



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017,
ANSI/NCSL Z540-1-1994 & ANSI/NCSL Z540.3-2006

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CALIBRATION

Valid To: March 31, 2021

Certificate Number: 2357.12

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations^{1,7}:

I. Dimensional

Parameter / Equipment	Range	CMC ^{2,4} (±)	Comments
Micrometers ³	Up to 4 in	(30 + 0.25L) µin	Grade 00 gage blocks
Calipers ³	Up to 6 in	(58 + 0.25L) µin	Grade 00 gage blocks

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,6} (±)	Comments
DC Voltage – Generate ³	(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	9.1 µV/V + 0.39 µV 4.8 µV/V + 0.62 µV 3.2 µV/V + 2.3 µV 3.2 µV/V + 3.9 µV 4.7 µV/V + 39 µV 6.3 µV/V + 390 µV	Fluke 5720A w/ 5725 amplifier
DC Voltage – Fixed Points – Measure & Generate ³	100 mV 1V 10 V 100 V 1000 V	2.3 µV/V 2.2 µV/V 2.2 µV/V 2.2 µV/V 2.3 µV/V	Fluke 8508A, Fluke 752A, Fluke 732B

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
DC Voltage – Measure ³	(0 to 200) mV (0.2 to 2) V (2 to 20) V (20 to 200) V (200 to 1050) V	6.4 μV/V + 0.10 μV 3.6 μV/V + 0.40 μV 3.5 μV/V + 4.0 μV 5.8 μV/V + 40 μV 7.4 μV/V + 0.53 mV	Fluke 8508A
DC Current – Generate ³	(0 to 220) μA (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A (2.2 to 11) A (3 to 11) A (11 to 20.5) A	41 μA/A + 5.4 nA 33 μA/A + 6.2 nA 33 μA/A + 39 nA 41 μA/A + 0.62 μA 71 μA/A + 12 μA 0.28 mA/A + 0.37 mA 0.39 mA/A + 0.39 mA 0.78 mA/A + 0.58 mA	Fluke 5720A w/5725 amplifier Fluke 5522A
DC Current – Measure ³	(0 to 200) μA (0.20 to 2.0) mA (2 to 20) mA (20 to 200) mA (0.2 to 2) A (2 to 20) A (1 to 20) A (20 to 100) A (100 to 150) A	25 μA/A + 0.40 nA 20 μA/A + 4.0 nA 21 μA/A + 40 nA 48 μA/A + 0.80 μA 0.19 mA/A + 16 μA 0.40 mA/A + 0.40 mA 75 μA/A + 7.8 μA 75 μA/A + 78 μA 0.011 % + 0.23 mA	Fluke 8508A Fluke 8508A and shunts
DC Resistance – Generate ³	(0 to 10.9999) Ω (11 to 32.9999) Ω (33 to 109.9999) Ω (110 to 329.9999) Ω (0.33 to 1.099999) kΩ (1.1 to 3.299999) kΩ (3.3 to 10.99999) kΩ (11 to 32.99999) kΩ (33 to 109.9999) kΩ (110 to 329.9999) kΩ (0.33 to 1.099999) MΩ (1.1 to 3.299999) MΩ (3.3 to 10.99999) MΩ (11 to 32.99999) MΩ (33 to 109.9999) MΩ (110 to 329.9999) MΩ (330 to 1100) MΩ	33 μΩ/Ω + 0.78 mΩ 24 μΩ/Ω + 1.2 mΩ 22 μΩ/Ω + 1.1 mΩ 23 μΩ/Ω + 1.6 mΩ 22 μΩ/Ω + 1.6 mΩ 23 μΩ/Ω + 16 mΩ 23 μΩ/Ω + 16 mΩ 23 μΩ/Ω + 0.16 Ω 23 μΩ/Ω + 0.16 Ω 26 μΩ/Ω + 1.6 Ω 26 μΩ/Ω + 1.6 Ω 48 μΩ/Ω + 23 Ω 0.10 mΩ/Ω + 39 Ω 0.20 mΩ/Ω + 1.9 kΩ 0.40 mΩ/Ω + 2.3 kΩ 2.3 mΩ/Ω + 78 kΩ 12 mΩ/Ω + 0.39 MΩ	Fluke 5522A

Parameter/Equipment	Range	CMC ^{2, 6} (\pm)	Comments
DC Resistance – Generate ³ (cont) Fixed Points	1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 k Ω 1.9 k Ω 10 k Ω 19 k Ω 100 k Ω 190 k Ω 1 M Ω 1.9 M Ω 10 M Ω 19 M Ω 100 M Ω	0.13 m Ω 0.18 m Ω 0.23 m Ω 0.44 m Ω 1.3 m Ω 2.4 m Ω 11 m Ω 24 m Ω 0.12 Ω 0.22 Ω 1.4 Ω 3.2 Ω 51 Ω 64 Ω 4.0 k Ω 8.5 k Ω 47 k Ω	Fluke 5720A
DC Resistance – Ratio Mode	0 Ω (0 to 2) Ω (2 to 20) Ω (20 to 200) Ω 0.2 Ω to 2 k Ω (2 to 20) k Ω (20 to 200) k Ω (0.2 to 2) M Ω (2 to 20) M Ω (20 to 100) M Ω	0.2 $\mu\Omega$ 13 $\mu\Omega/\Omega$ + 2.0 $\mu\Omega$ 94 $\mu\Omega/\Omega$ + 0.70 $\mu\Omega$ 710 $\mu\Omega/\Omega$ + 0.15 $\mu\Omega$ 55 $\mu\Omega/\Omega$ + 0.15 $\mu\Omega$ 49 $\mu\Omega/\Omega$ + 0.15 $\mu\Omega$ 710 $\mu\Omega/\Omega$ + 0.15 $\mu\Omega$ 35 $\mu\Omega/\Omega$ + 0.50 $\mu\Omega$ 110 $\mu\Omega/\Omega$ + 5.0 $\mu\Omega$ 130 $\mu\Omega/\Omega$ + 50 $\mu\Omega$	Fluke 8508A, Fluke 742A-XX, Agilent 16363A
DC Resistance – Measure ³ High Voltage Mode	(0 to 2) Ω (2 to 20) Ω (20 to 200) Ω (0 to 2) k Ω (2 to 20) k Ω (20 to 200) k Ω (0.2 to 2) M Ω (2 to 20) M Ω (20 to 200) M Ω (0 to 2) G Ω (2 to 20) G Ω	21 $\mu\Omega/\Omega$ + 4 $\mu\Omega$ 15 $\mu\Omega/\Omega$ + 14 $\mu\Omega$ 12 $\mu\Omega/\Omega$ + 50 $\mu\Omega$ 12 $\mu\Omega/\Omega$ + 0.50 m Ω 11 $\mu\Omega/\Omega$ + 5.0 m Ω 12 $\mu\Omega/\Omega$ + 50 m Ω 20 $\mu\Omega/\Omega$ + 1.0 Ω 33 $\mu\Omega/\Omega$ + 10 Ω 0.30 m Ω/Ω + 1.0 k Ω 0.24 m Ω/Ω + 0.10 M Ω 1.7 m Ω/Ω + 10 M Ω	Fluke 8508A

Parameter/Range	Frequency	CMC ^{2, 6} (\pm)	Comments
AC Voltage – Generate ³			
(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	1.2 mV/V + 4.0 μ V 0.91 mV/V + 4.0 μ V 0.90 mV/V + 4.0 μ V 1.5 mV/V + 4.0 μ V 2.1 mV/V + 5 μ V 3.6 mV/V + 10 μ V 5.2 mV/V + 20 μ V 6.6 mV/V + 20 μ V	Fluke 5720A w/ 5725A
(2.2 to 22) mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.32 mV/V + 4.0 μ V 0.18 mV/V + 4.0 μ V 0.18 mV/V + 4.0 μ V 0.33 mV/V + 4.0 μ V 0.59 mV/V + 5.0 μ V 1.3 mV/V + 10 μ V 1.7 mV/V + 20 μ V 3.2 mV/V + 20 μ V	
(22 to 220) mV	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.38 mV/V + 12 μ V 98 μ V/V + 7.0 μ V 86 μ V/V + 7.0 μ V 0.20 mV/V + 7.0 μ V 0.49 mV/V + 17 μ V 0.88 mV/V + 20 μ V 1.4 mV/V + 25 μ V 2.7 mV/V + 45 μ V	
(0.22 to 2.2) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.52 mV/V + 40 μ V 88 μ V/V + 15 μ V 45 μ V/V + 8.0 μ V 79 μ V/V + 10 μ V 0.14 mV/V + 30 μ V 0.42 mV/V + 80 μ V 0.96 mV/V + 0.20 mV 1.7 mV/V + 0.30 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 (0.5 to 1) MHz	0.38 mV/V + 0.40 mV 94 μ V/V + 0.15 mV 47 μ V/V + 50 μ V 81 μ V/V + 0.10 mV 0.11 mV/V + 0.20 mV 0.30 mV/V + 0.60 mV 0.99 mV/V + 2.0 mV 1.7 mV/V + 3.2 mV	

Parameter/Range	Frequency	CMC ^{2,6} (\pm)	Comments
AC Voltage – Generate ³ (cont) (22 to 220) V *Subject to 2.2 x 10 ⁷ Volt-Hz limitation (220 to 250) V (220 to 1000) V (220 to 750) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) kHz (15 to 50) Hz (1 to 20) kHz (20 to 30) kHz (0.03 to 50) kHz (50 to 100) kHz	0.44 mV/V + 4.0 mV 98 μ V/V + 1.5 mV 69 μ V/V + 0.60 mV 0.10 mV/V + 1.0 mV 0.17 mV/V + 2.5 mV 0.86 mV/V + 16 mV 4.2 mV/V + 40 mV 8.6 mV/V + 80 mV 0.28 mV/V + 16 mV 0.13 mV/V + 6.0 mV 0.49 mV/V + 11 mV 0.48 mV/V + 11 mV 1.8 mV/V + 45 mV	Fluke 5720A w/ 5725A
AC Voltage – Measure ³ Up to 199.99 mV (0.2 to 1.9999) V (2 to 19.999) V (20 to 199.99) V (200 to 1050) V	(1 to 10) Hz (1 to 10) Hz (1 to 10) Hz (1 to 10) Hz (1 to 10) Hz	0.64 mV/V + 14 μ V 0.93 mV/V + 0.12 mV 0.69 mV/V + 1.2 mV 0.82 mV/V + 12 mV 0.18 mV/V + 10 mV	Fluke 8508A
AC Voltage – Measure ³ (0 to 2.2) mV (2.2 to 7) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz (10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	2.6 μ V/V + 1.0 μ V 1.2 μ V/V + 1.0 μ V 0.68 μ V/V + 1.0 μ V 1.3 μ V/V + 1.6 μ V 1.9 μ V/V + 1.9 μ V 3.6 μ V/V + 3.1 μ V 3.8 μ V/V + 6.2 μ V 5.0 μ V/V + 6.2 μ V 4.0 μ V/V + 1.0 μ V 1.8 μ V/V + 1.0 μ V 1.0 μ V/V + 1.0 μ V 1.9 μ V/V + 1.6 μ V 2.8 μ V/V + 1.9 μ V 5.7 μ V/V + 3.1 μ V 6.2 μ V/V + 6.2 μ V 11 μ V/V + 6.2 μ V	Fluke 5790A

Parameter/Range	Frequency	CMC ^{2,6} (±)	Comments
AC Voltage – Measure ³			
(7 to 22) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	4.7 μV/V + 1.0 μV 3.1 μV/V + 1.0 μV 1.9 μV/V + 1.0 μV 3.4 μV/V + 1.6 μV 5.1 μV/V + 1.9 μV 13 μV/V + 3.1 μV 15 μV/V + 6.2 μV 27 μV/V + 6.2 μV	Fluke 5790A
(22 to 70) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	11 μV/V + 1.2 μV 6.2 μV/V + 1.2 μV 3.8 μV/V + 1.2 μV 6.5 μV/V + 1.6 μV 13 μV/V + 1.9 μV 25 μV/V + 3.1 μV 34 μV/V + 6.2 μV 54 μV/V + 6.2 μV	
(70 to 220) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	33 μV/V + 1.2 μV 15 μV/V + 1.2 μV 6.7 μV/V + 1.2 μV 12 μV/V + 1.6 μV 26 μV/V + 1.9 μV 42 μV/V + 3.1 μV 63 μV/V + 6.2 μV 0.016 % + 6.2 μV	
(200 to 700) mV	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	99 μV/V + 1.2 μV 37 μV/V + 1.2 μV 17 μV/V + 1.2 μV 25 μV/V + 1.6 μV 39 μV/V + 1.9 μV 86 μV/V + 3.1 μV 0.014 % + 6.2 μV 0.045 % + 6.2 μV	
(0.7 to 2.2) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.31 mV/V 0.11 mV/V 0.040 mV/V 0.073 mV/V 0.11 mV/V 0.25 mV/V 0.41 mV/V 1.4 mV/V	

Parameter/Range	Frequency	CMC ^{2,6} (\pm)	Comments
AC Voltage – Measure ³ (cont)			
(2.2 to 7) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.95 mV/V 0.34 mV/V 0.12 mV/V 0.24 mV/V 0.40 mV/V 0.90 mV/V 1.9 mV/V 5.6 mV/V	Fluke 5790
(7 to 22) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	3.2 mV/V 1.1 mV/V 0.48 mV/V 0.89 mV/V 1.4 mV/V 3.0 mV/V 6.2 mV/V 19 mV/V	
(22 to 70) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	9.4 mV/V 3.4 mV/V 1.6 mV/V 2.7 mV/V 4.4 mV/V 9.4 mV/V 19 mV/V 56 mV/V	
(70 to 220) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz	32 mV/V 11 mV/V 5.4 mV/V 9.1 mV/V 15 mV/V 31 mV/V 64 mV/V	
(220 to 700) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	94 mV/V 47 mV/V 20 mV/V 61 mV/V 0.23 V/V 0.16 V/V	

Parameter/Range	Frequency	CMC ^{2,6} (\pm)	Comments
AC Current – Generate ³			
(1 to 220) μ A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.42 mA/A + 16 nA 0.23 mA/A + 10 nA 0.21 mA/A + 8 nA 0.32 mA/A + 12 nA 1.0 mA/A + 65 nA	Fluke 5720A w/5725A
220 μ A 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	0.44 mA/A + 40 nA 0.33 mA/A + 35 nA 0.31 mA/A + 35 nA 0.35 mA/A + 0.11 μ A 1.0 mA/A + 0.65 μ A	
(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	0.35 mA/A + 0.40 μ A 0.17 mA/A + 0.35 μ A 0.13 mA/A + 0.35 μ A 0.20 mA/A + 0.55 μ A 1.0 mA/A + 5.0 μ A	
(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	0.36 mA/A + 4.0 μ A 0.17 mA/A + 3.5 μ A 0.13 mA/A + 2.5 μ A 0.2 mA/A + 3.5 μ A 1.0 mA/A + 10 μ A	
220 mA to 2.2 A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.27 mA/A + 35 μ A 0.47 mA/A + 80 μ A 6.3 mA/A + 0.16 mA	
(2.2 to 11) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.38 mA/A + 0.17 mA 0.76 mA/A + 0.38 mA 2.8 mA/A + 0.75 mA	
(11 to 20.5) A	(10 to 100) Hz (0.1 to 1) kHz (1 to 5) kHz	0.96 mA/A + 3.9 mA 1.2 mA/A + 3.9 mA 23 mA/A + 3.9 mA	

Parameter/Range	Frequency	CMC ^{2,6} (±)	Comments
AC Current – Measure/Generate ³			
(5 to 26) mA	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz	220 µA/A 96 µA/A 65 µA/A 100 µA/A	Fluke 5790, Fluke 5720 and HOLT HCS-1 Current shunts
(26 to 50) mA	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz	220 µA/A 96 µA/A 65 µA/A 100 µA/A	
(50 to 260) mA	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz	220 µA/A 97 µA/A 67 µA/A 110 µA/A	
(125 to 650) mA	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz	1400 µA/A 1700 µA/A 1600 µA/A 1700 µA/A	
(0.5 to 2.6) A	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz	220 µA/A 99 µA/A 78 µA/A 140 µA/A	
(1.25 to 6.5) A	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz	220 µA/A 110 µA/A 97 µA/A 190 µA/A	
(2.5 to 13) A	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz	230 µA/A 120 µA/A 110 µA/A 170 µA/A	
(2.5 to 13) A	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz	250 µA/A 160 µA/A 170 µA/A 210 µA/A	

Parameter/Range	Frequency	CMC ^{2, 6} (±)	Comments
AC Current – Measure³			
(9 to 199) μ A	(10 to 20) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.42 mA/A + 20 nA 0.62 mA/A + 20 nA 0.66 mA/A + 20 nA 1.7 mA/A + 20 nA	Fluke 8508A
(0.2 to 1.9999) mA	(10 to 20) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.32 mA/A + 0.20 μ A 0.91 mA/A + 0.20 μ A 0.95 mA/A + 0.20 μ A 1.9 mA/A + 0.20 μ A	
(2 to 19.999) mA	(10 to 20) Hz 10 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.32 mA/A + 2.0 μ A 0.80 mA/A + 2.0 μ A 0.85 mA/A + 2.0 μ A 2.7 mA/A + 2.0 μ A	
(20 to 199.99) mA	(10 to 20) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.33 mA/A + 20 μ A 0.60 mA/A + 20 μ A 2.7 mA/A + 20 μ A	
(0.2 to 1.9999) A	(10 to 20) Hz 10 Hz to 10 kHz (10 to 30) kHz	0.34 mA/A + 0.20 mA 3.2 mA/A + 0.20 mA 3.4 mA/A + 0.20 mA	
(20 to 19.999) A	10 Hz to 2 kHz (2 to 10) kHz	0.47 mA/A + 2.0 mA 2.2 mA/A + 2.0 mA	
Capacitance – Generate³			
(220 to 399.9) pF	10 Hz to 10 kHz	6.5 fF/pF + 7.8 pF	Fluke 5522A
(0.4 to 1.0999) nF	10 Hz to 10 kHz	4.7 pF/nF + 7.8 pF	
(1.1 to 3.3) nF	10 Hz to 3 kHz	4.0 pF/nF + 7.8 pF	
(3.3 to 11) nF	10 Hz to 1 kHz	2.0 pF/nF + 7.8 pF	
(11 to 110) nF	10 Hz to 1 kHz	2.0 pF/nF + 78 pF	
(110 to 330) nF	10 Hz to 1 kHz	2.1 pF/nF + 230 pF	
(0.33 to 1.1) μ F	(10 to 600) Hz	2.0 nF/ μ F + 0.78 nF	
(1.1 to 3.3) μ F	(10 to 300) Hz	2.0 nF/ μ F + 2.3 nF	
(3.3 to 11) μ F	(10 to 150) Hz	2.1 nF/ μ F + 7.8 nF	
(11 to 33) μ F	(10 to 120) Hz	3.2 nF/ μ F + 23 nF	
(33 to 110) μ F	(10 to 80) Hz	3.7 nF/ μ F + 78 nF	
(110 to 330) μ F	(10 to 50) Hz	3.7 nF/ μ F + 230 nF	
(0.33 to 1.1) mF	(10 to 20) Hz	3.7 μ F/mF + 0.78 μ F	
(1.1 to 3.3) mF	(0 to 6) Hz	3.5 μ F/mF + 2.3 μ F	
(3.3 to 11) mF	(0 to 2) Hz	3.5 μ F/mF + 7.8 μ F	
(11 to 33) mF	(0 to 0.6) Hz	5.8 μ F/mF + 23 μ F	
(33 to 110) mF	(0 to 0.2) Hz	8.5 μ F/mF + 78 μ F	

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
Electrical Calibration of Thermocouple Indicators ³ –			
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.25 °C 0.13 °C 0.12 °C 0.14 °C 0.18 °C	Fluke 5522A
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.26 °C 0.14 °C 0.13 °C 0.20 °C 0.31 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.45 °C 0.28 °C 0.26 °C 0.32 °C	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.38 °C 0.28 °C 0.29 °C 0.36 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.50 °C 0.19 °C 0.13 °C 0.11 °C	
Type U	(-200 to 0) °C (0 to 600) °C	0.44 °C 0.21 °C	
Electrical Calibration of RTD Indicators ³ –			
Pt 385, 100 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.085 °C 0.12 °C 0.12 °C 0.11 °C 0.10 °C 0.11 °C 0.20 °C	Fluke 5522A
Pt 3926, 100 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.064 °C 0.076 °C 0.075 °C 0.089 °C 0.095 °C 0.17 °C	

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
Electrical Calibration of RTD Indicators ³ – (cont)			
Pt 3916, 100 Ω	(-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.21 °C 0.060 °C 0.067 °C 0.070 °C 0.077 °C 0.084 °C 0.090 °C 0.13 °C 0.19 °C	Fluke 5522A
Pt 385, 200 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.041 °C 0.043 °C 0.044 °C 0.051 °C 0.11 °C 0.11 °C 0.11 °C 0.13 °C	
Pt 385, 500 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.036 °C 0.043 °C 0.044 °C 0.051 °C 0.066 °C 0.066 °C 0.073 °C 0.88 °C	
Pt 385, 1000 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.029 °C 0.029 °C 0.036 °C 0.042 °C 0.050 °C 0.018 °C 0.057 °C 0.018 °C	
Pt 385, 1000 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.029 °C 0.029 °C 0.036 °C 0.042 °C 0.050 °C 0.018 °C 0.057 °C 0.018 °C	

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
Electrical Calibration of RTD Indicators – (cont)			
Ni 120, 120 Ω	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.081 °C 0.11 °C 0.11 °C	Fluke 5522A
Cu 427, 10 Ω	(-100 to 260) °C	0.69 °C	
Distortion – Measure ³			
(-99.9 to 0) dB	20 Hz to 20 kHz (20 to 100) kHz	1.2 dB 2.3 dB	Agilent/HP 8903B
Oscilloscopes ³ –			
Amplitude - DC Voltage 50 Ω load	1 mV _{p-p} to 6.6 V _{p-p}	1.9 mV/V + 31 μV	Fluke 5522A/SC 1100
1 MΩ load	1 mV _{p-p} to 130 V _{p-p}	0.39 mV/V + 31 μV	
Amplitude – Square Wave 50 Ω load	1 mV _{p-p} to 6.6 V _{p-p} 10 Hz to 10 kHz	1.6 mV/V + 31 μV	
1 MΩ load	1 mV _{p-p} to 130 V _{p-p} 10 Hz to 10 kHz	0.78 mV/V + 31 μV	
Bandwidth	5 mV to 5.5 V: 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (0.6 to 1.1) GHz	2.8 % 3.0 % 4.1 % 4.7 %	
Resistance	40 Ω to 1.5 MΩ	0.79 mΩ/Ω	
Rise Time – Generate	1 kHz to 2 MHz, (200 to 300) ps	19 ps	
	(2 to 10) MHz, (200 to 350) ps	19 ps	
Time Marker	1 ns to 20 ms 50 ms to 5 s Non-cardinal point	2.1 μs/s 19 + 39t μs/s 39 μs/s	

III. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ^{2, 5, 8} (±)	Comments
RF Attenuation – Tuned RF Power Measure ³			
(-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	100 kHz to 1.3 GHz	0.031 dB 0.032 dB 0.037 dB 0.039 dB 0.041 dB 0.052 dB 0.054 dB 0.058 dB 0.065 dB 0.069 dB 0.12 dB 0.18 dB	Agilent/HP 8902A opt 50 w/ 11793A and 11722A
(-1 to -10) dB (-10 to -20) dB (-20 to -30) dB (-30 to -40) dB (-40 to -50) dB (-50 to -60) dB (-60 to -70) dB (-70 to -80) dB (-80 to -85) dB	(1.3 to 26.5) GHz	0.064 dB 0.067 dB 0.080 dB 0.082 dB 0.10 dB 0.10 dB 0.11 dB 0.11 dB 0.14 dB	Agilent/HP 8902A opt 50 w/ 11793A and 11792A
RF Power – Measure ³			
(-30 to +20) dBm	(100 to 500) kHz 500 kHz to 1 MHz 1 MHz to 2 GHz (2 to 4.2) GHz	2.5 % 1.5 % 1.3 % 1.8 %	HP 8482A w/ power meter
(-30 to +20) dBm	(4 to 8) GHz (8 to 12) GHz (12 to 18) GHz	1.9 % 2.0 % 2.1 %	HP 8481A w/ power meter
(-70 to -20) dBm	(10 to 30) MHz (0.03 to 4) GHz (4 to 6) GHz (6 to 10) GHz (10 to 12) GHz (12 to 14) GHz (14 to 15) GHz (15 to 18) GHz	2.5 % 2.7 % 2.7 % 2.9 % 2.8 % 2.7 % 2.8 % 3.5 %	HP 8484A w/ power meter

Parameter/Range	Frequency	CMC ^{2, 5, 8} (±)	Comments
RF Power – Measure ³ (cont)			
(-20 to + 20) dBm	(18 to 26.5) GHz	4.1 %	HP 8485A w/ power meter
(-35 to + 20) dBm	(10 to 100) MHz (> 0.10 to 2.4) GHz (> 2.4 to 8) GHz (> 8 to 12) GHz (>12 to 18) GHz (> 18 to 26.5) GHz	0.041 dB 0.048 dB 0.053 dB 0.061 dB 0.10 dB 0.13 dB	NRP-Z55 w/ power meter
1 mW reference	50 MHz	0.63 %	HP 8487B thermistor, Tegam 1830A
RF Power – Generate ³			
(20 to 24) dBm (14 to 20) dBm (-17 to +14) dBm (-48 to -17) dBm (-74 to -48) dBm (-84 to -74) dBm (-94 to -84) dBm	(0.01 to 100) kHz	0.023 dB 0.023 dB 0.024 dB 0.025 dB 0.16 dB 0.39 dB 0.45 dB	Fluke 96270A/LL/FF w/ leveling head
(20 to 24) dBm (14 to 20) dBm (-17 to + 14) dBm (-48 to -17) dBm (-74 to -48) dBm (-84 to -74) dBm (-94 to -84) dBm	(0.1 to 10) MHz	0.045 dB 0.042 dB 0.047 dB 0.047 dB 0.16 dB 0.39 dB 0.4 dB	
(20 to 24) dBm (0 to 20) dBm (-48 to 0) dBm (-54 to -48) dBm (-64 to -54) dBm (-74 to -64) dBm (-84 to -74) dBm (-94 to -84) dBm (-104 to -94) dBm (-114 to -104) dBm (-119 to -114) dBm (-129 to -119) dBm (-130 to -129) dBm	(10 to 128) MHz	0.047 dB 0.045 dB 0.047 dB 0.084 dB 0.084 dB 0.086 dB 0.087 dB 0.24 dB 0.55 dB 0.59 dB 0.61 dB 0.61 dB 0.98 dB	

Parameter/Range	Frequency	CMC ^{2,8} (±)	Comments
RF Power – Generate ³ (cont)			
(14 to 20) dBm (+ 4 to + 14) dBm (-48 to + 4) dBm (-54 to -48) dBm (-74 to -54) dBm (-84 to -74) dBm (-94 to -84) dBm (-119 to -94) dBm (-129 to -119) dBm (-130 to -129) dBm	(128 to 300) MHz	0.055 dB 0.061 dB 0.063 dB 0.085 dB 0.088 dB 0.24 dB 0.39 dB 1.2 dB 1.4 dB 2.4 dB	Fluke 96270A/LL/FF w/ leveling head
(-48 to 20) dBm (-74 to -48) dBm (-84 to -74) dBm (-94 to -84) dBm (-104 to -94) dBm (-114 to -104) dBm (-119 to -114) dBm (-129 to -119) dBm (-130 to -129) dBm	(0.3 to 1.4) GHz	0.16 dB 0.32 dB 0.39 dB 0.78 dB 1.2 dB 1.3 dB 1.4 dB 1.3 dB 1.9 dB	Fluke 96270A/LL/FF w/ leveling head
(-48 to + 14) dBm (-64 to -48) dBm (-74 to -64) dBm (-94 to -74) dBm	(1.4 to 3) GHz	0.24 dB 0.39 dB 0.41 dB 0.79 dB	
(-17 to + 14) dBm (-48 to -17) dBm (-64 to -48) dBm (-74 to -64) dBm (-84 to -74) dBm (-94 to -84) dBm	(3 to 4) GHz	0.24 dB 0.39 dB 0.39 dB 0.41 dB 0.79 dB 0.79 dB	
(-35 to +20) dBm (-35 to +20) dBm (-35 to +20) dBm (-35 to +20) dBm (-35 to +20) dBm (-35 to +20) dBm	DC to 100 MHz > 100 MHz to 2.4 GHz > (2.4 to 8.0) GHz > (8.0 to 12.4) GHz > (12.4 to 18.0) GHz > (18.0 to 26.5) GHz	0.041 dB 0.048 dB 0.053 dB 0.061 dB 0.10 dB 0.13 dB	Fluke 96270A and NRP- Z55

Parameter/Range	Frequency	CMC ^{2, 5, 8} (±)	Comments
Thermistor Mount Calibration – Calibration Factor ³	10 MHz	0.66 %	Tegam 2505A/1830A, RF Signal Generator, Function Generator
	50 MHz	0.57 %	
	500 MHz	0.64 %	
	1000 MHz	0.65 %	
	2000 MHz	0.68 %	
	3000 MHz	0.71 %	
	4000 MHz	0.69 %	
	5000 MHz	0.78 %	
	6000 MHz	0.90 %	
	7000 MHz	1.0 %	
	8000 MHz	1.0 %	
	9000 MHz	0.96 %	
	10 000 MHz	0.90 %	
	11 000 MHz	0.99 %	
	12 000 MHz	1.1 %	
	13 000 MHz	1.1 %	
	14 000 MHz	1.1 %	
	15 000 MHz	1.2 %	
16 000 MHz	1.4 %		
17 000 MHz	1.4 %		
18 000 MHz	1.3 %		
Power Sensor Calibration – Calibration Factor ³	50 MHz reference	0.75 %	Tegam 2505A/1830A, Agilent EPM 441A, RF signal generator, function generator
	0.006 MHz	0.80 %	
	0.009 MHz	0.73 %	
	0.02 MHz	0.69 %	
	0.03 MHz	0.68 %	
	0.04 MHz	0.68 %	
	0.05 MHz	0.69 %	
	0.06 MHz	0.69 %	
	0.07 MHz	0.69 %	
	0.08 MHz	0.70 %	
	0.09 MHz	0.69 %	
	0.10 MHz	0.82 %	
	0.20 MHz	0.78 %	
	0.30 MHz	0.77 %	
	0.46 MHz	0.77 %	
	0.50 MHz	0.77 %	
	1.00 MHz	0.75 %	
	1.25 MHz	0.75 %	
	3 MHz	0.75 %	
	5 MHz	0.76 %	
	10 MHz	0.75 %	
20 MHz	0.75 %		
30 MHz	0.75 %		
40 MHz	0.75 %		
50 MHz	0.75 %		

Parameter/Range	Frequency	CMC ^{2, 5, 8} (±)	Comments
Power Sensor Calibration – Calibration Factor ³ (cont)	60 MHz	0.75 %	Tegam 2505A/1830A, Agilent EPM 441A, RF signal generator, function generator
	70 MHz	0.75 %	
	80 MHz	0.76 %	
	90 MHz	0.75 %	
	100 MHz	0.75 %	
	150 MHz	0.75 %	
	200 MHz	0.75 %	
	250 MHz	0.75 %	
	300 MHz	0.75 %	
	350 MHz	0.75 %	
	400 MHz	0.76 %	
	450 MHz	0.75 %	
	500 MHz	0.76 %	
	550 MHz	0.76 %	
	600 MHz	0.76 %	
	650 MHz	0.75 %	
	700 MHz	0.76 %	
	750 MHz	0.76 %	
	800 MHz	0.76 %	
	850 MHz	0.76 %	
	900 MHz	0.76 %	
	950 MHz	0.76 %	
	1000 MHz	0.76 %	
	1050 MHz	0.76 %	
	1100 MHz	0.76 %	
	1150 MHz	0.76 %	
	1200 MHz	0.75 %	
	1250 MHz	0.75 %	
	1300 MHz	0.75 %	
	1350 MHz	0.75 %	
	1400 MHz	0.75 %	
	1450 MHz	0.75 %	
1500 MHz	0.76 %		
1550 MHz	0.76 %		
1600 MHz	0.76 %		
1650 MHz	0.75 %		
1700 MHz	0.76 %		
1750 MHz	0.76 %		
1800 MHz	0.76 %		
1850 MHz	0.76 %		
1900 MHz	0.77 %		
1950 MHz	0.77 %		
2000 MHz	0.75 %		
2100 MHz	0.77 %		
2200 MHz	0.77 %		
2300 MHz	0.77 %		
2400 MHz	0.78 %		
2500 MHz	0.78 %		
2600 MHz	0.78 %		
2700 MHz	0.78 %		
2800 MHz	0.78 %		
2900 MHz	0.78 %		
3000 MHz	0.78 %		
3100 MHz	0.78 %		
3200 MHz	0.77 %		

Parameter/Range	Frequency	CMC ^{2, 5, 8} (±)	Comments
Power Sensor Calibration – Calibration Factor ³ (cont)	3300 MHz	0.77 %	Tegam 2505A/1830A, Agilent EPM 441A, RF signal generator, function generator
	3400 MHz	0.77 %	
	3500 MHz	0.77 %	
	3600 MHz	0.77 %	
	3700 MHz	0.79 %	
	3800 MHz	0.79 %	
	3900 MHz	0.79 %	
	4000 MHz	0.79 %	
	4200 MHz	0.79 %	
	4400 MHz	0.79 %	
	4600 MHz	0.79 %	
	4800 MHz	0.83 %	
	5000 MHz	0.84 %	
	5200 MHz	0.84 %	
	5400 MHz	0.84 %	
	5600 MHz	0.85 %	
	5800 MHz	0.84 %	
	6000 MHz	0.84 %	
	6200 MHz	0.85 %	
	6400 MHz	0.85 %	
	6600 MHz	0.85 %	
	6800 MHz	0.86 %	
	7000 MHz	0.88 %	
	7200 MHz	0.88 %	
	7400 MHz	0.87 %	
	7600 MHz	0.87 %	
	8000 MHz	0.87 %	
	8200 MHz	0.88 %	
	8400 MHz	0.87 %	
	8600 MHz	0.86 %	
	8800 MHz	0.86 %	
	9000 MHz	0.86 %	
	9200 MHz	0.86 %	
	9400 MHz	0.86 %	
	9600 MHz	0.85 %	
	9800 MHz	0.85 %	
	10 000 MHz	0.85 %	
	10 200 MHz	0.88 %	
	10 400 MHz	0.88 %	
	10 600 MHz	0.89 %	
10 800 MHz	0.89 %		
11 000 MHz	0.90 %		
11 200 MHz	0.90 %		
11 400 MHz	0.90 %		
11 600 MHz	0.90 %		
11 800 MHz	0.91 %		
12 000 MHz	0.98 %		
12 200 MHz	0.97 %		
12 400 MHz	0.97 %		
12 750 MHz	1.00 %		
13 000 MHz	1.00 %		
13 250 MHz	1.00 %		
13 500 MHz	0.99 %		
13 750 MHz	1.00 %		
14 000 MHz	1.00 %		
14 250 MHz	1.00 %		

Parameter/Range	Frequency	CMC ^{2, 5, 8} (±)	Comments
Power Sensor Calibration – Calibration Factor ³ (cont)	14 500 MHz	1.00 %	Tegam 2505A/1830A, Agilent EPM 441A, RF signal generator, function generator
	14 750 MHz	1.00 %	
	15 000 MHz	1.00 %	
	15 250 MHz	1.10 %	
	15 500 MHz	1.10 %	
	15 750 MHz	1.10 %	
	16 000 MHz	1.10 %	
	16 250 MHz	1.10 %	
	16 500 MHz	1.10 %	
	16 750 MHz	1.10 %	
	17 000 MHz	1.10 %	
	17 250 MHz	1.10 %	
	17 500 MHz	1.10 %	
	17 750 MHz	1.10 %	
	18 000 MHz	1.10 %	
	50 MHz reference	1.0 %	Tegam 2510A/1830A, Agilent EPM 441A, RF signal generator, function generator
	10 MHz	1.4 %	
	20 MHz	1.4 %	
	30 MHz	1.4 %	
	40 MHz	1.5 %	
	50 MHz	1.2 %	
	60 MHz	1.0 %	
	70 MHz	1.1 %	
	80 MHz	1.1 %	
	90 MHz	1.1 %	
	100 MHz	1.0 %	
	150 MHz	1.0 %	
	200 MHz	1.0 %	
	250 MHz	1.1 %	
	300 MHz	1.1 %	
	350 MHz	1.1 %	
	400 MHz	1.1 %	
	450 MHz	1.1 %	
	500 MHz	1.1 %	
	550 MHz	1.1 %	
600 MHz	1.1 %		
650 MHz	1.1 %		
700 MHz	1.1 %		
750 MHz	1.1 %		
800 MHz	1.1 %		
850 MHz	1.1 %		
900 MHz	1.1 %		
950 MHz	1.1 %		
1000 MHz	1.1 %		
1050 MHz	1.1 %		
1100 MHz	1.1 %		
1150 MHz	1.1 %		
1200 MHz	1.1 %		
1250 MHz	1.1 %		
1300 MHz	1.1 %		
1350 MHz	1.1 %		
1400 MHz	1.1 %		
1450 MHz	1.1 %		
1500 MHz	1.1 %		

Parameter/Range	Frequency	CMC ^{2, 5, 8} (±)	Comments
Power Sensor Calibration – Calibration Factor ³ (cont)	1550 MHz	1.1 %	Tegam 2505A/1830A, Agilent EPM 441A, RF signal generator, function generator
	1600 MHz	1.1 %	
	1650 MHz	1.1 %	
	1700 MHz	1.1 %	
	1750 MHz	1.1 %	
	1800 MHz	1.1 %	
	1850 MHz	1.1 %	
	1900 MHz	1.1 %	
	1950 MHz	1.1 %	
	2000 MHz	1.1 %	
	2100 MHz	1.1 %	
	2200 MHz	1.1 %	
	2300 MHz	1.1 %	
	2400 MHz	1.1 %	
	2500 MHz	1.1 %	
	2600 MHz	1.1 %	
	2700 MHz	1.1 %	
	2800 MHz	1.2 %	
	2900 MHz	1.2 %	
	3000 MHz	1.2 %	
	3100 MHz	1.2 %	
	3200 MHz	1.2 %	
	3300 MHz	1.2 %	
	3400 MHz	1.2 %	
	3500 MHz	1.2 %	
	3600 MHz	1.2 %	
	3700 MHz	1.2 %	
	3800 MHz	1.3 %	
	3900 MHz	1.2 %	
	4000 MHz	1.2 %	
4200 MHz	1.2 %		
4400 MHz	1.2 %		
4600 MHz	1.2 %		
4800 MHz	1.3 %		
5000 MHz	1.3 %		
5200 MHz	1.3 %		
5400 MHz	1.3 %		
5600 MHz	1.4 %		
5800 MHz	1.4 %		

Parameter/Range	Frequency	CMC ^{2, 5, 8} (±)	Comments
Power Sensor Calibration – Calibration Factor ³ (cont)	6000 MHz	1.4 %	Tegam 2505A/1830A, Agilent EPM 441A, RF signal generator, function generator
	6200 MHz	1.4 %	
	6400 MHz	1.4 %	
	6600 MHz	1.4 %	
	6800 MHz	1.4 %	
	7000 MHz	1.4 %	
	7200 MHz	1.4 %	
	7400 MHz	1.4 %	
	7600 MHz	1.3 %	
	7800 MHz	1.4 %	
	8000 MHz	1.4 %	
	8200 MHz	1.4 %	
	8400 MHz	1.4 %	
	8600 MHz	1.4 %	
	8800 MHz	1.4 %	
	9000 MHz	1.4 %	
	9200 MHz	1.4 %	
	9400 MHz	1.5 %	
	9600 MHz	1.5 %	
	9800 MHz	1.5 %	
	10 000 MHz	1.5 %	
	10 200 MHz	1.5 %	
	10 400 MHz	1.5 %	
	10 600 MHz	1.5 %	
	10 800 MHz	1.5 %	
	11 000 MHz	1.5 %	
	11 200 MHz	1.5 %	
	11 400 MHz	1.5 %	
	11 600 MHz	1.6 %	
	11 800 MHz	1.6 %	
	12 000 MHz	1.6 %	
	12 200 MHz	1.6 %	
	12 400 MHz	1.7 %	
	12 750 MHz	1.7 %	
13 000 MHz	1.8 %		
13 250 MHz	1.8 %		
13 500 MHz	1.8 %		
13 750 MHz	1.8 %		
14 000 MHz	1.8 %		
14 250 MHz	1.8 %		
14 500 MHz	1.8 %		
14 750 MHz	1.7 %		
15 000 MHz	1.7 %		
15 250 MHz	1.7 %		
15 500 MHz	1.7 %		
15 750 MHz	1.7 %		
16 000 MHz	1.7 %		
16 250 MHz	1.7 %		
16 500 MHz	1.8 %		
16 750 MHz	1.7 %		

Parameter/Range	Frequency	CMC ^{2, 5, 8} (±)	Comments
Power Sensor Calibration – Calibration Factor ³ (cont)	17 000 MHz	1.8 %	Tegam 2505A/1830A, Agilent EPM 441A, RF signal generator, function generator
	17 250 MHz	1.7 %	
	17 500 MHz	1.8 %	
	17 750 MHz	1.8 %	
	18 000 MHz	1.9 %	
	19 000 MHz	2.2 %	
	20 000 MHz	2.2 %	
	21 000 MHz	2.2 %	
	22 000 MHz	2.2 %	
	23 000 MHz	2.2 %	
	24 000 MHz	2.2 %	
	25 000 MHz	2.3 %	
	26 000 MHz	2.3 %	
	26 500 MHz	2.3 %	
	27 000 MHz	2.4 %	
	28 000 MHz	2.3 %	
	29 000 MHz	2.5 %	
	30 000 MHz	2.6 %	
	31 000 MHz	2.8 %	
	32 000 MHz	2.8 %	
	33 000 MHz	2.8 %	
	34 000 MHz	3.0 %	
	34 500 MHz	3.0 %	
	35 000 MHz	2.6 %	
	36 000 MHz	2.5 %	
	37 000 MHz	2.5 %	
	38 000 MHz	2.5 %	
	39 000 MHz	2.5 %	
	40 000 MHz	3.0 %	
	41 000 MHz	3.7 %	
42 000 MHz	3.6 %		
43 000 MHz	3.4 %		
44 000 MHz	4.0 %		
45 000 MHz	4.8 %		
46 000 MHz	4.3 %		
47 000 MHz	3.5 %		
48 000 MHz	3.8 %		
49 000 MHz	4.6 %		
50 000 MHz	5.0 %		

Parameter/Range	Frequency	CMC ^{2, 4, 8} (\pm)	Comments
Reflection Coefficient ³ (Into 50 Ω)			
$0 < \rho \leq 0.2$	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	0.0019 ρ 0.0028 ρ 0.0053 ρ	Agilent 8753D/ Agilent 85032B
$0.2 < \rho \leq 0.4$	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	0.0022 ρ 0.0031 ρ 0.0056 ρ	
$0.4 < \rho \leq 0.6$	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	0.0027 ρ 0.0035 ρ 0.0062 ρ	
$0.6 < \rho \leq 0.8$	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	0.0033 ρ 0.0042 ρ 0.0078 ρ	
$0.8 < \rho \leq 1$	30 kHz to 1.2 GHz (1.2 to 3) GHz (3 to 6) GHz	0.004 ρ 0.005 ρ 0.0091 ρ	
$0.000 < \rho \leq 0.0476$	40 MHz to 2 GHz (>2 to 20) GHz (>20 to 40) GHz (>40 to 50) GHz	0.0094 ρ 0.0095 ρ 0.018 ρ 0.021 ρ	Anritsu 3797C/ HP 85056A
$0.0476 < \rho \leq 0.1111$	40 MHz to 2 GHz (>2 to 20) GHz (>20 to 40) GHz (>40 to 50) GHz	0.013 ρ 0.013 ρ 0.021 ρ 0.026 ρ	Anritsu 3797C / HP 85054B/85052B/8505 6A
$0.1111 < \rho \leq 0.200$	40 MHz to 2 GHz (>2 to 20) GHz (>20 to 40) GHz (>40 to 50) GHz	0.014 ρ 0.014 ρ 0.024 ρ 0.031 ρ	
$0.200 < \rho \leq 0.3333$	40 MHz to 2 GHz (>2 to 20) GHz (>20 to 40) GHz (>40 to 50) GHz	0.016 ρ 0.017 ρ 0.028 ρ 0.038 ρ	
$0.3333 < \rho \leq 0.500$	40 MHz to 2 GHz (>2 to 20) GHz (>20 to 40) GHz (>40 to 50) GHz	0.019 ρ 0.02 ρ 0.034 ρ 0.049 ρ	

Parameter/Range	Frequency	CMC ^{2, 5, 8} (\pm)	Comments
Amplitude Modulation – Measure³			
Rate: 50 Hz to 10 kHz Depth: (5 to 99) %	(0.15 to 10) MHz	1.6 % + 1 digit	HP 8902A
Rate: 20 Hz to 10 kHz Depth: (5 to 99) %	(0.15 to 10) MHz	2.4 % + 1 digit	
Rate: 50 Hz to 50 kHz Depth: (5 to 99) %	(0.01 to 1.3) GHz	0.89 % + 1 digit	
Rate: 20 Hz to 100 kHz Depth: (5 to 99) %	(1.3 to 1.6) GHz	2.4 % + 1 digit	
Rate: 50 Hz to 50 kHz Depth: (5 to 99) %	(1.3 to 26.5) GHz	1.3 % + 1 digit	HP 8902A w/microwave converter and LO
Rate: 20 Hz to 100 kHz Depth: (5 to 99) %	(1.3 to 26.5) GHz	2.4 % + 1 digit	
Frequency Modulation – Measure³			
Rate: 20 Hz to 10 kHz Dev: \leq 40 kHz peak	(0.25 to 10) MHz	1.6 % + 1 digit	HP 8902A
Rate: 50 Hz to 100 kHz Dev: \leq 400 kHz peak	(0.01 to 1.3) GHz	0.80 % + 1 digit	
Rate: 20 Hz to 200 kHz Dev: \leq 4.0 kHz peak	(0.01 to 1.3) GHz	3.9 % + 1 digit	
Rate: 50 Hz to 100 kHz Dev: \leq 400 kHz peak	(1.3 to 26.5) GHz	0.79 % + 1 digit	HP 8902A w/microwave converter and LO
Rate: 20 Hz to 200 kHz Dev: \leq 400 kHz peak	(1.3 to 26.5) GHz	3.9 % + 1 digit	
Frequency Modulation - Generate³			
<100 kHz Rate	(11 to 13.5) MHz	0.39 %	HP 11715A
	(88 to 108) MHz	0.38 %	
	(352 to 432) MHz	0.38 %	
<200 kHz Rate	(11 to 13.5) MHz	0.38 %	
	(88 to 108) MHz	0.38 %	
	(352 to 432) MHz	0.53 %	

Parameter/Range	Frequency	CMC ^{2, 5, 8} (±)	Comments
Amplitude Modulation ³ – Generate			
Rate: (0.05 to 50) kHz Depth: (0 to 99) %	(11 to 13.5) MHz	0.20 %	HP 11715A
Rate: (0.02 to 100) kHz Depth: (0 to 99) %	(12 to 13.5) MHz	0.33 %	
Phase Modulation – Measure ³			
Rate: (0.1 to 20) kHz	150 kHz to 1.3 GHz	2.4 % + 1 digit	HP 8902A
Rate: (0.1 to 20) kHz	(1.3 to 26.5) GHz	2.4 % + 1 digit	HP 8902A w/ microwave converter and LO

IV. Mechanical

Parameter / Equipment	Range	CMC ^{2, 5, 8} (±)	Comments
Torque Wrenches ³	(5 to 50) in·lbf (25 to 250) in·lbf (100 to 1000) in·lbf (20 to 250) ft·lbf (60 to 600) ft·lbf	0.29 % 0.34 % 0.75 % 0.31 % 0.39 %	CDI 5000ST w/ 4 in 1 transducer model 2000-400-02 CDI 2000-12-02
Pressure ³ – Pressure Standards	(0.2 to 1000) psig	0.002 psi	Ruska 2465
Scales & Balances ³	Up to 1 lb Up to 10 lb Up to 100 lb	89 mg 0.58 g 1.1 g	Class F weights

V. Thermodynamic

Parameter/Equipment	Range	CMC ^{2,5,8} (±)	Comments
Relative Humidity – Measuring Equipment	(20 to 50) % RH (50 to 80) % RH (80 to 95) % RH	0.51 % 0.52 % 0.53 %	Thunder scientific 2500
Temperature – Measure ³	(-196 to 350) °C	0.066 °C	PRT w/ Hart 850C
Relative Humidity ³ – Measure	(20 to 90) % RH	1.3 %	Vaisala HMI 141 w/ HP46 probe

VI. Time & Frequency

Parameter/Equipment	Range	CMC ^{2,8} (±)	Comments
Time Interval ³ – Measure	(1 to 10 000) sec	12 msec	Datum GPS w/ Agilent 53132A
Frequency ³ – Measure	0.1 Hz to 1 kHz (1 to 1000) kHz (1 to 225) MHz (0.1 to 3) GHz	0.12 mHz 0.12 mHz 0.12 Hz 1.1 kHz	Datum GPS w/ Agilent 53132A
Frequency – Measuring Equipment	0.001 Hz to 1 kHz 1 kHz to 20 MHz (0.01 to 50) GHz	0.12 mHz 0.12 nHz/Hz 75 pHz/Hz	Datum GPS w/ HP 33250A Datum GPS w/ HP 83650B

¹ This laboratory offers commercial and field calibration service.

² Calibration and Measurement Capability Uncertainty (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. CMCs represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of $k = 2$. The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

- ³ Field calibration service is available for this calibration 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 In the statement of CMC, L is the numerical value of the nominal length of the device measured in inches. In the statement of CMC, D is nominal diameter in inches. The symbol ρ refers to the magnitude of the reflection value being read.
- ⁵ In the statement of CMC, percentages are to be read as percent of reading, unless noted otherwise.
- ⁶ The stated measured values are determined using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure or generate the measured value in the ranges indicated. CMCs 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.
- ⁷ This scope meets A2LA's *P112 Flexible Scope Policy*.
- ⁸ The type of instrument or material being calibrated is defined by the parameter. This indicates the laboratory is capable of calibrating instruments that measure or generate the values in the ranges indicated for the listed measurement parameter.



Accredited Laboratory

A2LA has accredited

TEKTRONIX, INC

Phoenix, AZ

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/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 12th day of August 2019.

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

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2357.12
Valid to March 31, 2021
Revised October 7, 2019

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