.18 °C	
Type K	(-200 to -100) °C	0.26 °C	
	(-100 to -25) °C	0.14 °C	
	(-25 to 120) °C	0.13 °C	
	(120 to 1000) °C	0.20 °C	
	(1000 to 1372) °C	0.31 °C	
Type T	(-250 to -150) °C	0.49 °C	
	(-150 to 0) °C	0.19 °C	
	(0 to 120) °C	0.13 °C	
	(120 to 400) °C	0.11 °C	

Parameter/ Range	Frequency	CMC ^{2, 4, 5} (±)	Comments
AC Voltage – Generate ³			
(1 to 33) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.064 % + 6 µV 0.019 % + 6 µV 0.022 % + 6 µV 0.082 % + 6 µV 0.28 % + 12 µV 0.63 % + 50 µV	Fluke 5520A/SC1100; LCOMP off
(33 to 330) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.034 % + 8 µV 0.012 % + 8 µV 0.014 % + 8 µV 0.028 % + 8 µV 0.064 % + 32 µV 0.16 % + 70 µV	
(0.33 to 3.3) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.024 % + 50 µV 0.012 % + 60 µV 0.016 % + 60 µV 0.024 % + 50 µV 0.056 % + 130 µV 0.19 % + 600 µV	
(3.3 to 33) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.024 % + 0.6 mV 0.012 % + 0.6 mV 0.020 % + 0.6 mV 0.028 % + 0.6 mV 0.070 % + 1.6 mV	
(33 to 330) V	(45 to 1000) Hz (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.016 % + 2 mV 0.016 % + 6 mV 0.020 % + 6 mV 0.028 % + 6 mV 0.16 % + 50 mV	
(330 to 1020) V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.024 % + 12 mV 0.020 % + 12 mV 0.024 % + 12 mV	

Parameter/Range	Frequency	CMC ^{2, 4, 6} ($\pm$)	Comments
AC Voltage – Measure ³			
(1 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	0.035 % + 3.5 μ V 0.023 % + 1.3 μ V 0.035 % + 1.3 μ V 0.12 % + 1.3 μ V 0.58 % + 1.3 μ V 4.6 % + 2.4 μ V	HP 3458A opt-2
(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 (0.3 to 1) MHz	89 μ V/V + 4.7 μ V 89 μ V/V + 2.5 μ V 0.017 % + 2.6 μ V 0.035 % + 2.3 μ V 0.093 % + 2.4 μ V 0.35 % + 12 μ V 1.2 % + 12 μ V	
100 mV to 1 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 (0.3 to 1) MHz	89 μ V/V + 47 μ V 89 μ V/V + 25 μ V 0.017 % + 24 μ V 0.035 % + 24 μ V 0.093 % + 24 μ V 0.35 % + 0.12 mV 1.2 % + 0.12 mV	
(1 to 10) 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 (0.3 to 1) MHz	89 μ V/V + 0.48 mV 89 μ V/V + 0.26 mV 0.017 % + 0.31 mV 0.035 % + 0.26 mV 0.093 % + 0.25 mV 0.35 % + 1.2 mV 1.2 % + 1.2 mV	
(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	0.023 % + 4.7 mV 0.023 % + 2.5 mV 0.023 % + 2.5 mV 0.041 % + 2.3 mV 0.14 % + 2.4 mV	
(100 to 700) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.046 % + 47 mV 0.046 % + 24 mV 0.069 % + 23 mV 0.14 % + 23 mV 0.35 % + 23 mV	

Parameter/Range	Frequency	CMC ^{2, 4, 5} (±)	Comments
AC Current – Generate ³			
(22 to 220) µA	(10 to 20) Hz (20 to 40) Hz (40 to 1000) Hz (1 to 5) kHz (5 to 10) kHz	0.070 % + 16 nA 0.036 % + 20 nA 0.013 % + 8 nA 0.062 % + 40 nA 0.16 % + 80 nA	Fluke 5700A
(0.22 to 2.2) mA	(10 to 20) Hz (20 to 40) Hz (40 to 1000) Hz (1 to 5) kHz (5 to 10) kHz	0.075 % + 41 nA 0.037 % + 35 nA 0.016 % + 35 nA 0.060 % + 0.4 µA 0.16 % + 0.8 µA	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz (40 to 1000) Hz (1 to 5) kHz (5 to 10) kHz	0.075 % + 0.41 µA 0.036 % + 0.35 µA 0.013 % + 0.35 µA 0.060 % + 4.0 µA 0.16 % + 8.0 µA	
(22 to 220) mA	(10 to 20) Hz (20 to 40) Hz (40 to 1000) Hz (1 to 5) kHz (5 to 10) kHz	0.075 % + 4.1 µA 0.037 % + 3.5 µA 0.015 % + 3.5 µA 0.060 % + 60 µA 0.16 % + 80 µA	
(0.22 to 2.2) A	(20 to 1000) Hz (1 to 5) kHz (5 to 10) kHz	0.066 % + 35 µA 0.045 % + 80 µA 0.70 % + 160 µA	
(2.2 to 3) A	45 Hz to 1 kHz (1 to 5) kHz	0.047 % + 0.084 mA 0.47 % + 0.78 mA	Fluke 5520A/SC1100
(3 to 11) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.047 % + 1.6 mA 0.081 % + 1.6 mA 2.3 % + 1.6 mA	
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.096 % + 1.6 mA 0.096 % + 3.9 mA 2.3 % + 3.9 mA	

Parameter/Range	Frequency	CMC ^{2, 4, 5, 6} ($\pm$)	Comments
AC Current – Measure ³			
(5 to 100) μ A	45 Hz to 1 kHz	0.072 % + 0.035 μ A	HP 3458A opt-2
(0.1 to 1) mA	(45 to 100) Hz 100 Hz to 5 kHz	0.070 % + 0.23 μ A 0.036 % + 0.23 μ A	
(1 to 10) mA	(45 to 100) Hz 100 Hz to 5 kHz	0.070 % + 2.3 μ A 0.035 % + 2.3 μ A	
(10 to 100) mA	(45 to 100) Hz 100 Hz to 5 kHz	0.070 % + 23 μ A 0.036 % + 23 μ A	
(0.1 to 1) A	(45 to 100) Hz 100 Hz to 5 kHz	0.093 % + 0.23 mA 0.12 % + 0.23 mA	
5 mA to 1.3 A (1.25 to 6.5) A (5 to 13) A (10 to 26) A	40 Hz to 10 kHz 40 Hz to 10 kHz 40 Hz to 10 kHz 40 Hz to 5 kHz	0.036 % 0.058 % 0.054 % 0.11 %	Holt HCS-1 current shunts, Keysight 3458A opt 2
(> 1 to 20) A	(40 to 1000) Hz	0.042 % + 3.6 mA	Keysight 3458A opt-2 w/ Fluke Y5020
AC Current – Clamp-on Meter ³			
(20 to 150) A	(45 to 65) Hz (65 to 440) Hz	0.56 % + 290 mA 1.0 % + 290 mA	Fluke 5520A/SC1100 Fluke 5500A/coil
(150 to 1000) A	(45 to 65) Hz (65 to 440) Hz	0.57 % + 1 A 1.0 % + 1 A	
AC High Voltage – Generate ³	(1 to 20) kV, @ 60 Hz	0.25 % + 3.7 mV	Hipotronics HD100 monitored w/ HP 34401A & Ross Engineering VD60-6.2
AC High Voltage – Measure ³	(1 to 40) kV, @ 60 Hz	0.25 % + 3.7 mV	HP34401A & Ross Engineering VD60-6.2

Parameter/Equipment	Range	CMC ^{2, 4, 7} ($\pm$)	Comments
Capacitance ³ – Generate	1 pF to 1 μ F (0.19 to 3.2999) nF (3.3 to 10.9999) nF (11 to 109.999) nF (110 to 329.999) nF (0.33 to 1.099 99) μ F (1.1 to 3.299 99) μ F (3.3 to 10.9999) μ F (11 to 32.9999) μ F (33 to 109.999) μ F (110 to 329.999) μ F (0.33 to 1.099 99) mF (1.1 to 3.299 99) mF (3.3 to 10.9999) mF	0.12 % + 0.58R 0.39 % + 0.0085 nF 0.19 % + 0.011 nF 0.19 % + 0.1 nF 0.19 % + 0.32 nF 0.19 % + 1 nF 0.19 % + 2.9 nF 0.19 % + 12 nF 0.31 % + 33 nF 0.35 % + 150 nF 0.35 % + 420 nF 0.35 % + 1.1 μ F 0.35 % + 2.6 μ F 0.35 % + 9.7 μ F	HP 4236B & various fixed capacitors Fluke 5520A/SC1100
Capacitance ³ – Measure, 12 Hz to 100 kHz ⁸	(0.01 to 10) pF (10 to 100) pF 100 pF to 25 μ F (25 to 100) μ F (100 to 1000) μ F	0.47 % 0.075 % 0.035 % 0.063 % 0.063 %	GenRad 1689
Inductance – Generate	100 μ H 500 μ H 1 mH 10 mH 100 mH 1 H 10 H	0.13 μ H 0.90 μ H 1.3 μ H 4.9 μ H 31 μ H 270 μ H 7.2 mH	Various fixed inductors
Inductance – Measure ³	100 μ H to 100 mH > 100 mH to 1 H (> 1 to 10) H	0.062 % 0.066 % 0.23 %	GenRad 1689

IV. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ^{2, 4, 7} ($\pm$)	Comments
RF Power – Generate ³ (-20 to +20) dBm	100 kHz to 50 MHz	0.17 dB	E4418B power meter w/ 8482A sensor & HP11667A
	50 MHz to 2 GHz	0.17 dB	E4418B power meter w/ 8481A sensor & HP11667A
	(>2 to 12) GHz	0.26 dB	
	(>12 to 18) GHz	0.27 dB	
(-20 to +20) dBm	100 kHz to 1.3 GHz	0.16 dB	Agilent/HP 8902A w/ 11722A & 11667A
	(1.3 to 3) GHz	0.17 dB	
	(3 to 26.5) GHz	0.42 dB	Agilent/HP 8902A w/ 11722A & 11667B
Absolute RF Power – Measure ³ (-20 to +20) dBm	150 kHz to 2.6 GHz	0.066 dB	Agilent/HP 8902A w/ 11722A
	50 MHz to 3 GHz	0.088 dB	Agilent/HP 8902A w/ 8485A
	(3 to 26.5) GHz	0.13 dB	
	0 dBm	1.3 % (0.056 dB)	HP 432A power meter & thermistor w/ DC substitution
	(-20 to +20) dBm	1.8 %	E4418B power meter w/ 8482A sensor
	> 50 MHz to 2 GHz	1.6 %	E4418B power meter w/ 8481A sensor
	(> 2 to 12.4) GHz	1.8 %	
	(> 12.4 to 18) GHz	1.9 %	

Parameter/Equipment	Range	CMC ^{2, 4} (±)	Comments
RF Attenuation – Generate ³			
2.5 MHz to 1.3 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 < 100) dB (100 to < 110) dB (110 to < 120) dB (120 to 127) dB	0.020 dB 0.026 dB 0.036 dB 0.046 dB 0.056 dB 0.066 dB 0.076 dB 0.086 dB 0.096 dB 0.11 dB 0.52 dB 0.58 dB 0.80 dB	Agilent/HP 3335A level generator (2.5 to 80MHz), 83630B sweeper (> 80 MHz to 26.5 GHz), 11667A splitter, Agilent/HP 8902A measuring receiver (option 050 verified), & 11793A microwave converter (> 1.3 GHz)
(> 1.3 to 12.4) 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 < 99) dB (99 to < 100) dB (100 to < 110) dB (110 to < 120) dB (120 to 127) dB	0.020 dB 0.026 dB 0.036 dB 0.046 dB 0.056 dB 0.066 dB 0.076 dB 0.086 dB 0.096 dB 0.11 dB 0.29 dB 0.70 dB 0.75 dB 0.80 dB	
(> 12.4 to 18) 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 < 94) dB (94 to < 100) dB (100 to < 110) dB (110 to < 120) dB (120 to 127) dB	0.016 dB 0.026 dB 0.036 dB 0.046 dB 0.056 dB 0.066 dB 0.076 dB 0.086 dB 0.096 dB 0.11 dB 0.29 dB 0.70 dB 0.75 dB 0.80 dB	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
RF Attenuation – Measure ³ (cont)			
(> 1.3 to 12.4) GHz	(50 to < 60) dB	0.066 dB	Agilent/HP 8902A measuring receiver (option 050 verified), & 11793A microwave converter (> 1.3 GHz)
	(60 to < 70) dB	0.076 dB	
	(70 to < 80) dB	0.086 dB	
	(80 to < 90) dB	0.096 dB	
	(90 to < 99) dB	0.11 dB	
	(99 to < 100) dB	0.29 dB	
	(100 to < 110) dB	0.70 dB	
	(110 to < 120) dB	0.75 dB	
	(120 to 127) dB	0.80 dB	
(> 12.4 to 18) GHz	(0 to < 10) dB	0.016 dB	
	(10 to < 20) dB	0.026 dB	
	(20 to < 30) dB	0.036 dB	
	(30 to < 40) dB	0.046 dB	
	(40 to < 50) dB	0.056 dB	
	(50 to < 60) dB	0.066 dB	
	(60 to < 70) dB	0.076 dB	
	(70 to < 80) dB	0.086 dB	
	(80 to < 90) dB	0.096 dB	
	(90 to < 94) dB	0.11 dB	
	(94 to < 100) dB	0.29 dB	
	(100 to < 110) dB	0.70 dB	
	(110 to < 120) dB	0.75 dB	
	(120 to 127) dB	0.80 dB	
(> 18 to 26.5) GHz	(0 to < 10) dB	0.016 dB	
	(10 to < 20) dB	0.026 dB	
	(20 to < 30) dB	0.036 dB	
	(30 to < 40) dB	0.046 dB	
	(40 to < 50) dB	0.056 dB	
	(50 to < 60) dB	0.066 dB	
	(60 to < 70) dB	0.076 dB	
	(70 to < 80) dB	0.086 dB	
	(80 to < 89) dB	0.096 dB	
	(89 to < 90) dB	0.28 dB	
	(90 to < 100) dB	0.29 dB	
	(100 to < 110) dB	0.70 dB	
	(110 to < 120) dB	0.75 dB	
	(120 to 127) dB	0.80 dB	

Parameter/Range	Frequency	CMC ^{2, 4, 7} (±)	Comments
Amplitude Modulation – Measure ³ Rate: 50 Hz to 10 kHz Depths: (5 to 99) % Rate: 20 Hz to 10 kHz Depths: Up to 99 % Rate: 50 Hz to 50 kHz Depths: (5 to 99) % Rate: 20 Hz to 100 kHz Depths: Up to 99 % Rate: 50 Hz to 50 kHz Depths: (5 to 99) % Rate: 20 Hz to 100 kHz Depths: Up to 99 %	150 kHz to 10 MHz > 10 MHz to 1.3 GHz (>1.3 to 26.5) GHz	2.1 % + 1 digit 3.0 % + 1 digit 1.1 % + 1 digit 3.0 % + 1 digit 1.6 % + 1 digit 3.0 % + 1 digit	Agilent/HP 8902A measuring receiver w/ 11722A sensor
Amplitude Modulation – Generate ³ 50 Hz to 50 kHz < 95 % 50 Hz to 50 kHz < 99 % 20 Hz to 100 kHz < 95 % 20 Hz to 100 kHz < 99 % 20 Hz to 10 MHz < 95 % 20 Hz to 10 MHz < 99 %	(11 to 13.5) MHz	0.27 % 0.31 % 0.36 % 0.42 % 2.9 % 2.9 %	HP 11715A
Frequency Modulation – Generate ³ DC to 100 kHz Rates DC to 200 kHz Rates DC to 10 MHz Rates	(11 to 432) MHz	0.21 % 0.32 % 2.9 %	HP 11715A

Parameter/Range	Frequency	CMC ^{2, 4, 7} ($\pm$)	Comments
Frequency Modulation – Measure ³			
Rate: 20 Hz to 10 kHz Dev.: ≤ 40 kHz peak	(0.25 to 10) MHz	2.0 % + 1 digit	Agilent/HP 8902A w/ 11722A & 11792A sensors
Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz peak	(10 to 1300) MHz	1.1 % + 1 digit	
Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak	(10 to 1300) MHz	5.0 % + 1 digit	Plus Agilent/HP 11793A mixer
Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz peak	(10 to 26 500) MHz	2.7 % + 1 digit	
Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak	(10 to 26 500) MHz	6.3 % + 1 digit	
Phase Modulation – Measure			
Rate: 200 Hz to 10 kHz	150 kHz to 10 MHz	4 % + 0.015 rad	HP 8902A measuring receiver w/ HP 11792A sensor
Rate: 20 Hz to 200 kHz	10 MHz to 26.5 GHz	5 % + 0.019 rad	
Harmonic Distortion – Measure			
(-99 to 0) dB	20 Hz to 20 kHz	1.2 dB	HP 8903B audio analyzer
	(> 20 to 100) kHz	2.1 dB	
	> 100 kHz to 2.9 GHz	3.5 dB	Spectrum analyzer
	(> 2.9 to 22) GHz	6.1 dB	
	(> 22 to 26.5) GHz	7.9 dB	

V. Mechanical

Parameter/Equipment	Range	CMC ^{2, 7, 10} (±)	Comments
Force – Measuring Equipment ³ , Tension & Compression	Up to 300 lbf	0.05 % + 0.6R	Class F weights
Pressure – Measuring Equipment ³	(> 50 to 1000) psi (0 to 50) psi (0 to 30) in·Hg Vacuum	0.013 % + 0.0039 psi 0.012 % + 0.0053 psi 0.012 % + 0.0071 in·Hg	Ruska 7215xi pressure controller
Torque Measuring Equipment (Wrenches & Screwdrivers) ³	(1 to 10) ozf·in (10 to 100) ozf·in (5 to 150) lbf·in (15 to 150) lbf·ft	0.32 % 0.53 % 0.56 % 0.29 %	AWS Series IT transducers & display

VI. Thermodynamics

Parameter/Equipment	Range	CMC ^{2, 10} (±)	Comments
Temperature – Measure	(-196 to 420) °C	0.046 °C	Direct comparison Fluke 5616 PRT
Temperature – Measuring Equipment	(-50 to 160) °C (0 to 100) °C (Ambient to 350) °C	0.13 °C 0.062 °C 0.051 °C	Direct comparison Fluke 5616 PRT
Humidity – Measure ³	(0 to < 90) % RH (90 to 100) % RH	1.2 % RH 2.4 % RH	Vaisala HMI41/HMP46
Humidity – Measuring Equipment	(11 to 75) % RH	1.2 % RH	Vaisala HMI41/HMP46 & humidity salts

VII. Time & Frequency

Parameter/Equipment	Range	CMC ^{2, 7, 10} ($\pm$)	Comments
Frequency – Measuring Equipment	10 MHz Reference	12 pHz/Hz	Fluke 910 GPS
	1 Hz to 20 MHz	3.5×10^{-11} Hz/Hz + 20 μ Hz + 0.58R	GPS receiver w/ 3325 synthesized generator
	20 MHz to 26.5 GHz	3.5×10^{-11} Hz/Hz + 0.58R	83630B synthesized generator
Frequency – Measure	1 Hz to 225 MHz	1.3×10^{-10} Hz/Hz + 20 μ Hz + 0.58R	GPS receiver w/ 53131A counter
	> 225 MHz to 1.3GHz	4.2×10^{-10} Hz/Hz + 0.58R	GPS receiver w/ 53131A Opt 030 counter
	(> 1.3 to 26.5) GHz	3.5×10^{-11} Hz/Hz + 1.2 Hz	GPS receiver w/ 5351B counter
Timers/Stopwatches ³	Up to 24 hr	12 ms	Fluke 910 GPS w/ 53131A counter NIST RP 960-12

¹ This laboratory offers commercial 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 percent or fraction of the reading plus a fixed floor specification.
- ⁵ Based on using the standard at the temperature the Fluke 5520A with SC1100-was calibrated ($t_{cal} \pm 5^\circ\text{C}$) and assuming the instrument is zeroed at least every seven days or when the ambient temperature changes more than 5°C . For resistance, a zero calibration is performed at least every 12 hours within $\pm 1^\circ\text{C}$ of use.
- ⁶ Based on using the standard at the temperature the HP 3458A was calibrated ($t_{cal} \pm 5^\circ\text{C}$) and an auto-calibration (ACAL) was performed within the previous 24 hours ($\pm 1^\circ\text{C}$ of ambient temperature).
- ⁷ In the statement of CMC; the value is defined as the percentage of reading unless otherwise noted. In the statement of CMC, R is the numerical value of the resolution of the device. In the statement of CMC, L is the numerical value of the nominal length of the device measured in inches.
- ⁸ CMC uncertainties are best case at 1 kHz.
- ⁹ This scope meets A2LA's *P112 Flexible Scope Policy*.
- ¹⁰ 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.
- ¹¹ 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.



Accredited Laboratory

A2LA has accredited

SIMCO ELECTRONICS

Redmond, WA

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 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 16th day of November 2022.

A blue ink signature of a person, likely the Vice President of Accreditation Services, written over a horizontal line.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1395.12
Valid to September 30, 2024

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