



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

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CALIBRATION

Valid To: February 29, 2012

Certificate Number: 2662.01

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
Micrometer Set Standards ³	(0.1 to 1) in (2 to 6) in (7 to 12) in (13 to 18) in (19 to 24) in	93 µin 160 µin 28 µin/in + 0.21µin 19 µin/in + 4 7µin 9.8 µin/in +190 µin	Starrett amplifier and indicator blocks
Micrometers –	(0 to 4) in (4 to 24) in	7.5 µin/in +0.6R 13 µin/in +0.6R	Gage blocks R = Resolution
Height Gauges	(0 to 24) in	12 µin/in +0.6R	
Depth Gauges	(0 to 12) in	11 µin/in +0.6R	
Parallelism	(0 to 1) in	0.6R	

Parameter/Equipment	Range	CMC ² (±)	Comments
Calipers ³	(0 to 40) in	510 μin	Gage blocks
Indicators ³	(0 to 1) in (1 to 4) in	0.18 μin/in + 580 μin 0.35 μin/in + 290 μin	Gage blocks
Pin Gages ³	(0 to 1) in	30 μin	Laser micrometer
Rulers ³ – R = 1/64 in R = 1/32 in R = 1/16 in R = 1/8 in	Up to 48 in Up to 48 in Up to 48 in Up to 48 in	300 μin 300 μin 300 μin 310 μin	Micro-rule R = Resolution

II. Electrical – DC & Low Frequency

Parameter/Equipment	Range	CMC ^{2,4,8} (±)	Comments
DC Voltage ³ – Generate	(0 to 220) mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V	11 μV/V + 0.6 μV 10 μV/V + 1.0 μV 11 μV/V + 3.5 μV 10 μV/V + 6.5 μV 11 μV/V + 80 μV 13 μV/V + 500 μV	Fluke 5700A
DC High Voltage ³ – Generate	(1 to 15) kV	0.13 % + 250 mV	Peschel P20Y-D, Ross Eng. VD15-50Y-A-LB- AL, HP 34401A

Parameter/Equipment	Range	CMC ^{2,4,5,8} (±)	Comments
DC Voltage ³ – Measure	(0.01 to 1) mV (1 to 10) mV	52 μV/V + 10 nV 41 μV/V + 10 nV	HP 34420A
	Up to 100 mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	7.0 μV/V + 0.3 μV 6.0 μV/V + 0.3 μV 6.0 μV/V + 0.5 μV 8.0 μV/V + 30 μV 22 μV/V + 120 μV	HP 3458A
DC High Voltage ³ – Measure	(1 to 15) kV	0.17 % + 25 mV	Ross Eng., VD15-50Y-A-LB-AL, HP34401A
DC Voltage ³ – Measure	(15 to 100) kV	0.58 % + 150 mV	Hipotronics KVM 100D
DC Current ³ – Generate	(20 to 120) A	0.23 μA/A + 2.1 mA	HP 6031A, Guildline 9711A, HP3458A
	Up to 220 μA 220 μA to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A (2.2 to 11) A	6.8 μA/A + 9 nA 5.8 μA/A + 9 nA 5.8 μA/A + 92 nA 70 μA/A + 0.92 μA 93 μA/A + 26 μA 0.042 % + 0.55 mA	Fluke 5700A/5725A
Clamp On Only	(11 to 20.5) A	0.1 % + 750 μA	Fluke 5520A
	(20 to 1000) A	0.26 % + 0.13A	5500A/coil
DC Current ³ – Measure	100 nA to 10 μA (10 to 100) μA 100 μA to 10 mA (10 to 100) mA 100 mA to 1 A	22 μA/A + 0.14 nA 19 μA/A + 1.0 nA 24 μA/A + 58 nA 41 μA/A + 12 μA 0.013 % + 12 μA	HP 3458A
	(1 to 10) A (10 to 100) A (1 to 300) A	0.012 % + 10 μA 0.058 % + 18 μA 0.12 % + 16 μA	Guildline 9711A, HP 3458A

Parameter/Equipment	Range	CMC ^{2,4,5,8} (±)	Comments
DC Resistance ³ – Generate	(0 to 11) Ω (11 to 33) Ω (33 to 110) Ω (0.11 to 1.1) kΩ (1.1 to 11) kΩ (11 to 110) kΩ (0.11 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	48 μΩ/Ω + 0.002 Ω 48 μΩ/Ω + 0.002 Ω 48 μΩ/Ω + 0.002 Ω 48 μΩ/Ω + 0.002 Ω 34 μΩ/Ω + 0.02 Ω 34 μΩ/Ω + 0.02 Ω 38 μΩ/Ω + 2 Ω 0.016 % + 50 Ω 0.016 % + 50 Ω 0.06 % + 3.0 kΩ 0.06 % + 3.0 kΩ 0.004 % + 100 kΩ 0.0024 % + 500 kΩ	Fluke 5520A
	(1 to 100) MΩ	0.11 % + 1.3 kΩ	Biddle 72-6346-1
DC Resistance ³ – Generate, Fixed Points	0 Ω 1.0 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	58 μΩ 110 μΩ 210 μΩ 320 μΩ 590 μΩ 2.0 mΩ 3.7 mΩ 15 mΩ 29 mΩ 140 mΩ 260 mΩ 1.6 Ω 3.1 Ω 23 Ω 47 Ω 460 Ω 1 kΩ 13 kΩ	Fluke 5700A
	1 GΩ 10 GΩ 100 GΩ 1 TΩ	0.2 % 0.2 % 0.21 % 0.31 %	Keithley 5155-9 Keithley 5155-10 Keithley 5155-11 Keithley 5155-11
DC Resistance ³ – Measure	(0.01 to 1) Ω (1 to 10) Ω	81 μΩ/Ω + 2.7 μΩ 77 μΩ/Ω + 36 μΩ	HP 34420A
	(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 MΩ to 1 GΩ	15 μΩ/Ω + 500 μΩ 13 μΩ/Ω + 500 μΩ 13 μΩ/Ω + 5 mΩ 13 μΩ/Ω + 50 mΩ 18 μΩ/Ω + 2 Ω 53 μΩ/Ω + 100 Ω 0.058 % + 1.5 kΩ 0.57 % + 19 kΩ	HP 3458A

Parameter/Equipment	Range	CMC ^{2, 4, 5, 8} (±)	Comments
DC Power ³ – (0.33 to 330) mA (0.33 to 3) A (3 to 20.5) A	(0.033 to 1020) V (0.033 to 1020) V (0.033 to 1020) V	0.018 % 0.017 % 0.05 %	Fluke 5520A
Electrical Calibration of Thermocouple Indicators ³ –			
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.53 °C 0.42 °C 0.38 °C 0.41 °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	0.37 °C 0.33 °C 0.38 °C 0.59 °C 0.98 °C	
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.59 °C 0.23 °C 0.21 °C 0.23 °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	0.34 °C 0.23 °C 0.21 °C 0.24 °C 0.30 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.40 °C 0.24 °C 0.23 °C 0.33 °C 0.48 °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	0.48 °C 0.28 °C 0.25 °C 0.25 °C 0.34 °C	

Parameter/Equipment	Range	CMC ^{2,4,8} (±)	Comments	
Electrical Calibration of Thermocouple Indicators ³ (cont) –				
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.67 °C 0.43 °C 0.41 °C 0.48 °C	Fluke 5520A	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.56 °C 0.44 °C 0.45 °C 0.55 °C		
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.74 °C 0.31 °C 0.23 °C 0.21 °C		
Type U	(-200 to 0) °C (0 to 600) °C	0.56 °C 0.27 °C		
Electrical Calibration of RTD ³ –				
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	0.05 °C 0.07 °C 0.09 °C 0.10 °C 0.12 °C 0.23 °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	0.05 °C 0.07 °C 0.09 °C 0.10 °C 0.12 °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	0.25 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.08 °C 0.09 °C 0.10 °C 0.23 °C		

Parameter/Equipment	Range	CMC ^{2,4,8} (±)	Comments
Electrical Calibration of RTD ³ (cont) –			
Pt 385, 200 Ω	(-200 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.04 °C 0.05 °C 0.12 °C 0.13 °C 0.14 °C 0.16 °C	Fluke 5520A
Pt 385, 500 Ω	(-200 to -80) °C (-80 to 100) °C (100 to 260) °C (260 to 400) °C (400 to 600) °C (600 to 630) °C	0.04 °C 0.05 °C 0.06 °C 0.08 °C 0.09 °C 0.11 °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	0.03 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.23 °C	
PtNi 385, 120 Ω	(-80 to 100) °C (100 to 260) °C	0.08 °C 0.14 °C	
Cu 427, 10 Ω	(-100 to 260) °C	0.30 °C	

Parameter/Range	Frequency	CMC ^{2,4,8} (±)	Comments
Oscilloscope ³ –			
50 Ω load	DC	0.25 % of output + 40 μV	Fluke 5520A/SC1100
1 MΩ load	DC	0.05 % of output + 40 μV	
Squarewave Signal			
50 Ω at 1 kHz	1.0 mV to 6.6 V _{p-p}	0.25 % of output + 40 μV	
1 MΩ			
10 Hz to 1 kHz	1.0 mV to 130 V _{p-p}	0.1 % of output + 40 μV	
(1 to 10) kHz	1.0 mV to 130 V _{p-p}	0.25 % of output + 40 μV	
Level Sine Wave			
Amplitude (50 kHz reference)	50 kHz	2.0 % + 300 μV	
	50 kHz to 100 MHz	3.5 % + 300 μV	
	(100 to 300) MHz	4.0 % + 300 μV	
	(300 to 600) MHz	6.0 % + 300 mV	
	(600 to 1100) MHz	7.0 % + 300 mV	
Flatness (50 kHz reference)	50 kHz to 100 MHz	1.5 % + 100 μV	
	(100 to 300) MHz	2.0 % + 100 μV	
	(300 to 600) MHz	4.0 % + 100 μV	
	(600 to 1100) MHz	5.0 % + 100 μV	
Time Markers –			
Source and Period into a 50 Ω load	5 s to 50 ms	(25 + 1000t) μs/s	t = time in seconds
	20 ms to 2 ns	2.5 μs/s	
Rise Time			
≤ 2 MHz	≤300 ps	+ 0 ps / -100 ps	
> 2 MHz	≤350 ps	+ 0 ps / -100 ps	
Wave Generator			
Amplitude			
1 MΩ	1.8 mV to 55 V _{pk-pk}	3.0 % of output + 100 μV	
50 Ω	1.8 mV to 2.5 V _{pk-pk}	3.0 % of output + 100 μV	

Parameter/Range	Frequency	CMC ^{2,4,8} (±)	Comments
AC Power ³ – (45 to 65) Hz			
(3.3 to 9) mA	(33 to 330) mV (0.33 to 1020) V	0.11 % 0.09 %	Fluke 5520A
(9 to 33) mA	(33 to 330) mV (0.33 to 1020) V	0.1 % 0.06 %	
(33 to 90) mA	(33 to 330) mV (0.33 to 1020) V	0.11 % 0.09 %	
(90 to 330) mA	(33 to 330) mV (0.33 to 1020) V	0.1 % 0.06 %	
(0.33 to 0.9) A	(33 to 330) mV (0.33 to 1020) V	0.1 % 0.09 %	
(0.9 to 2.2) A	(33 to 330) mV (0.33 to 1020) V	0.09 % 0.07 %	
(2.2 to 4.5) A	(33 to 330) mV (0.33 to 1020) V	0.1 % 0.09 %	
(4.5 to 20.5) A	(33 to 330) mV (0.33 to 1020) V	0.09 % 0.1 %	
AC Voltage ³ – Generate			
(0.1 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	0.063 % + 5.2 μV 0.024 % + 5.2 μV 0.013 % + 5.2 μV 0.043 % + 5.2 μV 0.099 % + 8.1 μV 0.13 % + 15 μV 0.2 % + 29 μV 0.4 % + 29 μV	Fluke 5700A
(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	0.063 % + 5.8 μV 0.024 % + 5.8 μV 0.013 % + 5.8 μV 0.043 % + 5.8 μV 0.099 % + 8.1 μV 0.13 % + 14 μV 0.2 % + 29 μV 0.39 % + 29 μV	

Parameter/Range	Frequency	CMC ^{2,4,8} (±)	Comments
AC Voltage ³ – Generate (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	0.064 % + 15 μV 0.025 % + 9.2 μV 0.013 % + 9.2 μV 0.037 % + 9.2 μV 0.099 % + 9.2 μV 0.013 % + 29 μV 0.2 % + 40 μV 0.4 % + 92 μV	Fluke 5700A
(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 500 kHz to 1 MHz	0.058 % + 92 μV 0.019 % + 29 μV 89 μV/V + 6.7 μV 0.015 % + 18 μV 0.029 % + 81 μV 0.05 % + 150 μV 0.12 % + 0.4 μV 0.25 % + 0.98 μV	
(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	0.058 % + 0.92 mV 0.019 % + 0.34 mV 84 μV/V + 160 μV 0.014 % + 260 μV 0.029 % + 0.44 mV 0.058 % + 1.7 mV 0.14 % + 5.0 mV 0.31 % + 9.8 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	0.058 % + 9.3 mV 0.019 % + 3.1 mV 91 μV/V + 1.4 mV 0.026 % + 4.4 mV 0.058 % + 9.3 μV 0.17 % + 100 mV 0.54 % + 100 mV 1.4 % + 220 mV	
(220 to 1100) V	40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	0.01 % + 10 mV 0.019 % + 10 mV 0.07 % + 14 mV	
(220 to 750) V	(30 to 50) kHz (50 to 100) kHz	0.07 % + 13 mV 0.27 % + 52 mV	

Parameter/Range	Frequency	CMC ^{2,4,8} (±)	Comments
AC High Voltage ³ – Generate (1 to 10) kV	50/60 Hz	0.24 % + 1.5 mV	Ross Eng VD15-50Y- A-LB-AL, HP 34401, Peschel P20Y-D
AC High Voltage ³ – Measure	(1 to 15) kV	0.25 % + 2.3 V	Ross Eng., VD15-50Y- A-LB-AL, HP34401A
AC Current ³ – Generate			
10 nA to 220 µA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.081 % + 29 nA 0.041 % + 23 nA 0.017 % + 19 nA 0.07 % + 46 nA 0.18 % + 92 nA	Fluke 5700A
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	0.081 % + 46 nA 0.041 % + 40 nA 0.017 % + 40 nA 0.07 % + 460 nA 0.19 % + 1 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	0.081 % + 460 nA 0.041 % + 400 nA 0.017 % + 400 nA 0.07 % + 4.6 µA 0.19 % + 10 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	0.081 % + 4.6 µA 0.041 % + 4.0 µA 0.017 % + 4.0 µA 0.07 % + 46 µA 0.19 % + 92 µA	
220 mA to 2.2 A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.076 % + 40 µA 0.087 % + 92 µA 0.98 % + 180 µA	
(2.2 to 11) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.054 % + 200 µA 0.11 % + 440 µA 0.42 % + 870 µA	Fluke 5700A/5725A
(11 to 20.5) A	(45 to 100) Hz (0.100 to 1) kHz (1 to 5) kHz	0.12 % of output + 5.0 mA 0.15 % of output + 5.0 mA 3.0 % of output + 5.0 mA	Fluke 5520A
(20 to 1000) A	(45 to 440) Hz	0.8 % of output	Fluke 5500A/coil

Parameter/Range	Frequency	CMC ^{2,5,8} (±)	Comments
AC Voltage ³ – Measure			
(0 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 μV 0.023 % + 1.3 μV 0.035 % + 1.3 μV 0.12 % + 1.3 μV 0.58 % + 1.3 μV 4.7 % + 2.3 μV	Agilent 3458A
(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	80 μV/V + 4.8 μV 81 μV/V + 2.3 μV 0.017 % + 2.3 μV 0.035 % + 2.3 μV 0.092 % + 2.3 μV 0.35 % + 12 μV	
100 mV 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 (1 to 2) MHz	81 μV/V + 470 μV 81 μV/V + 230 μV 0.017 % + 230 μV 0.035 % + 230 μV 0.093 % + 230 μV 0.35 % + 1.2 mV 1.2 % + 1.2 mV 1.8 % + 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 (100 to 300) kHz (0.3 to 1) MHz	0.024 % + 4.6 mV 0.024 % + 2.3 mV 0.024 % + 2.3 mV 0.04 % + 2.3 mV 0.14 % + 2.3 mV 0.46 % + 12 mV 1.8 % + 12 mV	
100 V to 1 kV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.047 % + 46 mV 0.047 % + 23 mV 0.07 % + 23 mV 0.14 % + 23 mV 0.35 % + 23 mV	
50 MHz Power Reference	50 MHz	0.007 mW	HP 478A

Parameter/Range	Frequency	CMC ^{2,8} (±)	Comments	
Flatness ³ – Measure, Fixed Points (cont)	10 kHz	0.0036 V	1 Volt thermal converter (50 Ω)	
	30 kHz	0.0036 V		
100 kHz	0.0038 V			
300 kHz	0.0037 V			
1 MHz	0.0036 V			
3 MHz	0.0037 V			
8 MHz	0.0039 V			
10 MHz	0.0039 V			
20 MHz	0.0062 V			
30 MHz	0.0061 V			
50 MHz	0.0094 V			
70 MHz	0.015 V			
80 MHz	0.018 V			
	10 Hz	0.021 V		3 Volt thermal converter (50 Ω)
	100 Hz	0.021 V		
	10 kHz	0.021 V		
	30 kHz	0.021 V		
	100 kHz	0.021 V		
	300 kHz	0.021 V		
	1 MHz	0.1 V		
	3 MHz	0.021 V		
	8 MHz	0.022 V		
	10 MHz	0.022 V		
	20 MHz	0.12 V		
Capacitance ³ – Generate	(0.19 to 1.09) nF	10 Hz to 10 kHz	0.5 % + 0.01 nF	Fluke 5520A
	(1.1 to 3.29) nF	10 Hz to 3 kHz	0.5 % + 0.01 nF	
	(3.3 to 10.9) nF	10 Hz to 1 kHz	0.25 % + 0.01 nF	
	(11 to 109.9) nF	10 Hz to 1 kHz	0.25 % + 0.01 nF	
	(110 to 329.9) nF	10 Hz to 1 kHz	0.25 % + 0.3 nF	
	(0.33 to 1.09) μF	(10 to 600) Hz	0.25 % + 1 nF	
	(1.1 to 3.29) μF	(10 to 300) Hz	0.25 % + 3 nF	
	(3.29 to 10.9) μF	(10 to 150) Hz	0.25 % + 10 nF	
	(11 to 32.9) μF	(10 to 120) Hz	0.40 % + 30 nF	
	(33 to 109.9) μF	(10 to 80) Hz	0.45 % + 100 nF	
	(110 to 329.9) μF	(10 to 50) Hz	0.45 % + 300 nF	
	(0.33 to 1.09) mF	(10 to 20) Hz	0.45 % + 1 mF	
	(0.01 to 0.10) μF	100 Hz to 1 kHz	0.59 μF + 0.59 pF/μF	GR 1413
	(0.1 to 1.0) μF		0.59 μF + 0.59 pF/μF	
	(1 to 10) pF		0.59 pF + 0.59 pF/μF	
	(10 to 100) pF		0.59 pF + 0.59 pF/pF	
	(100 to 1000) pF		0.64 pF + 5.4 pF/pF	
	(1000 to 10 000) pF		0.59 pF + 0.60 pF/pF	
	1 pF	1 kHz	0.0026 pF	HP 16380A Set (4 terminal)
	10 pF		0.0031 pF	
100 pF	0.019 pF			
1000 pF	0.0068 pF			

Parameter/Range	Frequency	CMC ^{2,4,8} (±)	Comments
Capacitance – Measure (0 to 1100) μF	1 kHz	0.023 %	GR 1689
Inductance – Generate 100 mH	(100 Hz, 1 kHz)	0.11 mH	GR, 106K
0.1 mH	(100 Hz, 1 kHz, 10 kHz)	0.00055 mH	GR, 106L
1 mH	(100 Hz, 1 kHz, 10 kHz)	0.0013 mH	GR, 106G
Inductance – Measure (0 to 100) mH	1 kHz	0.023 %	GR 1689

III. Electrical – Microwave/RF

Parameter/Range	Frequency	CMC ² (±)	Comments
RF Power ³ – Generate	(0 to 26.5) GHz	1.9 dB	3325B, 8340B, 8902A, 8902A, 11722A, 11792A, 11793A, 11792A, 11793A
RF Power ³ – Measure	(0 to 26.5) GHz	1.9 dB	8902A, 11722A, 11792A, 11793A
	(26.5 to 40.0) GHz	0.087 dBm	Agilent 8487A, 437B
Attenuation ³ – Generate			
(10 to 100) dB	30 MHz	0.02 dB	Weinschel PA-2
10 dBm	10 MHz to 12.4 GHz (12.4 to 18) GHz	1.2 dBm 1.3 dBm	HP 8496A attenuator
20 dBm	10 MHz to 12.4 GHz (12.4 to 18) GHz	1.4 dBm 1.4 dBm	
30 dBm	10 MHz to 12.4 GHz (12.4 to 18) GHz	1.5 dBm 1.8 dBm	

Parameter/Range	Frequency	CMC ^{2,8} (±)	Comments
Attenuation ³ – Generate (cont)			
40 dBm	10 MHz to 12.4 GHz (12.4 to 18) GHz	1.8 dBm 2.1 dBm	HP 8496A attenuator
50 dBm	10 MHz to 12.4 GHz (12.4 to 18) GHz	2.0 dBm 2.6 dBm	
60 dBm	10 MHz to 12.4 GHz (12.4 to 18) GHz	2.3 dBm 3.0 dBm	
70 dBm	10 MHz to 12.4 GHz (12.4 to 18) GHz	2.7 dBm 3.4 dBm	
80 dBm	10 MHz to 12.4 GHz (12.4 to 18) GHz	3.0 dBm 3.9 dBm	
90 dBm	10 MHz to 12.4 GHz (12.4 to 18) GHz	3.3 dBm 4.3 dBm	
100 dBm	10 MHz to 12.4 GHz (12.4 to 18) GHz	3.6 dBm 4.7 dBm	
110 dBm	10 MHz to 12.4 GHz (12.4 to 18) GHz	3.7 dBm 5.2 dBm	
Attenuation ³ – Measure	10 MHz to 1.3 GHz (1.3 to 26.5) GHz	0.18 dB 0.18 dB	HP 8902A, 11722A 8902A, 11722A, 11792A, 11793A
Phase Modulation – Measure			
Rate: 200 Hz to 10 kHz (0 to 100) rad	Carrier: 150 kHz ≤ <i>f_c</i> < 10 MHz	4.7 % + 1 digit	8902A, 11793A
Rate: 200 Hz to 20 kHz (0 to 100) rad	10 MHz ≤ <i>f_c</i> < 1.3 GHz	3.6 % + 1 digit	
Amplitude Modulation Measure –			
Rate: 50 Hz to 10 kHz Depths: 5 % to 99 %	150 kHz to 10 MHz	2.4 % + 1 digit	8902A, 11793A
Rate: 20 Hz to 10 kHz Depths: to 99 %	150 kHz to 10 MHz	3.5 % + 1 digit	
Rate: 50 Hz to 50 kHz Depths: 5 % to 99 %	10 MHz to 1.3 GHz	1.2 % + 1 digit	

Parameter/Range	Frequency	CMC ^{2, 8} (±)	Comments
Amplitude Modulation Measure – (cont)			
Rate: 20 Hz to 100 kHz Depths: to 99 %	10 MHz to 1.3 GHz	3.5 % + 1 digit	8902A, 11793A
Rate: 50 Hz to 50 kHz Depths: 5 % to 99 %	(1.3 to 26.5) GHz	1.8 % + 1 digit	
Rate: 20 Hz to 100 kHz Depths: to 99 %	(1.3 to 26.5) GHz	3.6 % + 1 digit	
Frequency Modulation – Measure			
Rate: 20 Hz to 10 kHz Dev.: ≤ 40 kHz Peak	250 kHz to 10 MHz	2.3 % + 1 digit	8902A, 11793A
Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz Peak	10 MHz to 1.3 GHz	1.2 % + 1 digit	
Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz Peak	10 MHz to 1.3 GHz	5.8 % + 1 digit	
Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz Peak	(1.3 to 26.5) GHz	1.2 % + 1 digit	
Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz Peak	(1.3 to 26.5) GHz	5.8 % + 1 digit	
Distortion ³ – Measure			
	20 Hz to 20 kHz (20 to 100) kHz	1.2 db 2.3 db	HP 8903B
	100 kHz to 2.5 GHz (2.5 to 11) GHz	1.8 dBm 2.6 dBm	HP 8566A
Phase ³ – Generate			
	101 Hz to 1 kHz 100 kHz to 1 MHz (1 to 100) kHz (1 to 13) MHz	0.24 deg 0.36 deg 0.26 deg 2.4 deg	HP 3326A
Phase ³ – Measure Fixed Points			
	10 Hz to 100 kHz 13 MHz 1 kHz 1 MHz	0.13 deg 16 deg 0.13 deg 1.3 deg	Agilent 53131A

IV. Mechanical

Parameter/Equipment	Range	CMC ^{2,7,8} (±)	Comments
Scales & Balances ³ –	(1 to 200) g 200 g to 1 kg (1 to 5) kg	0.15 mg 5.6 mg 58 mg	Class 1 weights
	(1 to 100) lb (100 to 500) lb (500 to 1000) lb	0.0057 lb 0.053 lb 0.57 lb	Class F weights
Pressure Gauges, Transducers & Calibrators ³ – Measuring Equipment and Measure	(0.1 to 1.0) psi (1 to 100) psi (100 to 500) psi (500 to 1000) psi (1000 to 10 000) psi	0.0016 psi 0.05 psi 0.26 psi 0.52 psi 0.99 psi	Fluke 700P22 Fluke 700P06 Fluke 700P07 Fluke 700P08 Fluke 700P31
	(1 to 100) psi (100 to 1000) psi (1000 to 10 000) psi	0.0032 % 0.029 % 0.032 %	Ametek T-100-1/C
Vacuum Gauges & Transducers ³ – Measuring Equipment & Measure	(-15 to 0) psi	0.15 psi	Fluke 700PD7, 743
Torque Wrenches ³	4.0 in·lb to 250 ft·lb	0.39 %	CDI Suretest and 4 in 1 transducer
Force ³ – Compression & Tension	Up to 250 lbf	0.018 % + 0.6R	Class F Weights and hangers
RPM ³ –	Generate (Optical)	(0.01 to 100) rpm (100 to 1000) rpm (1000 to 99 999) rpm	0.0059 rpm 0.059 rpm 0.73 rpm
	Measure (Optical & Mechanical)	(0.01 to 100) rpm (100 to 1000) rpm (1000 to 99 999) rpm	0.012 rpm 0.12 rpm 1.2 rpm

V. Thermodynamics

Parameter/Equipment	Range	CMC ² (±)	Comments
Temperature ³ – Measuring Equipment SPRT, RTD, Thermocouples	(-100 to 125) °C (125 to 660) °C	0.031 °C 0.039 °C	Hart 7102, 1502A, 5628 Hart 9122, 1502A, 5628
IR Temperature ³ – Measuring Equipment R=0.01 R=1	(35 to 400) °C (35 to 400) °C	0.0066 °C/°C + 0.48 °C 0.0063 °C/°C + 0.64 °C	Hart 9131
Relative Humidity ³ – Measure	(10 to 70) % RH (70 to 90) % RH	1.0 % RH 2.0 % RH	Vaisala MI70, HMP77

VI. Time & Frequency

Parameter/ Range	Frequency	CMC ² (±)	Comments
Frequency ³ – Measuring Equipment	1 Hz to 26.5 GHz	0.01 nHz/Hz	GPS 58503A
Frequency – Measure	10 Hz to 3.0 GHz 3.0 GHz to 26.5 GHz 26.5 GHz to 40 GHz	0.029 Hz 0.58 Hz 0.58 Hz	58503A, 53131A-003 58503A, EIP 548 58503A, 5352B

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

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. Calibration and Measurement Capabilities 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 5500 series of instruments. This capability is suitable for the calibration of the devices intended to measure the stated measurand in the ranges indicated. Calibration and Measurement Capability is expressed as either a specific value that covers the full range or as a fraction of the reading plus a fixed floor specification.
- ⁵ The measurands stated are measured with the HP 3400 series of instruments. This capability is suitable for the calibration of the devices intended to generate the measurand in the ranges indicated. Calibration and Measurement Capability is expressed as either a specific value that covers the full range or as a combination of the fraction of the reading/output plus a range specification.
- ⁶ In the statement of Calibration and Measurement Capability, R is the numerical value of the resolution of the device in inches.
- ⁷ In the statement of Calibration and Measurement Capability, R is the numerical value of the resolution of the device in pounds force.
- ⁸ In the statement of Calibration and Measurement Capability, percentage refers to percent of reading, unless otherwise noted.



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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 27th day of May 2010.

A handwritten signature in black ink, appearing to read "Peter M. Meyer", written over a horizontal line.

President & CEO
For the Accreditation Council
Certificate Number 2662.01
Valid to February 29, 2012

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