



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017  
& ANSI/NCSL Z540-1-1994 & ANSI/NCSL Z540.3

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CALIBRATION

Valid To: March 31, 2022

Certificate Number: 2353.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1, 8</sup>:

I. Dimensional

Parameter/Equipment	Range	CMC <sup>2, 5, 7</sup> (±)	Comments
Flatness – Measure <sup>3</sup>	Up to 1 in	4.6 µin	Monochromatic light and optical flats
Hand Tools <sup>3</sup> – Indicators, Micrometers Depth Gages, Height Gages, Calipers	Up to 2 in (2 to 10) in (10 to 20) in (20 to 40) in	15 µin 62 µin 106 µin 209 µin	Gage blocks

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2, 4, 5, 6</sup> (±)	Comments
DC Voltage – 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	7.1 $\mu\text{V}/\text{V}$ + 0.40 $\mu\text{V}$ 3.7 $\mu\text{V}/\text{V}$ + 0.80 $\mu\text{V}$ 4.9 $\mu\text{V}/\text{V}$ + 3.0 $\mu\text{V}$ 4.9 $\mu\text{V}/\text{V}$ + 4.3 $\mu\text{V}$ 3.7 $\mu\text{V}/\text{V}$ + 48 $\mu\text{V}$ 4.7 $\mu\text{V}/\text{V}$ + 0.48 mV	Fluke 5720A
Fixed Point	10.0 V	3.4 $\mu\text{V}/\text{V}$	Fluke 732A
DC Voltage <sup>3</sup> – Measure	(0 to 0.1) V (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1100) V	9.5 $\mu\text{V}/\text{V}$ + 0.37 $\mu\text{V}$ 6.1 $\mu\text{V}/\text{V}$ + 0.37 $\mu\text{V}$ 5.8 $\mu\text{V}/\text{V}$ + 0.60 $\mu\text{V}$ 8.7 $\mu\text{V}/\text{V}$ + 37 $\mu\text{V}$ 8.7 $\mu\text{V}/\text{V}$ + 0.12 mV	Agilent 3458A
DC High Voltage <sup>3</sup> – Measure	(1 to 45) kV (45 to 200) kV	0.11 % 2.4 %	VD45 Ross divider, VMP200 Ross divider
DC Current <sup>3</sup> – Generate	Up to 220 $\mu\text{A}$ (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  (0 to 10.9999) A (11 to 20.5) A  (20 to 150) A (150 to 1000) A	35 $\mu\text{A}/\text{A}$ + 6.0 nA 31 $\mu\text{A}/\text{A}$ + 7.0 nA 30 $\mu\text{A}/\text{A}$ + 41 nA 41 $\mu\text{A}/\text{A}$ + 0.71 $\mu\text{A}$ 77 $\mu\text{A}/\text{A}$ + 12 $\mu\text{A}$ 0.034 % + 0.48 mA  0.057 % + 500 $\mu\text{A}$ 0.11 % + 750 $\mu\text{A}$  0.28 % + 500 $\mu\text{A}$ 0.57 % + 500 $\mu\text{A}$	Fluke 5720A       Fluke 5520A   Fluke 5500A coil/5520A
DC Current <sup>3</sup> – Measure	(0 to 100) $\mu\text{A}$ (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	17 $\mu\text{A}/\text{A}$ + 0.80 nA 17 $\mu\text{A}/\text{A}$ + 5.0 nA 17 $\mu\text{A}/\text{A}$ + 50 nA 31 $\mu\text{A}/\text{A}$ + 0.50 $\mu\text{A}$ 0.010 % + 10 $\mu\text{A}$	Agilent 3458A

Parameter/Equipment	Range	CMC <sup>2, 4, 5, 6</sup> ( $\pm$ )	Comments	
Resistance <sup>3</sup> – Generate	Up to 10.9999 $\Omega$	40 $\mu\Omega/\Omega$ + 1.0 m $\Omega$	Fluke 5520A, 4-wire	
	(11 to 32.9999) $\Omega$	30 $\mu\Omega/\Omega$ + 2.0 m $\Omega$		
	(33 to 109.9999) $\Omega$	28 $\mu\Omega/\Omega$ + 2.0 m $\Omega$		
	(110 to 329.9999) $\Omega$	28 $\mu\Omega/\Omega$ + 4.0 m $\Omega$		
	(0.33 to 1.099 999) k $\Omega$	28 $\mu\Omega/\Omega$ + 13 m $\Omega$		
	(1.1 to 3.299 999) k $\Omega$	28 $\mu\Omega/\Omega$ + 13 m $\Omega$		
	(3.3 to 10.999 99) k $\Omega$	28 $\mu\Omega/\Omega$ + 30 m $\Omega$		
	(11 to 32.999 99) k $\Omega$	28 $\mu\Omega/\Omega$ + 0.30 $\Omega$		
	(33 to 109.999) k $\Omega$	28 $\mu\Omega/\Omega$ + 0.30 $\Omega$		
	(110 to 329.999) k $\Omega$	32 $\mu\Omega/\Omega$ + 2.0 $\Omega$		
	(0.33 to 1.099 99) M $\Omega$	32 $\mu\Omega/\Omega$ + 2.2 $\Omega$	Fluke 5520A, 2-wire	
	(1.1 to 3.299 00) M $\Omega$	60 $\mu\Omega/\Omega$ + 39 $\Omega$		
	(3.3 to 10.9999) M $\Omega$	0.013 % + 63 $\Omega$		
	(11 to 32.9999) M $\Omega$	0.025 % + 2.5 k $\Omega$		
	(33 to 109.9999) M $\Omega$	0.050 % + 3.0 k $\Omega$		
	(110 to 329.9999) M $\Omega$	0.30 % + 0.10 M $\Omega$		
	(330 to 1100) M $\Omega$	1.5 % + 0.50 M $\Omega$		
Fixed Points	0 $\Omega$	41 $\mu\Omega$	Fluke 5720A	
	1 $\Omega$	81 $\mu\Omega/\Omega$		
	1.9 $\Omega$	82 $\mu\Omega/\Omega$		
	10, 19 $\Omega$	23 $\mu\Omega/\Omega$		
	100, 190 $\Omega$	9.5 $\mu\Omega/\Omega$		
	1, 1.9 k $\Omega$	8.5 $\mu\Omega/\Omega$		
	10, 19 k $\Omega$	8.5 $\mu\Omega/\Omega$		
	100, 190 k $\Omega$	11 $\mu\Omega/\Omega$		
	1 M $\Omega$	20 $\mu\Omega/\Omega$		
	1.9 M $\Omega$	30 $\mu\Omega/\Omega$		
	10 M $\Omega$	35 $\mu\Omega/\Omega$		
	19 M $\Omega$	45 $\mu\Omega/\Omega$		
	100 M $\Omega$	0.010 %		
	1 M $\Omega$	0.11 % per decade		IET HRRS-B-3-1M
	10 M $\Omega$	0.11 % per decade		
100 M $\Omega$	0.23 % per decade			

Parameter/Equipment	Range	CMC <sup>2, 4, 5</sup> (±)	Comments
Resistance <sup>3</sup> – Measure	100 mΩ 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 (0.1 to 1) GΩ	18 μΩ/Ω + 58 μΩ 12 μΩ/Ω + 0.58 mΩ 9.5 μΩ/Ω + 5.8 mΩ 9.5 μΩ/Ω + 58 mΩ 9.7 μΩ/Ω + 0.58 Ω 15 μΩ/Ω + 2.3 Ω 58 μΩ/Ω + 0.12 kΩ 0.058 % + 1.2 kΩ 0.59 % + 12 kΩ	Agilent 3458A

Parameter/Range	Frequency	CMC <sup>2, 4, 5</sup> (±)	Comments
AC Voltage <sup>3</sup> – 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	

Parameter/Range	Frequency	CMC <sup>2, 4, 5</sup> (±)	Comments
AC Voltage <sup>3</sup> – Generate (cont)			
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	Fluke 5720A
(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	
(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	

Parameter/Range	Frequency	CMC <sup>2, 4, 5</sup> (±)	Comments
AC Voltage <sup>3</sup> – Measure			
(0.1 to 10) mV	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.030 % + 3.3 μV 0.020 % + 1.8 μV 0.030 % + 1.8 μV 0.10 % + 1.8 μV 0.50 % + 1.8 μV 4.0 % + 1.8 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 (0.3 to 1) MHz (1 to 2) MHz	0.007 % + 10 μV 0.007 % + 2 μV 0.014 % + 2 μV 0.030 % + 2 μV 0.080 % + 2 μV 0.30 % + 10 μV 1.0 % + 10 μV 1.5 % + 10 μV	
100 mV to 1V	(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	0.007 % + 40 μV 0.007 % + 20 μV 0.014 % + 20 μV 0.030 % + 20 μV 0.080 % + 20 μV 0.30 % + 100 μV 1.0 % + 100 μV 1.5 % + 100 μV	
(1 to 10) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz (1 to 2) MHz	0.007 % + 0.40 mV 0.007 % + 0.20 mV 0.014 % + 0.20 mV 0.030 % + 0.20 mV 0.080 % + 0.20 mV 0.30 % + 1.0 mV 1.0 % + 1.0 mV 1.5 % + 1.0 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	0.02 % + 4.0 mV 0.02 % + 2.0 mV 0.02 % + 2.0 mV 0.04 % + 2.0 mV 0.12 % + 2.0 mV 0.40 % + 10 mV 1.5 % + 10 mV	

Parameter/Range	Frequency	CMC <sup>2, 4, 5, 6</sup> (±)	Comments
AC Voltage <sup>3</sup> – Measure (cont)  (100 to 707) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.04 % + 40 mV 0.04 % + 20 mV 0.06 % + 20 mV 0.12 % + 20 mV 0.30 % + 20 mV	Agilent 3458A
AC High Voltage <sup>3</sup> – Measure  (1 to 21) kV  (21 to 100) kV	60 Hz  60 Hz	0.26 %  4.4 %	Ross VD45  Ross VMP200
AC Current <sup>3</sup> – Generate  Up to 220 µA    (0.22 to 2.2) mA    (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 (10 to 30) kHz  (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz  (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.023 % + 16 nA 0.014 % + 10 nA 0.011 % + 8.0 nA 0.025 % + 12 nA 0.090 % + 65 nA 1.6 % + 0.40 µA  0.023 % + 41 nA 0.014 % + 36 nA 0.011 % + 36 nA 0.025 % + 0.11 µA 0.090 % + 0.65 µA 1.0 % + 0.60 µA  0.023 % + 0.40 µA 0.014 % + 0.36 µA 0.011 % + 0.36 µA 0.025 % + 0.56 µA 0.090 % + 5.0 µA 0.40 % + 4.0 µA	Fluke 5720A w/ 5725A  Fluke 5520A  Fluke 5720A w/ 5725A  Fluke 5520A  Fluke 5720A w/ 5725A  Fluke 5520A

Parameter/Range	Frequency	CMC <sup>2, 4, 5</sup> (±)	Comments
AC Current <sup>3</sup> – Generate (cont)			
(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 (10 to 30) kHz	0.023 % + 4.1 µA 0.014 % + 3.6 µA 0.011 % + 2.6 µA 0.018 % + 3.6 µA 0.090 % + 10 µA 0.40 % + 0.20 mA	Fluke 5720A w/ 5725A  Fluke 5520A
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 (10 to 30) kHz	0.023 % + 16 nA 0.014 % + 10 nA 0.011 % + 8.0 nA 0.025 % + 12 nA 0.090 % + 65 nA 1.6 % + 0.40 µA	Fluke 5720A w/ 5725A  Fluke 5520A
(0.22 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 (10 to 30) kHz	0.023 % + 41 nA 0.014 % + 36 nA 0.011 % + 36 nA 0.025 % + 0.11 µA 0.090 % + 0.65 µA 1.0 % + 0.60 µA	Fluke 5720A w/ 5725A  Fluke 5520A
(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 (10 to 30) kHz	0.023 % + 0.40 µA 0.014 % + 0.36 µA 0.011 % + 0.36 µA 0.025 % + 0.56 µA 0.090 % + 5.0 µA 0.40 % + 4.0 µA	Fluke 5720A w/ 5725A  Fluke 5520A
(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 (10 to 30) kHz	0.023 % + 4.1 µA 0.014 % + 3.6 µA 0.011 % + 2.6 µA 0.018 % + 3.6 µA 0.090 % + 10 µA 0.40 % + 0.20 mA	Fluke 5720A w/ 5725A  Fluke 5520A



Parameter/Range	Frequency	CMC <sup>2, 4, 5</sup> (±)	Comments
AC Current <sup>3</sup> – Generate (cont)			
(0.22 to 2.2) A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.024 % + 36 µA 0.039 % + 80 µA 0.60 % + 0.16 mA	Fluke 5720A w/ 5725A
(2.2 to 11) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.040 % + 0.18 mA 0.085 % + 0.39 mA 0.33 % + 0.75 mA	Fluke 5720A w/ 5725A
(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
(16.5 to 150) A	(45 to 65) Hz (65 to 440) Hz	0.38 % + 0.029 A 1.0 % + 0.031 A	Fluke 5520A w/ coil
(150 to 1025) A	(45 to 65) Hz (65 to 440) Hz	1.0 % + 0.031 A 1.0 % + 0.12 A	
AC Current <sup>3</sup> – Measure			
(5 to 100) µA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz	0.46 % + 0.035 µA 0.18 % + 0.035 µA 0.07 % + 0.035 µA	Agilent 3458A
(0.1 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz	0.46 % + 0.024 % 0.18 % + 0.024 % 0.07 % + 0.024 % 0.036 % + 0.024 %	
(0.1 to 1) A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 5) kHz	0.46 % + 0.23 mA 0.19 % + 0.23 mA 0.093 % + 0.23 mA 0.12 % + 0.23 mA	
100 mA to 20 A	Up to 1 kHz (1 to 5) kHz	0.039 % + 0.032 % * <i>F</i> 0.041 % + 0.032 % * <i>F</i>	w/ Fluke Y5020 shunt * <i>F</i> is the applied frequency

Parameter/Range	Frequency	CMC <sup>2, 4, 5, 6</sup> (±)	Comments
<p>Capacitance<sup>3</sup> – Generate</p> <p>(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</p> <p>Fixed Points –</p> <p>1 pF  10 pF  100 pF  1000 pF  (10, 100, 1000) nF</p>	<p>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</p> <p>1 kHz to 13 MHz  1 kHz to 13 MHz  1 kHz to 13 MHz  1 kHz to 13 MHz  120 Hz to 100 kHz</p>	<p>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</p> <p>0.37 %  0.040 %  0.067 %  0.33 %  0.010 %</p>	<p>Fluke 5520A</p> <p>Agilent 16381A  Agilent 16382A  Agilent 16383A  Agilent 16384A  Agilent 16380C</p>
<p>Inductance<sup>3</sup> – Generate,  Fixed Points</p> <p>100 μH  1 mH  10 mH  100 mH  1 H</p>	<p>400 Hz &amp; 1 kHz</p>	<p>1.2 %  0.13 %  0.083 %  0.083 %  0.083 %</p>	<p>GenRad 1482 series</p>

Parameter/Equipment	Range	CMC <sup>2, 4, 5</sup> (±)	Comments
Thermocouple <sup>3</sup> – Indicating Systems & Measure			
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.51 °C 0.17 °C 0.15 °C 0.17 °C 0.22 °C	Fluke 5522A
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.28 °C 0.17 °C 0.15 °C 0.18 °C 0.24 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.34 °C 0.19 °C 0.17 °C 0.27 °C 0.40 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.57 °C 0.36 °C 0.34 °C 0.41 °C	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.47 °C 0.37 °C 0.38 °C 0.46 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.63 °C 0.25 °C 0.17 °C 0.17 °C	

Parameter/Equipment	Range	CMC <sup>2, 4, 5, 6</sup> (±)	Comments
Electrical Calibration of RTDs <sup>3</sup> – Generate  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	0.052 °C 0.052 °C 0.052 °C 0.091 °C 0.10 °C 0.12 °C 0.23 °C	Fluke 5522A
Power Measuring Equipment AC, DC Power <sup>3</sup> – Generate  PF = 1: (33 to 329.99) mV (45 to 65) Hz  330 mV to 1020 V (45 to 65) Hz	(3.3 to 8.999) mA (9 to 32.999) mA (33 to 89.999) mA (90 to 329.99) mA (0.33 to 0.8999) A (0.9 to 2.1999) A (2.2 to 4.4999) A (4.5 to 20.5) A  (3.3 to 8.999) mA (9 to 32.999) mA (33 to 89.999) mA (90 to 329.99) mA (0.33 to 0.8999) A (0.9 to 2.1999) A (2.2 to 4.4999) A (4.5 to 20.5) A	0.16 % 0.11 % 0.16 % 0.12 % 0.15 % 0.12 % 0.15 % 0.13 %  0.14 % 0.09 % 0.14 % 0.09 % 0.13 % 0.1 % 0.14 % 0.12 %	Fluke 5520A
Phase/Power Factor <sup>3</sup> –  (10 to 65) Hz PF (0 to 1)	0Φ / PF 1 10Φ / PF 0.985 20Φ / PF 0.940 30Φ / PF 0.866 40Φ / PF 0.766 50Φ / PF 0.643 60Φ / PF 0.500 70Φ / PF 0.342 80Φ / PF 0.174	0.58 % 0.29 % 0.22 % 0.22 % 0.26 % 0.35 % 0.55 % 1.1 %	Fluke 5520A

Parameter/Equipment	Range	CMC <sup>2, 4, 5</sup> (±)	Comments
Phase Angle <sup>3</sup> – Measure (0 to 359.9)°	20 Hz to 10 kHz (10 to 40) kHz (40 to 100) kHz	0.081° 0.29° 0.98°	Krohn-Hite 6500
Oscilloscopes <sup>3</sup> –  Rise Time  Bandwidth	1 kHz to 10 MHz; (200 to 350) ps  50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (0.6 to 1.1) GHz  (1.1 to 4.2) GHz (4.2 to 18) GHz (18 to 26.5) GHz	120 ps  3.5 % + 300 μV 4 % + 300 μV 6 % + 300 μV 7 % + 300 μV  0.31 dB 0.74 dB 0.84 dB	Fluke 5520A-SC1100  Agilent 8340A w/: 8482A, 11667A 8481A, 11667A 8485A, 11667B
Audio Distortion <sup>3</sup> (THD)	Up to 100 kHz	1.2 dB	Agilent 8903B

### III. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> (±)	Comments
Power Meter – Power Reference, @ 1 mW	50 MHz	1.9 %	Agilent 432A w/ 478A
Relative Power (Tuned RF Level) – Measure  (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	100 kHz to 50 GHz	0.018 dB 0.019 dB 0.019 dB 0.056 dB 0.056 dB 0.057 dB 0.057 dB 0.094 dB 0.094 dB	Agilent E4448A

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> ( $\pm$ )	Comments
Relative Power (Tuned RF Level) – Measure (cont)  (-90 to -100) dB (-100 to -110) dB (-110 to -120) dB (-120 to -130) dB	100 kHz to 50 GHz	0.095 dB 0.096 dB 0.096 dB 0.097 dB	Agilent E4448A
Absolute Power – Measure  (-30 to -50) dBm (-50 to -60) dBm (-60 to 68) dBm  (-30 to +10) dBm  (+10 to +20) dBm	10 MHz to 18 GHz  100 kHz to 4.2 GHz (4.2 to 18) GHz (18 to 26.5) GHz (26.5 to 50) GHz  100 kHz to 4.2 GHz (4.2 to 18) GHz (18 to 26.5) GHz (26.5 to 50) GHz	1.3 % 2.6 % 15 %  3.3 % 3.5 % 4.2 % 5.0 %  5.9 % 6.0 % 6.5 % 7.0 %	Agilent N5531S w/: N-Type power sensor, w/ power meter  3.5 mm 2.4 mm  3.5 mm 2.4 mm
VSWR	5 MHz to 2 GHz (2 to 12.5) GHz (12.5 to 18) GHz	0.11 dB 0.53 dB 0.85 dB	E4448A opt 233  Measuring receiver w/ SWR bridges
Frequency Modulation – Measure  Mod Rate: 20 Hz to 10 kHz Dev.: 200 Hz to 40 kHz ( $\beta > 0.2$ )  Mod Rate: 50 Hz to 200 kHz Dev.: 250 Hz to 400 kHz ( $\beta > 0.2$ )	250 kHz to 10 MHz  10 MHz to 6.6 GHz (6.6 to 13.2) GHz (13.2 to 31.15) GHz (31.15 to 50) GHz	1.0 %  1.0 % 1.0 % 1.0 % 1.0 %	E4448A opt 233  $\beta$ is the ratio of the frequency deviation to the modulation rate

Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> ( $\pm$ )	Comments
<b>Amplitude Modulation – Measure</b>  Depth: (5 to 99) %  (5 to 20) % (20 to 99) %  (5 to 20) % (20 to 99) %  (5 to 20) % (20 to 99) %  (5 to 20) % (20 to 99) %	100 kHz to 10 MHz  10 MHz to 3 GHz 10 MHz to 3 GHz  (3 to 26.5) GHz (3 to 26.5) GHz  (26.5 to 31.15) GHz (26.5 to 31.15) GHz  (31.15 to 50) GHz (31.15 to 50) GHz	0.75 %  2.5 % 0.50 %  4.5 % 1.5 %  6.8 % 1.9 %  2.6 % 6.0 %	E4448A opt 233
<b>Phase Modulation –</b>  Mod Rate: (0.2 to 20) kHz  0.3 rad < Dev $\leq$ 0.7 rad Dev > 0.7 rad  0.6 rad < Dev $\leq$ 2.0 rad Dev > 2.0 rad  1.2 rad < Dev $\leq$ 4.0 rad Dev > 4.0 rad  1.3 rad < Dev $\leq$ 4.0 rad Dev > 4.0 rad  2.4 rad < Dev $\leq$ 8.0 rad Dev > 8.0 rad	100 kHz to 6.6 GHz  (6.6 to 13.2) GHz  (13.2 to 26.5) GHz  (26.5 to 31.5) GHz  (31.5 to 50) GHz	3.0 % 1.0 %  3.0 % 1.0 %  3.0 % 1.0 %  3.0 % 1.0 %	E4448A opt 233
<b>Transmission (S<sub>12</sub>/S<sub>21</sub>) – Measure</b>  Linear Phase Linear Mag.  Linear Phase Linear Mag.	Type-N Connectors 30 kHz to 2 GHz  (2 to 6) GHz	( $\pm$ 0.76 to $\pm$ 39) <sup>o</sup> ( $\pm$ 0.11 to $\pm$ 8.2) dB  ( $\pm$ 2.1 to $\pm$ 15) <sup>o</sup> ( $\pm$ 0.25 to $\pm$ 1.9) dB	Agilent 8753D VNA w/ 85032B calibration kit

Parameter/Range	Frequency	CMC <sup>2,5</sup> (±)	Comments
Reflection (S <sub>11</sub> /S <sub>22</sub> ) – Measure  Linear Phase Linear Mag.  Linear Phase Linear Mag.	Type-N Connectors 30 kHz to 2 GHz  (2 to 6) GHz	(± 2.4 to ± 13)° (± 0.33 to ± 0.36) dB  (± 12 to ± 35)° (± 1.1 to ± 1.6) dB	Agilent 8753D VNA w/ 85032B calibration kit
Single Side-Band Phase Noise – Measure  Noise Floor: -110 dB -110 dB -130 dB -140 dB -150 dB -155 dB -155 dB -155 dB	Carrier: 50 kHz to 26.5 GHz Offset Frequency: 10 Hz 100 Hz 1 kHz 10 kHz 100 kHz 1 MHz 10 MHz 100 MHz	1.5 dB 1.5 dB 1.5 dB 1.5 dB 1.5 dB 1.5 dB 1.5 dB 1.5 dB	Agilent E4448A
Relative Power – Measure  (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	10 MHz to 26.5 GHz 10 MHz to 26.5 GHz 10 MHz to 26.5 GHz 10 MHz to 26.5 GHz 10 MHz to 26.5 GHz 10 MHz to 26.5 GHz 10 MHz to 26.5 GHz 10 MHz to 26.5 GHz 10 MHz to 26.5 GHz 10 MHz to 26.5 GHz 10 MHz to 26.5 GHz 10 MHz to 26.5 GHz	0.046 dB 0.053 dB 0.080 dB 0.098 dB 0.11 dB 0.12 dB 0.13 dB 0.17 dB 0.18 dB 0.19 dB 0.19 dB 0.21 dB	Agilent 8902A



Parameter/Range	Frequency	CMC <sup>2, 5, 6</sup> (±)	Comments
Absolute Power – Measure			Agilent 437B / E4418B:
(-70 to -30) dBm	10 MHz to 18 GHz	2.7 %	8484A, N-type
(-30 to +10) dBm	100 kHz to 4.2 GHz	1.4 %	8482A, N-type
	(4.2 to 18) GHz	1.9 %	8481A, N-type
	(18 to 26.5) GHz	2.4 %	8485A, 3.5 mm
(+10 to +20) dBm	100 kHz to 4.2 GHz	3.3 %	8482A, N-type
	(4.2 to 18) GHz	3.5 %	8481A, N-type
	(18 to 26.5) GHz	3.8 %	8485A, 3.5 mm

#### IV. Mechanical

Parameter/Equipment	Range	CMC <sup>2, 5, 6</sup> (±)	Comments
Accelerometers <sup>3</sup> – Frequency Response	100 Hz (ref) 159 Hz (ref) (5 to 100) Hz 100 Hz to 1 kHz (1 to 10) kHz	1.5 % 1.7 % 2.9 % 2.0 % 2.5 %	Vibration transducer calibration system referenced @ 1 g
Balance & Scales <sup>3</sup>	(1 to 10) mg (10 to 100) mg 100 mg to 1 g (1 to 10) g (10 to 3200) g (3.2 to 22) kg (22 to 55) kg  Up to 1000 lbs Up to 4800 lbs	1 % + 0.6R 0.1 % + 0.6R 0.01 % + 0.6R 0.0034 % + 0.6R 0.00050 % + 0.6R 0.001 % + 0.6R 0.001 % + 0.6R  0.024 % 0.10 %	Class 1 weights Class 3 weights Class 6, F weights
Force Gages <sup>3</sup>	Up to 1000 lbf	0.025 %	Class 6 and F weights

Parameter/Equipment	Range	CMC <sup>2, 5, 6, 7</sup> (±)	Comments
Torque Tools <sup>3</sup>	(4 to 50) in·lbf 30 to 400) in·lbf (80 to 1000) in·lbf (60 to 600) ft·lbf 20 ft·lbs to 250 ft·lbf	0.33 % 0.33 % 0.33 % 0.33 % 0.27 %	CDI 5000-ST
Pressure – Measuring Equipment <sup>3</sup> –			
Hydraulic	(0 to 1000) psig (0 to 10 000) psig	0.56 % + 0.052 % 0.068 % + 0.058 %	Dead Weight Tester w/: Additel ADT672-1K Additel ADT672-10K
Pneumatic	(0 to 1) psid (-15 to 30) psig (30 to 100) psig (100 to 500) psig (500 to 1000) psig (1000 to 3000) psig (3000 to 10 000) psig	0.01 % + 0.0015 psid 0.01 % + 0.023 psig 0.01 % + 0.05 psig 0.01 % + 0.25 psig 0.01 % + 0.50 psig 0.035 % + 2.5 psig 0.035 % + 8.3 psig	Process calibrator w/: 700P22 700PD5 700P06 700P07 700P08 700P29 700P31

#### V. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2, 6, 7</sup> (±)	Comments
Relative Humidity <sup>3</sup> – Measure	(10 to 90) % RH	2.7 %	Vaisala 141/HMP46
Temperature <sup>3</sup> – Measure	(-200 to 200) °C (200 to 750) °C	0.17 °C 0.19 °C	Burns 12001 PRT w/ Fluke 2180A
Relative Humidity – Measuring Equipment	(10 to 90) %	2.7 %	Vaisala 141/HMP46
Temperature – Measuring Equipment	(-200 to 750) °C	0.19 °C	Burns 12001 PRT w/ Fluke 2180A

## VI. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2, 7</sup> (±)	Comments
Frequency – Measuring Equipment	1 mHz to 50 GHz	2.5 parts in 10 <sup>12</sup> + 0.1 mHz	GPS receiver w/ generator
Frequency – Measure	0.001 Hz to 46 GHz	2.5 parts in 10 <sup>12</sup> + 0.1 mHz	Counter locked to 10 MHz reference

<sup>1</sup> This laboratory offers commercial calibration service and field calibration service.

<sup>2</sup> 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.

<sup>3</sup> 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.

<sup>4</sup> The stated measured values are determined using the indicated instruments (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.

<sup>5</sup> CMC components that can be reasonably attributed to the Unit Under Test have not been utilized in the calculation of the CMC value of this measurement parameter.

<sup>6</sup> In the statement of CMC, percentages are to be read as percent of reading unless indicated otherwise;  $R$  is the resolution of the unit under test.

<sup>7</sup> 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.

<sup>8</sup> This scope meets A2LA's P112 *Flexible Scope Policy*.



# Accredited Laboratory

A2LA has accredited

**TRESCAL, INC.**

*Boonton, NJ*

for technical competence in the field of

## Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NC SL Z540-1-1994, the requirements of ANSI/NC SL Z540.3-2006 and 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 22<sup>nd</sup> day of October 2020.

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

Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 2353.01  
Valid to March 31, 2022

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