



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

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CALIBRATION

Valid To: January 31, 2013

Certificate Number: 1623.05

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations¹:

I. Dimensional

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
Calipers ³	Up to 24 in	(610 + 1.6L) µin	Grade 1 gage blocks
Gage Blocks	(0.05 to 4) in	(3.7 + 1.6L) µin	Mechanical comparison w/ grade 1 gage blocks
Indicators ³	Up to 2 in	(65 + 1.6L) µin	Grade 1 gage blocks
Micrometers, Height Gages, and Depth Gages ³	Up to 24 in	(65 + 1.6L) µin	Grade 1 gage blocks
Pins ³	(0.05 to 10) in	(73 + 1.6L) µin	Gage blocks w/ Pratt & Whitney model C super-micrometer
Rulers ³	Up to 24 in	(0.009 + 1.6L) µin	Grade 1 gage blocks

Parameter/Equipment	Range	CMC ² (±)	Comments
Surface Plate Flatness ³	Up to 24 in × 48 in	66 μin	24 in Planekator Note: Uncertainty is to be no less than the acceptable closure error for the procedure.

II. Electrical – DC & Low Frequency

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments
AC Current – Generate ^{3, 4}			
(9 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 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 % + 40 nA 0.016 % + 35 nA 0.012 % + 35 nA 0.02 % + 110 nA 0.11 % + 650 nA	
(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 % + 0.4 μA 0.016 % + 0.35 μA 0.012 % + 0.35 μA 0.02 % + 0.6 μA 0.11 % + 5 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 μA 0.016 % + 3.5 μA 0.012 % + 2.5 μA 0.02 % + 3.5 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 0.7 % + 160 μA	

Parameter/Range	Frequency	CMC ^{2,7} (\pm)	Comments
AC Current – Generate ^{3,4} (cont.)			
(2.2 to 11) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.046 % + 170 μ A 0.095 % + 380 μ A 0.36 % + 750 μ A	Fluke 5720A
(11 to 100) A	10 Hz to 1 kHz	0.1 % + 0.15 % of range	Valhalla 2555A
Clamp On Only –			
(0 to 110) A (0 to 550) A	(65 to 440) Hz (45 to 65) Hz	0.32 % + 0.5 A 0.38 % + 0.5 A	Fluke 5520A w/50-turn coil
AC Current – Measure ^{3,5}			
(5 to 100) μ A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 1 kHz	0.46 % + 0.03 μ A 0.17 % + 0.03 μ A 0.07 % + 0.03 μ A 0.07 % + 0.03 μ A	HP 3458A, opt. 002
(0.1 to 1 mA)	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.5 % + 0.2 μ A 0.17 % + 0.2 μ A 0.07 % + 0.2 μ A 0.04 % + 0.2 μ A	
(1 to 10) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.46 % + 2 μ A 0.17 % + 2 μ A 0.07 % + 2 μ A 0.04 % + 2 μ A	
(10 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.46 % + 20 μ A 0.17 % + 20 μ A 0.07 % + 20 μ A 0.04 % + 20 μ A	
100 mA to 1 A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	0.46 % + 200 μ A 0.18 % + 200 μ A 0.09 % + 200 μ A 0.12 % + 200 μ A	
(1 to 20) A	DC to 5 kHz	(0.025 % + 0.012 %*F) of reading	Fluke Y5020; F is frequency in kHz
(20 to 100) A	1 kHz	0.12 %	Valhalla 2575A

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments
AC Resistance Generate ³ –			
10 Ω	DC to 1 MHz (1 to 2) MHz (2 to 3) MHz (3 to 4) MHz (4 to 5) MHz (5 to 10) MHz (10 to 13) MHz	0.13 % 0.14 % 0.17 % 0.19 % 0.26 % 0.66 % 1 %	HP 42030A resistor set
100 Ω	DC to 1 MHz (1 to 2) MHz (2 to 3) MHz (3 to 4) MHz (4 to 5) MHz (5 to 10) MHz (10 to 13) MHz	0.13 % 0.14 % 0.17 % 0.14 % 0.17 % 0.34 % 0.46 %	
1 kΩ	DC to 3 MHz (3 to 5) MHz (5 to 10) MHz (10 to 13) MHz	0.09 % 0.11 % 0.28 % 0.41 %	
(10, 100) kΩ	DC to 1 MHz	0.09 %	
AC Voltage Generate ^{3,4} –			
(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 500 kHz to 1 MHz	0.024 % + 4 μV 90 μV/V + 4 μV 80 μV/V + 4 μV 0.02 % + 4 μV 0.05 % + 5 μV 0.11 % + 10 μV 0.14 % + 20 μV 0.27 % + 20 μV	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 500 kHz to 1 MHz	0.024 % + 4 μV 90 μV/V + 4 μV 80 μV/V + 4 μV 0.02 % + 4 μV 0.05 % + 5 μV 0.11 % + 10 μV 0.14 % + 20 μV 0.27 % + 20 μV	Fluke 5720A w/ 5725A

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments
AC Voltage Generate ^{3,4} – (cont.)			
(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 500 kHz to 1 MHz	0.024 % + 12 µV 90 µV/V + 7 µV 80 µV/V + 7 µV 0.02 % + 7 µV 0.046 % + 17 µV 0.09 % + 20 µV 0.14 % + 25 µV 0.27 % + 45 µV	Fluke 5720A w/ 5725A
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 500 kHz to 1 MHz	0.024 % + 40 µV 90 µV/V + 15 µV 45 µV/V + 8 µV 75 µV/V + 10 µV 0.011 % + 0.3 mV 0.042 % + 80 µV 0.1 % + 0.2 mV 0.17 % + 0.3 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 500 kHz to 1 MHz	0.024 % + 0.4 mV 90 µV/V + 0.15 mV 45 µV/V + 50 µV 75 µV/V + 0.1 mV 0.01 % + 0.2 mV 0.028 % + 0.6 mV 0.1 % + 2 mV 0.15 % + 3.2 mV	
(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 500 kHz to 1 MHz	0.024 % + 4 mV 90 µV/V + 1.5 mV 52 µV/V + 0.6 mV 80 µV/V + 1 mV 0.015 % + 2.5 mV 0.09 % + 16 mV 0.44 % + 40 mV 0.8 % + 80 mV	
(220 to 750) V	30 kHz to 50 kHz (50 to 100) kHz	0.06 % + 11 mV 0.23 % + 45 mV	
(220 to 1100) V	(15 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	0.03 % + 16 mV 90 µV/V + 4 mV 0.017 % + 6 mV 0.06 % + 11 mV	

Parameter/Range	Frequency	CMC ^{2,7} (\pm)	Comments
AC Voltage – Measure ^{3,5}			
3 μ V 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	0.03 % + 3 μ V 0.02 % + 2 μ V 0.03 % + 2 μ V 0.12 % + 2 μ V 0.58 % + 2 μ V 4.6 % + 2 μ V	HP 3458A, opt. 002 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 (1 to 2) MHz	80 μ V/V + 4 μ V 80 μ V/V + 2 μ V 0.02 % + 2 μ V 0.03 % + 2 μ V 0.09 % + 2 μ V 0.35 % + 10 μ V 1.2 % + 10 μ V 1.7 % + 10 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 300 kHz to 1 MHz (1 to 2) MHz	80 μ V/V + 40 μ V 80 μ V/V + 20 μ V 0.02 % + 20 μ V 0.03 % + 20 μ V 0.09 % + 20 μ V 0.35 % + 100 μ V 1.2 % + 100 μ V 1.7 % + 100 μ V	
(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 300 kHz to 1 MHz (1 to 2) MHz	80 μ V/V + 0.4 mV 80 μ V/V + 0.2 mV 0.02 % + 0.2 mV 0.03 % + 0.2 mV 0.09 % + 0.2 mV 0.35 % + 1 mV 1.2 % + 1 mV 1.7 % + 1 mV	
(10 to 100) V	(1 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.02 % + 4 mV 0.02 % + 2 mV 0.04 % + 2 mV 0.14 % + 2 mV 0.46 % + 10 mV 1.7 % + 10 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	0.05 % + 40 mV 0.05 % + 20 mV 0.07 % + 20 mV 0.14 % + 20 mV 0.35 % + 20 mV	

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments
Capacitance Generate ³ –			
Fixed Points			
1 pF	(0.1 to 1) kHz 1 kHz to 1 MHz (1 to 2) MHz (2 to 3) MHz (3 to 4) MHz (4 to 5) MHz (5 to 10) MHz (10 to 13) MHz	0.01 % 0.04 % 0.04 % 0.07 % 0.13 % 0.2 % 0.7 % 1 %	HP 16380C and HP 16380A standard capacitor sets
(10, 100) pF	(0.1 to 1) kHz 1 kHz to 1 MHz (1 to 2) MHz (2 to 3) MHz (3 to 4) MHz (4 to 5) MHz (5 to 10) MHz (10 to 13) MHz	0.01 % 0.02 % 0.02 % 0.03 % 0.04 % 0.05 % 0.11 % 0.14 %	
1000 pF	(0.1 to 1) kHz 1 kHz to 1 MHz (1 to 2) MHz (2 to 3) MHz (3 to 4) MHz (4 to 5) MHz (5 to 10) MHz (10 to 13) MHz	0.01 % 0.04 % 0.04 % 0.07 % 0.1 % 0.14 % 0.34 % 0.48 %	
10 nF	(100 to 120) Hz (0.12 to 1) kHz (1 to 10) kHz (10 to 100) kHz	0.02 % 0.01 % 0.02 % 0.04 %	
100 nF	(100 to 120) Hz (0.12 to 1) kHz (1 to 10) kHz (10 to 100) kHz	0.03 % 0.01 % 0.03 % 0.04 %	
1 μF	(100 to 120) Hz (0.12 to 1) kHz (1 to 10) kHz (10 to 100) kHz	0.03 % 0.01 % 0.03 % 0.07 %	

Parameter/Range	Frequency	CMC ² (±)	Comments
Capacitance Generate ^{3,7} – (cont.)			
Fixed Points –			
0.001 µF	1 kHz	0.03 %	GenRad 1409F
0.01 µF	1 kHz	0.03 %	GenRad 1409L
0.05 µF	1 kHz	0.03 %	GenRad 1409R
0.1 µF	1 kHz	0.03 %	GenRad 1409T
0.5 µF	1 kHz	0.03 %	GenRad 1409X
1.0 µF	1 kHz	0.03 %	GenRad 1409Y
Capacitance – Measure ^{3,7}			
0.1 pF to 1 mF	1 kHz	0.011 %	GenRad 1620A bridge

Parameter/Equipment	Range	CMC ^{2,7} (±)	Comments
DC Current – Generate ^{3,4}	(0.01 to 2) pA (2 to 20) pA (20 to 200) pA (0.2 to 2) nA (2 to 20) nA (20 to 200) nA (0.2 to 2) µA	0.49 % + 10 fA 0.44 % + 10 fA 0.29 % + 30 fA 0.08 % + 100 fA 0.08 % + 1 pA 0.05 % + 10 pA 0.03 % + 100 pA	Keithley 263
	(0.2 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	40 µA/A + 8 nA 35 µA/A + 8 nA 35 µA/A + 80 nA 60 µA/A + 0.8 µA 80 µA/A + 25 µA 360 µA/A + 480 µA	Fluke 5720A
	(11 to 20) A (20 to 100) A	0.04 % + 6 mA 0.04 % + 30 mA	Valhalla 2555A
Clamp-On Only	(0 to 550) A	0.3 % + 0.5 A	Fluke 5520A w/50- turn coil

Parameter/Equipment	Range	CMC ^{2,7} (\pm)	Comments	
DC Current – Measure ^{3,5}	100 pA to 100 μ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	24 μ A/A + 0.8 nA 24 μ A/A + 5 nA 24 μ A/A + 50 nA 41 μ A/A + 0.5 μ A 0.013 % + 10 μ A	HP 3458A opt. 002	
	(1 to 10) A	0.03 %	Valhalla 2575A	
	(10 to 20) A (20 to 200) A	0.04 % 0.06 %	HP 3458A, SR 20A and 200A shunts	
DC Resistance – Measure ^{3,5}	(1 to 10) Ω	0.0020 % + 0.05 m Ω	HP 3458A opt. 002	
	(10 to 100) Ω	0.0016 % + 0.5 m Ω		
	(0.1 to 1) k Ω	0.0013 % + 0.5 m Ω		
	(1 to 10) k Ω	0.0012 % + 5 m Ω		
	(10 to 100) k Ω	0.0013 % + 0.05 Ω		
	(0.1 to 1) M Ω	0.0024 % + 2 Ω		
	(1 to 10) M Ω	0.0065 % + 100 Ω		
	(10 to 100) M Ω	0.058 % + 1 k Ω		
	100 M Ω to 1 G Ω	0.58 % + 10 k Ω		
	(0.1 to 1) G Ω	0.000006 %		Guildline 6500A Teraohmeter
	(1 to 10) G Ω	0.000008 %		
(10 to 100) G Ω	0.000014 %			
(0.1 to 10) T Ω	0.000026 %			
(1 to 10) T Ω	0.000042 %			
(10 to 100) T Ω	0.000074 %			

Parameter/Equipment	Range	CMC ² (±)	Comments
DC Resistance – Generate ^{3,4,7}	(0 to 11) Ω	40 μΩ/Ω + 1 mΩ	Fluke 5520A
	(11 to 33) Ω	30 μΩ/Ω + 1.5 mΩ	
	(33 to 110) Ω	28 μΩ/Ω + 1.4 mΩ	
	(0.11 to 1.1)kΩ	28 μΩ/Ω + 2 mΩ	
	(1.1 to 11) kΩ	28 μΩ/Ω + 20 mΩ	
	(11 to 110) kΩ	28 μΩ/Ω + 0.2 Ω	
	(110 to 330) kΩ	32 μΩ/Ω + 2 Ω	
	(0.33 to 1.1) MΩ	32 μΩ/Ω + 2 Ω	
	(1.1 to 3.3) MΩ	60 μΩ/Ω + 30 Ω	
	(3.3 to 11) MΩ	0.013 % + 50 Ω	
	(11 to 33) MΩ	0.025 % + 2.5 kΩ	
	(33 to 110) MΩ	0.05 % + 3 kΩ	
	(110 to 330) MΩ	0.3 % + 100 kΩ	
	330 MΩ to 1.1 GΩ	1.5 % + 0.5 MΩ	
Fixed Points	0.001 Ω	29 μΩ/Ω	YEW 2792
	0.01 Ω	25 μΩ/Ω	L & N 4222-B
	0.1 Ω	28 μΩ/Ω	L & N 4221-B
	1 Ω	95 μΩ/Ω	Fluke 5720A
	1.9 Ω	95 μΩ/Ω	
	10 Ω	23 μΩ/Ω	
	19 Ω	23 μΩ/Ω	
	100 Ω	10 μΩ/Ω	
	190 Ω	10 μΩ/Ω	
	1 kΩ	8.5 μΩ/Ω	
	1.9 kΩ	8.5 μΩ/Ω	
	10 kΩ	8.5 μΩ/Ω	
	19 kΩ	8.5 μΩ/Ω	
	100 kΩ	11 μΩ/Ω	
	190 kΩ	11 μΩ/Ω	
	1 MΩ	20 μΩ/Ω	
	1.9 MΩ	21 μΩ/Ω	
	10 MΩ	40 μΩ/Ω	
	19 MΩ	47 μΩ/Ω	
	100 MΩ	100 μΩ/Ω	
1 GΩ	0.13 %	Keithley 263	
10 GΩ	0.28 %		
100 GΩ	0.46 %		

Parameter/Equipment	Range	CMC ² (±)	Comments
DC Voltage – Generate ^{3,4}	(0 to 220) mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V	8 μV/V + 0.4 μV 5.5 μV/V + 0.7 μV 4 μV/V + 2.5 μV 4 μV/V + 4 μV 5.5 μV/V + 40 μV 7 μV/V + 400 μV	Fluke 5720A
DC Voltage – Measure ^{3,5,7}	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1100) V (1 to 40) kV	6.2 μV/V + 0.3 μV 5.2 μV/V + 0.3 μV 5.2 μV/V + 0.5 μV 7.3 μV/V + 30 μV 7.3 μV/V + 110 μV + 12(V _{in} /1000) ² μV/V 0.58 %	HP 3458A opt. 002 Ross VD 60
Distortion – Measure ^{3,7}			
(- 99.99 to 0) dB dist. (0.001 to 100) % dist.	20 Hz to 20 kHz (20 to 100) kHz	1.2 dB 2.3 dB	HP 8903B
5 Hz to 600 kHz, Fundamental Freq.			HP 334A
(0.3 to 100) % dist. < 30 V	10 Hz to 1 MHz (1 to 3) MHz	3.5 % 6.9 %	Harmonic
(30 to 300) V	10 Hz to 300 kHz (300 to 500) kHz 500 kHz to 3 MHz	3.5 % 6.9 % 14 %	Harmonic
0.1 % distortion < 30 V	10 Hz to 300 kHz (300 to 500) kHz 500 kHz to 3 MHz	3.5 % 7 % 14 %	Harmonic
0.1 % distortion (30 to 300) V	30 Hz to 300 kHz (300 to 500) kHz 500 kHz to 1.2 MHz	3.6 % 7 % 14 %	Harmonic

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of Thermocouple Indicators ³ –			
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.5 °C 0.4 °C 0.36 °C 0.39 °C	Fluke 5520A
Type C	(0 to 150) °C (150 to 650) °C (650 to 1000) °C (1000 to 1800) °C (1800 to 2316) °C	0.36 °C 0.32 °C 0.37 °C 0.56 °C 0.9 °C	
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.56 °C 0.22 °C 0.2 °C 0.22 °C 0.27 °C	
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.33 °C 0.22 °C 0.2 °C 0.23 °C 0.29 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.39 °C 0.24 °C 0.22 °C 0.32 °C 0.46 °C	
Type L	(-200 to -100) °C (-100 to 800) °C (800 to 900) °C	0.43 °C 0.32 °C 0.23 °C	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.46 °C 0.28 °C 0.25 °C 0.24 °C 0.33 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.63 °C 0.41 °C 0.39 °C 0.46 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of Thermocouple Indicators – (cont.) ^{3,4}			
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.53 °C 0.42 °C 0.43 °C 0.52 °C	Fluke 5520A
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.69 °C 0.3 °C 0.22 °C 0.2 °C	
Type U	(-200 to 0) °C (0 to 600) °C	0.62 °C 0.33 °C	
Electrical Calibration of RTDs ^{3,4} –			
Pt 385, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.06 °C 0.08 °C 0.1 °C 0.11 °C 0.13 °C 0.24 °C	Fluke 5520A
Pt 3926, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.06 °C 0.08 °C 0.1 °C 0.11 °C 0.13 °C	
Pt 3916, 100 Ω	(-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.26 °C 0.05 °C 0.06 °C 0.07 °C 0.08 °C 0.09 °C 0.1 °C 0.11 °C 0.24 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of RTDs – (cont.) ^{3,4}			
Pt 385, 200 Ω	(-200 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	0.05 °C 0.05 °C 0.06 °C 0.13 °C 0.14 °C 0.15 °C 0.17 °C	Fluke 5520A
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	0.05 °C 0.06 °C 0.06 °C 0.07 °C 0.09 °C 0.09 °C 0.1 °C 0.12 °C	
Pt 385, 1000 Ω	(-200 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 600) °C (600 to 630) °C	0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.08 °C 0.24 °C	
Ni 120, 120 Ω	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.09 °C 0.09 °C 0.15 °C	
Cu 427, 10 Ω	(-100 to 260) °C	0.31 °C	

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments
Inductance Generate ³ – 100 µH (1, 5, 10, 20, 100) mH, 1 H 10 H	100 Hz to 1 kHz	0.1 % 0.03 % 0.3 %	GenRad 1482X series

Parameter/Equipment	Frequency	CMC ^{2,7} (±)	Comments
Oscilloscopes – Bandwidth ³	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz	2.2 % 2.7 % 4.8 % 5.9 %	Fluke 5520A/SC1100

III. Electrical – RF & Microwave

Parameter/Range	Frequency	CMC ^{2,7} (±)	Comments
Absolute RF Power – Measure ³ (-70 to 20) dBm (-120 to 70) dBm	10 MHz to 50 GHz (26.5 to 31.2) GHz (31.2 to 50) GHz	2.9 % 3.7 dB 3.9 dB	HP 437B, 8487A, 8481D, and 8487D HP 8565E
Amplitude Modulation Generate ³ – Rate: 1 kHz Depths: 30 % Rate: DC to 10 kHz Depths: 0 % to 90 %	10 MHz to 50 GHz 10 MHz to 50 GHz	5.8 % 5.8 % + 0.25 dB	HP 83650B

Parameter/Range	Frequency	CMC ^{2,7} (\pm)	Comments
Amplitude Modulation – Measure ³			
Rate: 50 Hz to 10 kHz Depths: 5 % to 99 %	150 kHz to 10 MHz	2 % + 1 digit	HP 8902A
Rate: 20 Hz to 10 kHz Depths: to 99 %	150 kHz to 10 MHz	3 % + 1 digit	
Rate: 50 Hz to 50 kHz Depths: 5 % to 99 %	10 MHz to 1.3 GHz	1 % + 1 digit	
Rate: 20 Hz to 100 kHz Depths: to 99 %	10 MHz to 1.3 GHz	3 % + 1 digit	
Rate: 20 Hz to 100 kHz Depths: to 99 %	(1.3 to 26.5) GHz	1.5 % + 1 digit	w/ HP 11793A
Rate: 20 Hz to 100 kHz Depths: to 99 %	(1.3 to 26.5) GHz	3 % + 1 digit	
Frequency Modulation – Generate ³			
Rate: 100 kHz to 8 MHz Dev.: \leq 10 MHz	10 kHz to 50 GHz	10 %	HP 83650B
Frequency Modulation – Measure ³			
Rate: 20 Hz to 10 kHz Dev.: \leq 40 kHz peak	250 kHz to 10 MHz	2 % + 1 digit	HP 8902A
Rate: 50 Hz to 100 kHz Dev.: \leq 400 kHz peak	10 MHz to 1.3 GHz	1 % + 1 digit	
Rate: 20 Hz to 200 kHz Dev.: \leq 400 kHz peak	10 MHz to 1.3 GHz	5 % + 1 digit	
Rate: 50 Hz to 100 kHz Dev.: \leq 400 kHz peak	(1.3 to 26.5) GHz	1 % + 1 digit	w/ HP 11793A
Rate: 20 Hz to 200 kHz Dev.: \leq 400 kHz peak	(1.3 to 26.5) GHz	5 % + 1 digit	

Parameter/Range	Frequency	CMC ² (±)	Comments
Phase Modulation – Measure ^{3,7} Peak Phase Deviation (0.1 to 400 radians) Rate: (0.2 to 10) kHz Rate: (0.2 to 20) kHz	 150 kHz to 10 MHz 10 MHz to 1.3 GHz	 4 % + 1 digit 3 % + 1 digit	 HP 8902A and HP 11722A
Phase Reflection ³ – Into 50 Ω, 0° to 360° 0.2 < Γ ≤ 0.4 0.4 < Γ ≤ 1.0	 50 MHz to 20 GHz (20 to 40) GHz 50 MHz to 20 GHz (20 to 40) GHz	 3.5° 5.9° 2.4° 3.6°	 HP 8722ES vector network analyzer
Reflection Magnitude ³ – Into 50 Ω 0 < Γ ≤ 0.5 0.5 < Γ ≤ 0.75 0.75 < Γ ≤ 1.0	 50 MHz to 20 GHz (20 to 40) GHz 50 MHz to 20 GHz (20 to 40) GHz 50 MHz to 20 GHz (20 to 40) GHz	 0.018 dB 0.031 dB 0.024 dB 0.042 dB 0.035 dB 0.053 dB	 HP 8722ES vector network analyzer

Parameter/Range	Frequency	CMC ² (±)	Comments
RF Power Generate ³ –			
(-127 to 13) dBm	10 kHz to 20 MHz	1.2 dB	HP 8656B
(-10 to 10) dBm	20 MHz to 2 GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	0.73 dB 0.89 dB 1.2 dB 2.1 dB	HP 83650B
(-60 to -10) dBm	20 MHz to 2 GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	1.1 dB 1.2 dB 1.6 dB 2.5 dB	
(-110 to -60) dBm	20 MHz to 2 GHz (2 to 20) GHz (20 to 40) GHz (40 to 50) GHz	1.7 dB 1.8 dB 2.1 dB 3.1 dB	
Transmission Phase ³	50 MHz to 40 GHz	2.4°	HP 8722ES vector network analyzer
Transmission Magnitude ³ –			
(10 to 0) dB (0 to -10) dB (-10 to -20) dB (-20 to -30) dB (-30 to -40) dB	50 MHz to 2 GHz	0.08 dB 0.08 dB 0.14 dB 0.35 dB 0.95 dB	HP 8722ES vector network analyzer
(10 to 0) dB (0 to -10) dB (-10 to -20) dB (-20 to -30) dB (-30 to -40) dB	(2 to 20) GHz	0.12 dB 0.12 dB 0.14 dB 0.16 dB 0.19 dB	
(10 to 0) dB (0 to -10) dB (-10 to -20) dB (-20 to -30) dB (-30 to -40) dB	(20 to 40) GHz	0.24 dB 0.21 dB 0.24 dB 0.24 dB 0.29 dB	

Parameter/Range	Frequency	CMC ² (±)	Comments
Tuned RF Power – Measure ³			
(0.0 to -1) dB	2.5 MHz to 26.5 GHz	0.01 dB	HP 8902A
(-1 to -10) dB		0.03 dB	HP 11722A
(-10 to -20) dB		0.06 dB	HP 11792A
(-20 to -30) dB		0.08 dB	HP 11793A
(-30 to -40) dB		0.11 dB	
(-40 to -50) dB		0.14 dB	
(-50 to -60) dB		0.16 dB	
(-60 to -70) dB		0.2 dB	
(-70 to -80) dB		0.22 dB	
(-80 to -90) dB		0.24 dB	
(-90 to -100) dB		0.26 dB	
(-100 to -110) dB		0.32 dB	
(-110 to -120) dB		0.37 dB	

IV. Mechanical

Parameter/Equipment	Range	CMC ² (±)	Comments	
Pressure Gauges & Transducers ^{3,7}	Up to 6000 psig	0.012 %	Mensor 5014	
	(5 to 10 000) psig	0.12 %	Ametek DWT	
Scales & Balances ³	(1 to 10) mg	0.016 mg	Class S1 weights	
	(10 to 300) mg	0.08 mg		
	(0.5 to 1) g	0.25 mg		
	(1 to 50) g	0.64 mg		
	(50 to 300) g	3.1 mg		
	(0.3 to 1) kg	10 mg		
	(1 to 3) kg	30 mg		
	(3 to 5) kg	50 mg		
	(2 to 5) lb	0.001 lb		Class F weights
	(5 to 10) lb	0.0012 lb		
	(10 to 30) lb	0.004 lb		
	(25 to 50) lb	0.006 lb		
	(50 to 100) lb	0.014 lb		

Parameter/Equipment	Range	CMC ² (±)	Comments
Torque Wrenches ^{3,7}	(5 to 50) in·lb (40 to 400) in·lb (100 to 1000) in·lb (25 to 250) ft·lb (250 to 600) ft·lb	0.32 % 0.32 % 0.32 % 0.32 % 0.32 %	CDI 5000ST
Vacuum Gauges & Transducers ³	(0.5 to -14.7) psig	0.012 % of range	Mensor 5014

V. Thermodynamic

Baths, Ovens, and Temperature Chambers

Parameter/Equipment	Range	CMC ² (±)	Comments
Temperature – Measure ³	(-200 to 100) °C (100 to 400) °C	0.03 °C 0.05 °C	Hart 5613 PRT w/ 1502 meter and Hart 5614 PRT w/ 1502 meter

V. Time & Frequency

Parameter/Equipment	Range	CMC ² (±)	Comments
Time Interval ³	1 s to 3 hr	0.5 s	HP 5345A frequency counter

Parameter / Equipment	Frequency	CMC ² (±)	Comments
Frequency – Measuring Equipment ³	100 kHz, (1, 5) MHz	5 parts in 10 ¹² Hz	Datum GPS receiver
	10 kHz to 990 MHz	5 parts in 10 ¹² Hz	HP 8656B
	(0.99 to 50) GHz	5 parts in 10 ¹² Hz	HP 83650B
			Uncertainty based upon 24-hour observation period

¹ This laboratory offers commercial calibration service and field calibration service.

² Calibration and Measurement Capability (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. CMC's 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 and this laboratory meets A2LA R104 – *General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the actual uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.

⁴ The measurands stated are generated with the Fluke 5720A, 5520A, Keithley 263 and Valhalla 2555A where defined. This capability is suitable for the calibration of the devices intended to measure the stated measurand in the ranges indicated. CMC is read as output plus one-year floor specifications where defined. Where “ $\mu\text{V/V}$,” “ $\mu\text{A/A}$,” or “ $\mu\Omega/\Omega$ ” appear in the CMC, it is equivalent to that part in 10⁶.

⁵ The measurands stated are measured with the HP 3458A. This capability is suitable for the calibration of the devices intended to generate the measurand in the ranges indicated. CMC is based upon one-year floor specifications and is read as output plus range. Where “ $\mu\text{V/V}$,” “ $\mu\text{A/A}$,” or “ $\mu\Omega/\Omega$ ” appear in the CMC, it is equivalent to that part in 10⁶.

⁶ In the statement of CMC, L is the numerical value of the nominal length of the device measured in inches.

⁷ In the statement of CMC, percentages are percentages of reading.



The American Association for Laboratory Accreditation

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Accredited Laboratory

A2LA has accredited

TEKTRONIX SERVICE SOLUTIONS

Phoenix, AZ

for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and any additional program requirements in the field of calibration. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

Presented this 26th day of August 2011.



A handwritten signature in black ink, appearing to read "Peter Meyer".

President & CEO
For the Accreditation Council
Certificate Number 1623.05
Valid to January 31, 2013

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