



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

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CALIBRATION

Valid To: September 30, 2023

Certificate Number: 2357.16

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 ^{2,4} (\pm)	Comments
Micrometers ³			
Linearity	Up to 12 in (12 to 48) in	(9.3 + 3.3L) μ in (15 + 2.8L) μ in	Grade 0.5 gage blocks
Flatness	Up to 1 in	5.2 μ in	Optical flat
Parallelism	Up to 1 in	10 μ in	Optical parallel
Calipers ³	Up to 4 in (4 to 12) in (12 to 48) in	(30 + 1.3L) μ in (290 + 1.3L) μ in (270 + 2.8L) μ in	Grade 0.5 gage blocks
Indicators ³	Up to 2 in	35 μ in	ULM
Height Gages	(0.05 to 4) in (4 to 12) in (12 to 48) in	590 μ in 590 μ in (590 + 0.3L) μ in	Grade 0.5 gage blocks

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
DC Voltage ³ – Generate	Up 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	8.3 μV/V + 0.60 μV 6.3 μV/V + 1.0 μV 6.4 μV/V + 3.5 μV 6.3 μV/V + 6.5 μV 7.0 μV/V + 80 μV 8.7 μV/V + 500 μV	Fluke 5700A
DC Voltage ³ – Measure	Up to 100 mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	12 μV/V + 0.23 μV 7.1 μV/V + 0.23 μV 6.3 μV/V + 0.39 μV 9.4 μV/V + 23 μV 22 μV/V + 78 μV	HP 3458A, OPT 002
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 (2.2 to 11) A (11 to 20.5) A	48 μA/A + 8.0 nA 48 μA/A + 8.0 nA 48 μA/A + 80 nA 56 μA/A + 0.8 μA 75 μA/A + 25 μA 0.28 mA/A + 0.48 mA 0.78 mA/A + 0.58 mA	Fluke 5700A/5725A Fluke 5520A
Clamp-On Only	(0 to 150) A (150 to 1025) A	3.9 mA/A + 0.11 mA 4.0 mA/A + 0.39 mA	Fluke 5520A w/coil
DC Current ³ – Measure	Up to 100 nA (0.1 to 1) μA (1 to 10) μA (10 to 100) μA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A (1 to 15) A (15 to 100) A (100 to 300) A	66 μA/A + 31 pA 32 μA/A + 31 pA 16 μA/A + 78 pA 19 μA/A + 0.62 nA 19 μA/A + 3.9 nA 19 μA/A + 39 nA 36 μA/A + 0.39 μA 88 μA/A + 7.8 μA 51 μA/A 72 μA/A 58 μA/A	HP 3458A HP 3458A w/Guidline 9211

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
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 (100 to 1200) MΩ	12 μΩ/Ω + 39 μΩ 9.0 μΩ/Ω + 0.39 mΩ 8.0 mΩ/kΩ + 0.39 mΩ 8.0 mΩ/kΩ + 3.9 mΩ 8.0 mΩ/kΩ + 39 mΩ 12 Ω/MΩ + 1.6 Ω 39 Ω/MΩ + 78 Ω 0.40 kΩ/MΩ + 0.78 kΩ 4.7 kΩ/MΩ + 7.8 kΩ	HP 3458A
DC Resistance ³ – Generate	(0 to 11) Ω (11 to 33) Ω (33 to 110) Ω (0.11 to 0.33) kΩ (0.33 to 1.1) kΩ (1.1 to 3.3) kΩ (3.3 to 11) kΩ (11 to 33) kΩ (33 to 110) kΩ (0.11 to 0.33) MΩ (0.33 to 1.1) MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ (330 to 1100) MΩ	32 μΩ/Ω + 0.78 mΩ 26 μΩ/Ω + 1.2 mΩ 24 μΩ/Ω + 1.1 mΩ 24 μΩ/Ω + 1.6 mΩ 24 μΩ/Ω + 1.6 mΩ 24 μΩ/Ω + 16 mΩ 23 μΩ/Ω + 16 mΩ 24 μΩ/Ω + 0.16 Ω 24 μΩ/Ω + 0.16 Ω 29 μΩ/Ω + 1.6 Ω 28 μΩ/Ω + 1.6 Ω 64 μΩ/Ω + 23 Ω 0.10 mΩ/Ω + 39 Ω 0.42 mΩ/Ω + 1.9 kΩ 0.41 mΩ/Ω + 2.3 kΩ 2.5 mΩ/Ω + 78 kΩ 12 mΩ/Ω + 0.39 MΩ	Fluke 5520A
Fixed Values	1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	0.13 mΩ 0.18 mΩ 0.27 mΩ 0.48 mΩ 1.7 mΩ 3.1 mΩ 12 mΩ 23 mΩ 0.11 Ω 0.21 Ω 1.3 Ω 3.1 Ω 50 Ω 61 Ω 0.40 kΩ 0.86 kΩ 10 kΩ	Fluke 5700A

Parameter/Range	Frequency	CMC ^{2,5} (\pm)	Comments
Distortion ³ – Measure, 20 Hz to 100 kHz, Fundamental Frequency			
20 Hz to 20 kHz (20 to 100) kHz	(0 to -99) dB (0 to -99) dB	1.2 dB 2.3 dB	HP 8903B
AC Voltage ³ – Generate			
(0.2 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	1.2 mV/V + 3.9 μ V 0.87 mV/V + 3.9 μ V 0.86 mV/V + 3.9 μ V 1.4 mV/V + 3.9 μ V 2.1 mV/V + 6.2 μ V 3.5 mV/V + 12 μ V 4.9 mV/V + 23 μ V 7.1 mV/V + 31 μ V	Fluke 5700A w/5725A
(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	0.51 mV/V + 4.7 μ V 0.25 mV/V + 4.7 μ V 0.17 mV/V + 4.7 μ V 0.4 mV/V + 4.7 μ V 0.82 mV/V + 6.2 μ V 1.3 mV/V + 12 μ V 1.7 mV/V + 23 μ V 4.1 mV/V + 31 μ V	
(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	0.55 mV/V + 12 μ V 190 μ V/V + 7.8 μ V 93 μ V/V + 7.8 μ V 0.29 mV/V + 7.8 μ V 0.71 mV/V + 23 μ V 0.88 mV/V + 23 μ V 1.4 mV/V + 31 μ V 2.9 mV/V + 78 μ V	
(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	0.63 mV/V + 78 μ V 140 μ V/V + 23 μ V 69 μ V/V + 5.4 μ V 120 μ V/V + 15 μ V 0.24 mV/V + 62 μ V 0.4 mV/V + 120 μ V 0.96 mV/V + 0.31 mV 2 mV/V + 0.78 mV	

Parameter/Range	Frequency	CMC ^{2,5} (±)	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	0.55 mV/V + 0.78 mV 0.14 mV/V + 0.23 mV 70 μV/V + 54 μV 120 μV/V + 160 μV 0.23 mV/V + 0.31 mV 0.49 mV/V + 1.3 mV 1.1 mV/V + 3.9 mV 2.5 mV/V + 7 mV	Fluke 5700A w/5725A
(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	0.59 mV/V + 7.8 mV 140 μV/V + 2.3 mV 74 μV/V + 0.78 mV 200 μV/V + 3.1 mV 0.47 mV/V + 7.8 mV 1.3 mV/V + 85 mV 4.2 mV/V + 85 mV 11 mV/V + 170 mV	
(220 to 1100) V	(15 to 50) Hz 50 Hz to 1 kHz	0.36 mV/V + 16 mV 80 μV/V + 3.1 mV	w/5725
(220 to 750) V	40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	80 μV/V + 3.1 mV 0.13 mV/V + 4.7 mV 0.49 mV/V + 8.5 mV	w/5725
(750 to 1100) V	30 Hz to 50 kHz (50 to 100) kHz	0.47 mV/V + 8.5 mV 1.8 mV/V + 35 mV	
Wideband Output (OPT 003)			
Absolute			
Up to 1.1 mV	30 Hz to 500 kHz	6.4 mV/V + 1.6 μV	Fluke 5700A
(1.1 to 3) mV	30 Hz to 500 kHz	5.5 mV/V + 2.3 μV	
(3 to 11) mV	30 Hz to 500 kHz	5.5 mV/V + 6.2 μV	
(11 to 33) mV	30 Hz to 500 kHz	4.7 mV/V + 12 μV	
(33 to 110) mV	30 Hz to 500 kHz	4.7 mV/V + 31 μV	
(110 to 330) mV	30 Hz to 500 kHz	3.9 mV/V + 78 μV	
330 mV to 1.1 V	30 Hz to 500 kHz	3.9 mV/V + 0.31 mV	
(1.1 to 3.5) V	30 Hz to 500 kHz	3.1 mV/V + 0.39 mV	
Flatness			
Up to 1.1 mV	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.4 mV/V 0.98 mV/V 2.2 mV/V + 2.3 μV 3.7 mV/V + 2.3 μV 5.5 mV/V + 2.3 μV 13 mV/V + 12 μV	

Parameter/Range	Frequency	CMC ^{2,5} (\pm)	Comments
AC Voltage ³ – Generate (cont)			
Flatness (1.1 to 3) mV	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.4 mV/V 0.94 mV/V 1.3 mV/V + 2.3 μ V 2.2 mV/V + 2.3 μ V 4.9 mV/V + 2.3 μ V 13 mV/V + 2.3 μ V	Fluke 5700A
(3 to 11) mV	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.4 mV/V 0.94 mV/V 1.1 mV/V + 2.3 μ V 2 mV/V + 2.3 μ V 3.9 mV/V + 2.3 μ V 8.6 mV/V + 2.3 μ V	
(11 to 33) mV	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.4 mV/V 0.91 mV/V 1 mV/V + 2.3 μ V 2 mV/V + 2.3 μ V 3.8 mV/V + 2.3 μ V 8.5 mV/V + 2.3 μ V	
(33 to 110) mV	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.4 mV/V 0.87 mV/V 1 mV/V + 2.3 μ V 2 mV/V + 2.3 μ V 3.8 mV/V + 2.3 μ V 8.1 mV/V + 2.3 μ V	
(110 to 330) mV	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.3 mV/V 0.84 mV/V 1 mV/V + 2.3 μ V 2 mV/V + 2.3 μ V 3.8 mV/V + 2.3 μ V 8.5 mV/V + 2.3 μ V	
330 mV to 1.1 V	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.3 mV/V 0.84 mV/V 1 mV/V + 2.3 μ V 2 mV/V + 2.3 μ V 3.8 mV/V + 2.3 μ V 8.5 mV/V + 2.3 μ V	
(1.1 to 3.5) V	(10 to 30) Hz 30 Hz to 120 kHz (0.12 to 2) MHz (2 to 10) MHz (10 to 20) MHz (20 to 30) MHz	2.3 mV/V 0.84 mV/V 1 mV/V + 2.3 μ V 2 mV/V + 2.3 μ V 3.8 mV/V + 2.3 μ V 8.5 mV/V + 2.3 μ V	

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
AC Current ³ – Measure			
(10 to 100) µA	(10 to 20) Hz 20 Hz to 45 Hz 45 Hz to 5 kHz	3.1 nA/µA + 23 nA 1.2 nA/µA + 23 nA 0.49 nA/µA + 23 nA	HP 3458A
(0.1 to 1) mA	(10 to 20) Hz 20 Hz to 45 Hz (45 to 100) Hz 100 Hz to 5 kHz	3.1 µA/mA + 0.16 µA 1.2 µA/mA + 0.16 µA 0.52 µA/mA + 0.16 µA 0.28 µA/mA + 0.16 µA	
(1 to 10) mA	(10 to 20) Hz 20 Hz to 45 Hz (45 to 100) Hz 100 Hz to 5 kHz	3.1 µA/mA + 1.6 µA 1.2 µA/mA + 1.6 µA 0.49 µA/mA + 1.6 µA 0.28 µA/mA + 1.6 µA	
(10 to 100) mA	(10 to 20) Hz 20 Hz to 45 Hz (45 to 100) Hz 100 Hz to 5 kHz	3.1 µA/mA + 16 µA 1.2 µA/mA + 16 µA 0.49 µA/mA + 16 µA 0.28 µA/mA + 16 µA	
(0.1 to 1) A	(10 to 20) Hz 20 Hz to 45 Hz (45 to 100) Hz 100 Hz to 5 kHz	3.1 mA/A + 0.16 mA 1.3 mA/A + 0.16 mA 0.69 mA/A + 0.16 mA 0.83 mA/A + 0.16 mA	

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
AC Voltage ³ – Measure			
(0.03 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 kHz to 1 MHz	0.38 μV/mV + 2.3 μV 0.19 μV/mV + 0.85 μV 0.25 μV/mV + 0.85 μV 0.79 μV/mV + 0.85 μV 3.9 μV/mV + 0.85 μV 31 μV/mV + 3.9 μV	HP 3458A (synchronous sub-sampled mode)
(10 to 100) mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.30 μV/mV + 3.1 μV 87 nV/mV + 1.6 μV 0.12 μV/mV + 1.6 μV 0.26 μV/mV + 1.6 μV 0.63 μV/mV + 1.6 μV 2.3 μV/mV + 7.8 μV 7.9 μV/mV + 7.8 μV	
(0.10 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	0.28 mV/V + 31 μV 75 μV/V + 16 μV 0.12 mV/V + 16 μV 0.26 mV/V + 16 μV 0.63 mV/V + 16 μV 2.3 mV/V + 78 μV 8.0 mV/V + 78 μV	
(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	0.28 mV/V + 0.31 mV 74 μV/V + 0.16 mV 0.12 mV/V + 0.16 mV 0.26 mV/V + 0.16 mV 0.63 mV/V + 0.16 mV 2.3 mV/V + 0.78 mV 8.0 mV/V + 0.78 mV	
(10 to 100) 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	0.31 mV/V + 3.1 mV 0.16 mV/V + 1.6 mV 0.16 mV/V + 1.6 mV 0.30 mV/V + 1.6 mV 0.94 mV/V + 1.6 mV 3.1 mV/V + 7.8 mV 12 mV/V + 7.8 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	0.42 mV/V + 31 mV 0.31 mV/V + 16 mV 0.47 mV/V + 16 mV 0.94 mV/V + 16 mV 2.3 mV/V + 16 mV	

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
AC Current – Generate			
(9 to 220) µA	(10 to 20) Hz (20 to 40) Hz (0.040 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.70 mA/A + 25 nA 0.33 mA/A + 20 nA 0.13 mA/A + 16 nA 0.57 mA/A + 40 nA 1.4 mA/A + 80 nA	Fluke 5700A w/5725A
(0.22 to 2.2) mA	(10 to 20) Hz (20 to 40) Hz (0.040 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.67 mA/A + 40 nA 0.34 mA/A + 35 nA 0.16 mA/A + 35 nA 0.56 mA/A + 0.40 µA 1.4 mA/A + 0.80 µA	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz (0.040 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.68 mA/A + 0.40 µA 0.33 mA/A + 0.35 µA 0.16 mA/A + 0.35 µA 0.56 mA/A + 4.0 µA 1.4 mA/A + 8.0 µA	
(22 to 220) mA	(10 to 20) Hz (20 to 40) Hz (0.040 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.68 mA/A + 4.0 µA 0.33 mA/A + 3.5 µA 0.13 mA/A + 3.5 µA 0.55 mA/A + 40 µA 1.4 mA/A + 80 µA	

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
AC Current – Generate (cont)			
(0.22 to 2.2) A	(0.020 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.59 mA/A + 35 µA 0.67 mA/A + 80 µA 7.8 mA/A + 0.16 mA	Fluke 5700A w/5725A
(2.2 to 11) A	(0.020 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.40 mA/A + 0.17 mA 0.76 mA/A + 0.38 mA 2.8 mA/A + 0.75 mA	
(11 to 20.5) A	(10 to 100) Hz (0.1 to 1) kHz (1 to 5) kHz	0.95 mA/A + 3.9 mA 1.2 mA/A + 3.9 mA 23 mA/A + 3.9 mA	Fluke 5520A
(16.5 to 149.999) A	(45 to 65) Hz (65 to 440) Hz	0.31 % 0.81 %	Fluke 5520A w/coil
(150 to 1025) A	(45 to 65) Hz (65 to 440) Hz	0.33 % 0.82 %	
Capacitance ³ – Generate			
(0.19 to 1.1) nF	10 Hz to 10 kHz	4.1 pF/nF + 7.8 pF	Fluke 5520A
(1.1 to 3.3) nF	10 Hz to 3 kHz	4 pF/nF + 7.8 pF	
(3.3 to 10.9) nF	10 Hz to 1 kHz	2.3 pF/nF + 7.8 pF	
(10.9 to 109.9) nF	10 Hz to 1 kHz	2.3 pF/nF + 78 pF	
(110 to 329.9) nF	10 Hz to 1 kHz	2.3 pF/nF + 0.23 nF	
(0.33 to 1.09) µF	(10 to 600) Hz	2.3 nF/µF + 0.78 nF	
(1.1 to 3.29) µF	(10 to 300) Hz	2.3 nF/µF + 2.3 nF	
(3.29 to 10.9) µF	(10 to 150) Hz	2.3 nF/µF + 7.8 nF	
(11 to 32.9) µF	(10 to 120) Hz	3.4 nF/µF + 23 nF	
(33 to 109.9) µF	(10 to 80) Hz	3.7 nF/µF + 78 nF	
(110 to 329.9) µF	(10 to 50) Hz	3.5 nF/µF + 0.23 µF	
(0.33 to 1.09) mF	(10 to 20) Hz	3.5 µF/mF + 0.78 µF	
(1.09 to 3.29) mF	(0 to 6) Hz	3.5 µF/mF + 2.3 µF	
(3.29 to 10.9) mF	(0 to 2) Hz	3.5 µF/mF + 7.8 µF	
(10.9 to 32.9) mF	(0 to 0.6) Hz	5.8 µF/mF + 23 µF	
(32.9 to 110) mF	(0 to 0.2) Hz	8.5 µF/mF + 78 µF	

Parameter/Range	Frequency	CMC ^{2,4,5} (±)	Comments		
Capacitance ³ – Generate Fixed Points	1 pF	100 Hz to 1 kHz	0.39 fF	16380A cap set	
		1 kHz to 1 MHz	0.4 fF		
		(1 to 2) MHz	0.45 fF		
		(2 to 3) MHz	0.57 fF		
		(3 to 4) MHz	0.73 fF		
		(4 to 5) MHz	1.5 fF		
		(5 to 10) MHz	2.5 fF		
	(10 to 13) MHz	4.1 fF			
	10 pF	100 Hz to 1 kHz	3.5 fF		
		1 kHz to 1 MHz	3.5 fF		
		(1 to 2) MHz	3.8 fF		
		(2 to 3) MHz	3.8 fF		
		(3 to 4) MHz	3.5 fF		
		(4 to 5) MHz	3.5 fF		
		(5 to 10) MHz	4.1 fF		
	(10 to 13) MHz	4.3 fF			
	100 pF	100 Hz to 1 kHz	43 fF		
		1 kHz to 1 MHz	35 fF		
		(1 to 2) MHz	36 fF		
		(2 to 3) MHz	37 fF		
		(3 to 4) MHz	38 fF		
		(4 to 5) MHz	39 fF		
		(5 to 10) MHz	52 fF		
	(10 to 13) MHz	64 fF			
	1000 pF	100 Hz to 1 kHz	0.35 pF		16380C cap set
		1 kHz to 1 MHz	0.35 pF		
		(1 to 2) MHz	0.38 pF		
		(2 to 3) MHz	0.45 pF		
(3 to 4) MHz		0.56 pF			
(4 to 5) MHz		0.72 pF			
(5 to 10) MHz		2 pF			
(10 to 13) MHz	2.9 pF				
10 nF	(100 to 200) Hz	0.62 pF			
	(120 to 1000) Hz	0.71 pF			
	(1 to 10) kHz	0.71 pF			
	(10 to 100) kHz	0.73 pF			

Parameter/Range	Frequency	CMC ^{2,4,5} (±)	Comments
Capacitance ³ – Generate Fixed Points (cont)			
100 nF	(100 to 120) Hz (120 to 1000) Hz (1 to 10) kHz (10 to 100) kHz	7.1 pF 7.1 pF 7.1 pF 9.1 pF	16380C cap set
1 μF	(100 to 120) Hz (120 to 1000) Hz (1 to 10) kHz (10 to 100) kHz	76 pF 70 pF 70 pF 0.58 nF	
Oscilloscopes ³ – Amplitude			
DC			
50 Ω	± 1 mV to ± 5.0 V	0.19 mV/V + 19 μV	Wavetek 9500B
1 MΩ	± 1 mV to ± 200 V	0.20 mV/V + 19 μV	
10 Hz to 100 kHz	Squarewave		
50 Ω	± 1 mV to ± 5.0 V _(p-p)	0.78 mV/V + 7.8 μV	Wavetek 9500B w/9530
1 MΩ	± 1 mV to ± 200 V _(p-p)	0.78 mV/V + 7.8 μV	
Time Marker	450.5 ps to 55 s	0.54 μs/s	
Bandwidth ³	0.01 Hz to 300 MHz	2.6 %	
	(300 to 550) MHz	2.9 %	
	(0.55 to 3.2) GHz	4.1 %	
Rise Time ³ – Generate	≥ 150 ps	18 ps	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of Thermocouple Indicators and Simulators ³ –			
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.25 °C 0.13 °C 0.12 °C 0.14 °C 0.18 °C	Fluke 5520A
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	0.50 °C 0.19 °C 0.13 °C 0.11 °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	0.085 °C 0.12 °C 0.12 °C 0.11 °C 0.097 °C 0.11 °C 0.20 °C	Fluke 5520A
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	0.064 °C 0.076 °C 0.075 °C 0.089 °C 0.095 °C 0.17 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of RTD Indicators ³ – (cont)			
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	0.21 °C 0.060 °C 0.068 °C 0.070 °C 0.077 °C 0.084 °C 0.090 °C 0.13 °C 0.19 °C	Fluke 5520A
Pt 385, 200 Ω	(-200 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	0.041 °C 0.043 °C 0.044 °C 0.051 °C 0.098 °C 0.11 °C 0.11 °C 0.13 °C	
Pt 385, 500 Ω	(-200 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	0.036 °C 0.043 °C 0.044 °C 0.051 °C 0.066 °C 0.066 °C 0.073 °C 0.088 °C	



Parameter/Range	Frequency	CMC ² (±)	Comments
Electrical Calibration of RTD Indicators ³ – (cont)			
Pt 385, 1000 Ω	(-200 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	0.029 °C 0.029 °C 0.036 °C 0.042 °C 0.050 °C 0.18 °C 0.057 °C 0.18 °C	Fluke 5520A
PtNi 385, 120 Ω (Ni 120)	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.081 °C 0.11 °C 0.11 °C	
Cu 427, 10 Ω	(-100 to 260) °C	0.69 °C	

III. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ^{2,4,5} (±)	Comments
RF Power – Generate			
(13.5 to 24) dBm (-56 to 13.5) dBm	DC to 20 MHz	0.37 dB 0.42 dB	HP 3325B
(13 to -60) dBm (-120 to -60) dBm	10 MHz to 26.5 GHz	2.2 dB 2.6 dB	HP 83630B
RF Power ³ – Measure			
(+30 to -20) dBm	100 kHz to 2 GHz (2 to 4.2) GHz	1.4 % 1.5 %	HP E4419B w/8482A
	50 MHz to 12 GHz (12 to 18) GHz (18 to 26.5) GHz	2.4 % 2.9 % 3.4 %	HP E4419B w/8485A

Parameter/Range	Frequency	CMC ^{2, 4, 5} (±)	Comments
RF Power ³ – Measure (cont)			
(+20 to -20) dBm	(0.01 to 0.05) GHz (0.05 to 2) GHz (2 to 4) GHz (4 to 6) GHz (6 to 8) GHz (8 to 12) GHz (12 to 13) GHz (13 to 14) GHz (14 to < 18) GHz 18 GHz	1.5 % 1.5 % 1.7 % 1.8 % 1.9 % 1.9 % 2.2 % 2.2 % 2.2 % 2.0 %	HP E4419B w/8481A
(-20 to -70) dBm	(10 to 30) MHz (0.03 to 4) GHz (4 to 6) GHz (6 to 10) GHz (10 to 12) GHz (12 to 15) GHz (15 to 18) GHz	2.5 % 2.0 % 2.1 % 2.1 % 2.3 % 2.4 % 2.5 %	HP E4419B w/8481D
RF Attenuation ³ – Tuned RF Power Measure and Measuring Equipment			
(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	100 kHz to 1.3 GHz	0.064 dB 0.067 dB 0.080 dB 0.082 dB 0.10 dB 0.10 dB 0.11 dB 0.11 dB 0.14 dB 0.14 dB 0.15 dB 0.18 dB 0.20 dB	Agilent/HP 8902A w/11722A

Parameter/Range	Frequency	CMC ^{2, 4, 5} (±)	Comments
RF Attenuation ³ – Tuned RF Power Measure and Measuring Equipment (cont) (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 -85) dB	1.3 GHz to 26.5 GHz	0.064 dB 0.067 dB 0.080 dB 0.082 dB 0.10 dB 0.10 dB 0.11 dB 0.11 dB 0.14 dB	Agilent/HP 8902A w/ 11792A and 11793A
Phase Modulation – Measure ³ Rate: (0.1 to 20) kHz Rate: (0.1 to 20) kHz	150 kHz to 1.3 GHz (1.3 to 26.5) GHz	3.5 % + 1 Digit 3.5 % + 1 Digit	HP 8902A HP 8902A w/ microwave converter and LO
Amplitude Modulation – Measure and Measuring Equipment ³ – Rate: 50 Hz to 10 kHz Depth: (5 to 99) % Rate: 20 Hz to 10 kHz Depth: (5 to 99) % Rate: 50 Hz to 50 kHz Depth: (5 to 99) % Rate: 20 Hz to 100 kHz Depth: (5 to 99) % Rate: 50 Hz to 50 kHz Depth: (5 to 99) % Rate: 20 Hz to 100 kHz Depth: (5 to 99) %	(0.15 to 10) MHz (0.15 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	2.4 % + 1 Digit 3.5 % + 1 Digit 1.2 % + 1 Digit 3.5 % + 1 Digit 1.8 % + 1 Digit 3.5 % + 1 Digit	HP 8902A HP 8902A w/ microwave converter and LO

Parameter/Range	Frequency	CMC ^{2,4,5} (±)	Comments
Amplitude Modulation ³ – Generate Rate: (0.05 to 50) kHz Depths: (0 to 99) % Rate: (20 to 50) Hz and (50 to 100) kHz Depths: (0 to 99) %	(11 to 13.5) MHz (11 to 13.5) MHz	0.20 % 0.33 %	HP 11715A
Frequency Modulation – Generate ³ <100 kHz Rate <200 kHz Rate	(11 to 13.5) MHz (88 to 108) MHz (352 to 432) MHz (11 to 13.5) MHz (88 to 108) MHz (352 to 432) MHz	0.39 % 0.38 % 0.38 % 0.38 % 0.38 % 0.53 %	HP 11715A
Frequency Modulation – Measure and Measuring Equipment ³ – Rate: 20 Hz to 10 kHz Dev: ≤ 40 kHz peak Rate: 50 Hz to 100 kHz Dev: ≤ 400 kHz peak Rate: 20 Hz to 200 kHz Dev: ≤ 4.0 kHz peak Rate: 50 Hz to 100 kHz Dev: ≤ 400 kHz peak Rate: 20 Hz to 200 kHz Dev: ≤ 400 kHz peak	(0.25 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	2.3 % + 1 Digit 1.2 % + 1 Digit 5.8 % + 1 Digit 1.2 % + 1 Digit 5.8 % + 1 Digit	HP 8902A HP 8902A w/microwave converter and LO

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
Average Noise/Residuals – Spectrum Analyzers	10 kHz to 3 GHz (3 to 6.6) GHz (6.6 to 22) GHz (22 to 26) GHz	0.80 dBm 2.0 dBm 2.6 dBm 2.6 dBm	HP 85052D
Noise System Sidebands – Offset	100 Hz to 10 MHz	2.3 dBc/Hz	HP 8663A
Spectrum Analyzer Measure Functions –			Agilent E4440A
Harmonic Spurs	3 Hz to 3 GHz (3 to 6.6) GHz (6.6 to 22) GHz (22 to 26.5) GHz	1.7 dBc 2.4 dBc 3.8 dBc 4.7 dBc	
Non-Harmonic Spurs	Fundamental Freq: 1 GHz	2.7 dBc	
	Fundamental Freq: 1.9765 GHz	4.5 dBc	

IV. Mechanical

Parameter/Equipment	Range	CMC ^{2,4,7} (±)	Comments
Pressure – Measure	(-14 to 30) psi (1 to 1000) psi	0.0011 psi/psi 0.30 psi	Druck DPI1610 w/ transducer
Pressure – Measuring Equipment ³ ; Gauges & Transducers	(100 to 10 000) psi	0.12 %	Ametek T-100-1 DWT

Parameter/Equipment	Range	CMC ^{2, 4, 7} (±)	Comments
Scales & Balances ³	Up to 1 mg (1 to 2) mg (2 to 5) mg (5 to 10) mg (10 to 20) mg (20 to 50) mg (50 to 100) mg (100 to 200) mg (200 to 500) mg (0.5 to 1) g (1 to 2) g (2 to 3) g (3 to 5) g (5 to 10) g (10 to 50) g (50 to 100) g (100 to 200) g (200 to 300) g (300 to 500) g (0.5 to 1) kg (1 to 2) kg	7.2 µg 7.2 µg 7.3 µg 9.7 µg 12 µg 14 µg 19 µg 24 µg 30 µg 41 µg 51 µg 60 µg 71 µg 73 µg 0.12 mg 0.19 mg 0.37 mg 0.41 mg 0.96 mg 1.9 mg 2.2 mg	Class E2 weights
Torque – Measuring Equipment ³			
Wrenches	(4 to 50) in·lbf (30 to 400) in·lbf (80 to 1000) in·lbf (20 to 250) ft·lbf	0.29 % 0.29 % 0.29 % 0.29 %	TTC2000SYS w/ 4 in 1 transducer TTC400
Screwdrivers	(5 to 50) in·lbf	0.26 %	Mountz LTT2100 w/ transducer RTSX50I

VI. Thermodynamics

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
Temperature – Measure	(-200 to 420) °C	0.052°C	Hart Scientific 5614B PRT and 1502A
Temperature – Measuring Equipment	(-40 to 140) °C	0.21°C	Hart Scientific 5614B PRT w/E instruments TCS140 Temp Bath
Relative Humidity ³ – Measuring Equipment & Measure	(5 to 90) % RH	1.3 % RH	Vaisala HM70 used w/ humidity generator

V. Time & Frequency

Parameter/Equipment	Frequency	CMC ^{2,7} (±)	Comments
Frequency ³ – Measuring Equipment	DC to 1 kHz 1 kHz to 50 MHz	0.12 µHz/Hz 0.72 nHz/Hz	HP 3325B w/Efratom PRF-102
	20 MHz to 26.5 GHz	0.70 nHz/Hz	HP 83630B w/Efratom PRF-102
Frequency ³ – Measure	DC to 1 kHz 1 kHz to 3 GHz	0.12 mHz/Hz 0.69 nHz/Hz	HP 53132A w/Efratom PRF-102
	(0.5 to 26.5) GHz	0.69 nHz/Hz	HP 5351B w/Efratom PRF-102

¹ This laboratory offers commercial calibration service 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 In the statement of CMC, L is the numerical value of the nominal length of the device measured in inches. In the statement of CMC, 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. 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.

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

TEKTRONIX, INC.

Zapopan, Jalisco, C.P. MEXICO

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 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 25th day of October 2021.

A blue ink signature of the Vice President of Accreditation Services.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2357.16
Valid to September 30, 2023

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