



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005,
ANSI/NCSL Z540-1-1994 & ANSI/NCSL Z540.3-2006

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CALIBRATION

Valid To: February 29, 2020

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 (±)	Comments
Diameter, External – Cylindrical Gauging – Pin, Wire and Plug Gages	Up to 4 in	15 µin	THV w/ gage blocks
Diameter, Internal – Plain Ring Gages	(0.4 to 3) in	6.3 µin/in + 19 µin	THV w/ master rings
Flatness ³	1.5 in	3.5 µin	Optical flat
Hand Tools ³ – Indicators Micrometers Depth Gages Height Gages Calipers	Up to 1 in Up to 48 in Up to 12 in Up to 48 in Up to 48 in	2.9 µin/in + 5.8 µin	Gage blocks
Length Standard	Up to 4 in (4 to 24) in	15 µin 3.7 µin/in + 25 µin	THV w/ gage blocks gage blocks & height comparator

Parameter/Equipment	Range	CMC ² (±)	Comments
Rulers	Up to 48 in	310 µin	Micro-rule

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,4} (±)	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	7.1 µV/V + 0.40 µV 3.7 µV/V + 0.80 µV 4.9 µV/V + 3.0 µV 4.9 µV/V + 4.3 µV 3.7 µV/V + 48 µV 4.7 µV/V + 0.48 mV	Fluke 5720A
DC High Voltage ³ – Generate	(1 to 15) kV	0.0025 VDC + 1.2 VDC/KVDC	Peschel P20Y-D w/ Ross VD15-50Y-A- LB-AL, Agilent 34401A
DC Voltage ³ – Measure	(0.01 to 1) mV (1 to 10) mV Up to 100 mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	52 µV/V + 10 nV 41 µV/V + 4.8 nV 9.5 µV/V + 0.37 µV 6.1 µV/V + 0.37 µV 5.8 µV/V + 0.60 µV 8.7 µV/V + 37 µV 8.7 µV/V + 0.12 mV	Agilent 34420A Agilent 3458A
DC High Voltage ³ – Measure	(1 to 15) kV (15 to 60) kV	0.0025 VDC + 1.2 VDC/KVDC 0.0064 VDC + 1.2 VDC/KVDC	Ross VD15-50Y-A- LB-AL w/ Agilent 34401A Ross VD60-6.2Y-A- LB-ACD

Parameter/Equipment	Range	CMC ^{2,4} (\pm)	Comments
DC Current ³ – Generate	Up 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	35 μ A/A + 6.0 nA 31 μ A/A + 7.0 nA 30 μ A/A + 41 nA 41 μ A/A + 0.71 μ A 77 μ A/A + 12 μ A 0.034 % + 0.48 mA	Fluke 5720A w/ 5725A
	(11 to 20.5) A	0.10 % + 0.91 A	Fluke 5520A
	(20 to 120) A	0.23 μ A/A + 2.1 mA	Agilent 3458A w/ 6031A, 9711A
Clamp On Only ³	(20.5 to 1000) A	0.58 % + 0.16 A	Fluke 5520A w/ coil
DC Current ³ – Measure	100 nA to 10 μ A (10 to 100) μ A 100 μ A to 10 mA (10 to 100) mA 100 mA to 1 A	17 μ A/A + 0.80 nA 17 μ A/A + 5.0 nA 17 μ A/A + 50 nA 31 μ A/A + 0.50 μ A 0.010 % + 10 μ A	Agilent 3458A
	(1 to 10) A (10 to 100) A (1 to 300) A	0.012 % + 10 μ A 0.058 % + 18 μ A 0.12 % + 16 μ A	Guildline 9711A w/ Agilent 3458A
DC Resistance ³ – Generate	Up to 10.9999 Ω (11 to 32.9999) Ω (33 to 109.9999) Ω (110 to 329.9999) Ω (0.33 to 1.099999) k Ω (1.1 to 3.299999) k Ω (3.3 to 10.99999) k Ω (11 to 32.99999) k Ω (33 to 109.999) k Ω (110 to 329.999) k Ω	40 $\mu\Omega/\Omega$ + 1.0 m Ω 30 $\mu\Omega/\Omega$ + 2.0 m Ω 28 $\mu\Omega/\Omega$ + 2.0 m Ω 28 $\mu\Omega/\Omega$ + 4.0 m Ω 28 $\mu\Omega/\Omega$ + 13 m Ω 28 $\mu\Omega/\Omega$ + 13 m Ω 28 $\mu\Omega/\Omega$ + 30 m Ω 28 $\mu\Omega/\Omega$ + 0.30 Ω 28 $\mu\Omega/\Omega$ + 0.30 Ω 32 $\mu\Omega/\Omega$ + 2.0 Ω	Fluke 5520A, 4-wire

Parameter/Equipment	Range	CMC ^{2,4} (\pm)	Comments
DC Resistance ³ – Generate (cont)	(0.33 to 1.09999) M Ω (1.1 to 3.29900) M Ω (3.3 to 10.9999) M Ω (11 to 32.9999) M Ω (33 to 109.9999) M Ω (110 to 329.9999) M Ω (330 to 1100) M Ω	32 $\mu\Omega/\Omega$ + 2.2 Ω 60 $\mu\Omega/\Omega$ + 39 Ω 0.013 % + 63 Ω 0.025 % + 2.5 k Ω 0.050 % + 3.0 k Ω 0.30 % + 0.10 M Ω 1.5 % + 0.50 M Ω	Fluke 5520A, 2-wire
	Fixed Points 0 Ω 1 Ω 1.9 Ω 10, 19 Ω 100, 190 Ω 1, 1.9 k Ω 10, 19 k Ω 100, 190 k Ω 1 M Ω 1.9 M Ω 10 M Ω 19 M Ω 100 M Ω 1 G Ω 10 G Ω 100 G Ω 1 T Ω	(1 to 100) M Ω 41 $\mu\Omega$ 81 $\mu\Omega/\Omega$ 82 $\mu\Omega/\Omega$ 23 $\mu\Omega/\Omega$ 9.5 $\mu\Omega/\Omega$ 8.5 $\mu\Omega/\Omega$ 8.5 $\mu\Omega/\Omega$ 11 $\mu\Omega/\Omega$ 20 $\mu\Omega/\Omega$ 30 $\mu\Omega/\Omega$ 35 $\mu\Omega/\Omega$ 45 $\mu\Omega/\Omega$ 0.010 % 0.20 % 0.20 % 0.21 % 0.31 %	Biddle 72-6346-1 Fluke 5700A 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 Up to 10 Ω (10 to 100) Ω (100 to 1000) Ω (1 to 10) k Ω (10 to 100) k Ω (100 to 1000) k Ω (1 to 10) M Ω (10 to 100) M Ω (0.1 to 1) G Ω	81 $\mu\Omega/\Omega$ + 2.7 $\mu\Omega$ 77 $\mu\Omega/\Omega$ + 36 $\mu\Omega$ 18 $\mu\Omega/\Omega$ + 58 $\mu\Omega$ 12 $\mu\Omega/\Omega$ + 0.58 m Ω 9.5 $\mu\Omega/\Omega$ + 5.8 m Ω 9.5 $\mu\Omega/\Omega$ + 58 m Ω 9.7 $\mu\Omega/\Omega$ + 0.58 Ω 15 $\mu\Omega/\Omega$ + 2.3 Ω 58 $\mu\Omega/\Omega$ + 0.12 k Ω 0.058 % + 1.2 k Ω 0.59 % + 12 k Ω	Agilent 34420A Agilent 3458A

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments	
Thermocouple ³ – Measure				
Type J	(-210 to -100) °C (-100 to 800) °C (800 to 1200) °C	0.14 °C 0.09 °C 0.1 °C	Fluke 5520A	
Type K	(-250 to -200) °C (-200 to -100) °C (-100 to 500) °C (500 to 800) °C (800 to 1372) °C	0.46 °C 0.16 °C 0.1 °C 0.1 °C 0.13 °C		
Type T	(-250 to -200) °C (-200 to -100) °C (-100 to 0) °C (0 to 200) °C (200 to 400) °C	0.35 °C 0.16 °C 0.11 °C 0.09 °C 0.09 °C		
Electrical Calibration of Thermocouple Indicators ³ –				
Type B	(600 to 800) °C (800 to 1550) °C (1550 to 1820) °C	0.35 °C 0.28 °C 0.22 °C		Fluke 5520A
Type C	(0 to 1000) °C (1000 to 1800) °C (1800 to 2000) °C (2000 to 2316) °C	0.16 °C 0.23 °C 0.26 °C 0.35 °C		
Type E	(-250 to -200) °C (-200 to -100) °C (-100 to 0) °C (0 to 600) °C (600 to 1000) °C	0.25 °C 0.12 °C 0.09 °C 0.08 °C 0.1 °C		
Type J	(-210 to -100) °C (-100 to 800) °C (800 to 1200) °C	0.14 °C 0.09 °C 0.1 °C		

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Electrical Calibration of Thermocouple Indicators ³ – (cont)			
Type K	(-250 to -200) °C (-200 to -100) °C (-100 to 500) °C (500 to 800) °C (800 to 1372) °C	0.46 °C 0.16 °C 0.1 °C 0.1 °C 0.13 °C	Fluke 5520A
Type L	(-200 to -100) °C (-100 to 900) °C	0.1 °C 0.09 °C	
Type N	(-250 to -200) °C (-200 to -100) °C (-100 to 0) °C (0 to 100) °C (100 to 800) °C (800 to 1300) °C	0.73 °C 0.23 °C 0.12 °C 0.11 °C 0.1 °C 0.12 °C	
Type R	(-50 to -25) °C (-25 to 0) °C (0 to 100) °C (100 to 400) °C (400 to 600) °C (600 to 1000) °C (1000 to 1600) °C (1600 to 1767) °C	0.55 °C 0.45 °C 0.39 °C 0.28 °C 0.22 °C 0.21 °C 0.19 °C 0.23 °C	
Type S	(-50 to -25) °C (-25 to 0) °C (0 to 100) °C (100 to 400) °C (400 to 600) °C (600 to 1000) °C (1000 to 1600) °C (1600 to 1767) °C	0.51 °C 0.43 °C 0.38 °C 0.29 °C 0.23 °C 0.22 °C 0.22 °C 0.26 °C	
Type T	(-250 to -200) °C (-200 to -100) °C (-100 to 0) °C (0 to 200) °C (200 to 400) °C	0.35 °C 0.16 °C 0.11 °C 0.09 °C 0.09 °C	
Type U	(-200 to 0) °C (0 to 200) °C (200 to 600) °C	0.16 °C 0.1 °C 0.1 °C	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Electrical Calibration of RTDs ³ – Generate			
Pt 385, 100 Ω	(-200 to -80) °C (-80 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 800) °C	0.013 °C 0.02 °C 0.024 °C 0.026 °C 0.033 °C 0.038 °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	0.013 °C 0.015 °C 0.017 °C 0.022 °C 0.026 °C 0.032 °C	
Pt 3916, 100 Ω	(-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.01 °C 0.013 °C 0.015 °C 0.017 °C 0.022 °C 0.026 °C 0.031 °C 0.033 °C	
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 630) °C	0.053 °C 0.056 °C 0.06 °C 0.06 °C 0.069 °C 0.071 °C 0.088 °C	
Pt 385, 500 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.026 °C 0.028 °C 0.034 °C 0.038 °C 0.045 °C	
Pt 385, 1000 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.015 °C 0.018 °C 0.024 °C 0.026 °C 0.033 °C	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Voltage ³ – Generate			
Up 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	0.022 % + 4.0 μV 85 μV/V + 4.0 μV 75 μV/V + 4.0 μV 0.018 % + 4.0 μV 0.046 % + 5.0 μV 0.090 % + 10 μV 0.12 % + 20 μV 0.25 % + 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	0.022 % + 4.0 μV 85 μV/V + 4.0 μV 75 μV/V + 4.0 μV 0.018 % + 4.0 μV 0.046 % + 5.0 μV 0.090 % + 10 μV 0.12 % + 20 μV 0.25 % + 20 μV	
(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	0.022 % + 12 μV 85 μV/V + 7.0 μV 75 μV/V + 7.0 μV 0.018 % + 7.0 μV 0.042 % + 17 μV 0.075 % + 20 μV 0.12 % + 25 μV 0.25 % + 45 μV	
220 mV to 2.2 V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.022 % + 82 μV 85 μV/V + 82 μV 40 μV/V + 82 μV 70 μV/V + 82 μV 0.011 % + 82 μV 0.034 % + 82 μV 0.090 % + 0.20 mV 0.15 % + 0.32 mV	

Parameter/Range	Frequency	CMC ^{2,4} (±)	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 500 kHz to 1 MHz	0.022 % + 0.40 mV 80 μV/V + 0.15 mV 40 μV/V + 50 μV 70 μV/V + 0.10 mV 95 μV/V + 0.20 mV 0.026 % + 0.60 mV 0.090 % + 2.0 mV 0.13 % + 3.2 mV	Fluke 5720A
(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	0.022 % + 4.0 mV 80 μV/V + 1.5 mV 47 μV/V + 0.61 mV 75 μV/V + 1.0 mV 0.013 % + 2.5 mV 0.080 % + 16 mV 0.42 % + 40 mV 0.70 % + 80 mV	* 220 V range subject to 2.2E7 V-Hz limitation
(220 to 1100) V	40 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	80 μV/V + 4.1 mV 0.013 % + 6.1 mV 0.036 % + 11 mV	
(220 to 750) V	(30 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (500 to 1000) KHz	0.036 % + 11 mV 0.080 % + 45 mV 0.13 % + 83 mV 0.42 % + 91 mV 0.70 % + 1.1 V	
AC High Voltage ³ – Generate			
(1 to 10) kV	50/60 Hz	2.3 VAC + 2.5 VAC/KVAC	Ross VD15-50Y-A- LB-AL w/ Agilent 34401A, Peschel P20Y-D
AC High Voltage ³ – Measure			
(1 to 60) kV	50/60 Hz	2.3 VAC + 2.5 VAC/KVAC	Ross VD15-50Y-A- LB-AL w/ Agilent 34401A

Parameter/Range	Frequency	CMC ^{2,4} (±)	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 % + 4.1 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 0.070 % + 23 mV 0.14 % + 23 mV 0.35 % + 23 mV	

Parameter/Range	Frequency	CMC ^{2, 4, 5} (±)	Comments
AC Current ³ – Generate			
Up to 220 µA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.023 % + 16 nA 0.014 % + 10 nA 0.011 % + 8.0 nA 0.025 % + 12 nA 0.090 % + 65 nA	Fluke 5720A w/ 5725A
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	0.023 % + 40 nA 0.014 % + 36 nA 0.011 % + 36 nA 0.025 % + 0.11 µA 0.090 % + 0.65 µA	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.023 % + 0.41 µA 0.014 % + 0.36 µA 0.011 % + 0.36 µA 0.025 % + 0.56 µA 0.090 % + 5.0 µA	
(22 to 220) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.023 % + 4.0 µA 0.014 % + 4.0 µA 0.011 % + 3.0 µA 0.018 % + 4.0 µA 0.090 % + 10 µA	
220 mA to 2.2 A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.024 % + 35 µA 0.039 % + 80 µA 0.60 % + 0.16 mA	
(2.2 to 11) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.040 % + 0.19 mA 0.085 % + 0.39 mA 0.33 % + 0.75 mA	
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.12 % + 5.1 mA 0.15 % + 5.1 mA 3.0 % + 5.1 mA	Fluke 5520A
(20.5 to 150) A (150 to 1000) A	(45 to 65) Hz (45 to 65) Hz	0.31 % + 0.6R 0.32 % + 0.6R	Fluke 5520A w/ coil
(20.5 to 150) A	(65 to 440) Hz	0.95 % + 35 mA	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Current ³ – Measure			
(5 to 100) µA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 5 kHz	0.46 % + 35 nA 0.15 % + 30 nA 0.060 % + 30 nA	Agilent 3458A
(0.1 to 1) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.40 % + 0.20 µA 0.15 % + 0.20 µA 0.060 % + 0.20 µA 0.030 % + 0.20 µA 0.060 % + 0.20 µA 0.40 % + 0.40 µA 0.55 % + 1.5 µA	
(1 to 10) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.40 % + 2.0 µA 0.15 % + 2.0 µA 0.060 % + 2.0 µA 0.030 % + 2.0 µA 0.060 % + 2.0 µA 0.40 % + 4.0 µA 0.55 % + 15 µA	
(10 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz	0.40 % + 0.20 µA 0.15 % + 0.20 µA 0.06 % + 0.20 µA	
(10 to 100) mA	100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.03 % + 0.20 µA 0.06 % + 0.20 µA 0.40 % + 0.40 µA 0.55 % + 20 µA	
(0.1 to 1) A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz	0.40 % + 0.2 mA 0.160 % + 0.2 mA 0.080 % + 0.2 mA 0.10 % + 0.2 mA 0.30 % + 0.2 mA 1.0 % + 0.4 mA	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Current ³ – Measure (cont)			
(1 to 2) A	Up to 1 kHz	1.2 mA/A + 5.6 µA	Agilent 3458A w/ Valhalla 2575A
(1 to 2) A	(1 to 10) kHz	1.2 mA/A + 16 µA	
(2 to 20) A	Up to 1 kHz	1.2 mA/A + 210 µA	
(2 to 20) A	(1 to 10) kHz	5.8 mA/A + 210 µA	
(20 to 100) A	Up to 1 kHz	1.2 mA/A + 5.7 mA	
DC Power ³			
(0.33 to 329.99) mA	33 mV to 1020 V	0.023 %	Fluke 5520A
(0.33 to 2.9999) A	33 mV to 1020 V	0.022 %	
(3 to 20.5) A	33 mV to 1020 V	0.07 %	
AC Power ³ , (45 to 65) Hz			
(3.3 to 9) mA	(33 to 330) mV (0.33 to 1020) V	0.11 % 0.090 %	Fluke 5520A
(9 to 33) mA	(33 to 330) mV (0.33 to 1020) V	0.10 % 0.060 %	
(33 to 90) mA	(33 to 330) mV (0.33 to 1020) V	0.11 % 0.090 %	
(90 to 330) mA	(33 to 330) mV (0.33 to 1020) V	0.10 % 0.060 %	
(0.33 to 0.9) A	(33 to 330) mV (0.33 to 1020) V	0.10 % 0.090 %	
(0.9 to 2.2) A	(33 to 330) mV (0.33 to 1020) V	0.090 % 0.070 %	
(2.2 to 4.5) A	(33 to 330) mV (0.33 to 1020) V	0.10 % 0.090 %	
(4.5 to 20.5) A	(33 to 330) mV (0.33 to 1020) V	0.090 % 0.10 %	

Parameter/Range	Frequency	CMC ^{2, 4, 5} (±)	Comments
AC Ratio, Fixed Points	400 Hz 1 kHz	0.00012 % 0.00015 %	DT72A
Synchro/Resolver Indicators ³ – 0° to 360°	400 Hz	0.000063°	DSRS-5DR
Synchro/Resolver Simulators ³ – 0° to 360°	400 Hz	0.000083°	DCRB-5C-4R
Capacitance ³ – Generate (0.10 to 3.299) nF (0.33 to 10.999) nF (11 to 109.999) nF (110 to 329.99) nF (0.33 to 1.0999) µF (1.1 to 3.2999) µF (3.3 to 10.999) µF (11 to 32.999) µF (33 to 109.99) µF (110 to 329.99) µF (0.33 to 1.0999) mF (1.1 to 3.2999) mF (3.3 to 10.999) mF (11 to 32.999) mF (33 to 110) mF	10 Hz to 10 kHz (10 to 1000) Hz (10 to 1000) Hz (10 to 1000) Hz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz Up to 50 Hz Up to 20 Hz Up to 6 Hz Up to 2 Hz Up to 0.6 Hz Up to 0.2 Hz	0.51 % + 12 pF 0.26 % + 12 pF 0.26 % + 0.12 nF 0.26 % + 0.31 nF 0.26 % + 1.2 nF 0.26 % + 3.1 nF 0.26 % + 12 nF 0.42 % + 31 nF 0.46 % + 0.12 µF 0.46 % + 0.31 µF 0.46 % + 1.2 µF 0.46 % + 3.1 µF 0.46 % + 12 µF 0.78 % + 31 µF 1.2 % + 0.12 mF	Fluke 5520A
Capacitance ³ – Generate, Fixed Points 1 pF 10 pF 100 pF 1000 pF	1 kHz to 13 MHz	0.37 % 0.040 % 0.067 % 0.33 %	Agilent 16380A set (4 terminal)

Parameter/Range	Frequency	CMC ^{2, 4, 5} (±)	Comments
Capacitance ³ – Measure (0 to 1100) μF	(0.1, 0.12, 1 and 10) kHz	0.023 %	GenRad 1689
Inductance – Generate, Fixed Points 100 mH 0.1 mH 1 mH	(0.1, 1) kHz (0.1, 1, 10) kHz (0.1, 1, 10) kHz	0.11 mH 0.00055 mH 0.0013 mH	GenRad 106K GenRad 106L GenRad 106G
Inductance ³ – Measure 1 μH to 10 H	1 kHz	0.023 %	GenRad 1689

Parameter/Equipment	Range	CMC ^{2, 4, 5} (±)	Comments
Oscilloscope ³ – 50 Ω Load 1 MΩ Load	DC DC	0.25 % of output + 40 μV 0.050 % of output + 40 μV	Fluke 5520A/SC1100
Squarewave Signal – 50 Ω @ 1 kHz 1 MΩ 10 Hz to 1 kHz (1 to 10) kHz	1.0 mV to 6.6 V _{pk-pk} 1.0 mV to 130 V _{pk-pk} 1.0 mV to 130 V _{pk-pk}	0.25 % of output + 40 μV 0.10 % of output + 40 μV 0.25 % of output + 40 μV	
Level Sine Wave – Amplitude (50 kHz Reference)	50 kHz 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz	2.0 % + 300 μV 3.5 % + 300 μV 4.0 % + 300 μV 6.0 % + 300 mV 7.0 % + 300 mV	

Parameter/Equipment	Range	CMC ^{2, 4, 5} (\pm)	Comments
Oscilloscope ³ – (cont)			
Flatness – (50 kHz Reference)	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz	1.5 % + 100 μ V 2.0 % + 100 μ V 4.0 % + 100 μ V 5.0 % + 100 μ V	Fluke 5520A/SC1100
Time Markers – Source and Period Into a 50 Ω Load	5 s to 50 ms 20 ms to 2 ns	(25 + 1000t) μ s/s 2.5 μ s/s	t = time in seconds
Rise Time – \leq 2 MHz $>$ 2 MHz	\leq 300 ps \leq 350 ps	+ 0 ps / -100 ps + 0 ps / -100 ps	
Wave Generator –			
Amplitude – 1 M Ω 50 Ω	1.8 mV to 55 V _{pk-pk} 1.8 mV to 2.5 V _{pk-pk}	3.0 % of output + 100 μ V 3.0 % of output + 100 μ V	
Phase ³ – Measure, Fixed Points	101 Hz 1 kHz 101 kHz 1 MHz 13 MHz	0.010° 0.0061° 0.068° 0.67° 8.4°	Agilent 53131A
AC Flatness ³ – Measure, Fixed Points	100/200 Hz 10 kHz 30 kHz 100 kHz 300 kHz 1 MHz 3 MHz 8 MHz 10 MHz 20 MHz 30 MHz 50 MHz 70 MHz 80 MHz	0.0044 V 0.0041 V 0.0042 V 0.0042 V 0.0041 V 0.0041 V 0.0042 V 0.0042 V 0.0042 V 0.0045 V 0.0048 V 0.0067 V 0.0098 V 0.012 V	Precision Measurements EL 1200 (75 Ω) Precision Measurements EL 1200 (50 Ω)

Parameter/Equipment	Range	CMC ² (±)	Comments
AC Flatness ³ – Measure, Fixed Points (cont)	10 Hz	0.0035 V	Precision Measurements EL 1200 (50 Ω)
	100 Hz	0.0036 V	
	10 kHz	0.0036 V	
	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	Ballantine 1395A-3 (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	0.10 V	
	3 MHz	0.021 V	
	8 MHz	0.022 V	
	10 MHz	0.022 V	
	20 MHz	0.12 V	

III. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ^{2,4,5} (±)	Comments	
Power Meter ³ – Power Reference, @ 1 mW	50 MHz	1.9 %	Agilent 432A w/ 478A	
RF Power ³ – Generate	(0 to 26.5) GHz	1.9 dB	HP 3325B, 8340B, 8902A, 11722A, 11792A, 11793A	
RF Power ³ – Measure	(0 to 26.5) GHz	1.9 dB	HP 8902A w/ 11722A, 11792A, 11793A	
	(26.5 to 40.0) GHz	0.087 dBm	Agilent 8487A, 437B	
Attenuation ³ – Measure	(0 to -10) dB	10 MHz to 26.5 GHz	HP 8902A w/ 11722A, 11792A	
	(-10 to -20) dB	10 MHz to 26.5 GHz		
	(-20 to -30) dB	10 MHz to 26.5 GHz		
	(-30 to -40) dB	10 MHz to 26.5 GHz		
	(-40 to -50) dB	10 MHz to 26.5 GHz		
	(-50 to -60) dB	10 MHz to 26.5 GHz		
	(-60 to -70) dB	10 MHz to 26.5 GHz		
	(-70 to -80) dB	10 MHz to 26.5 GHz	HP 8902A w/ 11722A	
	(-80 to -90) dB	10 MHz to 26.5 GHz		
	(-90 to -100) dB	10 MHz to 26.5 GHz		
	(-100 to -110) dB	10 MHz to 1.3 GHz		
	(-110 to -120) dB	10 MHz to 1.3 GHz		

Parameter/Range	Frequency	CMC ² (±)	Comments
Attenuation ³ – Generate			
10 dB	30 MHz	0.010 dB	Weinschel PA-2
20 dB		0.016 dB	
30 dB		0.022 dB	
40 dB		0.021 dB	
50 dB		0.028 dB	
60 dB		0.031 dB	
70 dB		0.033 dB	
80 dB		0.042 dB	
90 dB		0.045 dB	
100 dB		0.051 dB	
10 dBm	10 MHz to 12.4 GHz (12.4 to 18) GHz	0.58 dBm 0.69 dBm	HP 8496B
20 dBm	10 MHz to 12.4 GHz (12.4 to 18) GHz	0.81 dBm 0.92 dBm	
30 dBm	10 MHz to 12.4 GHz (12.4 to 18) GHz	1.0 dBm 1.4 dBm	
40 dBm	10 MHz to 12.4 GHz (12.4 to 18) GHz	1.4 dBm 1.8 dBm	
50 dBm	10 MHz to 12.4 GHz (12.4 to 18) GHz	1.7 dBm 2.8 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	2.4 dBm 3.2 dBm	
80 dBm	10 MHz to 12.4 GHz (12.4 to 18) GHz	2,8 dBm 3.7 dBm	
90 dBm	10 MHz to 12.4 GHz (12.4 to 18) GHz	3.1 dBm 4.2 dBm	
100 dBm	10 MHz to 12.4 GHz (12.4 to 18) GHz	3.5 dBm 4.6 dBm	
110 dBm	10 MHz to 12.4 GHz (12.4 to 18) GHz	3.5 dBm 5.1 dBm	

Parameter/Range	Frequency	CMC ^{2,4,5} (±)	Comments
Amplitude Modulation Measure –			
Rate: 50 Hz to 10 kHz Depths: 5 % to 99 %	150 kHz to 10 MHz	2.4 % + 1.0 digit	HP 8902A w/ 11793A
Rate: 20 Hz to 10 kHz Depths: to 99 %	150 kHz to 10 MHz	3.5 % + 1.0 digit	
Rate: 50 Hz to 50 kHz Depths: 5 % to 99 %	10 MHz to 1.3 GHz	1.2 % + 1.0 digit	
Rate: 20 Hz to 100 kHz Depths: to 99 %	10 MHz to 1.3 GHz	3.5 % + 1.0 digit	
Rate: 50 Hz to 50 kHz Depths: 5 % to 99 %	(1.3 to 26.5) GHz	1.8 % + 1.0 digit	
Rate: 20 Hz to 100 kHz Depths: to 99 %	(1.3 to 26.5) GHz	3.6 % + 1.0 digit	
Frequency Modulation – Measure			
Rate: 20 Hz to 10 kHz Dev.: ≤ 40 kHz Peak	250 kHz to 10 MHz	2.3 % + 1.0 digit	HP 8902A w/ 11793A
Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz Peak	10 MHz to 1.3 GHz	1.2 % + 1.0 digit	
Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz Peak	10 MHz to 1.3 GHz	5.8 % + 1.0 digit	
Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz Peak	(1.3 to 26.5) GHz	1.2 % + 1.0 digit	
Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz Peak	(1.3 to 26.5) GHz	5.8 % + 1.0 digit	
Phase Modulation – Measure			
Rate: 200 Hz to 10 kHz (0 to 100) rad	Carrier: 150 kHz ≤ f_c < 10 MHz	4.7 % + 1.0 digit	HP 8902A w/ 11793A
Rate: 200 Hz to 20 kHz (0 to 100) rad	10 MHz ≤ f_c < 1.3 GHz	3.6 % + 1.0 digit	
Rate: 200 Hz to 20 kHz (0 to 100) rad	10 MHz ≤ f_c < 26.5 GHz	3.5 % + 1.0 digit	

Parameter/Range	Frequency	CMC ² (±)	Comments
Reflection S ₁₁ /S ₂₂ – Measure VSWR	45 MHz 45 MHz to 2 GHz (2 to 8) GHz (8 to 20) GHz (20 to 26.5) GHz	0.0076 lin 0.0070 lin 0.013 lin 0.013 lin 0.014 lin	HP 8902A w/ 8510C, 85053B, 85131D, 85052B
Transmission S ₁₂ /S ₂₁ – Measure (0 to 20) dB (20 to 40) dB (40 to 60) dB (0 to 20) dB (20 to 40) dB (40 to 60) dB 0 to 20) dB (20 to 40) dB (40 to 60) dB (0 to 20) dB (20 to 40) dB (40 to 60) dB (0 to 20) dB (20 to 40) dB (40 to 60) dB	45 MHz 45 MHz to 2 GHz (2 to 8) GHz (8 to 20) GHz (20 to 26.5) GHz	(0.025 to 0.038) dB 0.16 dB (0.095 to 0.11) dB (0.032 to 0.043) dB (0.15 to 0.16) dB 0.23 dB (0.043 to 0.051) dB 0.19 dB (0.11 to 0.12) dB (0.068 to 0.074) dB (0.21 to 0.22) dB 0.34 dB (0.086 to 0.091) dB (0.25 to 0.26) dB 0.72 dB	HP 8902A w/ 8510C, 85053B, 85131D, 85052B
Distortion ³ – Measure	20 Hz to 20 kHz (20 to 100) kHz 100 kHz to 2.5 GHz (2.5 to 26.5) GHz	1.2 dB 2.3 dB 1.8 dBm 2.6 dBm	HP 8903B HP 8566A HP 8563E

IV. Mechanical

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Balances ³	(1 to 200) g 200 g to 1 kg (1 to 5) kg	0.031 mg + 3.0 µg/g 0.41 mg + 4.0 µg/g 0.61 mg + 3.0 µg/g	Class 1 weights
Scales ³	(1 to 100) lb (100 to 500) lb (500 to 1200) lb	0.0057 lb 0.053 lb 0.57 lb	Class F weights
Pressure – Gauges & Transducers ³	(0.1 to 1.0) psi (1 to 100) psi (100 to 1000) psi (1000 to 10 000) psi	0.0019 psi 0.032 % 0.029 % 0.032 %	Fluke 700P22 Ametek T-100-1/C
Torque Wrenches ³	(4 to 50) lbf·in (50 to 400) lbf·in (400 to 1000) lbf·in (83 to 250) lbf·ft	0.57 % 0.34 % 0.38 % 0.38 %	CDI Suretest and 4 in 1 transducer
Force ³ – Compression & Tension	Up to 250 lbf	0.080 % + 0.6R	Class F weights and hangers
Tachometers ³	(1 to 1000) rpm (1000 to 99 999) rpm	0.059 rpm 0.58 rpm	HP 3325B + LED
Air Velocity – Anemometers	(0.5 to 35) m/s	0.9 % rdg + 0.021 m/s	Direct comparison w/ furnace controls micromanometer, TSI airflow pitot static tube

V. Thermodynamics

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Temperature – Measuring Equipment	-78 °C	0.0036 % + 0.071 °C	Hart 1502A, 5628, isopropanol/dry ice slurry
	(-5 to 580) °C	0.0037 % + 0.044 °C	Hart 1502A, 5628, temperature baths / blocks
Temperature ³ – Measure RTD, Thermocouples & Thermometers	(-200 to 660) °C	0.0024 % + 0.027 °C	Hart 1502A, 5628
Relative Humidity ³ – Measuring Equipment	(10 to 90) % RH, (10 to 55) °C	1.4 % RH	Geo instruments 2000SP
Relative Humidity ³ – Measure	(10 to 90) % RH	1.2 % RH	Vaisala MI70, HMP77

VI. Time & Frequency

Parameter/Equipment	Frequency	CMC ² (±)	Comments
Frequency ³ – Measuring Equipment	10 MHz 0.01 Hz to 26.5 GHz	0.010 nHz/Hz 0.010 nHz/Hz + 5 µHz	GPS 58503A GPS receiver w/ generator
Frequency – Measure	0.01 Hz to 3.0 GHz	0.058 mHz	58503A, 53132A-003
	(3.0 to 26.5) GHz	0.58 Hz	58503A, EIP 28B

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

- ² Calibration and Measurement Capability Uncertainty (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. CMCs represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of $k = 2$. The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.
- ³ Field calibration service is available for this calibration 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 using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure the measurand in the ranges indicated. CMC's are expressed as either a specific value that covers the full range or as a fraction or percent/fraction of the reading plus a fixed floor specification.
- ⁵ In the statement of CMC, percentage refers to percent of reading, unless otherwise noted. In the statement of CMC, R is the resolution of the unit under test.



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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/NCSLI Z540-1-1994 and the requirements of ANSI/NCSLI Z540.3-2006 and R205 – Specific Requirements: Calibration Laboratory Accreditation Program. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).



Presented this 18th day of June 2018.

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

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2662.01
Valid to February 29, 2020
Revised September 23, 2019

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