



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

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CALIBRATION

Valid To: September 30, 2023

Certificate Number: 1395.05

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations and dimensional testing^{1,9}:

I. Dimensional

Parameter/Equipment	Range ⁴	CMC ^{2,5} (±)	Comments
Gage Blocks	(0.01 to 0.09) in (0.1 to 4) in (0.5 to 100) mm	2.9 μin (2.5 + 0.21L) μin (0.083 + 0.000 87L) μm	Federal 130B-24 gage block comparator
Angle – Sine Bars/Plates: Center-to-Center Distance	Up to 15 in	(17 + 4.8L) μin	Gage blocks, MU-checker, surface Plate
Angle Blocks	Up to 45°	5.0 arcsec	Gage blocks, MU-checker, angle gage blocks, sine plate
Protractors & Inclinometers	Up to 180°	0°, 00', 1.5" + 0.58R	Angle block set

Parameter/Equipment	Range ⁴	CMC ^{2, 5} (\pm)	Comments
Optical Flats/Parallels –			
Flatness	Up to 4 in	3.1 μ in	Van Keuren optical flat, gage blocks
Parallelism	Up to 4 in	2.4 μ in	Federal 130B-4 gage block comparator
Thickness	Up to 1 in	4.2 μ in	Federal 130B-4 gage block comparator, gage blocks
Length Standards	Up to 60 in	(22 + 3.3L) μ in	SIP MUL 4000, laser, gage blocks
Micrometers ³ –	Up to 48 in	(11 + 4.8L) μ in	Gage blocks
Flatness ³	Up to 48 in	6.3 μ in	Optical flats
Parallelism ³	Up to 48 in	11 μ in	Optical parallels
Height Gages ³	Up to 40 in	(69 + 1.5L) μ in	Gage blocks, surface plate
Depth Gages ³	Up to 12 in	(38 + 0.88L) μ in	Gage blocks, surface plate
Calipers ³	Up to 5 in (5 to 48) in (48 to 72) in	(290 + 10L) μ in (550 + 6.4L) μ in (630 + 6.4L) μ in	Gage blocks
Indicators ³	Up to 6 in	(37 + 0.67L) μ in	Gage blocks, surface plate
Tapes & Rules	Up to 60 in	(38 + 1.9L) μ in	SIP MUL 4000, Agilent laser head
Glass Scales	Up to 24 in	(32 + 3.5L) μ in	SIP MUL 4000, gage blocks, Agilent laser head

Parameter/Equipment	Range ⁴	CMC ^{2, 5} (\pm)	Comments
Plain Ring Gages	(0.25 to 4) in	$(14 + 2.2L) \mu\text{in}$	Gage blocks, Pratt & Whitney Universal Supermic TM
Pin Gages	(0.005 to 4) in	$(13 + 4.8L) \mu\text{in}$ $(0.33 + 0.0048L) \mu\text{m}$	Pratt & Whitney Universal Supermic TM , gage blocks
Thread Plug Gages – Major Diameter Pitch Diameter	Up to 12 in Up to 12 in	$(34 + 4.8L) \mu\text{in}$ $(0.86 + 0.0048L) \mu\text{m}$ $(72 + 4.8L) \mu\text{in}$ $(1.8 + 0.0048L) \mu\text{m}$	Pratt & Whitney Universal Supermic TM w/ gage blocks & thread wires
Crimper Tools	Up to 2 in	0.00032 in	Optical comparator
Levels	Up to 0.015 in	11 $\mu\text{in}/\text{ft}$	Sine plate & gage blocks
Linear Indicators, Comparators	Up to 4 in	$(3.7 + 6.1L) \mu\text{in}$	Gage blocks, Agilent 5508A
V Blocks – Parallelism Squareness 1-2-3 Blocks Parallelism Squareness	(0 to 0.1) in (0 to 0.1) in (0 to 0.1) in (0 to 0.1) in	15 μin 69 μin 15 μin 65 μin	Gage blocks, MU-Checker, cylindrical square Gage blocks, MU-Checker, pin gage
Surface Plates ³ – Flatness Repeatability	Up to 12 in (12 to 72) in Up to 0.001 in	8.7 μin 78 μin 36 μin	Gage blocks, MU-checker Surface plate, Planekator, Repeat-o-meter Repeat-o-meter

Parameter/Equipment	Range ⁴	CMC ^{2, 5} (±)	Comments
Precision Balls	Up to 2 in	23 µin	MU checker, universal supermic & gage blocks
	(2 to 4) in	18 µin	Laser measurement machine
Parallels	Up to 24 in	26 µin	MU checker, granite parallels & gage blocks
Precision Squares	Up to 24 in	26 µin	Master square, MU checker, true square

II. Dimensional Testing/Calibration¹

Parameter/Equipment	Range	CMC ² (±)	Comments
Length – 3 Dimensional ⁶ X, Y & Z	Up to 56 in	340 µin	Mitutoyo B231 CMM

III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 7, 8} (±)	Comments
DC Voltage – Generate ³	± (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	0.00075 % + 0.55 µV 0.0005 % + 1.4 µV 0.000 35 % + 7.1 µV 0.000 35 % + 22 µV 0.0005 % + 110 µV 0.000 65 % + 1500 µV	Fluke 5730A-05/5725A
	(1000 to 60 000) V	0.12 % + 720 µV	Ross VD60-6.2-B-K-AC, DMM, high voltage source

Parameter/Equipment	Range	CMC ^{2, 7, 8} (±)	Comments
DC Voltage – Measure ³	± (0 to 100) mV ± (0.1 to 1) V ± (1 to 10) V ± (10 to 100) V ± (100 to 1000) V*	0.00058 % + 0.09 µV 0.0004 % + 0.21 µV 0.0004 % + 1.2 µV 0.0006 % + 41 µV 0.0006 % + 1.8 mV*	HP 3458A OPT-2 *add 12(V _{in} /1000) ² ppm to all V _{in} > 100
	(1000 to 60 000) V	0.12 %	Ross VD60-6.2-B-K-AC
DC Current – Generate ³	± (0 to 10) µA ± (10 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	0.004 % + 6.9 nA 0.004 % + 6.4 nA 0.0035 % + 7 nA 0.0035 % + 44 nA 0.0045 % + 2.3 µA 0.008 % + 39 µA 0.036 % + 660 µA	Fluke 5730A-05/5725A
	(11 to 20.5) A	0.079 % + 590 µA	Fluke 5520A/SC600
	(11 to 20) A (20 to 100) A	0.075 % + 3 mA 0.074 % + 3 mA	Valhalla 2555A
Clamp Meters	(>20.5 to <150) A (150 to 1025) A	0.6 % + 0.17 A 0.6 % + 0.88 A	Fluke 5500A/coil & 5520A/SC600
DC Current – Measure ³	(0 to 100) nA (0.1 to 1) µA (1 to 10) µA (10 to 100) µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	0.04 % + 7.5 pA 0.0045 % + 0.021 nA 0.0022 % + 0.58 nA 0.0022 % + 0.19 nA 0.0021 % + 1.4 nA 0.0021 % + 3.1 nA 0.0035 % + 0.22 µA 0.011 % + 4.7 µA	HP 3458A OPT-2
	(1 to 2) A (2 to 20) A (20 to 100) A	0.0007 A 0.0021 A 0.05 A	Valhalla 2575A

Parameter/Equipment	Range	CMC ^{2,7,8} (±)	Comments
Resistance – Generate ³	(0 to 10.9999) Ω	31 μΩ/Ω + 0.077 Ω	Fluke 5522A-SC1100
	(11 to 32.9999) Ω	23 μΩ/Ω + 1.2 mΩ	
	(33 to 109.9999) Ω	22 μΩ/Ω + 1.2 mΩ	
	(110 to 329.9999) Ω	22 μΩ/Ω + 2.8 mΩ	
	(0.33 to 1.099 99) kΩ	22 μΩ/Ω + 5.9 mΩ	
	(1.1 to 3.299 999) kΩ	22 μΩ/Ω + 29 mΩ	
	(3.3 to 10.999 99) kΩ	22 μΩ/Ω + 81 mΩ	
	(11 to 32.999 99) kΩ	22 μΩ/Ω + 0.29 Ω	
	(33 to 109.9999) kΩ	22 μΩ/Ω + 0.32 Ω	
	(110 to 329.999 99) kΩ	25 μΩ/Ω + 2.7 Ω	
	(0.33 to 1.099 999) MΩ	25 μΩ/Ω + 7.3 Ω	
	(1.1 to 3.299 99) MΩ	47 μΩ/Ω + 43 Ω	
	(3.3 to 10.999 99) MΩ	0.01 % + 200 Ω	
	(11 to 32.999 99) MΩ	0.019 % + 2.9 kΩ	
	(33 to 109.9999) MΩ	0.039 % + 2.6 kΩ	
	(110 to 329.9999) MΩ	0.23 % + 110 kΩ	
	(0.33 to 1.1) GΩ	1.2 % + 1.4 MΩ	
Fixed Points	0.001 Ω	0.0063 %	Standard resistors Guildline, L&N
	0.01 Ω	0.012 % + 0.039 μΩ	
	0.1 Ω	0.012 % + 0.37 μΩ	
	1 Ω	0.012 % + 2.7 μΩ	
	0 Ω	41 μΩ	Fluke 5730A-05
	1 Ω	95 μΩ/Ω + 11 μΩ	
	1.9 Ω	95 μΩ/Ω + 23 μΩ	
	10 Ω	23 μΩ/Ω + 36 μΩ	
	19 Ω	23 μΩ/Ω + 54 μΩ	
	100 Ω	10 μΩ/Ω + 180 μΩ	
	190 Ω	10 μΩ/Ω + 540 μΩ	
	1 kΩ	6.5 μΩ/Ω + 1.6 mΩ	
	1.9 kΩ	6.5 μΩ/Ω + 3.3 mΩ	
	10 kΩ	6.5 μΩ/Ω + 18 mΩ	
	19 kΩ	6.5 μΩ/Ω + 31 mΩ	
	100 kΩ	8.5 μΩ/Ω + 160 mΩ	
	190 kΩ	8.5 μΩ/Ω + 320 mΩ	
	1 MΩ	13 μΩ/Ω + 4.1 Ω	
	1.9 MΩ	18 μΩ/Ω + 10 Ω	
	10 MΩ	40 μΩ/Ω + 70 Ω	
19 MΩ	47 μΩ/Ω + 370 Ω		
100 MΩ	100 μΩ/Ω + 3 kΩ		
	100 MΩ	0.26 % + 0.14 MΩ	Keithley 5155
	1 GΩ	0.26 % + 0.86 MΩ	
	10 GΩ	0.26 % + 0.092 GΩ	

Parameter/Equipment	Range	CMC ^{2, 7, 8} (±)	Comments
Resistance – Measure ³	(0 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 (100 to 1000) MΩ	25 μΩ/Ω + 50 μΩ 21 μΩ/Ω + 0.5 mΩ 12 μΩ/Ω + 0.5 mΩ 12 μΩ/Ω + 5 mΩ 12 μΩ/Ω + 50 mΩ 20 μΩ/Ω + 2 Ω 59 μΩ/Ω + 100 Ω 0.061 % + 1 kΩ 32 % + 10 kΩ	HP 3458A OPT-002
Capacitance – Generate ³	(0.220 to <1.1) nF (1.1 to <3.3) nF (3.3 to <11) nF (11 to <33) nF (33 to <110) nF (110 to <330) nF (0.33 to <1.1) μF (1.1 to <3.3) μF (3.3 to <11) μF (11 to <33) μF (33 to <110) μF (110 to <330) μF (0.33 to <1.1) mF (1.1 to <3.3) mF (3.3 to <11) mF (11 to <33) mF (33 to <110) mF	0.39 % + 7.8 pF 0.39 % + 8 pF 0.19 % + 8.2 pF 0.19 % + 78 pF 0.19 % + 82 pF 0.19 % + 240 pF 0.19 % + 0.95 nF 0.19 % + 2.8 nF 0.19 % + 9.5 nF 0.31 % + 28 nF 0.35 % + 95 nF 0.35 % + 280 nF 0.35 % + 0.95 μF 0.35 % + 2.8 μF 0.35 % + 9.8 μF 0.58 % + 29 μF 0.85 % + 96 μF	Fluke 5522A-SC1100
Phase Angle – Generate ³ (0.5 & 3) V (10 to 65) Hz (65 to 500) Hz (0.5 to 1) kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	(-180 to 180)°	0.12° 0.29° 0.58° 2.9° 5.8° 12°	Fluke 5522A-SC1100

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation of Thermocouples Indicating Devices – Generate & Measure ³			
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.42 °C 0.23 °C 0.17 °C 0.21 °C 0.23 °C	Fluke 5520A
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 0.21 °C 0.17 °C 0.19 °C 0.26 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.31 °C 0.2 °C 0.19 °C 0.26 °C 0.36 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.53 °C 0.23 °C 0.18 °C 0.17 °C	

Parameter/Equipment	Range ⁴	CMC ^{2, 7, 8} (\pm)	Comments
Oscilloscopes ³ –			
DC Signal –			
Into 50 Ω	(1 to 24.999) mV (25 to 109.99) mV 110 mV to 2.1999 V (2.2 to 6.599) V	0.011 mV + 40 μ V 0.024 mV + 40 μ V 0.000 59 V + 40 μ V 0.002 V + 40 μ V	Fluke 5522A- SC1100
Into 1 M Ω	(1 to 24.999) mV (25 to 109.99) mV 110 mV to 2.1999 V (2.2 to 10.999) V (11 to 130) V	0.013 mV + 40 μ V 0.020 mV + 40 μ V 0.000 27 V + 40 μ V 0.002 V + 40 μ V 0.014 V + 40 μ V	
Level Sine Wave –			
50 kHz Reference	5 mV to 5.5 V	0.38 % + 0.3 mV	
50 kHz to 100 MHz	5 mV to 5.5 V	2.2 % + 0.4 mV	
(100 to 300) MHz	5 mV to 5.5 V	2.7 % + 0.4 mV	
(300 to 600) MHz	5 mV to 5.5 V	4.8 % + 0.4 mV	
(600 to 1100) MHz	5 mV to 5.5 V	4.8 % + 0.4 mV	
Square Wave –			
50 Ω , 10 Hz to 10 kHz	1 mV to 6.599 V	0.19 % + 40 μ V	
1 M Ω , 10 Hz to 1 kHz	1 mV to 130 V	0.078 % + 40 μ V	
1 M Ω , (1 to 10) kHz	1 mV to 130 V	0.19 % + 40 μ V	
Time Marker Output Into 50 Ω	(2 to 5) ns 10 ns (20 to 50) ns (20 to 100) ms	16 parts in 10 ⁶ s 6.3 parts in 10 ⁶ s 5.5 parts in 10 ⁶ s 11 parts in 10 ⁶ s	
Pulse Rise Time	1 kHz to 2 MHz (200 to 300) ps	40 ps	
	(2 to 10) MHz (200 to 350) ps	59 ps	

Parameter/Range	Frequency	CMC ^{2, 7, 8} (±)	Comments
AC Voltage – Generate ³			
(0.22 to 2.2) 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	0.024 % + 4.1 μV 0.009 % + 4.1 μV 0.008 % + 4.1 μV 0.02 % + 4.1 μV 0.05 % + 5.1 μV 0.11 % + 10 μV 0.14 % + 20 μV 0.27 % + 21 μV	Fluke 5730A-05 & 5725A
(2.2 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	0.024 % + 4.2 μV 0.009 % + 4.2 μV 0.008 % + 4.2 μV 0.02 % + 4.4 μV 0.05 % + 5.8 μV 0.11 % + 11 μV 0.14 % + 21 μV 0.26 % + 24 μV	
(22 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	0.024 % + 4.4 μV 0.009 % + 4.2 μV 0.008 % + 4.2 μV 0.02 % + 4.4 μV 0.05 % + 5.8 μV 0.11 % + 52 μV 0.14 % + 77 μV 0.27 % + 140 μV	
(0.22 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	0.024 % + 61 μV 0.009 % + 40 μV 0.0042 % + 22 μV 0.0065 % + 33 μV 0.0085 % + 52 μV 0.034 % + 140 μV 0.1 % + 310 μV 0.17 % + 870 μV	
(2.2 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	0.024% + 600 μV 0.009 % + 380 μV 0.0042 % + 230 μV 0.0067 % + 330 μV 0.0083 % + 470 μV 0.025 % + 1600 μV 0.1% + 3500 μV 0.15% + 10 000 μV	
(22 to 220) V	(10 to 20) Hz (20 to 40) Hz (0.04 to 20) kHz (20 to 50) kHz	0.024 % + 6.8 mV 0.009 % + 4.4 mV 0.0052 % + 2.7 mV 0.008 % + 3.4 mV	

Parameter/Range	Frequency	CMC ^{2, 7, 8} (±)	Comments
AC Voltage – Generate ³ (cont)			
(22 to 220) V	(50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz	0.015 % + 8.3 mV 0.09 % + 18 mV 0.44 % + 43 mV 0.8 % + 100 mV	Fluke 5730A-05 & 5725A
(220 to 250) V	(15 to 50) Hz	0.03 % + 21 mV	
(220 to 1100) V	(0.04 to 1) kHz (1 to 20) kHz (20 to 30) kHz	0.007 % + 8.7 mV 0.017 % + 28 mV 0.06 % + 65 mV	
(220 to 750) V	(30 to 50) kHz (50 to 100) kHz	0.06 % + 12 mV 0.23 % + 100 mV	
(1000 to 40 000) V	(50 to 60) Hz	0.59 % + 2.3 mV	Ross VD60-6.2-B-K-AC, DMM, high voltage source
Wideband AC Voltage – Generate ³			
Amplitude –			
(0.3 to 1.1) mV (1.1 to 3) mV (3 to 11) mV (11 to 33) mV (33 to 110) mV (110 to 330) mV (0.3 to 1.1) V (1.1 to 3.5) V	(0.03 to 500) kHz	0.8 % + 2.8 μV 0.7 % + 3.6 μV 0.7 % + 8.4 μV 0.6 % + 17 μV 0.6 % + 44 μV 0.5 % + 120 μV 0.5 % + 440 μV 0.4 % + 810 μV	Fluke 5730A-05
Flatness Relative to 1 kHz Reference –			
0.3 mV to 3.5 V	(10 to 30) Hz (30 to 120) Hz (0.12 to 119.999) kHz (1.2 to 2) MHz (2 to 11.9) MHz (12 to 20) MHz (20 to 30) MHz (30 to 50) MHz	0.3 % + 5.8 μV 0.1 % + 5.8 μV 0.1 % + 5.8 μV 0.1 % + 6.7 μV 0.21 % + 6.7 μV 0.41 % + 6.7 μV 1 % + 6.7 μV 2 % + 6.7 μV	

Parameter/Range	Frequency	CMC ^{2, 7, 8} (±)	Comments
AC Voltage – Measure ³			
(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	0.048 % + 3 μV 0.037 % + 1.1 μV 0.048 % + 1.1 μV 0.12 % + 1.1 μV 0.61 % + 1.1 μV 4.7 % + 2 μV	HP 3458A OPT-002
(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 300 kHz to 1 MHz	0.011 % + 4 μV 0.0091 % + 2 μV 0.017 % + 2 μV 0.036 % + 2 μV 0.096 % + 2 μV 0.76 % + 10 μV 1.2 % + 10 μV	
(0.1 to 1) 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 300 kHz to 1 MHz	0.0083 % + 40 μV 0.0082 % + 20 μV 0.016 % + 20 μV 0.035 % + 20 μV 0.093 % + 20 μV 0.35 % + 0.1 mV 1.2 % + 0.1 mV	
(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 300 kHz to 1 MHz	0.0085 % + 0.4 mV 0.0084 % + 0.2 mV 0.016 % + 0.2 mV 0.035 % + 0.2 mV 0.093 % + 0.2 mV 0.35 % + 1.0 mV 1.2 % + 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 300 kHz to 1 MHz	0.023 % + 4 mV 0.023 % + 2 mV 0.023 % + 2 mV 0.041 % + 2 mV 0.14 % + 2 mV 0.46 % + 10 mV 1.7 % + 10 mV	
(100 to 1000) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.046 % + 40 mV 0.046 % + 20 mV 0.069 % + 20 mV 0.14 % + 20 mV 0.35 % + 20 mV	
(1000 to 40 000) V	(50 to 60) Hz	0.61 % + 3.9 mV	Ross VD60-6.2-B-K-AC

Parameter/Range	Frequency	CMC ^{2, 7, 8} (±)	Comments
AC Voltage Flatness – Measure ³ Relative to 1 kHz Reference 3 V	(10 to 100) Hz (0.1 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz (1 to 8) MHz (8 to 20) MHz (20 to 30) MHz (30 to 50) MHz (50 to 70) MHz (70 to 80) MHz (80 to 100) MHz	0.2 % 0.058 % 0.13 % 0.13 % 0.22 % 0.23 % 0.24 % 0.30 % 0.67 % 0.43 % 0.49 %	Thermal converters & HP 3458A

Parameter/Range	Frequency	CMC ^{2, 7, 8} (±)	Comments
AC Current ³ – Generate			
(9 to 22) μA	(20 to 1000) Hz (1 to 10) kHz	0.01 % + 8.8 nA 0.11 % + 66 nA	Fluke 5730A-05/ 5725A
(22 to 220) μA	(10 to 20) Hz (20 to 40) Hz (0.04 to 1) kHz (1 to 5) kHz (5 to 10) kHz	0.025 % + 18 nA 0.016 % + 12 nA 0.01 % + 11 nA 0.028 % + 29 nA 0.11 % + 110 nA	
(0.22 to 2.2) mA	(10 to 20) Hz (20 to 40) Hz (40 to 1000) Hz (1 to 5) kHz (5 to 10) kHz	0.025 % + 92 nA 0.016 % + 71 nA 0.01 % + 71 nA 0.02 % + 170 nA 0.11 % + 780 nA	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz (40 to 1000) Hz (1 to 5) kHz (5 to 10) kHz	0.025 % + 0.95 μA 0.016 % + 0.72 μA 0.01 % + 0.71 μA 0.02 % + 1.7 μA 0.11 % + 7.8 μA	
(22 to 220) mA	(10 to 20) Hz (20 to 40) Hz (40 to 1000) Hz (1 to 5) kHz (5 to 10) kHz	0.025 % + 11 μA 0.016 % + 64 μA 0.01 % + 65 μA 0.02 % + 16 μA 0.11 % + 61 μA	
(0.22 to 2.2) A	(20 to 1000) Hz (1 to 5) kHz (5 to 10) kHz	0.024 % + 110 μA 0.045 % + 270 μA 0.85 % + 290 μA	

Parameter/Range	Frequency	CMC ^{2, 7, 8} (±)	Comments
AC Current ³ – Generate (cont)			
(2.2 to 11) A	(40 to 1000) Hz (1 to 5) kHz (5 to 10) kHz	0.046 % + 1500 µA 0.095 % + 1500 µA 0.36 % + 1700 µA	Fluke 5730A-05/ 5725A
(2 to 20) A	60 Hz	0.71 % + 0.6 A	Valhalla 2555A
Clamp Meters –			
(>20.5 to <150) A (150 to 1025) A	(45 to 65) Hz	0.68 % + 0.3 A 0.67 % + 1.2 A	Fluke 5500A/coil & 5520A/SC600 LCOMP ON
(>20.5 to <150) A (150 to 1025) A	(> 65 to 440) Hz	1.2 % + 0.3 A 1.2 % + 1.2 A	
AC Current – Measure ³			
10 µA (>10 to 100) µA (>0.1 to 1) mA (>1 to 10) mA (>10 to 100) mA (>0.1 to 1) A	(0.045 to 1) kHz (0.045 to 5) kHz	0.067 % + 0.58 nA 0.067 % + 3.6 nA 0.063 % + 2.3 nA 0.063 % + 660 nA 0.063 % + 190 nA 0.1 % + 42 µA	HP 3458A OPT-002
(>1 to 2) A (>2 to 20) A (>20 to 100) A	(45 to 1000) Hz	0.14 % + 0.2 mA 0.17 % + 2 mA 0.16 % + 2 mA	Valhalla 2575A

IV. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ² (±)	Comments
RF Power – Generate			
(13 to -5) dB (-20 to -58) dB (-50 to -80) dB	200 Hz to 80 MHz	0.054 dB 0.12 dB 0.26 dB	HP 3335A
(26 to >20) dBm (20 to -10) dBm (-10 to -90) dBm	250 kHz to 40 GHz	1.2 dB 0.95 dB 1.2 dB	Agilent E8257D

Parameter/Range	Frequency	CMC ^{2,7,8} (±)	Comments
RF Power – Generate (cont)			
(10 to -10) dBm	(2 to 26.5) GHz	1.1 dB	HP 83630B
(-10 to >-60) dBm		1.4 dB	
(-60 to -110) dBm		2 dB	
(10 to -20) dBm	(2 to 50) GHz	2.3 dB	HP 83650B
RF Power – Measure ³			
0 dBm	50 MHz	0.4 %	HP 432A, 478A-H76, 3458A
(-50 to +30) dBm	9 kHz to 18 GHz	0.11 dB	Agilent E4419A & E9304A-H19
(-70 to +20) dBm	(0.01 to 18) GHz	0.09 dB	Agilent E4419A & E4412A
(-30 to +20) dBm	(0.01 to 50) GHz	0.18 dB	Agilent E4419A & 8487A
Displayed Average Noise Level to 30 dBm	3 Hz to 3 GHz	0.62 dB	Agilent E4448A
	100 kHz to 3 GHz	0.91 dB	
	(>3 to 6.6) GHz	1.7 dB	
	(>6.6 to 22) GHz	2.2 dB	
	(>22 to 26.8) GHz	2.7 dB	
	(>26.8 to 31.15) GHz	2.2 dB	
	(>31.15 to 50) GHz	2.8 dB	
Tuned RF Level – Measure ³			
(+16 to -10) dBm	100 kHz to 50 GHz	0.026 dB	Agilent N5531S
(-10 to -20) dBm		0.024 dB	
(-20 to -30) dBm		0.029 dB	
(-30 to -40) dBm		0.04 dB	
(-40 to -50) dBm		0.053 dB	
(-50 to -60) dBm		0.056 dB	
(-60 to -70) dBm		0.063 dB	
(-70 to -80) dBm		0.074 dB	
(-80 to -90) dBm		0.078 dB	
(-90 to -100) dBm		0.096 dB	

Parameter/Range	Frequency	CMC ^{2,7,8} (±)	Comments
Tuned RF Level – Measure ³ (cont)			
(<-100 to -140) dBm	100 kHz to 3.05 GHz	0.096 dB	Agilent N5531S
(<-103 to -133) dBm	(>3.05 to 6.6) GHz	0.29 dB	
(<-100 to -130) dBm	(>6.6 to 13.2) GHz	0.30 dB	
(<-98 to -128) dBm	(>13.2 to 19.2) GHz	0.12 dB	
(<-86 to -116) dBm	(>19.2 to 26.5) GHz	0.36 dB	
(<-87 to -117) dBm	(>26.5 to 31.15) GHz	0.21 dB	
(<-76 to -106) dBm	(>31.15 to 41) GHz	0.15 dB	
(<-70 to -100) dBm	(>41 to 45) GHz	0.15 dB	
(<-58 to -88) dBm	(>45 to 50) GHz	0.15 dB	
RF Attenuation – Generate			
(0 to -10) dB	@ 50 MHz	0.0046 dB	Agilent 8494G & 8496G
(-10 to -20) dB		0.0049 dB	
(-20 to -30) dB		0.0075 dB	
(-30 to -40) dB		0.0076 dB	
(-40 to -50) dB		0.0094 dB	
(-50 to -60) dB		0.010 dB	
(-60 to -70) dB		0.015 dB	
(-70 to -80) dB		0.018 dB	
(-80 to -90) dB		0.021 dB	
(-90 to -100) dB		0.030 dB	
(-100 to -110) dB		0.037 dB	
(-110 to -121) dB		0.045 dB	
(0 to -10) dB	@ 1.195 GHz	0.011 dB	Agilent 8494G & 8496G, Agilent E4448A
(-10 to -20) dB		0.013 dB	
(-20 to -30) dB		0.019 dB	
(-30 to -40) dB		0.019 dB	
(-40 to -50) dB		0.019 dB	
(-50 to -60) dB		0.024 dB	
(-60 to -70) dB		0.028 dB	
(-70 to -80) dB		0.040 dB	
(-80 to -90) dB		0.050 dB	
(-90 to -100) dB		0.058 dB	
(-100 to -110) dB		0.080 dB	
(-110 to -121) dB		0.11 dB	
(0 to -10) dB	@ 4 GHz	0.020 dB	Agilent 8494G & 8496G, Agilent E4448A
(-10 to -20) dB		0.025 dB	
(-20 to -30) dB		0.029 dB	
(-30 to -40) dB		0.035 dB	
(-40 to -50) dB		0.042 dB	
(-50 to -60) dB		0.046 dB	
(-60 to -70) dB		0.053 dB	

Parameter/Range	Frequency	CMC ^{2, 7, 8} (±)	Comments
RF Attenuation – Generate (cont) (-70 to -80) dB (-80 to -90) dB (-90 to -100) dB (-100 to -110) dB (-110 to -121) dB	@ 4 GHz	0.057 dB 0.063 dB 0.070 dB 0.098 dB 0.29 dB	Agilent 8494G & 8496G, Agilent E4448A
Amplitude Modulation – Generate 50 Hz to 50 kHz <95 % 50 Hz to 50 kHz <99 % 20 Hz to 100 kHz <95 % 20 Hz to 100 kHz <99 %	(11 to 13.5) MHz	0.27 % AM 0.33 % AM 0.38 % AM 0.43 % AM	HP 11715A
Amplitude Modulation – Measure Rate: 50 Hz to 10 kHz Depth: (5 to 99) % Rate: 50 Hz to 100 kHz Depth: (5 to 20) % Depth: (20 to 99) % Depth: (5 to 20) % Depth: (20 to 99) % Depth: (5 to 20) % Depth: (20 to 99) % Depth: (5 to 20) % Depth: (20 to 99) %	(0.1 to 10) MHz (0.01 to 3) GHz (3 to 26.5) GHz (26.5 to 31.15) GHz (31.15 to 50) GHz	0.87 % + 0.0005 % AM 2.9 % + 0.0005 % AM 0.58 % + 0.0005 % AM 5.2 % + 0.0005 % AM 1.7 % + 0.0005 % AM 7.9 % + 0.0005 % AM 2.3 % + 0.0005 % AM 30 % + 0.0005 % AM 6.9 % + 0.0005 % AM	Agilent N5531S

Parameter/Range	Frequency	CMC ^{2, 8} (±)	Comments
Frequency Modulation – Generate DC to 100 kHz Rate DC to 200 kHz Rate DC to 10 MHz Rate	(11 to 432) MHz (11 to 432) MHz (11 to 432) MHz	0.15 % + 0.005 lsd 0.31 % + 0.005 lsd 2.9 % + 0.005 lsd	HP 11715A
Frequency Modulation – Measure Rate: 20 Hz to 10 kHz Deviation: 200 Hz to 40 kHz Rate: 50 Hz to 200 kHz Deviation: 250 Hz to 400 kHz	(0.25 to 10) MHz >0.2 β >1.2 β (0.01 to 6.6) GHz >0.2 β >0.45 β (6.6 to 13.2) GHz >0.2 β >8 β (13.2 to 31.15) GHz >0.2 β >16 β (31.15 to 50) GHz >0.2 β >32 β	1.7 % + 0.68 Hz 1.2 % + 0.87 Hz 1.7 % + 2.4 Hz 1.2 % + 27 Hz 2.9 % + 19 Hz 1.2 % + 19 Hz 4.4 % + 27 Hz 1.2 % + 25 Hz 9.8 % + 5.8 Hz 1.2 % + 5.8 Hz	Agilent N5531S β is the ratio of frequency deviation to modulation rate
Phase Modulation – Measure > 0.7 rad > 0.3 rad > 2 rad > 0.6 rad > 4 rad > 1.2 rad > 4 rad > 1.3 rad > 8 rad > 2.4 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	1.2 % + 0.0051 rad 3.5 % + 0.0058 rad 1.2 % + 0.011 rad 3.5 % + 0.01 rad 1.2 % + 0.021 rad 3.5 % + 0.021 rad 1.2 % + 0.0016 rad 3.5 % + 0.00095 rad 1.2 % + 0.05 rad 3.5 % + 0.0011 rad	Agilent N5531S

Parameter/Range	Frequency	CMC ^{2, 8} (±)	Comments	
Phase Noise – Measure (0.25 to 1.6) GHz	Offsets from CW 1 Hz 10 Hz 100 Hz 1 kHz 10 kHz 100 kHz	2.6 dB 2.6 dB 2.5 dB 2.4 dB 2.4 dB 2.3 dB	Agilent E8257D & N5500A	
(1.2 to 26.5) GHz	Offsets from CW 1 Hz 10 Hz 100 Hz 1 kHz 10 kHz 100 kHz	2.8 dB 2.5 dB 2.4 dB 2.4 dB 2.4 dB 2.3 dB		
1 MHz to 50 GHz	Offsets from CW 10 Hz 100 Hz 1 kHz 10 kHz 100 kHz 1 MHz 10 MHz 100 MHz	4.4 dBc/Hz 2.1 dBc/Hz 1.1 dBc/Hz 0.98 dBc/Hz 0.89 dBc/Hz 0.99 dBc/Hz 1.3 dBc/Hz 1.8 dBc/Hz		Agilent E4448A
Phase Noise – Generate ³ (0.25 to 40) GHz	Offsets from CW 1 Hz 10 Hz 100 Hz 1 kHz 10 kHz 100 kHz 30 kHz 1 MHz 6 MHz	2.5 dB 2.6 dB 2.4 dB 2.3 dB 2.3 dB 2.3 dB 3.1 dB 3.1 dB 3.1 dB		Agilent E8257D Wenzel 500-13438C

Parameter/Range	Frequency	CMC ^{2, 7, 8} (\pm)	Comments
Audio Distortion – Measure ³	20 Hz to 20 kHz (>20 to 100) kHz	1.3 dB 2.3 dB	HP 8903B
Modulation Distortion - Measure	100 kHz to 50 GHz (0.02 to 250) kHz	1.3 dB	Agilent E4448A
Audio Distortion – Generate	20 Hz to 20 kHz (>20 to 100) kHz	1.3 dB 2.3 dB	HP 8903B
Dynamic Accuracy- Measure (0 to -10) dB (-10 to -50) dB (-50 to -60) dB (-60 to -80) dB (-80 to -90) dB (-90 to -100) dB	5 Hz to 200 MHz	0.046 dB 0.023 dB 0.059 dB 0.18 dB 0.89 dB 1.0 dB	HP 3577A
Reflection S ₁₁ /S ₂₂ – Measure (0.6 to 1) lin (0.2 to 0.5) lin (0.0 to 0.1) lin (0.6 to 1) lin (0.2 to 0.5) lin (0.0 to 0.1) lin	(30 to 300) kHz >300 kHz to 1.3 GHz (>1.3 to 3.0) GHz (>3.0 to 6.0) GHz 45 MHz to 18 GHz 45 MHz to 18 GHz	0.0057 lin 0.0063 lin 0.0086 lin 0.014 lin (0.012 to + 0.018) lin (0.83 to + 0.94) ^o (0.0064 to + 0.011) lin (1.1 to + 1.8) ^o (0.0051 to + 0.0056) lin (3.3 to + 180) ^o (0.0093 to + 0.015) lin (0.63 to + 0.72) ^o (0.0048 to + 0.0081) lin (0.77 to + 1.4) ^o (0.0035 to + 0.004) lin (2.3 to + 180) ^o	HP 8753ES, HP 85029B, HP 85050A HP 8510C, 85054A type-N (sliding load cal) HP 8510C, 85050A 7 mm (sliding load cal)

Parameter/Range	Frequency	CMC ^{2, 7, 8} (\pm)	Comments
Reflection S ₁₁ /S ₂₂ – Measure			
(0.6 to 1) lin	45 MHz to 26.5 GHz	(0.014 to + 0.023) lin (1.2 to + 1.2) ^o	H-P 8510C, 85052B 3.5 mm (sliding load cal)
(0.2 to 0.5) lin		(0.0073 to + 0.012) lin (1.3 to + 2.1) ^o	
(0.0 to 0.1) lin		(0.0059 to + 0.0064) lin (3.3 to + 180) ^o	
(0 to 0.1) lin	40 MHz to 2 GHz (>2 to 20) GHz (>20 to 40) GHz (>40 to 50) GHz (>50 to 65) GHz	0.011 lin 0.011 lin 0.017 lin 0.019 lin 0.023 lin	Anritsu 37397D, Anritsu 3654B
(0.1 to 1.0) lin	40 MHz to 2 GHz (>2 to 20) GHz (>20 to 40) GHz (>40 to 50) GHz (>50 to 65) GHz	0.014 lin 0.015 lin 0.024 lin 0.034 lin 0.040 lin	
Reflection S ₂₁ /S ₁₂ – Measure			
(+10 to 0) dB (0 to -30) dB (-30 to -50) dB (-50 to -60) dB	(0.04 to 2) GHz	0.13 dB 0.10 dB 0.15 dB 0.35 dB	Anritsu 37397D, Anritsu 3654B
(+10 to 0) dB (0 to -30) dB (-30 to -50) dB (-50 to -60) dB	(>2 to 20) GHz	0.16 dB 0.13 dB 0.21 dB 0.55 dB	
(+10 to 0) dB (0 to -30) dB (-30 to -50) dB (-50 to -60) dB	(>20 to 40) GHz	0.23 dB 0.20 dB 0.51 dB 1.30 dB	
(+10 to 0) dB (0 to -30) dB (-30 to -50) dB (-50 to -60) dB	(>40 to 50) GHz	0.42 dB 0.39 dB 0.77 dB 2.00 dB	

Parameter/Range	Frequency	CMC ^{2, 7, 8} (\pm)	Comments
Reflection S ₂₁ /S ₁₂ – Measure (cont) (+10 to 0) dB (0 to -30) dB (-30 to -50) dB (-50 to -60) dB	(>50 to 65) GHz	0.45 dB 0.48 dB 2.10 dB 5.40 dB	Anritsu 37397D, Anritsu 3654B
Transmission S ₁₂ /S ₂₁ – Measure 10 dB 0 dB -10 dB -20 dB -30 dB -40 dB -50 dB -60 dB 10 dB 0 dB -10 dB	(30 to 50) kHz (>50 to 300) kHz (>0.3 to 1.3) GHz (>1.3 to 3.0) GHz (>3.0 to 6.0) GHz 45 MHz to 18 GHz 45 MHz to 18 GHz	0.042 lin 0.042 lin 0.042 lin 0.045 lin 0.068 lin (0.13 to +0.22) dB (1.3 to +4.2) ^o (0.051 to +0.093) dB (0.21 to +3.9) ^o (0.066 to +0.093) dB (0.33 to +4) ^o (0.067 to +0.094) dB (0.34 to +4) ^o (0.07 to +0.097) dB (0.37 to +4) ^o (0.076 to +0.12) dB (0.45 to +4.2) ^o (0.11 to +0.2) dB (0.73 to +4.8) ^o (0.24 to +0.49) dB (1.7 to +6.7) ^o (0.068 to +0.22) dB (1.3 to +3.8) ^o (0.046 to +0.049) dB (0.18 to +3.6) ^o (0.05 to +0.065) dB (0.3 to +3.7) ^o	HP 8753ES, HP 85029B, HP 85050A HP 8510C, 85054A type-N (sliding load cal)

Parameter/Range	Frequency	CMC ^{2, 7, 8} (\pm)	Comments
Transmission S ₁₂ /S ₂₁ — Measure (cont)			
-20 dB	45 MHz to 18 GHz	(0.051 to + 0.067) dB (0.31 to + 3.7) ^o	HP 8510C, 85050A 7 mm (sliding load cal)
-30 dB		(0.054 to + 0.068) dB (0.34 to + 3.7) ^o	
-40 dB		(0.063 to + 0.073) dB (0.43 to + 3.9) ^o	
-50 dB		(0.11 to + 0.15) dB (0.72 to + 4.5) ^o	
-60 dB		(0.24 to + 0.45) dB (1.7 to + 6.4) ^o	
10 dB		(0.13 to + 0.22) dB (1.3 to + 5.8) ^o	
0 dB		(0.054 to + 0.11) dB (0.21 to + 5.7) ^o	
-10 dB		(0.069 to + 0.11) dB (0.31 to + 5.7) ^o	
-20 dB	45 MHz to 26.5 GHz	(0.07 to + 0.11) dB (0.34 to + 5.7) ^o	HP 8510C, 85052B 3.5 mm (sliding load cal)
-30 dB		(0.073 to + 0.13) dB (0.38 to + 5.9) ^o	
-40 dB		(0.076 to + 0.2) dB (0.46 to + 6.4) ^o	
-50 dB		(0.11 to + 0.46) dB (0.75 to + 8.1) ^o	
-60 dB		(0.24 to + 1.4) dB (1.7 to + 14) ^o	
(0 to 1) lin	40 MHz to 2 GHz (>2 to 20) GHz (>20 to 40) GHz (>40 to 50) GHz (>50 to 65) GHz	0.042 lin 0.043 lin 0.046 lin 0.061 lin 0.063 lin	Anritsu 37397D, Anritsu 3654B

V. Mechanical

Parameter/Equipment	Range ⁴	CMC ^{2, 5, 8} (\pm)	Comments
Scales & Balances ³	(1 to 500) mg 1 g 2 g 5 g 10 g 20 g 50 g 100 g 200 g 500 g 1 kg 2 kg 5 kg 10 kg 20 kg 30 kg	6.1 μ g + 0.58R 20 μ g + 0.58R 20 μ g + 0.58R 21 μ g + 0.58R 33 μ g + 0.58R 50 μ g + 0.58R 0.14 mg + 0.58R 0.21 mg + 0.58R 0.38 mg + 0.58R 0.90 mg + 0.58R 1.9 mg + 0.58R 3.7 mg + 0.58R 9.0 mg + 0.58R 19 mg + 0.58R 37 mg + 0.58R 56 mg + 0.58R	Troemner Ultra-Class weight set
	(0 to 500) lb	0.012 % + 0.58R	Class F weights
Torque Transducers	(1 to 10) ozf·in (>10 to 50) ozf·in >50 ozf·in to 8 lbf·in (>8 to 100) lbf·in (10 to 100) lbf·ft (>100 to 1000) lbf·ft	0.15 % 0.15 % 0.13 % 0.13 % 0.14 % 0.27 %	Torque wheels & torque arms w/ Ultra Class & Class F weights
Torque ³ – Wrenches & Drivers	(1 to 10) ozf·in (>10 to 50) ozf·in (1 to 10) lbf·in (10 to 100) lbf·in (8 to 100) lbf·ft (100 to 1000) lbf·ft	1.2 % 0.60 % 0.59 % 0.59 % 0.76 % 0.56 %	AWS ITIO-10 AWS ITIO-50 AWS ITO-10 AWS ITI-100 AKO TSD 2050 torque system
Vacuum ³	(0.01 to 10) Torr (10 to 1000) Torr	0.088 % 0.096 %	MKS reference transducers

Parameter/Equipment	Range ⁴	CMC ^{2, 5, 8} (\pm)	Comments
Pressure ³ – Nitrogen Gas	(0.01 to 10) Torr (>10 to 1000) Torr	0.12 Torr + 0.58R 0.14 Torr + 0.58R	Mensor 2101
	(1.45 to 60) psi (>60 to 300) psi (1.45 to 200) psi (>200 to 1000) psi	0.011 psi + 0.58R 0.035 psi + 0.58R 0.35 psi + 0.58R 0.12 psi + 0.58R	Additel 780S w/ ADT160A AP3000Q, AP1KQ
Oil	(45 to 1000) psi (>1000 to 14 000) psi	0.012 % + 0.0022 psi 0.015 % + 0.56 psi	DHI 50000 system
	(100 to 2000) psi (>2000 to 5000) psi (>5000 to 10 000) psi (>10 000 to 20 000) psi (>20 000 to 30 000) psi	0.27 psi 0.59 psi 1.2 psi 10 psi 15 psi	Ruska 2450
Air Velocity – Generate	(30 to 250) FPM (250 to 1500) FPM (1500 to 9000) FPM	2.4 % + 0.58R 2.4 % + 0.58R 1.3 % + 0.58R	TSI 8390 wind tunnel
Pipettes	(2 to 10) μ L (10 to 100) μ L (100 to 500) μ L (500 to 1000) μ L (1000 to 5000) μ L	0.099 μ L 0.37 μ L 0.55 μ L 1.6 μ L 2 μ L	Gravimetric calibration using A&D AD- 4212B-PT & Mettler AT200
Force Gages – Tension & Compression ³	(0 to 1) lbf (>1 to 10) lbf (>10 to 100) lbf (>100 to 500) lbf	0.0023 lbf + 0.58R 0.0026 lbf + 0.58R 0.054 lbf + 0.58R 0.15 lbf + 0.58R	Weights, weight hangers

VI. Thermodynamic

Parameter/Equipment	Range	CMC ² (\pm)	Comments
Temperature – Measure ³	(-196 to 0) °C (>0 to 420) °C (>420 to 660) °C	0.018 °C 0.062 °C 0.087 °C	Fluke probe w/ display

Parameter/Equipment	Range	CMC ² (±)	Comments
Temperature – Measuring Equipment ³	(-75 to 175) °C (0 to 100) °C (-20 to 350) °C	0.068 °C 0.045 °C 0.063 °C	Fluke 1523 w/ baths, chambers, dry block calibrators
Relative Humidity – Measure ³	(5 to 15) % RH (>15 to 35) % RH (>35 to 55) % RH (>55 to 77) % RH (>77 to 95) % RH	0.58 % RH 0.60 % RH 0.60 % RH 0.63 % RH 0.65 % RH	RH Systems 973
Frost & Dew Point – Measure	(-50 to < 0) °C (0 to 20) °C	0.17 °C 0.13 °C	RH Systems 973

VII. Time & Frequency

Parameter/Equipment	Range ⁴	CMC ^{2, 8} (±)	Comments
Frequency – Measuring Equipment ³ GPS Reference	10 MHz 1 PPS 0.001 Hz to 10 MHz (>0.01 to 12) GHz (>12 to 50) GHz	(5.8 x 10 ⁻¹²) Hz (7.2 x 10 ⁻¹²) Hz (4.5 x 10 ⁻¹²) Hz + 0.58R (5.1 x 10 ⁻¹²) Hz + 0.58R (310 x 10 ⁻¹²) Hz + 0.58R	Fluke 910 GPS frequency standard Fluke 910 GPS standard HP 3325A & 83650B
Frequency – Measure ³	0.001 Hz to 10 MHz (>0.01 to 12) GHz (>12 to 50) GHz 100 kHz to 50 GHz	(5.5 x 10 ⁻¹²) Hz + 0.58R (5.1 x 10 ⁻¹²) Hz + 0.58R (520 x 10 ⁻¹²) Hz + 0.58R 0.12 Hz	Fluke 910 GPS frequency standard, Agilent 53132A-124 & N5531S Agilent E4448A, Fluke 910 GPS frequency standard
Period – Measure	80.6 ps to 4.44 ns 4.44 ns to 5 μs 5 μs to 10 ms >10 ms	3.2 x 10 ⁻⁸ ps 7.9 x 10 ⁻¹¹ μs 2.4 x 10 ⁻⁹ μs 3.8 x 10 ⁻⁷ ms	Agilent E4438C, Fluke 910 GPS, Agilent 53132A, Agilent 3325B

Parameter/Equipment	Range ⁴	CMC ^{2, 8} (\pm)	Comments
Timers & Stopwatches ³	Totalize Up to 24 hours	46 ms	Fluke 910 GPS standard, HP 53132A & 3325B
	Stopwatch to Stopwatch	58 ms	Stopwatch comparison
Pulse Characterization			
Time Interval, Pulse Width, Transition Time & Jitter – Measure ³	DC to 50 GHz 7 ps to 1 ms	9.2 ps + 0.12 %	HP 54750A & 54752A
Time Interval, Pulse Width, Transition Time	1 ns to 100 000 s	1.3 ns	HP 53132A, Fluke 910 GPS frequency standard, HP 81130A

¹ This laboratory offers commercial dimensional testing/calibration, 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. 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 Where ranges are not specified, the CMC stated is for the cardinal points only.

⁵ In the statement of CMC, L is the numerical value of the nominal length of the device measured in inches or millimeters. In the statement of CMC, R is the numerical value of the resolution of the device.

⁶ This laboratory meets R205 – *Specific Requirements: Calibration Laboratory Accreditation Program* for the types of dimensional tests listed above and is considered equivalent to that of a calibration.

⁷ 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 fraction/percentage of the reading plus a fixed floor specification.

⁸ In the statement of CMC, a % is defined as the percentage of reading unless otherwise noted.

⁹ This scope meets A2LA's *P112 Flexible Scope Policy*.



Accredited Laboratory

A2LA has accredited

SIMCO ELECTRONICS

Panorama City, CA

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/NCSL 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 16th day of August 2021.

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 1395.05
Valid to September 30, 2023

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