



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

J.H. METROLOGY CO., INC.
1801 Hicks Road, Unit E
Rolling Meadows, IL 60008
Neil E. Willert Phone: 847 991 0290

CALIBRATION

Valid To: April 30, 2025

Certificate Number: 1618.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations^{1, 8}:

I. Dimensional

Parameter/Equipment	Range	CMC ² (±)	Comments
Micrometers ³	Up to 1 in (1 to 2) in (2 to 3) in (3 to 4) in (4 to 5) in (5 to 6) in (6 to 7) in (7 to 8) in (8 to 9) in (9 to 10) in (10 to 11) in (11 to 12) in (12 to 20) in	44 µin 53 µin 58 µin 67 µin 97 µin 99 µin 110 µin 110 µin 110 µin 110 µin 180 µin 190 µin 210 µin	Gage blocks
Anvil Flatness	Up to 1 in	4 µin	Optical flat
Anvil Parallelism	Up to 1 in	6 µin	
Height Gages ^{3, 6}	Up to 6 in (6 to 24) in	22 µin/in + 150 µin + 0.58R 11 µin/in + 210 µin + 0.58R	Gage blocks or caliper checker

Parameter/Equipment	Range	CMC ² (±)	Comments
Calipers ³	Up to 12 in (12 to 40) in	330 µin 600 µin	Gage blocks or caliper checker
Depth Gages ³	Up to 1 in Up to 2 in Up to 3 in Up to 4 in Up to 5 in Up to 6 in Up to 7 in Up to 8 in Up to 9 in Up to 10 in Up to 11 in Up to 12 in	61 µin 67 µin 71 µin 86 µin 120 µin 120 µin 120 µin 120 µin 120 µin 120 µin 210 µin 210 µin	Gage blocks
Plug Gages/Pin Gages— Cylindrical OD	Up to 0.25 in (0.25 to 0.5) in (0.5 to 0.75) in (0.75 to 1) in	18 µin 18 µin 20 µin 20 µin	Gage blocks & Supermicrometer™
Indicators ^{3, 6}	(0 to 4) in	5 µin/in + 50 µin + 0.58R	Gage blocks
Test Indicators ^{3, 6}	(0 to 0.25) in	100 µin/in + 10 µin + 0.58R	
Cylindrical OD, Pin Sets ³	Up to 1 in	60 µin	Laser micrometer
Cylindrical ID, Ring Gages	Up to 1 in Up to 2 in Up to 3 in Up to 4 in Up to 5 in Up to 6 in (6 to 7) in Up to 8 in Up to 10 in	17 µin 31 µin 45 µin 58 µin 60 µin 65 µin 73 µin 74 µin 80 µin	Gage blocks, internal comparator, & linear amplifier

Parameter/Equipment	Range	CMC ² (±)	Comments
Squareness	Up to 12 in	84 µin	Surface plate, master square, & linear amplifier
Outside Threads – Major Diameter	Up to 1 in	23 µin	Gage blocks, thread wires, & Supermicrometer™
Pitch Diameter	Up to 1 in	43 µin	
Gage Blocks – Length Only	(0.05 to 1.0) in (1.00 to 4.00) in	10 µin/in + 18 µin 2.3 µin/in + 26 µin	Gage blocks & Supermicrometer™
Micrometer Rods	(1 to 6) in (6 to 29) in	200 µin/in + 84 µin 220 µin/in + 83 µin	Gage blocks, surface plate, height stand, indicator, Supermicrometer™, gage blocks
Precision Levels –			
Bubble Level	Up to 24 inches	0.034°	Gage blocks, surface plate
Digital Level, Protractors	Up to 360°	250 µ°/° + 0.034°	Gage blocks, sine bar, surface plate
Length – Rules & Tapes	Up to 40 in	57 µin/in + 0.002 in	DRO ME-HZ 1000 slide caliper
Length – Rules & Tape Measures (unable to remove from fixture) ³	Up to 100 ft	0.0091 in every 3 ft	Gage blocks or caliper checker

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 4, 5} ($\pm$)	Comments
DC Voltage ³ – Generate	10 V (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	0.50 μ V/V 7.8 μ V/V + 400 nV 5.0 μ V/V + 0.7 μ V 3.5 μ V/V + 2.5 μ V 3.6 μ V/V + 4 μ V 5.0 μ V/V + 40 μ V 6.5 μ V/V + 400 μ V	Fluke 732A Fluke 5720A
Generate, Compare	(100 to 1400) V (1401 to 10 000) V (10 001 to 24 000) V (24 001 to 100 000) V (100 001 to 150 000) V	500 μ V/V + 15 mV 300 μ V/V + 280 mV 560 μ V/V + 0.4 V 570 μ V/V + 1.0 V 920 μ V/V + 8.0V	Vitretek 4700 w/ HVL-150
DC Voltage ³ – Measure	Up to 200 mV (0.2 to 2.0) V (2.0 to 20) V (20 to 200) V (200 to 1000) V 10 V (100 to 1400) V (1401 to 10 000) V (10 001 to 24 000) V (24 001 to 100 000) V (100 001 to 150 000) V	7.6 μ V/V + 0.1 μ V 3.7 μ V/V + 0.4 μ V 3.6 μ V/V + 4 μ V 5.6 μ V/V + 40 μ V 5.5 μ V/V + 500 μ V 0.30 μ V/V 500 μ V/V + 15 mV 300 μ V/V + 280 mV 560 μ V/V + 0.4 V 570 μ V/V + 1.0 V 920 μ V/V + 8.0V	Fluke 8508A Fluke 732A DC voltage reference & Fluke 8508A Vitretek 4700 w/ HVL-150

Parameter/Equipment	Range	CMC ^{2, 4, 5} ($\pm$)	Comments
DC Current ^{3, 6} – Generate	(0 to 2) pA	2.4 % + 0.02 pA	Keithley 263
	(2 to 20) pA	0.64 % + 0.02 pA	
	(20 to 200) pA	0.27 % + 0.04 pA	
	200 pA to 2 nA	0.11 % + 0.13 nA	
	(2 to 20) nA	0.090 % + 1.1 pA	
	(20 to 220) μ A	40 μ A/A + 6 nA	Fluke 5720A
	220 μ A to 2.2 mA	35 μ A/A + 7 nA	Standard resistor, Fluke 8508A, & Fluke 5520A
	(2.2 to 22) mA	35 μ A/A + 40 nA	
	(22 to 220) mA	45 μ A/A + 0.7 μ A	
	220 mA to 2.2 A	80 μ A/A + 12 μ A	
	(10 to 100) μ A	0.0035 % + 0.4 nA	
	100 μ A to 10 mA	0.0035 % + 4 nA	Standard shunt, Fluke 8508A, Ballantine 1620A, & Fluke 5720A
	10 mA to 1 A	0.0036 % + 0.4 μ A	
	(1 to 10) A	0.0036 % + 4 μ A	
	20 A	0.012 % + 0.1 mA	
	(15 to 100) A	0.042 % + 0.1 mA	
	(100 to 300) A	0.042 % + 0.1 mA	
	(20 to 149.99) A	5.5 mA/A + 90 mA	Fluke 5500A/coil & 5520A
	(149.9995 to 1025)	4.9 mA/A + 180 mA	
	(0 to 200) μ A	13 μ A/A + 0.4 nA	Fluke 8508A
	(0.2 to 2.0) mA	13 μ A/A + 4 nA	
	(2.0 to 20) mA	15 μ A/A + 40 nA	
DC Current ^{3, 6} – Measure	(20 to 200) mA	50 μ A/A + 0.8 μ A	
	20 mA to 2 A	0.19 mA/A + 16 μ A	
	(2 to 20) A	0.40 mA/A + 400 μ A	
	(10 to 100) μ A	0.0032 % IV + 0.4 nA	L&N 4000 series, Biddle Cat. # 601235, & Fluke 8508A
	100 μ A to 10 mA	0.0032 % IV + 4 nA	
	10 mA to 1 A	0.0032 % IV + 0.4 μ A	
	(1 to 10) A	0.0032 % IV + 4 μ A	
	(10 to 15) A	0.014 % IV + 0.1 mA	
	(15 to 100) A	0.029 % IV + 0.1 mA	L&N 4360 shunt w/ Fluke 8508A
	(100 to 300) A	0.046 % IV + 0.1 mA	L&N 4361 shunt w/ Fluke 8508A
			L&N 4363 shunt w/ Fluke 8508A

Parameter/Equipment	Range	CMC ^{2, 4, 5} ($\pm$)	Comments
DC Power – Generate ³ 33 mV to 1020 V	100 mW to 330 W (331 to 3000) W (3001 to 20 000) W	140 μ W/W + 29 nW 400 μ W/W + 460 nW 1.1 mW/W + 42 μ W	Fluke 5520A
Capacitance ^{3, 6} – Measure, @ 1 kHz	(10, 100, 1000) pF 1 pF to 1 μ F (1 to 10) μ F (10 to 100) μ F	0.012 % IV 0.012 % IV 1.1 μ F/F + 900 nF 410 μ F/F + 1.8 nF	General radio 1615-A, General radio 1404 series, & ESI SC 1000 standard capacitors General radio 1615-A General radio 1683
Capacitance ^{3, 6} – Generate @ 1 kHz	(10, 100, 1000) pF 1 pF to 1 μ F (1 to 10) μ F (10 to 100) μ F	0.0018 % IV 0.053 % IV + 0.7 pF 1.1 μ F/F + 900 nF 410 μ F/F + 1.8 nF	General radio 1404 series & ESI SC 1000 standard capacitors General radio 1413-decade capacitor J.H. decade capacitor

Parameter/Equipment	Range	CMC ^{2, 4, 5} ($\pm$)	Comments
Resistance ³ – Measure	(0.0 to 2) Ω (2 to 20) Ω (20 to 200) Ω 200 Ω to 2 k Ω (2 to 20) k Ω (20 to 200) k Ω 200 k Ω to 2 M Ω (2 to 20) M Ω (20 to 200) M Ω 200 M Ω to 1 G Ω	20 $\mu\Omega/\Omega$ + 4 $\mu\Omega$ 11 $\mu\Omega/\Omega$ + 14 $\mu\Omega$ 8.4 $\mu\Omega/\Omega$ + 50 $\mu\Omega$ 8.3 $\mu\Omega/\Omega$ + 0.5 m Ω 8.3 $\mu\Omega/\Omega$ + 5 m Ω 8.6 $\mu\Omega/\Omega$ + 50 m Ω 11 $\mu\Omega/\Omega$ + 1 Ω 24 $\mu\Omega/\Omega$ + 100 Ω 140 $\mu\Omega/\Omega$ + 10 k Ω 1.5 m Ω/Ω + 30 k Ω	Fluke 8508A
Fixed Points	0.0001 Ω 0.001 Ω 0.01 Ω	190 $\mu\Omega/\Omega$ 110 $\mu\Omega/\Omega$ 82 $\mu\Omega/\Omega$	Fluke 8508A, Guildline 1659, Biddle #601235, & L&N 4334B standard resistors
Shunts	50 $\mu\Omega$ to 0.1 Ω	84 $\mu\Omega/\Omega$	Fluke 8508A, Agilent 3458A, & L&N 436x standard shunt
Resistance ³ – Generate	(0.1 to 10) Ω 10 Ω to 1 k Ω (1 to 100) k Ω 100 k Ω to 10 M Ω (10 to 100) M Ω 100 M Ω to 1G Ω	44 $\mu\Omega/\Omega$ 42 $\mu\Omega/\Omega$ 42 $\mu\Omega/\Omega$ 42 $\mu\Omega/\Omega$ 44 $\mu\Omega/\Omega$ 1.5 m Ω/Ω + 30 k Ω	Thomas 1 Ω , ESI SR104 & SR 1010 standard resistors ESI SR104, ESI SR1010, & ESI SR1050 standard resistors
Fixed Points	1.0 Ω 0.1 Ω 0.01 Ω 0.001 Ω 0.0001 Ω	4.7 $\mu\Omega/\Omega$ 78 $\mu\Omega/\Omega$ 41 $\mu\Omega/\Omega$ 84 $\mu\Omega/\Omega$ 330 $\mu\Omega/\Omega$	Biddle Cat. #601235 standard resistor, Guildline type 1659 standard resistor, & L&N 4334B standard resistor
Inductance ³ – Generate, @ 1 kHz	100 μ H to 10 H	0.031 % IV	General radio 1482 series standard inductors & DT72A ratio transformer
Inductance ³ – Measure, @ 1 kHz	100 μ H to 10 H	0.026 % IV	General radio 1482 standard inductor & ESI DT 72A

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation Thermocouple Indicators ³ –			
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.47 °C 0.37 °C 0.34 °C 0.36 °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	0.34 °C 0.30 °C 0.35 °C 0.52 °C 0.86 °C	
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.52 °C 0.22 °C 0.20 °C 0.22 °C 0.26 °C	
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.31 °C 0.22 °C 0.20 °C 0.23 °C 0.28 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.36 °C 0.23 °C 0.22 °C 0.32 °C 0.43 °C	
Type L	(-200 to -100) °C (-100 to 800) °C (800 to 900) °C	0.40 °C 0.30 °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	0.43 °C 0.27 °C 0.24 °C 0.23 °C 0.31 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.59 °C 0.38 °C 0.36 °C 0.43 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation Thermocouple Indicators ³ – (cont)			
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.50 °C 0.39 °C 0.40 °C 0.49 °C	Fluke 5520A
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.65 °C 0.28 °C 0.22 °C 0.20 °C	
Type U	(-200 to 0) °C (0 to 600) °C	0.58 °C 0.31 °C	
Electrical Simulation 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	0.10 °C 0.10 °C 0.14 °C 0.18 °C 0.20 °C 0.24 °C 0.46 °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 600) °C (600 to 630) °C	0.08 °C 0.08 °C 0.08 °C 0.10 °C 0.24 °C 0.26 °C 0.28 °C 0.32 °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	0.08 °C 0.10 °C 0.10 °C 0.12 °C 0.16 °C 0.16 °C 0.18 °C 0.22 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation RTD Indicators ³ – (cont)			
Pt 385, 1 kΩ	(-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	0.06 °C 0.06 °C 0.08 °C 0.10 °C 0.12 °C 0.14 °C 0.14 °C 0.46 °C	Fluke 5520A
PtNi 385, 120 Ω	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.16 °C 0.16 °C 0.28 °C	
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	0.10 °C 0.10 °C 0.14 °C 0.18 °C 0.20 °C 0.24 °C	
Cu 427, 10 Ω	(600 to 630) °C	0.60 °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	0.50 °C 0.08 °C 0.10 °C 0.12 °C 0.14 °C 0.16 °C 0.18 °C 0.20 °C 0.46 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation & Measure Thermocouple Indicators ³ –			
Type B	(40 to 100) °C (100 to 260) °C (260 to 500) °C (500 to 700) °C (700 to 1100) °C (1100 to 1500) °C (1500 to 1820) °C	0.14 °C 0.047 °C 0.028 °C 0.024 °C 0.017 °C 0.014 °C 0.016 °C	Fluke 5720A & Fluke 8508A
Type C	(0 to 100) °C (100 to 400) °C (400 to 1000) °C (1000 to 1500) °C (1500 to 1700) °C (1700 to 2000) °C (2000 to 2320) °C	0.011 °C 0.010 °C 0.011 °C 0.016 °C 0.018 °C 0.022 °C 0.031 °C	
Type E	(-270 to -200) °C (-200 to -100) °C (-100 to 100) °C (100 to 700) °C (700 to 1000) °C	0.013 °C 0.0070 °C 0.0060 °C 0.0070 °C 0.0090 °C	
Type J	(-210 to -100) °C (-100 to 500) °C (500 to 900) °C (900 to 1100) °C (1100 to 1200) °C	0.0070 °C 0.0060 °C 0.0070 °C 0.0080 °C 0.010 °C	
Type K	(-270 to -150) °C (-150 to 500) °C (500 to 1100) °C (1100 to 1200) °C (1200 to 1372) °C	0.049 °C 0.0070 °C 0.0080 °C 0.010 °C 0.013 °C	
Type L	(-200 to 0) °C (-0 to 100) °C (100 to 700) °C (700 to 900) °C	0.0070 °C 0.0060 °C 0.0070 °C 0.0080 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation & Measure Thermocouple Indicators ³ – (cont)			
Type N	(-270 to -250) °C (-250 to -150) °C (-150 to 0) °C (0 to 900) °C (900 to 1100) °C (1100 to 1300) °C	0.14 °C 0.015 °C 0.0080 °C 0.0070 °C 0.0090 °C 0.011 °C	Fluke 5720A & Fluke 8508A
Type R	(-50 to 0) °C (0 to 100) °C (100 to 900) °C (900 to 1300) °C (1300 to 1768) °C	0.028 °C 0.021 °C 0.015 °C 0.013 °C 0.017 °C	
Type S	(-50 to 0) °C (0 to 100) °C (100 to 1300) °C (1300 to 1768) °C	0.028 °C 0.021 °C 0.015 °C 0.018 °C	
Type T	(-270 to -250) °C (-250 to -200) °C (-200 to -100) °C (-100 to 100) °C (100 to 250) °C (250 to 300) °C (300 to 350) °C (350 to 400) °C	0.070 °C 0.029 °C 0.0080 °C 0.0070 °C 0.0060 °C 0.0070 °C 0.0060 °C 0.0070 °C	
Type U	(-200 to -150) °C (-150 to -50) °C (-50 to 250) °C (250 to 600) °C	0.0090 °C 0.0070 °C 0.0060 °C 0.0070 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation & Measure RTD Indicators ³ –			
Pt 385, 100 Ω	(-200 to -40) °C (-40 to 150) °C (150 to 260) °C (260 to 400) °C (400 to 500) °C (500 to 700) °C (700 to 800) °C (800 to 850) °C	0.0060 °C 0.0070 °C 0.0080 °C 0.0090 °C 0.012 °C 0.013 °C 0.014 °C 0.016 °C	Fluke 5720A & Fluke 8508A
Pt 3926, 100 Ω	(-200 to -40) °C (-40 to 150) °C (150 to 260) °C (260 to 400) °C (400 to 600) °C (600 to 660) °C	0.0060 °C 0.0070 °C 0.0080 °C 0.0090 °C 0.012 °C 0.013 °C	
Pt 3916, 100 Ω	(-200 to -40) °C (-40 to 150) °C (150 to 260) °C (260 to 400) °C (400 to 600) °C (600 to 660) °C	0.0060 °C 0.0070 °C 0.0080 °C 0.0090 °C 0.012 °C 0.013 °C	
Pt 385, 200 Ω	(-200 to -20) °C (-20 to 100) °C (100 to 200) °C (200 to 300) °C (300 to 400) °C (400 to 500) °C (500 to 700) °C (700 to 850) °C	0.0060 °C 0.0070 °C 0.0080 °C 0.0090 °C 0.010 °C 0.011 °C 0.012 °C 0.014 °C	
Pt 385, 500 Ω	(-200 to -50) °C (-50 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 500) °C (500 to 700) °C (700 to 850) °C	0.0060 °C 0.0070 °C 0.0080 °C 0.010 °C 0.011 °C 0.012 °C 0.014 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation & Measure RTD Indicators ³ – (cont)			
Pt 385, 1 kΩ	(-200 to -50) °C (-50 to 100) °C (100 to 200) °C (200 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 700) °C (700 to 850) °C	0.0060 °C 0.0070 °C 0.0080 °C 0.010 °C 0.011 °C 0.012 °C 0.014 °C 0.016 °C	Fluke 5720A & Fluke 8508A
PtNi 385, 120 Ω	(-80 to 90) °C (90 to 260) °C	0.0060 °C 0.0070 °C	
Cu 427, 10 Ω	(-190 to -100) °C (-100 to 50) °C (50 to 260) °C	0.0060 °C 0.0070 °C 0.0080 °C	
YSI, 400 Ω	(15 to 50) °C	0.0060 °C	

Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
AC Current – Measure ^{3, 6}			
Up to 200 μA 200 μA to 2 mA (2 to 20) mA (20 to 200) mA	10 Hz to 10 kHz 10 Hz to 10 kHz 10 Hz to 10 kHz 10 Hz to 10 kHz	0.036 % + 20 nA 0.031 % + 0.2 μA 0.032 % + 2 μA 0.030 % + 20 μA	Fluke 8508A
200 mA to 2 A	10 Hz to 2 kHz (2 to 10) kHz	0.063 % + 0.2 mA 0.073 % + 0.2 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	0.012 % + 0.2 μA 0.012 % + 0.2 μA 0.0082 % + 0.2 μA 0.0096 % + 0.2 μA 0.0098 % + 0.2 μA	Fluke A40 shunts, Fluke 5720A, & 8508A
(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	0.012 % + 2 μA 0.012 % + 2 μA 0.0082 % + 2 μA 0.0098 % + 2 μA 0.0098 % + 2 μA	

Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
AC Current – Measure ^{3, 6} (cont)			
220 mA to 2.2 A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.015 % + 20 µA 0.015 % + 20 µA 0.012 % + 20 µA 0.013 % + 20 µA 0.013 % + 20 µA	Fluke A40 shunts, Fluke 5720A, & 8508A
(2 to 10) A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.065 % + 0.2 mA 0.064 % + 0.2 mA 0.064 % + 0.2 mA 0.064 % + 0.2 mA 0.064 % + 0.2 mA	
(10 to 20) A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.068 % + 0.2 mA 0.068 % + 0.2 mA 0.068 % + 0.2 mA 0.068 % + 0.2 mA 0.068 % + 0.2 mA	
(10 to 100) A	60 Hz	0.045 % + 2 mA	
(100 to 300) A	60 Hz	0.078 % + 2 mA	L&N 4361 shunt, Fluke 8508A
(20 to 100) A	(45 to 65) Hz	150 µA/A + 16 mA	L&N 4363 shunt, Fluke 8508A
(100 to 1000) A	(45 to 65) Hz	450 µA/A + 0.019 A	Fluke 5520A, Fluke 5500A coil

Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
AC Current – Generate ^{3, 6}			
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	0.025 % + 16 nA 0.016 % + 10 nA 0.012 % + 8 nA 0.028 % + 12 nA 0.11 % + 65 nA	Fluke 5720A
220 µA to 2.2 mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.025 % + 40 nA 0.016 % + 35 nA 0.012 % + 35 nA 0.020 % + 110 nA 0.11 % + 650 nA	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.025 % + 400 nA 0.016 % + 350 nA 0.012 % + 350 nA 0.020 % + 500 nA 0.11 % + 5 µA	
(22 to 220) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.025 % + 4 µA 0.016 % + 3.5 µA 0.012 % + 2.5 µA 0.020 % + 3.5 µA 0.11 % + 10 µA	
220 mA to 2.2 A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.026 % + 35 µA 0.045 % + 80 µA 0.70 % + 650 nA	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.014 % + 0.2 µA 0.014 % + 0.2 µA 0.011 % + 0.2 µA 0.013 % + 0.2 µA 0.013 % + 0.2 µA	Fluke 5720A, Fluke A40 AC shunts, & 8508A
(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	0.014 % + 2 µA 0.017 % + 2 µA 0.011 % + 2 µA 0.013 % + 2 µA 0.013 % + 2 µA	
(220 to 2.2) A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.017 % + 20 µA 0.016 % + 20 µA 0.014 % + 20 µA 0.016 % + 20 µA 0.016 % + 20 µA	

Parameter/Range	Frequency	CMC ^{2, 4, 5} ($\pm$)	Comments
AC Current – Generate ^{3, 6} (cont)			
(2 to 10) A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.065 % + 0.2 mA 0.064 % + 0.2 mA 0.064 % + 0.2 mA 0.064 % + 0.2 mA 0.064 % + 0.2 mA	Fluke A40 AC shunts, 5720A, 5220A, & 8508A
(10 to 100) A	45 Hz to 1 kHz	0.60 %	Fluke 5720A & Ballentine AC current calibrator
(20 to 34.999) A	(45 to 65) Hz (66 to 400) Hz	1.8 % 2.3 %	
(35 to 49.999) A	(45 to 65) Hz (66 to 400) Hz	1.3 % 1.7 %	
(50 to 54.9995) A	(45 to 65) Hz (66 to 400) Hz	1.1 % 1.5 %	
(55 to 99.995) A	(45 to 65) Hz (66 to 400) Hz	1 % 1.5 %	
(100 to 1025) A	(45 to 65) Hz (65 to 400) Hz	5.6 mA/A + 40 mA 9.7 mA/A + 87 mA	Fluke 5520A w/ 5500A/coil

Parameter/Range	Frequency	CMC ^{2,4} ($\pm$)	Comments
AC Voltage – Measure ³			
(0 to 200) mV	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz (0.1 to 2) kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.17 mV/V + 14 μ V 0.14 mV/V + 4.3 μ V 0.35 mV/V + 4.3 μ V 0.11 mV/V + 2.1 μ V 0.13 mV/V + 4.7 μ V 0.34 mV/V + 8.3 μ V 0.87 mV/V + 20 μ V	Fluke 8508A
(0.2 to 2) V	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz (0.1 to 2) kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz	0.15 mV/V + 0.12 mV 0.12 mV/V + 21 μ V 0.091 mV/V + 21 μ V 0.076 mV/V + 21 μ V 0.11 mV/V + 21 μ V 0.22 mV/V + 40 μ V 0.58 mV/V + 0.20 mV 3.0 mV/V + 2.0 mV 10 mV/V + 20 mV	
(2 to 20) V	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz (0.1 to 2) kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz	0.15 mV/V + 1.2 mV 0.11 mV/V + 0.21 mV 0.091 mV/V + 0.20 mV 0.076 mV/V + 0.21 mV 0.11 mV/V + 0.21 mV 0.22 mV/V + 0.41 mV 0.58 mV/V + 2.0 mV 3.0 mV/V + 20 mV 10 mV/V + 200 mV	
(20 to 200) V	(1 to 10) Hz (10 to 40) Hz (40 to 100) Hz (0.1 to 2) kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz	0.15 mV/V + 12 mV 0.12 mV/V + 2.1 mV 0.091 mV/V + 2.1 mV 0.076 mV/V + 2.0 mV 0.11 mV/V + 2.1 mV 0.22 mV/V + 4.1 mV 0.58 mV/V + 21 mV 3.1 mV/V + 200 mV 10 mV/V + 2.0 V	
(200 to 1050) V	(1 to 10) Hz (10 to 40) Hz 40 Hz to 10 kHz (10 to 30) kHz (30 to 100) kHz	0.16 mV/V + 73 mV 0.12 mV/V + 21 mV 0.12 mV/V + 21 mV 0.23 mV/V + 42 mV 0.59 mV/V + 210 mV	

Parameter/Range	Frequency	CMC ^{2, 4, 5} (±)	Comments
AC Voltage – Measure, Range			
(7 to 22) mV	(10 to 19.99) Hz (20 to 39.99) Hz (40 to 99.99) Hz (100 to 999.9) Hz (1 to 9.99) kHz (10 to 19.99) kHz (20 to 49.99) kHz (50 to 99.99) kHz (100 to 299.9) kHz (300 to 499.9) kHz (500 to 799.9) kHz (800 to 999.9) kHz 1 MHz	0.022 % 0.011 % 0.011 % 0.011 % 79 µV/V 0.017 % 73 µV/V 88 µV/V 0.024 % 0.027 % 0.042 % 0.048 % 0.041 %	Fluke 792A & 8508A-01
(22 to 70) mV	(10 to 19.99) Hz (20 to 39.99) Hz (40 to 99.99) Hz (100 to 999.9) Hz (1 to 9.99) kHz (10 to 19.99) kHz (20 to 49.99) kHz (50 to 99.99) kHz (100 to 299.9) kHz (300 to 499.9) kHz (500 to 799.9) kHz (800 to 999.9) kHz 1 MHz	0.018 % 0.021 % 64 µV/V 56 µV/V 47 µV/V 55 µV/V 0.016 % 41 µV/V 47 µV/V 0.021 % 0.20 % 0.29 % 0.33 %	
(70 to 220) mV	(10 to 19.99) Hz (20 to 39.99) Hz (40 to 99.99) Hz (100 to 999.9) Hz (1 to 9.99) kHz (10 to 19.99) kHz (20 to 49.99) kHz (50 to 99.99) kHz (100 to 299.9) kHz (300 to 499.9) kHz (500 to 799.9) kHz (800 to 999.9) kHz 1 MHz	0.38 % 41 µV/V 44 µV/V 34 µV/V 29 µV/V 23 µV/V 27 µV/V 25 µV/V 44 µV/V 86 µV/V 0.016 % 0.019 % 0.023 %	

Parameter/Range	Frequency	CMC ^{2, 4, 5} ($\pm$)	Comments
AC Voltage – Measure, Range ³ (cont)			
(220 to 700) mV	(10 to 19.99) Hz (20 to 39.99) Hz (40 to 99.99) Hz (100 to 999.9) Hz (1 to 9.99) kHz (10 to 19.99) kHz (20 to 49.99) kHz (50 to 99.99) kHz (100 to 299.9) kHz (300 to 499.9) kHz (500 to 799.9) kHz (800 to 999.9) kHz 1 MHz	62 μ V/V 62 μ V/V 78 μ V/V 0.011 % 26 μ V/V 20 μ V/V 15 μ V/V 19 μ V/V 22 μ V/V 21 μ V/V 18 μ V/V 14 μ V/V 30 μ V/V	Fluke 792A & 8508A-01
700 mV to 2.2 V	(10 to 19.99) Hz (20 to 39.99) Hz (40 to 99.99) Hz (100 to 999.9) Hz (1 to 9.99) kHz (10 to 19.99) kHz (20 to 49.99) kHz (50 to 99.99) kHz (100 to 299.9) kHz (300 to 499.9) kHz (500 to 799.9) kHz (800 to 999.9) kHz 1 MHz	66 μ V/V 27 μ V/V 25 μ V/V 19 μ V/V 14 μ V/V 10 μ V/V 10 μ V/V 13 μ V/V 19 μ V/V 48 μ V/V 49 μ V/V 51 μ V/V 63 μ V/V	
(2.2 to 7.0) V	(10 to 19.99) Hz (20 to 39.99) Hz (40 to 99.99) Hz (100 to 999.9) Hz (1 to 9.99) kHz (10 to 19.99) kHz (20 to 49.99) kHz (50 to 99.99) kHz (100 to 299.9) kHz (300 to 499.9) kHz (500 to 799.9) kHz (800 to 999.9) kHz 1 MHz	63 μ V/V 55 μ V/V 18 μ V/V 18 μ V/V 12 μ V/V 9 μ V/V 9 μ V/V 12 μ V/V 14 μ V/V 38 μ V/V 34 μ V/V 40 μ V/V 89 μ V/V	

Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
AC Voltage – Measure, Range ³ (cont)			
(7 to 22) V	(10 to 19.99) Hz (20 to 39.99) Hz (40 to 99.99) Hz (100 to 999.9) Hz (1 to 9.99) kHz (10 to 19.99) kHz (20 to 49.99) kHz (50 to 99.99) kHz (100 to 299.9) kHz (300 to 499.9) kHz (500 to 799.9) kHz (800 to 999.9) kHz 1 MHz	87 µV/V 31 µV/V 24 µV/V 19 µV/V 12 µV/V 9.0 µV/V 9.0 µV/V 11 µV/V 14 µV/V 36 µV/V 40 µV/V 61 µV/V 86 µV/V	Fluke 792A & 8508A-01
(22 to 70) V	(10 to 19.99) Hz (20 to 39.99) Hz (40 to 99.99) Hz (100 to 999.9) Hz (1 to 9.99) kHz (10 to 19.99) kHz (20 to 49.99) kHz (50 to 99.99) kHz (100 to 299.9) kHz 300 kHz	70 µV/V 31 µV/V 26 µV/V 20 µV/V 14 µV/V 11 µV/V 11 µV/V 13 µV/V 15 µV/V 55 µV/V	
(70 to 220) V	(10 to 19.99) Hz (20 to 39.99) Hz (40 to 99.99) Hz (100 to 999.9) Hz (1 to 9.99) kHz (10 to 19.99) kHz (20 to 49.99) kHz (50 to 99.99) kHz 100 kHz	72 µV/V 28 µV/V 25 µV/V 14 µV/V 14 µV/V 11 µV/V 13 µV/V 27 µV/V 48 µV/V	

Parameter/Range	Frequency	CMC ^{2, 4, 5} (±)	Comments
AC Voltage – Measure, Range ³ (cont)			
(220 to 700) V	(20 to 39.99) Hz (40 to 99.99) Hz (100 to 999.9) Hz (1 to 9.99) kHz (10 to 19.99) kHz (20 to 49.99) kHz (50 to 99.99) kHz 100 kHz	48 µV/V 30 µV/V 22 µV/V 18 µV/V 15 µV/V 16 µV/V 34 µV/V 64 µV/V	Fluke 792A & 8508A-01
(700 to 1000) V	(20 to 39.99) Hz (40 to 99.99) Hz (100 to 999.9) Hz (1 to 9.99) kHz (10 to 19.99) kHz (20 to 49.99) kHz (50 to 99.99) kHz 100 kHz	64 µV/V 31 µV/V 23 µV/V 22 µV/V 19 µV/V 22 µV/V 42 µV/V 67 µV/V	Fluke 792A, 5720A, & 5205A
(100 to 1000) V (1000 to 7071) V (7071 to 70 710) V (70 711 to 100 000) V	(30 to 600) Hz	1.3 mV/V + 110 mV 1.7 mV/V + 150 mV 1.6 mV/V + 0.63 V 5.4 mV/V + 1.1 V	Vitrek 4700 w/ HVL-150
AC Voltage – Generate, Range ³			
(220 to 700) mV	(10 to 19.99) Hz (20 to 39.99) Hz (40 to 99.99) Hz (100 to 999.9) Hz (1 to 9.99) kHz (10 to 19.99) kHz (20 to 49.99) kHz (50 to 99.99) kHz (100 to 299.9) kHz (300 to 499.9) kHz (500 to 799.9) kHz (800 to 999.9) kHz 1 MHz	0.032 % 0.031 % 0.013 % 0.012 % 0.012 % 0.012 % 0.012 % 0.024 % 0.055 % 0.11 % 0.16 % 0.30 % 0.30 %	Fluke 792A & 5720A

Parameter/Range	Frequency	CMC ^{2, 4, 5} (±)	Comments
AC Voltage – Generate, Range ³ (cont)			
700 mV to 2.2 V	(10 to 19.99) Hz (20 to 39.99) Hz (40 to 99.99) Hz (100 to 999.9) Hz (1 to 9.99) kHz (10 to 19.99) kHz (20 to 49.99) kHz (50 to 99.99) kHz (100 to 299.9) kHz (300 to 499.9) kHz (500 to 799.9) kHz (800 to 999.9) kHz 1 MHz	0.033 % 0.031 % 0.012 % 0.010 % 0.010 % 0.010 % 0.010 % 0.022 % 0.051 % 0.11 % 0.18 % 0.32 % 0.32 %	Fluke 792A & 5720A
(2.2 to 7) V	(10 to 19.99) Hz (20 to 39.99) Hz (40 to 99.99) Hz (100 to 999.9) Hz (1 to 9.99) kHz (10 to 19.99) kHz (20 to 49.99) kHz (50 to 99.99) kHz (100 to 299.9) kHz (300 to 499.9) kHz (500 to 799.9) kHz (800 to 999.9) kHz 1 MHz	0.027 % 0.027 % 0.011 % 86 µV/V 85 µV/V 85 µV/V 85 µV/V 0.021 % 0.048 % 0.095 % 0.15 % 0.29 % 0.29 %	
(7 to 22) V	(10 to 19.99) Hz (20 to 39.99) Hz (40 to 99.99) Hz (100 to 999.9) Hz (1 to 9.99) kHz (10 to 19.99) kHz (20 to 49.99) kHz (50 to 99.99) kHz (100 to 299.9) kHz (300 to 499.9) kHz (500 to 799.9) kHz (800 to 999.9) kHz 1 MHz	0.032 % 0.032 % 0.012 % 56 µV/V 55 µV/V 54 µV/V 54 µV/V 92 µV/V 0.014 % 0.038 % 0.014 % 0.21 % 0.21 %	

Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
AC Voltage – Generate ³			
(0.22 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	240 µV/V + 4 µV 90 µV/V + 4 µV 80 µV/V + 4 µV 200 µV/V + 4 µV 500 µV/V + 5 µV 1.1 mV/V + 10 µV 1.4 mV/V + 20 µV 2.7 mV/V + 20 µV	Fluke 5720A
(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	240 µV/V + 12 µV 90 µV/V + 7 µV 80 µV/V + 7 µV 200 µV/V + 7 µV 460 µV/V + 17 µV 900 µV/V + 20 µV 1.4 mV/V + 25 µV 2.7 mV/V + 45 µV	
(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	240 µV/V + 40 µV 90 µV/V + 15 µV 45 µV/V + 8 µV 77 µV/V + 10 µV 110 µV/V + 30 µV 420 µV/V + 80 µV 1.0 mV/V + 200 µV 1.7 mV/V + 300 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	240 µV/V + 400 µV 90 µV/V + 150 µV 45 µV/V + 50 µV 77 µV/V + 100 µV 100 µV/V + 200 µV 280 µV/V + 600 µV 1.0 mV/V + 2 mV 1.5 mV/V + 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	240 µV/V + 4 mV 90 µV/V + 1.5 mV 55 µV/V + 600 µV 81 µV/V + 1 mV 150 µV/V + 2.5 mV	
(220 to 1000) V	(15 to 50) Hz* 50 Hz to 1 kHz	300 µV/V + 16 mV 71 µV/V + 3.5 mV	* Max output 250 V from 15 Hz to 50 Hz

Parameter/Range	Frequency	CMC ^{2,4} ($\pm$)	Comments
AC Voltage – Generate ³ (cont)			
(330 to 1000) V	(1.001 to 5) kHz (5.001 to 10) kHz	250 μ V/V + 1.5 mV 280 μ V/V + 18 mV	Fluke 5520A
(100 to 1000) V (1000 to 7071) V (7071 to 70 710) V (70 711 to 100 000) V	(30 to 600) Hz	1.3 mV/V + 110 mV 1.7 mV/V + 150 mV 1.6 mV/V + 0.63 V 5.4 mV/V + 1.1 V	Vitretek 4700 w/ HVL-150 & source
AC Power ³ – Generate PF = 1			
(30 to 700) mW 700 mW to 33 W (34 to 90) W (91 to 330) W (331 to 900) W (901 to 2200) W (2201 to 5000) W (5001 to 20 000) W	(45 to 65) Hz (45 to 65) Hz (45 to 65) Hz (45 to 65) Hz (45 to 65) Hz (45 to 65) Hz (45 to 65) Hz (45 to 65) Hz	1.4 mW/W + 75 nW 1.7 mW/W + 550 nW 1.2 mW/W + 68 nW 820 μ W/W + 350 nW 1.1 mW/W + 210 nW 910 μ W/W + 270 nW 1.7 mW/W + 170 μ W 1.8 mW/W + 670 μ W	Fluke 5520A
(30 to 100) mW 100 mW to 330 W (331 to 11 000) W (11 001 to 20 000) W	66 Hz to 1 kHz 66 Hz to 1 kHz 66 Hz to 1 kHz 66 Hz to 1 kHz	640 μ W/W + 1.9 μ W 580 μ W/W + 5.7 μ W 1.3 mW/W + 510 μ W 1.8 mW/W + 670 μ W	
110 mW to 3000 W	1.01 kHz to 5 kHz	10 mW/W + 540 μ W	

Parameter/Range	Frequency	CMC ^{2, 4} (±)	Comments
Oscilloscopes ³ –			Fluke 5520A/ SC1100
Volts DC, 50Ω Load	(1 to 109.99) mV 110 mV to 2.1999 V (2.2 V to 5 V)	2.5 mV/V + 40 μV 2.5 mV/V + 100 μV 2.8 mV/V + 1 mV	
Volts DC, 1MΩ Load	(1 to 109.99) mV 110 mV to 2.1999 V (2.2 to 10.999) V (11 to 130.00) V	500 μV/V + 40 μV 520 μV/V + 100 μV 1.3 mV/V + 1 mV 12 mV/V + 10 mV	
Volts, Square Wave, 1 kHz, 50Ω Load	(1 to 24.999) mVpp 25 mVpp to 2.1999 Vpp (2.2 to 5) Vpp	2.9 mVpp/Vpp + 40 μVpp 2.5 mVpp/Vpp + 40 μVpp 2.8 mVpp/Vpp + 40 μVpp	
Volts, Square Wave, 1 kHz, 1 MΩ Load	(1 to 109.99) mVpp 110 mVpp to 2.1999 Vpp (2.2 to 10.999) Vpp (11 to 130) Vpp	1 mVpp/Vpp + 40 μVpp 1.1 mVpp/Vpp + 40 μVpp 1.9 mVpp/Vpp + 40 μVpp 18 mVpp/Vpp + 40 μVpp	
Rise Time	Edge Function, 1 kHz to 2 MHz Edge Function, > (2 to 10) MHz	-0.00/+320 ps -0.00/360 ps	
Leveled Sine Wave Flatness (Relative to 50 kHz)	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz	0.018 V/V + 100 μV 0.022 V/V + 100 μV 0.041 V/V + 100 μV 0.051 V/V + 100 μV	
Time Marker Absolute Uncertainty	(1 to 5) ns (Sine Wave) 10 ns, Square Wave, Sine Wave 20 ns-50 ns Spike, Square Wave 100 ns-20 ms Spike, Square Wave (20 % Duty Cycle), Square Wave (50 % Duty Cycle) 50 ms-5s Square Wave & Spike	2.7 μs/s + 1 ps 2.7 μs/s + 10 ps 2.7 μs/s + 10 ps 2.7 μs/s + 100ps 1 ms/s + 10 μs	

III. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ^{2, 4, 5} ($\pm$)	Comments
RF Power ³ – Measure			
1 mW DC Substitution Method	(1 to 1000) MHz	0.74 %	Agilent 478A-H75 & 34401A
RF Power Meter Display Accuracy, DC Substitution Method	3 μ W to 100 mW	3.3 mW/W	Hewlett Packard 11683A range calibrator
(1 to 10) μ W, 50 Ω	100 kHz to 10 MHz (10 to 30) MHz (30 to 500) MHz 500 MHz to 1.2 GHz (1.2 to 6.0) GHz (6 to 8) GHz (8 to 12.4) GHz (12.4 to 14) GHz (14 to 18) GHz (18 to 26.5) GHz	76 mW/W + 32 nW 68 mW/W + 36 nW 69 mW/W + 37 nW 71 mW/W + 37 nW 72 mW/W + 37 nW 73 mW/W + 38 nW 75 mW/W + 39 nW 75 mW/W + 37 nW 75 mW/W + 31 nW 78 mW/W + 41 nW	Frequency sources w/Agilent E4418B or E4419B power meter & Agilent 8482A/E4412A/E44 13A power sensors
(10 to 100) μ W, 50 Ω	100 kHz to 10 MHz (10 to 30) MHz (30 to 500) MHz 500 MHz to 1.2 GHz (1.2 to 6.0) GHz (6 to 8) GHz (8 to 12.4) GHz (12.4 to 14) GHz (14 to 18) GHz (18 to 26.5) GHz	70 mW/W + 360 nW 68 mW/W + 240 nW 68 mW/W + 340 nW 70 mW/W + 180 nW 72 mW/W + 380 nW 73 mW/W + 380 nW 75 mW/W + 380 nW 75 mW/W + 370 nW 76 mW/W + 380 nW 78 mW/W + 390 nW	
100 μ W to 1 mW, 50 Ω	100 kHz to 10 MHz (10 to 30) MHz (30 to 500) MHz 500 MHz to 1.2 GHz (1.2 to 6.0) GHz (6 to 8) GHz (8 to 12.4) GHz (12.4 to 14) GHz (14 to 18) GHz (18 to 26.5) GHz	70 mW/W + 3.6 μ W 69 mW/W + 3.4 μ W 68 mW/W + 3.0 μ W 71 mW/W + 3.8 μ W 69 mW/W + 900 nW 73 mW/W + 3.8 μ W 75 mW/W + 4.0 μ W 73 mW/W + 1.6 μ W 73 mW/W + 100 nW 78 mW/W + 3.7 μ W	

Parameter/Range	Frequency	CMC ^{2, 5} ($\pm$)	Comments
RF Power ³ – Measure (cont)			
(1 to 10) mW, 50 Ω	100 kHz to 10 MHz (10 to 30) MHz (30 to 500) MHz 500 MHz to 1.2 GHz (1.2 to 6.0) GHz (6 to 8) GHz (8 to 12.4) GHz (12.4 to 14) GHz (14 to 18) GHz (18 to 26.5) GHz	70 mW/W + 36 μ W 69 mW/W + 33 μ W 68 mW/W + 33 μ W 71 mW/W + 38 μ W 61 mW/W + 89 μ W 71 mW/W + 18 μ W 75 mW/W + 36 μ W 73 mW/W + 23 μ W 74 mW/W + 21 μ W 76 mW/W + 720 μ W	Frequency sources w/Agilent E4418B or E4419B power meter & Agilent 8482A/E4412A/E4413 A power sensors
(10 to 100) mW, 50 Ω	100 kHz to 10 MHz (10 to 30) MHz (30 to 500) MHz 500 MHz to 1.2 GHz (1.2 to 6.0) GHz (6 to 8) GHz (8 to 12.4) GHz (12.4 to 14) GHz (14 to 18) GHz (18 to 26.5) GHz	100 mW/W + 660 μ W 100 mW/W + 590 μ W 99 mW/W + 640 μ W 100 mW/W + 640 μ W 94 mW/W + 160 μ W 100 mW/W + 580 μ W 100 mW/W + 630 μ W 100 mW/W + 550 μ W 100 mW/W + 80 μ W 110 mW/W + 720 μ W	
RF Power – Generate ³			
(1 to 10) μ W, 50 Ω	100 kHz to 10 MHz (10 to 30) MHz (30 to 500) MHz 500 MHz to 1.2 GHz (1.2 to 6.0) GHz (6 to 8) GHz (8 to 12.4) GHz (12.4 to 14) GHz (14 to 18) GHz (18 to 26.5) GHz	76 mW/W + 32 nW 68 mW/W + 36 nW 69 mW/W + 37 nW 71 mW/W + 37 nW 72 mW/W + 37 nW 73 mW/W + 38 nW 75 mW/W + 39 nW 75 mW/W + 37 nW 75 mW/W + 31 nW 78 mW/W + 41 nW	Frequency sources w/Agilent E4418B or E4419B power meter & Agilent 8482A/E4412A/E4413 3A power sensors

Parameter/Range	Frequency	CMC ^{2, 5} ($\pm$)	Comments
RF Power – Generate ³ (cont)			
(10 to 100) μ W, 50 Ω	100 kHz to 10 MHz (10 to 30) MHz (30 to 500) MHz 500 MHz to 1.2 GHz (1.2 to 6.0) GHz (6 to 8) GHz (8 to 12.4) GHz (12.4 to 14) GHz (14 to 18) GHz (18 to 26.5) GHz	76 mW/W + 32 nW 68 mW/W + 36 nW 69 mW/W + 37 nW 71 mW/W + 37 nW 72 mW/W + 37 nW 73 mW/W + 38 nW 75 mW/W + 39 nW 75 mW/W + 37 nW 75 mW/W + 31 nW 78 mW/W + 41 nW	Frequency sources w/Agilent E4418B or E4419B power meter & Agilent 8482A/E4412A/E441 3A power sensors
100 μ W to 1 mW, 50 Ω	100 kHz to 10 MHz (10 to 30) MHz (30 to 500) MHz 500 MHz to 1.2 GHz (1.2 to 6.0) GHz (6 to 8) GHz (8 to 12.4) GHz (12.4 to 14) GHz (14 to 18) GHz (18 to 26.5) GHz	70 mW/W + 360 nW 68 mW/W + 240 nW 68 mW/W + 340 nW 70 mW/W + 180 nW 72 mW/W + 380 nW 73 mW/W + 380 nW 75 mW/W + 380 nW 75 mW/W + 370 nW 76 mW/W + 380 nW 78 mW/W + 390 nW	
(1 to 10) mW, 50 Ω	100 kHz to 10 MHz (10 to 30) MHz (30 to 500) MHz 500 MHz to 1.2 GHz (1.2 to 6.0) GHz (6 to 8) GHz (8 to 12.4) GHz (12.4 to 14) GHz (14 to 18) GHz (18 to 26.5) GHz	70 mW/W + 36 μ W 69 mW/W + 33 μ W 68 mW/W + 33 μ W 71 mW/W + 38 μ W 61 mW/W + 89 μ W 71 mW/W + 18 μ W 75 mW/W + 36 μ W 73 mW/W + 23 μ W 74 mW/W + 21 μ W 76 mW/W + 720 μ W	
(10 to 31.6) mW, 50 Ω	100 kHz to 10 MHz (10 to 30) MHz (30 to 500) MHz 500 MHz to 1.2 GHz (1.2 to 6.0) GHz (6 to 8) GHz (8 to 12.4) GHz (12.4 to 14) GHz (14 to 18) GHz (18 to 26.5) GHz	100 mW/W + 660 μ W 100 mW/W + 590 μ W 99 mW/W + 640 μ W 100 mW/W + 640 μ W 94 mW/W + 160 μ W 100 mW/W + 580 μ W 100 mW/W + 630 μ W 100 mW/W + 550 μ W 100 mW/W + 80 μ W 110 mW/W + 720 μ W	

IV. Mechanical

[illegible]

Parameter/Equipment	Range	CMC ^{2, 5, 7} ($\pm$)	Comments
Scales & Balance ³ (cont)	1 lb 2 lb 5 lb 10 lb 20 lb 50 lb 250 lb (0 to 500) lb (500 to 3000) lb	0.0055 oz 0.013 oz 0.012 oz 0.018 oz 0.041 oz 0.084 oz 0.24 oz 0.44 oz 2.6 oz	ASTM Class 6 weights ASTM Class 6 weights transfer method
Force ³ – Load Cells	0 to 500 lb 501 to 5 klb 5.1 to 50 klb	0.15 % 0.15 % 0.16 %	Interface load cells
Torque – Measure ³	5 ozf·in to 1000 lbf·ft	0.80 %	CDI torque calibrator
Pipettes	(1 to 10) μ L (11 to 50) μ L (51 to 100) μ L (101 to 200) μ L (201 to 500) μ L (0.501 to 1) mL	0.0049 μ L 0.0042 μ L 0.0046 μ L 0.0040 μ L 0.0045 μ L 0.015 μ L	Gravimetric method

V. Thermodynamics

Parameter/Equipment	Range	CMC ^{2, 5, 7} ($\pm$)	Comments
Relative Humidity – Measure ³	(10 to 100) % RH	0.007 % IV + 1 % RH	Vaisala MI 70 w/HMP 75B

Parameter/Equipment	Range	CMC ^{2, 7} ($\pm$)	Comments
Temperature – Measuring Equipment & Measure ³	(-80 to -30) °C	0.24 °C	Hart 1560 w/2560 black stack thermometer, Hart 5626 PRT & bath
	(-30 to 100) °C	0.025 °C	Hart 1560 w/ 2560 black stack thermometer, Hart 5626 PRT, & Lauda RE106 fluid bath
	(100.1 to 640) °C	0.059 °C	Hart 1560 w/2560 black stack thermometer, Hart 5626 PRT, & Jofra CTC-650B dry well
Infrared Temperature Source ³	(35 to 500) °C	0.0049 °C/°C + 0.28 °C	Fluke 4181 $\epsilon = 0.95$, $\lambda = (8 \text{ to } 14) \mu\text{m}$

VI. Time & Frequency

Parameter/Equipment	Frequency	CMC ^{2, 7} ($\pm$)	Comments
Frequency – Measuring Equipment ³	10 MHz	2 pHz/Hz	Spectracom SecureSync® OCXO (GPS-disciplined) frequency standard (coverage over 24 hours when GPS locked)
	10 MHz	0.5 nHz/Hz	Spectracom SecureSync® OCXO (w/ loss of GPS-discipline) frequency standard (without GPS after 2 weeks of GPS lock)

Parameter/Equipment	Range	CMC ^{2, 7} ($\pm$)	Comments
Frequency – Measuring Equipment ³ (cont)	0.1 Hz to 80 MHz	58 nHz/Hz	Calibration accuracy of the Agilent 33250A tied to the Spectracom SecureSync® OCXO (GPS-Disciplined) frequency standard (coverage over 24 hours when GPS locked)
	0.1 Hz to 80 MHz	58 nHz/Hz	Calibration accuracy of the Agilent 33250A tied to the Spectracom SecureSync® OCXO (w/ loss of GPS-discipline) frequency standard (without GPS after 2 weeks of GPS lock)
	10 MHz to 18 GHz	8.3 nHz/Hz	Calibration accuracy of the Hewlett Packard 8340B Spectracom SecureSync® OCXO (GPS-disciplined) frequency standard (coverage over 24 hours when GPS locked)
	10 MHz to 18 GHz	8.4 nHz/Hz	Calibration accuracy of the Hewlett Packard 8340B tied to the Spectracom SecureSync® OCXO (w/ loss of GPS-discipline) frequency standard (without GPS after 2 weeks of GPS lock)
Frequency – Measure ³	0.1 Hz to 18 GHz	1.8 nHz/Hz	Spectracom SecureSync® OCXO (GPS-disciplined) frequency standard (coverage over 24 hours when GPS locked), Agilent 53131A Opt 10, Opt 124, & Agilent 5340B Opt 001, Opt 011
	0.1 Hz to 18 GHz	18 nHz/Hz	Spectracom SecureSync® OCXO (w/ loss of GPS-discipline) frequency standard (without GPS after 2 weeks of GPS Lock), Agilent 53131A Opt 10, Opt 124, & Agilent 5340B Opt 001, Opt 011

Parameter/Equipment	Frequency	CMC ^{2, 7} ($\pm$)	Comments
Timers/Stop Watches	(0.1 to 86 400) s	0.057 s/day	HK 4500 Timometer

¹ This laboratory offers commercial calibration service 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. CMC 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. 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 stated measure 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 fraction of the reading/percent plus a range specification.

⁵ In the statement of CMC, percentages are to be read as percent of reading; otherwise, % RH represents percent relative humidity, % FS represents percent of full scale, and % IV represents percent of indicated value.

⁶ The contributions from the "best existing device" are not included in the CMC claim. When used 0.58R is the contributor due to resolution of the Unit Under Test.

⁷ 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.

⁸ This scope meets A2LA's *P112 Flexible Scope Policy*.



Accredited Laboratory

A2LA has accredited

J. H. METROLOGY CO., INC.

Rolling Meadows, IL

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/NCCL Z540-1-1994 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 5th day of July 2023.

A blue ink signature of Mr. Trace McInturff.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 1618.01
Valid to April 30, 2025

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