



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

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CALIBRATION

Valid until: February 29, 2016

Certificate Number: 3272.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations¹:

I. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 5, 6} (±)	Comments
DC Voltage ³ – Measure	(1 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	5.7 μV/V + 0.83 μV 9.6 μV/V + 0.34 μV 10 μV/V 12 μV/V + 33 μV 21 μV/V - 0.78 mV	Agilent / HP 3458A
	(10 to 200) mV (0.2 to 2) V (2 to 20) V (20 to 200) V (200 to 1000) V	1.3 μV/V + 0.13 μV 1.8 μV/V + 0.020 μV 1.9 μV/V + 0.034 μV 1.8 μV/V + 13 μV 1.8 μV/V + 25 μV	Fluke 8508A characterized, Fluke 752A
DC Voltage ³ – Generate	(0 to 320) mV (0.32 to 3.2) V (3.2 to 32) V (32 to 320) V (320 to 1100) V	21 μV/V + 1.0 μV 11 μV/V + 2.5 μV 12 μV/V + 23 μV 19 μV/V + 0.19 mV 18 μV/V + 1.9 mV	Fluke 5520A
	(0 to 220) mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (22 to 1100) V	6.4 μV/V + 0.53 μV 4.6 μV/V + 0.74 μV 3.2 μV/V + 2.6 μV 3.1 μV/V + 39 μV 5.1 μV/V + 0.39 mV 6.7 μV/V + 0.43 mV	Fluke 5720A

Parameter/Equipment	Range	CMC ^{2, 4, 5, 6} (\pm)	Comments
DC Voltage ³ – Generate (cont)	(0 to 200) mV (0.2 to 2.0) V (2.0 to 20) V (20 to 200) V (200 to 1100) V	1.9 μ V/V + 15 nV 1.9 μ V/V + 0.45 nV 1.9 μ V/V + 34 nV 1.8 μ V/V + 1.7 μ V 1.8 μ V/V + 21 μ V	Fluke 5720A characterized calibrator
DC Current ³ – Measure	(1 to 10) μ A (10 to 100) μ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A (10 to 200) μ A (0.2 to 2.0) mA (2.0 to 20) mA (20 to 200) mA (0.2 to 1) A (1 to 2) A (2 to 5) A (5 to 10) A (10 to 20) A (1 to 20) pA (20 to 200) pA (0.2 to 2) nA (2 to 20) nA (20 to 200) nA (0.2 to 2) μ A (2 to 10) μ A	1.1 μ A/A + 0.64 nA 22 μ A/A + 1.1 nA 23 μ A/A + 6.2 nA 23 μ A/A + 61 nA 41 μ A/A + 0.60 μ A 0.013 % + 11 μ A 5.7 μ A/A + 27 pA 6.6 μ A/A + 1.1 nA 6.3 μ A/A + 16 nA 8.6 μ A/A + 0.15 μ A 26 μ A/A + 51 nA 22 μ A/A + 0.12 μ A 24 μ A/A + 2.7 μ A 26 μ A/A + 10 μ A 27 μ A/A + 4.9 μ A 0.96 mA/A + 0.0006 pA 0.59 mA/A + 0.0019 pA 0.59 mA/A + 0.026 pA 0.24 mA/A + 0.056 pA 0.24 mA/A + 2.6 pA 0.010 mA/A + 8.0 pA 0.021 mA/A + 2.1 pA	Agilent / HP 3458A Fluke 8508A standard resistors precision current shunts Keithley 6517B characterized micro- current meter
DC Current ³ – Generate	(0 to 320) μ A (0.32 to 3.2) mA (3.2 to 32) mA (32 to 320) mA (0.32 to 1.1) A (1.1 to 3) A (3 to 11) A (0 to 220) μ A (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A (2.2 to 11) A	0.016 % + 17 nA 0.011 % + 54 nA 0.010 % + 0.30 μ A 0.010 % + 2.7 μ A 0.022 % + 35 μ A 0.038 % + 51 μ A 0.055 % + 0.58 mA 42 μ A/A + 5.7 nA 33 μ A/A + 6.5 nA 32 μ A/A + 44 nA 0.020 % - 0.90 μ A 0.080 % + 12 μ A 0.040 % + 0.40 mA	Fluke 5520A Fluke 5720A Fluke 5725A

Parameter/Equipment	Range	CMC ^{2, 4, 5, 6} (\pm)	Comments
DC Current ³ – Generate (cont)	(10 to 200) μ A (0.20 to 2.0) mA (2.0 to 20) mA (20 to 200) mA (0.20 to 2.0) A	5.5 μ A/A + 47 pA 7.1 μ A/A + 0.33 nA 6.3 μ A/A + 16 nA 8.5 μ A/A - 0.17 μ A 22 μ A/A + 0.12 μ A	Fluke5720A characterized
	(2.0 to 10) A	27 μ A/A + 2.8 μ A	Fluke 5725A characterized
	(10 to 20) A	28 μ A/A + 8.4 μ A	Fluke 5520A characterized
	(1 to 20) pA (20 to 200) pA (0.2 to 2) nA (2 to 20) nA (20 to 200) nA (0.2 to 2) μ A (2 to 10) μ A	0.92 mA/A + 0.0013 pA 0.47 mA/A + 0.015 pA 0.53 mA/A + 0.049 pA 0.23 mA/A + 0.069 pA 0.22 mA/A + 1.2 pA 0.021 mA/A + 20 pA 0.029 mA/A + 26 pA	Fluke 5700A Keithley 5156 Fluke 741A-1M
DC Level ³ – Generate	0 V to \pm 6.6 V (50 Ω)	0.26 % + 29 μ V	5520A W/SC1100
	0 V to \pm 1 V (1 M Ω)	0.024 % + 0.55 mV	
	\pm 1 to \pm 130 V (1 M Ω)	0.050 % + 0.34 mV	
	0 V to \pm 0.1 V (50 Ω)	0.31 mV/V + 29 μ V	9500B/9530
	\pm 0.1 V to \pm 5 V (50 Ω)	0.35 mV/V + 0.17 mV	
	0 V to \pm 1 V (1 M Ω)	0.15 mV/V + 0.57 mV	
\pm 1 to \pm 10 V (1 M Ω)	0.26 mV/V + 0.36 mV		
\pm 10 to \pm 200 V (1 M Ω)	0.28 mV/V + 2.0 mV		
Resistance ^{3, 4} – Measure	(0 to 10) Ω	16 $\mu\Omega/\Omega$ + 69 $\mu\Omega$	Agilent / HP 3458A
	(10 to 100) Ω	13 $\mu\Omega/\Omega$ + 0.73 m Ω	
	(0.1 to 1) k Ω	11 $\mu\Omega/\Omega$ + 1.6 m Ω	
	(1 to 10) k Ω	12 $\mu\Omega/\Omega$ + 14 m Ω	
	(10 to 100) k Ω	11 $\mu\Omega/\Omega$ + 0.16 Ω	
	(0.1 to 1) M Ω	18 $\mu\Omega/\Omega$ + 2.8 Ω	
	(1 to 10) M Ω	57 Ω/Ω + 150 Ω	
	(10 to 100) M Ω	0.059 % + 1700 Ω	
	(100 to 1000) M Ω	0.6 %	

Parameter/Equipment	Range	CMC ^{2, 4, 5} (±)	Comments
Resistance ³ – Measure (cont)	1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ 1000 MΩ	6.4 μΩ 83 μΩ 0.61 mΩ 6.3 mΩ 41 mΩ 0.63 Ω 8.9 Ω 0.10 kΩ 2.7 kΩ 0.19 MΩ	Fluke 8508A characterized DMM
Resistance ³ – Generate	(0 to 10.9999) Ω (11 to 32.9999) Ω 33 Ω to 109.9999 kΩ 110 kΩ to 1.099999 MΩ (1.1 to 3.299999) MΩ (3.3 to 10.00000) MΩ (11 to 32.99999) MΩ (33 to 109.9999) MΩ (110 to 329.9999) MΩ (330 to 1100) MΩ	40 μΩ/Ω + 10 μΩ 34 μΩ/Ω + 29 μΩ 28 μΩ/Ω 33 μΩ/Ω + 0.35 Ω 65 μΩ/Ω + 0.86 Ω 0.012 % + 66 Ω 0.025 % + 83 Ω 0.049 % + 520 Ω 0.30 % 1.5 %	Fluke 5520A
Fixed Points	1 Ω 1.9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 k Ω 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	0.00009 Ω 0.00017 Ω 0.00022 Ω 0.00043 Ω 0.00098 Ω 0.0019 Ω 0.0078 Ω 0.016 Ω 0.080 Ω 0.16 Ω 1.1 Ω 2.4 Ω 18 Ω 0.26 kΩ 0.43 kΩ 6.2 kΩ 13 kΩ	Fluke 5720A

Parameter/Equipment	Range	CMC ^{2,4,5} (±)	Comments
Resistance ³ – Generate (cont)			
Fixed Points	1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ	0.0000065 Ω 0.000081 Ω 0.00061 Ω 0.0061 Ω 0.041 Ω 0.63 Ω 8.9 Ω 0.10 k Ω	Fluke 742A-1 742A-10 742A-10 742A-1k 742A-10k 742A-100k 742A-1M 742A-10M
	100 MΩ 1 GΩ 10 G 100 G 1 T 10 T 100 T	2.7 k Ω 0.19 MΩ 15 MΩ 0.25 GΩ 1.6 GΩ 17 GΩ 0.24 TΩ	Guildline 9334A-100M 9334A-1G 9334A-10G 9334A-100G 9337-1T 9337-10T 9337-100T

Parameter/Range	Frequency	CMC ^{2,4,6} (±)	Comments
AC Voltage ³ – Measure (2 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	77 μV/V + 5.3 μV 76 μV/V + 3.4 μV 0.016 % + 3.2 μV 0.034 % + 4.6 μV 0.094 % + 2.7 μV 0.36 % + 12 μV 1.2 % + 11 μV	Agilent / HP 3458A
(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	78 μV/V + 58 μV 79 μV/V + 36 μV 0.016 % + 32 μV 0.035 % + 36 μV 0.094 % + 26 μV 0.36 % + 0.11 mV 1.2 % + 0.13 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	88 μV/V + 0.62 mV 89 μV/V + 0.39 mV 0.016 % + 0.32 mV 0.035 % + 0.47 mV 0.094 % + 0.30 mV 0.36 % + 1.7 mV 0.12 % + 12 mV	

Parameter/Range	Frequency	CMC ^{2, 4, 5, 6} (\pm)	Comments
AC Voltage ³ – Measure (cont)			
(10 to 100) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.023 % + 4.8 mV 0.023 % + 3.1 mV 0.023 % + 3.0 mV 0.040 % + 2.7 mV 0.14 % + 2.6 mV 0.47 % + 9.0 mV	Agilent / HP 3458A
(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	0.040 % + 55 mV 0.050 % + 22 mV 0.050 % + 45 mV 0.14 % + 23 mV 0.36 % + 10 mV	
Sine at 1 kHz (50 Ω load)	100 mV 300 mV 1 V	0.92 mV 2.7 mV 9.3 mV	
Sine at 50 kHz (50 Ω load)	30 mV 100 mV 300 mV 1 V 3 V	0.11 mV 0.13 mV 1.2 mV 4.0 mV 12 mV	Agilent / HP 3458A 011-0129-00 (50 Ω load, fixed points, amplitude)
Sine at 100 kHz (50 Ω load)	30 mV 100 mV 300 mV 1 V 3 V	0.11 mV 0.38 mV 1.1 mV 3.7 mV 11 mV	
(10 to 20) 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 + 1.3 μ V 0.21 mV/V + 1.3 μ V 0.13 mV/V + 1.2 μ V 0.22 mV/V + 2.0 μ V 0.34 mV/V + 2.4 μ V 0.90 mV/V + 3.0 μ V 1.0 mV/V + 8.0 μ V 1.8 mV/V + 8.0 μ V	Fluke 5790A

Parameter/Range	Frequency	CMC ^{2,4,5} (\pm)	Comments
AC Voltage ³ – Measure (cont)			
(20 to 70) 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	0.30 mV/V + 0.72 μ V 0.14 mV/V + 1.3 μ V 0.072 mV/V + 1.5 μ V 0.13 mV/V + 2.0 μ V 0.26 mV/V + 2.4 μ V 0.52 mV/V + 4.6 μ V 0.72 mV/V + 7.6 μ V 1.2 mV/V + 7.8 μ V	Fluke 5790A
(70 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	0.22 mV/V + 0.67 μ V 0.093 mV/V + 1.5 μ V 0.043 mV/V + 1.3 μ V 0.069 mV/V + 2.2 μ V 0.17 mV/V + 1.7 μ V 0.26 mV/V + 4.3 μ V 0.39 mV/V + 7.7 μ V 1.0 mV/V + 8.3 μ V	
(0.22 to 0.7) 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	0.24 mV/V + 0.25 μ V 0.09 mV/V 0.035 mV/V + 2.5 μ V 0.055 mV/V + 1.5 μ V 0.083 mV/V + 2.3 μ V 0.18 mV/V + 5.8 μ V 0.33 mV/V + 2.5 μ V 0.98 mV/V + 7.5 μ V	
(0.7 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	0.23 mV/V 0.075 mV/V 0.026 mV/V + 0.33 μ V 0.048 mV/V + 0.67 μ V 0.075 mV/V 0.17 mV/V 0.27 mV/V + 6.7 μ V 0.89 mV/V + 17 μ V	
(2.2 to 7) 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	0.22 mV/V + 2.0 μ V 0.074 mV/V + 0.25 μ V 0.025 mV/V + 3.3 μ V 0.048 mV/V + 7.5 μ V 0.083 mV/V + 2.5 μ V 0.19 mV/V + 2.0 μ V 0.41 mV/V + 2.5 μ V 1.2 mV/V + 2.5 μ V	

Parameter/Range	Frequency	CMC ^{2,4,5} (±)	Comments
AC Voltage ³ – Measure (cont)			
(7 to 22) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.23 mV/V 0.07 mV/V 0.03 mV/V 0.050 mV/V + 6.7 μV 0.083 mV/V + 10 μV 0.19 mV/V + 67 μV 0.41 mV/V + 33 μV 1.2 mV/V + 0.17mV	Fluke 5790A
(22 to 70) 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	0.22 mV/V + 95 μV 0.077 mV/V + 45 μV 0.034 mV/V + 20 μV 0.058 mV/V + 75 μV 0.097 mV/V + 45 μV 0.20 mV/V + 0.18 mV	
(70 to 220) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.23 mV/V 0.075 mV/V + 67 μV 0.034 mV/V + 67 μV 0.069 mV/V + 0.17 mV 0.098 mV/V + 0.33 mV 0.21 mV/V + 0.33 mV	
(220 to 700) V	40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.10 mV/V + 0.10 mV 0.045 mV/V + 0.50 mV 0.13 mV/V + 0.10 mV 0.5 mV/V	
(700 to 1000) V	45 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz	0.10 mV/V 0.04 mV/V + 1.0 mV 0.10 mV/V + 30 mV	
AC Voltage ³ – Generate			
(1 to 32.999) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	8.3 μV/V + 6.0 μV 0.017 % + 6.4 μV 0.021 % + 6.1 μV 0.10 % + 5.9 μV 0.36 % + 10 μV 0.83 % + 46 μV	Fluke 5520A
(33 to 329.999) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.031 % + 9.3 μV 0.016 % + 7.9 μV 0.016 % + 8.7 μV 0.034 % + 9.5 μV 0.082 % + 30 μV 0.20 % + 73 μV	

Parameter/Range	Frequency	CMC ^{2,4,5} (±)	Comments
AC Voltage ³ – Generate (cont)			
(0.33 to 3.29999) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.032 % + 46 μV 0.017 % + 58 μV 0.019 % + 64 μV 0.032 % + 38 μV 0.069 % + 0.15 mV 0.24 % + 0.61 mV	Fluke 5520A
(3.3 to 32.9999) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.031 % + 0.67 mV 0.017 % + 0.54 mV 0.024 % + 0.62 mV 0.034 % + 0.73 mV 0.089 % + 1.6 mV	
(33 to 329.999) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.019 % + 2.0 mV 0.020 % + 6.4 mV 0.025 % + 6.8 mV 0.032 % + 5.5 mV 0.20 % + 53 mV	
(330 to 1020) V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.031 % + 11 mV 0.026 % + 10 mV 0.032 % + 4.6 mV	
(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 1MHz	0.56 % + 8.8 μV 0.024 % + 4.4 μV 74 μV/V + 3.5 μV 0.020 % + 4.4 μV 0.052 % + 4.7 μV 0.11 % + 9.5 μV 0.21 % + 18 μV 0.30 % + 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	0.06 % + 8.0 μV 10 μV/V + 51 μV 84 μV/V + 6.6 μV 0.019 % + 7.2 μV 0.048 % + 16 μV 0.087 % + 20 μV 0.14 % + 24 μV 0.26 % + 48 μV	

Parameter/Range	Frequency	CMC ^{2,4,5} (±)	Comments
AC Voltage ³ – Generate (cont)			
(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	0.010 % + 1.1 mV 0.027 % + 3.7 μV 55 μV/V + 6.6 μV 73 μV/V + 9.4 μV 0.010 % + 31 μV 0.039 % + 83 μV 0.096 % + 0.19 mV 0.16 % + 0.33 mV	Fluke 5720A
(2.2 to 22) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz	55 μV/V + 9.8 mV 0.023 % + 0.11 mV 51 μV/V + 78 μV 73 μV/V + 9.4 μV 96 μV/V + 0.20 mV	
(2.2 to 22) V	(100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz	0.026 % + 0.59 mV 0.092 % + 0.87 mV 0.15 % + 3.2 mV	
(22 to 220) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.080 % + 84 mV 0.028 % + 60 μV 68 μV/V + 5.2 mV 82 μV/V + 0.96 mV 0.014 % + 2.3 mV 0.084 % + 16 mV	
(220 to 1100) V	(15 to 50) Hz 50 Hz to 1 kHz	0.012 % + 36 mV 0.012 % + 2.0 mV	
(220 to 1100) V	(1 to 20) kHz (20 to 30) kHz	0.013 % + 7.8 mV 0.046 % + 18 mV	Fluke 5725A
(220 to 750) V	(30 to 50) kHz (50 to 100) kHz	0.048 % + 14 mV 0.17 % + 82 mV	
(10 to 200) 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	0.24 mV/V + 2.5 μV 0.11 mV/V + 2.1 μV 0.047 mV/V + 2.2 μV 0.081 mV/V + 2.6 μV 0.18 mV/V + 3.6 μV 0.29 mV/V + 5.1 μV	Fluke 5720A characterized

Parameter/Range	Frequency	CMC ^{2,4,5} (±)	Comments
AC Voltage ³ – Generate (cont)			
(0.20 to 2.0) 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	0.25 mV/V + 0.25 μV 0.084 mV/V + 0.88 μV 0.029 mV/V + 1.4 μV 0.052 mV/V + 1.4 μV 0.084 mV/V + 0.88 μV 0.18 mV/V + 0.88 μV 0.31 mV/V + 2.2 μV 1.3 mV/V + 5.0 μV	Fluke 5720A characterized
(2.0 to 20) 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	0.24 mV/V + 0.49 mV 0.078 mV/V + 28 μV 0.033 mV/V + 0.63 μV 0.052 mV/V + 14 μV 0.094 mV/V + 6.9 μV 0.22 mV/V + 8.1 μV 0.46 mV/V + 13 μV 1.4 mV/V + 0.11 mV	
(20 to 220) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.26 mV/V + 4.1 mV 0.076 mV/V + 1.5 mV 0.039 mV/V + 38 μV 0.079 mV/V + 38 μV 0.12 mV/V + 31 μV 0.24 mV/V + 0.16 μV	
(200 to 1000) V	45 Hz to 1 kHz (1 to 10) kHz (10 to 30) kHz	0.12 mV/V + 1.4 mV 0.05 mV/V 0.16 mV/V	Fluke 5725A characterized
(200 to 700) V	(30 to 100) kHz	0.37 mV/V + 69 mV	

Parameter/Range	Frequency	CMC ^{2,4,5} (±)	Comments
AC Current ³ – Measure			
(0.015 to 1) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 5 kHz (5 to 30) kHz	0.22 mA/A + 15 nA 0.092 mA/A + 4.9 nA 0.063 mA/A + 3.3 nA 0.079 mA/A + 3.9 nA	Fluke 5790A precision current shunts
(1 to 10) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 30 kHz	0.22 mA/A + 0.16 µA 0.078 mA/A + 98 nA 0.035 mA/A + 78 nA	
(10 to 20) mA	(10 to 20) Hz 20 Hz to 30 kHz	0.24 mA/A + 0.37 µA 0.029 mA/A + 0.29 µA	
(20 to 50) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 5 kHz (5 to 30) kHz	0.25 mA/A + 0.31 µA 0.075 mA/A + 0.60 µA 0.029 mA/A + 0.51 µA 0.036 mA/A + 0.34 µA	
(50 to 100) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 30 kHz	0.21 mA/A + 3.4 µA 0.078 mA/A + 1.3 µA 0.032 mA/A + 1.4 µA	
(100 to 200) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 30 kHz	0.24 mA/A + 3.7 µA 0.070 mA/A + 3.5 µA 0.028 mA/A + 3.6 µA	
(200 to 500) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 30 kHz	0.25 mA/A + 3.1 µA 0.079 mA/A + 5.1 µA 0.032 mA/A + 4.3 µA	
(0.5 to 1) A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 30 kHz	0.25 mA/A + 12 µA 0.076 mA/A + 15 µA 0.032 mA/A + 14 µA	
(1 to 2) A	(10 to 20) Hz (20 to 40) Hz 40 Hz to 30 kHz	0.26 mA/A 0.070 mA/A + 35 µA 0.029 mA/A + 28 µA	
(2 to 5) A	40 Hz to 30 kHz	0.030 mA/A + 85 µA	
(5 to 10) A	40 Hz to 5 kHz (5 to 10) kHz	0.032 mA/A + 0.16 mA 0.048 mA/A + 0.11 mA	
(10 to 20) A	40 Hz to 5 kHz (5 to 10) kHz	0.046 mA/A + 0.18 mA 0.049 mA/A + 0.22 mA	

Parameter/Range	Frequency	CMC ^{2,4,5} (±)	Comments
AC Current ³ – Measure (cont)			
(0.1 to 1) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	4.7 mA/A + 0.23 µA 1.8 mA/A + 0.22 µA 0.72 mA/A + 0.23 µA 0.38 mA/A + 0.23 µA	HP/Agilent 3458A
(1 to 10) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	4.7 mA/A + 2.2 µA 1.8 mA/A + 2.2 µA 0.72 mA/A + 2.3 µA 0.38 mA/A + 2.3 µA	
(10 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	4.7 mA/A + 22 µA 1.8 mA/A + 22 µA 0.72 mA/A + 23 µA 0.28 mA/A + 22 µA	
(100 to 1000) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	4.7 mA/A + 0.22 mA 1.9 mA/A + 0.23 mA 0.98 mA/A + 0.22 mA 1.2 mA/A + 0.23 mA	
AC Current ³ – Generate			
(10 to 32.999) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.18 % + 1.8 µA 0.10 % + 2.0 µA 0.039 % + 2.4 µA 0.082 % + 2.8 µA 0.20 % + 4.0 µA 0.39 % + 5.8 µA	Fluke 5520A
(33 to 329.99) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.18 % + 21 µA 0.090 % + 28 µA 0.042 % + 21 µA 0.099 % + 54 µA 0.20 % + 0.10 mA 0.39 % + 0.22 mA	
(0.33 to 1.09999) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.18 % + 0.11 mA 0.052 % + 0.11 mA 0.69 % + 1.0 mA 2.5 % + 5.1 mA	
(1.1 to 2.99999) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.13 % + 1.4 mA 0.062 % + 0.08 mA 0.58 % + 1.3 mA 2.5 % + 5.3 mA	

Parameter/Range	Frequency	CMC ^{2, 4, 5} (±)	Comments
AC Current ³ – Generate (cont)			
(3 to 10.9999) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.067 % + 2.0 mA 0.11 % + 1.6 mA 3.0 % + 2.1 mA	Fluke 5520A
(10 to 22) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.023 % + 0.79 µA 0.016 % + 0.86 µA 0.011 % + 0.87 µA 0.019 % + 0.99 µA 0.090 % + 3.2 µA	Fluke 5720A
(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	0.028 % + 3.2 µA 0.020 % + 2.6 µA 0.016 % + 1.9 µA 0.021 % + 2.9 µA 0.11 % + 7.8 µA	
(0.22 to 2.2) A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.041 % + 4.4 µA 0.052 % + 56 µA 0.64 % + 0.11 mA	
(2.2 to 11) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.039 % + 0.14 mA 0.074 % + 0.37 mA 0.29 % + 0.43 mA	Fluke 5725A
(0.015 to 0.2) mA	(10 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.47 mA/A + 5.4 nA 0.048 mA/A + 3.1 nA 0.053 mA/A + 3.0 nA 0.063 mA/A + 3.0 nA	Fluke 5720A/5520A characterized
(0.2 to 2) mA	(10 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.50 mA/A + 8.0 nA 0.030 mA/A + 22 nA 0.028 mA/A + 27 nA 0.026 mA/A + 33 nA	
(2 to 20) mA	(10 to 40) Hz 40 Hz to 10 kHz	0.40 mA/A + 0.52 µA 0.022 mA/A + 0.27 µA	
(20 to 200) mA	(10 to 40) Hz 40 Hz to 10 kHz	0.35 mA/A + 5.9 nA 0.022 mA/A + 0.27 µA	
(0.2 to 2) A	(10 to 40) Hz 40 Hz to 5 kHz (5 to 10) kHz	0.22 mA/A + 12 µA 0.024 mA/A + 26 µA 0.035 mA/A + 20 µA	
(2 to 20) A	(10 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.44 mA/A + 0.19 mA 0.053 mA/A + 0.11 mA 0.064 mA/A + 63 µA 0.070 mA/A + 60 µA	

Parameter/Range	Frequency	CMC ^{2, 4, 5} (±)	Comments
Capacitance ³ – Measure			
(1 to 10) nF 10 nF to 100 μF 100 μF to 1 mF	100 Hz	1.1 mF/F + 1.3 pF 1.3 mF/F + 0.028 nF 1.2 mF/F + 5.2 nF	Fluke 6306
(0.19 to 0.3) nF (0.3 to 1) nF 1 nF to 100 nF 100 nF to 1 μF	1 kHz	0.2 mF/F + 0.3 pF 1.2 mF/F 1.2 mF/F + 0.2 pF 1.2 mF/F + 1 pF	
(1 to 100) nF	10 kHz	1.2 mF/F	

Parameter/Equipment	Range	CMC ^{2, 4} (±)	Comments
Capacitance ³ – Generate	(0.19 to 0.3999) nF (0.4 to 1.0999) nF (1.1 to 3.2999) nF (3.3 to 10.9999) nF (11 to 32.9999) nF (33 to 109.999) nF (110 to 329.999) nF (0.33 to 1.0999) μF (1.1 to 3.2999) μF (3.3 to 10.9999) μF (11 to 32.9999) μF (33 to 109.999) μF (110 to 329.999) μF (0.33 to 1.0999) mF (1.1 to 3.2999) mF (3.3 to 10.9999) mF	0.51 % + 10 pF 0.62 % + 9.7 pF 0.48 % + 12 pF 0.25 % + 11 pF 0.23 % + 0.12 nF 0.25 % + 0.11 nF 0.20 % + 0.60 nF 0.26 % + 1.0 nF 0.20 % + 6.0 nF 0.26 % + 10 nF 0.34 % + 59 nF 0.45 % + 0.11 μF 0.43 % + 0.49 μF 0.45 % + 1.1 μF 0.47 % + 4.7 μF 0.50 % + 9.7 μF	Fluke 5520A
Capacitance ³ – Generate, Fixed Points	24.47 pF 84.39 pF	0.28 pF 0.63 pF	Fixed capacitor
Rise Time ³ – Measure	≥ 150 ps ≥ 500 ps	12 ps 28 ps	TDS8200(80E04)
	≥ 15 ps ≥ 25 ps ≥ 70 ps	4 ps 4 ps 12 ps	TDS8200(80E01)

Parameter/Equipment	Range	CMC ² (±)	Comments
Rise Time ³ – Generate	300 ps 150 ps 70 ps 25 ps	57 ps 27 ps 19 ps 9.1 ps	5520A W/SC1100 Fluke 9500B/9530 Fluke 9500B/9560 Fluke 9500B/9550
Period ³ – Measure Fixed Points	10.000 ns 100.00 ns 1000.0 ns 1.0000 ms 10.000 ms	0.000013 ps 0.00013 ps 0.0013 ps 1.3 ps 14 ps	Agilent/HP 53131A Fluke 910
Pulse Width ³ – Measure	4.0 ns 20.00 ns 100.0 ns	0.062 ns 0.065 ns 0.13 ns	Agilent / HP 53131A Fluke 910
Resistance ³ – Measure	50 Ω 1 MΩ 50 Ω 1 MΩ	0.06 Ω 0.0012 MΩ 0.064 Ω 0.0012 MΩ	5520A W/SC1100 Fluke 9500B/9530
Resistance ³ – Generate	50 Ω 1 MΩ	0.023 Ω 310 Ω	ESI DB62
Time Marker ³ – Generate	1 ns to 5s (1 to 100) ns 100 ns to 100 μs 100 μs to 5 s	0.091 ms/s 0.28 ps 1.1 μs/s 0.3 μs/s	5520A W/SC1100 Fluke 9500B/9530
Level Flatness ³ – Generate	5 mV to 5.5 V, 50 kHz to 600 MHz 5 mV to 3.5 V, (600 to 1100) MHz 5 mV to 5 V (50 kHz to 550 MHz) 5 mV to 3 V (550 MHz to 2.5 GHz) 5 mV to 2 V (2.5 GHz to 3.2 GHz)	0.40 dB 0.48 dB 0.33 dB 0.33 dB 0.33 dB	5520A W/SC1100 Fluke 9500B/9530

Parameter/Equipment	Range	CMC ² (±)	Comments
Level Flatness ³ – Generate (cont)	5 mV to 5 V (50 kHz to 550 MHz)	0.69 dB	Fluke 9500B/9560
	5 mV to 3 V (550 MHz to 2.5 GHz)	0.69 dB	
	25 mV to 2 V (2.5 GHz to 6.4 GHz)	0.69 dB	
	60 mV to 1 V (6 GHz to 12 GHz)	0.63 dB	Agilent N1912A Agilent E4413A Agilent N5183A
	60 mV to 1 V (12 GHz to 16 GHz)	0.90 dB	
	60 mV to 1 V (16 GHz to 20 GHz)	1.1 dB	
	1 V to 3 V (6 GHz to 12 GHz)	0.42 dB	
	1 V to 3 V (12 GHz to 16 GHz)	0.58 dB	
	1 V to 3 V (16 GHz to 20 GHz)	0.67 dB	

II. Electrical – RF/Microwave

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments		
RF Flatness ⁴ – Measure	100 mV	(10 to 550) MHz	1.4 %	Rhode and Schwarz NRVS and NRV-Z5	
		(10 to 550) MHz	1.4 %		
		550 MHz to 1.5 GHz	2.1 %		
		(1.5 to 3) GHz	2.7 %		
	300 mV	10 MHz to 1 GHz (1 to 3) GHz	1.4 %		
			2.6 %		
	1 V	(10 to 550) MHz	1.3 %		
			550 MHz to 1.5 GHz		1.9 %
			(1.5 to 3) GHz		2.6 %
	3 V	10 MHz to 2.5 GHz	1.4 %		

III. Thermodynamics

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
IR Temperature – Measuring Equipment	(20 to 50) °C (50 to 100) °C	0.34 °C 0.28 % + 0.18 °C	Fluke 4180 IR calibrator ε = 0.95
	(100 to 200) °C (200 to 500) °C	0.12 % + 0.19 °C 0.24 % + 1.2 °C	Fluke 4181 IR calibrator ε = 0.95

IV. Time & Frequency

Parameter/Range	Frequency	CMC ² (±)	Comments
Frequency ³ – Measuring Equipment	(0.01 to 1119.99) Hz (120 to 1199.9) Hz (1.2 to 11.999) kHz (12.00 to 119.99) kHz (120 to 1199.9) kHz (1.200 to 2.000) MHz	2.9 μHz/Hz + 8.4 μHz 2.7 μHz/Hz + 25 μHz 2.7 μHz/Hz + 0.14 mHz 2.5 μHz/Hz + 1.6 mHz 2.5 μHz/Hz + 5.1 mHz 2.4 μHz/Hz + 0.25 Hz	Fluke 5520A
Frequency – Measure ³	10 Hz to 1 kHz 1 kHz to 2 MHz	0.35 μHz/Hz 0.02 μHz/Hz	Agilent/HP 53131A, Fluke 910

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

² Calibration and Measurement Capability (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. Calibration and Measurement Capabilities 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, percentages are percentages of reading.

- ⁵ The measurands stated are generated with the Fluke 5500 & 5700 series of instruments. This capability is suitable for the calibration of the devices intended to measure the stated measurand in the ranges indicated. CMC is expressed as either a specific value that covers the full range or as a fraction of the reading plus a fixed floor specification.
- ⁶ The measurands stated are measured with the HP 3458A. This capability is suitable for the calibration of the devices intended to generate the measurand in the ranges indicated. CMC is expressed as either a specific value that covers the full range or as a combination of the fraction of the reading/output plus a range specification.

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CALIBRATION

Valid until: February 29, 2016

Certificate Number: 3272.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations¹:

I. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2, 4, 5, 6} (±)	Comments
DC Voltage ³ – Measure	(1 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	5.7 μV/V + 0.83 μV 9.6 μV/V + 0.34 μV 10 μV/V 12 μV/V + 33 μV 21 μV/V - 0.78 mV	Agilent / HP 3458A
DC Voltage ³ – Generate	(0 to 320) mV (0.32 to 3.2) V (3.2 to 32) V (32 to 320) V (320 to 1100) V	21 μV/V + 1.0 μV 11 μV/V + 2.5 μV 12 μV/V + 23 μV 19 μV/V + 0.19 mV 18 μV/V + 1.9 mV	Fluke 5522A
	(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	6.4 μV/V + 0.53 μV 4.6 μV/V + 0.74 μV 3.2 μV/V + 2.6 μV 3.1 μV/V + 39 μV 5.1 μV/V + 0.39 mV 6.7 μV/V + 0.43 mV	Fluke 5720A
DC Current ³ – Measure	(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	1.1 μA/A + 0.64 nA 22 μA/A + 1.1 nA 23 μA/A + 6.2 nA 23 μA/A + 61 nA 41 μA/A + 0.60 μA 0.13 mA/A + 11 μA	Agilent / HP 3458A

Parameter/Equipment	Range	CMC ^{2, 4, 5, 6} (\pm)	Comments
DC Current ³ – Generate	(0 to 320) μ A (0.32 to 3.2) mA (3.2 to 32) mA (32 to 320) mA (0.32 to 1.1) A (1.1 to 3) A (3 to 11) A	0.16 mA/A + 17 nA 0.11 mA/A + 54 nA 0.10 mA/A + 0.30 μ A 0.10 mA/A + 2.7 μ A 0.22 mA/A + 35 μ A 0.38 mA/A + 51 μ A 0.55 mA/A + 0.58 mA	Fluke 5522A
	(0 to 220) μ A (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A	42 μ A/A + 5.7 nA 33 μ A/A + 6.5 nA 32 μ A/A + 44 nA 0.20 mA/A - 0.90 μ A 0.80 μ A/A + 12 μ A	Fluke 5720A
	(2.2 to 11) A	0.40 mA/A + 0.40 mA	Fluke 5725A
DC Level ³ – Generate	0 V to \pm 6.6 V (50 Ω) 0 V to \pm 1 V (1 M Ω) \pm 1 to \pm 130 V (1M Ω)	2.6 mV/V + 29 μ V 0.24 mV/V + 0.55 mV 0.50 mV/V + 0.34 mV	Fluke 5522A w/SC1100
	0 V to \pm 0.1 V (50 Ω) \pm 0.1 V to \pm 5 V (50 Ω)	0.31 mV/V + 29 μ V 0.35 mV/V + 0.17 mV	Fluke 9500A/9530
	0 V to \pm 1 V (1 M Ω) \pm 1 to \pm 10 V (1 M Ω) \pm 10 to \pm 200 V (1 M Ω)	0.15 mV/V + 0.57 mV 0.26 mV/V + 0.36 mV 0.28 mV/V + 2.0 mV	
Resistance ³ – Measure	(0 to 10) Ω (10 to 100) Ω (0.1 to 1) k Ω (1 to 10) k Ω (10 to 100) k Ω (0.1 to 1) M Ω (1 to 10) M Ω (10 to 100) M Ω (100 to 1000) M Ω	16 $\mu\Omega/\Omega$ + 69 $\mu\Omega$ 13 $\mu\Omega/\Omega$ + 0.73 m Ω 11 $\mu\Omega/\Omega$ + 1.6 m Ω 12 $\mu\Omega/\Omega$ + 14 m Ω 11 $\mu\Omega/\Omega$ + 0.16 Ω 18 $\mu\Omega/\Omega$ + 2.8 Ω 0.057 m Ω/Ω + 150 Ω 0.59 m Ω/Ω + 1700 Ω 6.0 m Ω/Ω	Agilent / HP 3458A

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Resistance ³ – Measure	50 Ω 1 MΩ	0.06 Ω 0.0012 MΩ	Fluke 5522A w/SC 1100
	50 Ω 1 MΩ	0.064 Ω 0.0012 MΩ	Fluke 9500B/9530
Resistance ³ – Generate	(0 to 10.9999) Ω (11 to 32.9999) Ω 33 Ω to 109.9999 kΩ 110 kΩ to 1.099999 MΩ (1.1 to 3.299999) MΩ (3.3 to 10.00000) MΩ (11 to 32.99999) MΩ (33 to 109.9999) MΩ (110 to 329.9999) MΩ (330 to 1100) MΩ	40 μΩ/Ω + 10 μΩ 34 μΩ/Ω + 29 μΩ 28 μΩ/Ω 33 μΩ/Ω + 0.35 Ω 65 μΩ/Ω + 0.86 Ω 0.12 mΩ/Ω + 66 Ω 0.25 mΩ/Ω + 83 Ω 0.49 mΩ/Ω + 520 Ω 3.0 mΩ/Ω 15 mΩ/Ω	Fluke 5522A
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 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ	0.00009 Ω 0.00017 Ω 0.00022 Ω 0.00043 Ω 0.00098 Ω 0.0019 Ω 0.0078 Ω 0.016 Ω 0.080 Ω 0.16 Ω 1.1 Ω 2.4 Ω 18 Ω 0.26 kΩ 0.43 kΩ 6.2 kΩ 13 kΩ	Fluke 5720A

Parameter/Range	Frequency	CMC ^{2,6} (±)	Comments
AC Voltage ³ – Measure			
(2 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	77 µV/V + 5.3 µV 76 µV/V + 3.4 µV 0.16 mV/V + 3.2 µV 0.34 mV/V + 4.6 µV 0.94 mV/V + 2.7 µV 3.6 mV/V + 12 µV 12 mV/V + 11 µV	Agilent / HP 3458A
(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	78 µV/V + 58 µV 79 µV/V + 36 µV 0.16 mV/V + 32 µV 0.35 mV/V + 36 µV 0.94 mV/V + 26 µV 3.6 mV/V + 0.11 mV 12 mV/V + 0.13 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	88 µV/V + 0.62 mV 89 µV/V + 0.39 mV 0.16 mV/V + 0.32 mV 0.35 mV/V + 0.47 mV 0.94 mV/V + 0.30 mV 3.6 mV/V + 1.7 mV 1.2 mV/V + 12 mV	
(10 to 100) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.23 mV/V + 4.8 mV 0.23 mV/V + 3.1 mV 0.23 mV/V + 3.0 mV 0.40 mV/V + 2.7 mV 1.4 mV/V + 2.6 mV 4.7 mV/V + 9.0 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	0.40 mV/V + 55 mV 0.50 mV/V + 22 mV 0.50 mV/V + 45 mV 1.4 mV/V + 23 mV 3.6 mV/V + 10 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	88 µV/V + 0.62 mV 89 µV/V + 0.39 mV 0.16 mV/V + 0.32 mV 0.35 mV/V + 0.47 mV 0.94 mV/V + 0.30 mV 3.6 mV/V + 1.7 mV 1.2 mV/V + 12 mV	

Parameter/Range	Frequency	CMC ^{2, 5, 6} (\pm)	Comments
AC Voltage ³ – Measure (cont)			
(10 to 100) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.23 mV/V + 4.8 mV 0.23 mV/V + 3.1 mV 0.23 mV/V + 3.0 mV 0.40 mV/V + 2.7 mV 1.4 mV/V + 2.6 mV 4.7 mV/V + 9.0 mV	Agilent / HP 3458A
(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	0.40 mV/V + 55 mV 0.50 mV/V + 22 mV 0.50 mV/V + 45 mV 1.4 mV/V + 23 mV 3.6 mV/V + 10 mV	
AC Voltage ³ – Generate			
(1 to 32.999) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	8.3 μ V/V + 6.0 μ V 0.17 mV/V + 6.4 μ V 0.21 mV/V + 6.1 μ V 1.0 mV/V + 5.9 μ V 3.6 mV/V + 10 μ V 8.3 mV/V + 46 μ V	Fluke 5522A
(33 to 329.999) mV	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.31 mV/V + 9.3 μ V 0.16 mV/V + 7.9 μ V 0.16 mV/V + 8.7 μ V 0.34 mV/V + 9.5 μ V 0.82 mV/V + 30 μ V 2.0 mV/V + 73 μ V	
(0.33 to 3.29999) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz	0.32 mV/V + 46 μ V 0.17 mV/V + 58 μ V 0.19 mV/V + 64 μ V 0.32 mV/V + 38 μ V 0.69 mV/V + 0.15 mV 2.4 mV/V + 0.61 mV	
(3.3 to 32.9999) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.31 mV/V + 0.67 mV 0.17 mV/V + 0.54 mV 0.24 mV/V + 0.62 mV 0.34 mV/V + 0.73 mV 0.89 mV/V + 1.6 mV	

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
AC Voltage ³ – Generate (cont)			
(33 to 329.999) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.19 mV/V + 2.0 mV 0.20 mV/V + 6.4 mV 0.25 mV/V + 6.8 mV 0.32 mV/V + 5.5 mV 2.0 mV/V + 53 mV	Fluke 5522A
(330 to 1020) V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.31 mV/V + 11 mV 0.26 mV/V + 10 mV 0.32 mV/V + 4.6 mV	
(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	5.6 mV/V + 8.8 μV 0.24 mV/V + 4.4 μV 74 μV/V + 3.5 μV 0.20 mV/V + 4.4 μV 0.52 mV/V + 4.7 μV 1.1 mV/V + 9.5 μV 2.1 mV/V + 18 μV 3.0 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	0.6 mV/V + 8.0 μV 10 μV/V + 51 μV 84 μV/V + 6.6 μV 0.19 mV/V + 7.2 μV 0.48 mV/V + 16 μV 0.87 mV/V + 20 μV 1.4 mV/V + 24 μV 2.6 mV/V + 48 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	0.10 mV/V + 1.1 mV 0.27 mV/V + 3.7 μV 55 μV/V + 6.6 μV 73 μV/V + 9.4 μV 0.10 mV/V + 31 μV 0.39 mV/V + 83 μV 0.96 mV/V + 0.19 mV 1.6 mV/V + 0.33 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 500 kHz to 1 MHz	55 μV/V + 9.8 mV 0.23 mV/V + 0.11 mV 51 μV/V + 78 μV 73 μV/V + 9.4 μV 96 μV/V + 0.20 mV 0.26 mV/V + 0.59 mV 0.92 mV/V + 0.87 mV 1.5 mV/V + 3.2 mV	

Parameter/Range	Frequency	CMC ^{2, 5, 6} (\pm)	Comments
AC Voltage ³ – Generate (cont)			
(22 to 220) V	(10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	0.80 mV/V + 84 mV 0.28 mV/V + 60 μ V 68 μ V/V + 5.2 mV 82 μ V/V + 0.96 mV 0.14 mV/V + 2.3 mV 0.84 mV/V + 16 mV	Fluke 5720A
(220 to 1100) V	(15 to 50) Hz 50 Hz to 1 kHz	1.1 mV/V + 36 mV 0.12 mV/V + 2.0 mV	
(220 to 1100) V	(1 to 20) kHz (20 to 30) kHz	0.13 mV/V + 7.8 mV 0.46 mV/V + 18 mV	Fluke 5725A
(220 to 750) V	(30 to 50) kHz (50 to 100) kHz	0.48 mV/V + 14 mV 1.7 mV/V + 82 mV	
AC Current ³ – Measure			
(0.1 to 1) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	4.7 mA/A + 0.23 μ A 1.8 mA/A + 0.22 μ A 0.72 mA/A + 0.23 μ A 0.38 mA/A + 0.23 μ A	Agilent/HP 3458A
(1 to 10) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	4.7 mA/A + 2.2 μ A 1.8 mA/A + 2.2 μ A 0.72 mA/A + 2.3 μ A 0.38 mA/A + 2.3 μ A	
(10 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	4.7 mA/A + 22 μ A 1.8 mA/A + 22 μ A 0.72 mA/A + 23 μ A 0.28 mA/A + 22 μ A	
(100 to 1000) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz	4.7 mA/A + 0.22 mA 1.9 mA/A + 0.23 mA 0.98 mA/A + 0.22 mA 1.2 mA/A + 0.23 mA	

Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
AC Current ³ – Generate			
(10 to 32.999) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	1.8 mA/A + 1.8 µA 1.0 mA/A + 2.0 µA 0.39 mA/A + 2.4 µA 0.82 mA/A + 2.8 µA 2.0 mA/A + 4.0 µA 3.9 mA/A + 5.8 µA	Fluke 5522A
(33 to 329.99) mA	(10 to 20) Hz (20 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	1.8 mA/A + 21 µA 0.90 mA/A + 28 µA 0.42 mA/A + 21 µA 0.99 mA/A + 54 µA 2.0 mA/A + 0.10 mA 3.9 mA/A + 0.22 mA	
(0.33 to 1.09999) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	1.8 mA/A + 0.11 mA 0.52 mA/A + 0.11 mA 6.9 mA/A + 1.0 mA 25 mA/A + 5.1 mA	
(1.1 to 2.99999) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	1.3 mA/A + 1.4 mA 0.62 mA/A + 0.08 mA 5.8 mA/A + 1.3 mA 25 mA/A + 5.3 mA	
(3 to 10.9999) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.67 mA/A + 2.0 mA 1.1 mA/A + 1.6 mA 30 mA/A + 2.1 mA	
(10 to 22) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.23 mA/A + 0.79 µA 0.16 mA/A + 0.86 µA 0.11 mA/A + 0.87 µA 0.19 mA/A + 0.99 µA 0.90 mA/A + 3.2 µA	Fluke 5720A
(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	0.28 mA/A + 3.2 µA 0.20 mA/A + 2.6 µA 0.16 mA/A + 1.9 µA 0.21 mA/A + 2.9 µA 1.1 mA/A + 7.8 µA	
(0.22 to 2.2) A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.41 mA/A + 4.4 µA 0.52 mA/A + 56 µA 6.4 mA/A + 0.11 mA	
(2.2 to 11) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.39 mA/A + 0.14 mA 0.74 mA/A + 0.37 mA 2.9 mA/A + 0.43 mA	Fluke 5725A

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Capacitance ³ – Generate	(0.22 to 0.3999) nF (0.4 to 1.0999) nF (1.1 to 3.2999) nF (3.3 to 10.9999) nF (11 to 32.9999) nF (33 to 109.999) nF (110 to 329.999) nF (0.33 to 1.0999) μF (1.1 to 3.2999) μF (3.3 to 10.9999) μF (11 to 32.9999) μF (33 to 109.999) μF (110 to 329.999) μF (0.33 to 1.0999) mF (1.1 to 3.2999) mF (3.3 to 10.9999) mF	5.1 mF/F + 10 pF 6.2 mF/F + 9.7 pF 4.8 mF/F + 12 pF 2.5 mF/F + 11 pF 2.3 mF/F + 0.12 nF 2.5 mF/F + 0.11 nF 2.0 mF/F + 0.60 nF 2.6 mF/F + 1.0 nF 2.0 mF/F + 6.0 nF 2.6 mF/F + 10 nF 3.4 mF/F + 59 nF 4.5 mF/F + 0.11 μF 4.3 mF/F + 0.49 μF 4.5 mF/F + 1.1 μF 4.7 mF/F + 4.7 μF 5.0 mF/F + 9.7 μF	Fluke 5522A
Rise Time – Generate ³	300 ps 150 ps 70 ps 25 ps	57 ps 27 ps 19 ps 9.1 ps	Fluke 5522A w/SC1100 Fluke 9500B/9530 Fluke 9500B/9560 Fluke 9500B/9550
Time Marker ³ – Generate	1 ns to 5 s (1 to 100) ns 100 ns to 100 μs 100 μs to 5 s	0.091 ms/s 0.28 ps 1.1 μs/s 0.3 μs/s	Fluke 5522A w/SC1100 Fluke 9500B/9530
Level Flatness ³ – Generate	5 mV to 5.5 V (50 kHz to 600 MHz) 5 mV to 3.5 V (600 MHz to 1100 MHz) 5 mV to 5 V (50 kHz to 550 MHz) 5 mV to 3 V (550 MHz to 2.5 GHz) 5 mV to 2 V (2.5 GHz to 3.2 GHz)	0.40 dB 0.48 dB 0.33 dB 0.33 dB 0.33 dB	Fluke 5522A w/SC1100 Fluke 9500B/9530

Parameter/Equipment	Range	CMC ² (±)	Comments
Level Flatness ³ – Generate (cont)	5 mV to 5 V (50 kHz to 550 MHz)	0.69 dB	Fluke 9500B/9560
	5 mV to 3 V (550 MHz to 2.5 GHz)	0.69 dB	
	25 mV to 2 V (2.5 GHz to 6.4 GHz)	0.69 dB	

II. Time & Frequency

Parameter/Equipment	Range	CMC ² (±)	Comments
Frequency ³ – Measuring Equipment	(0.01 to 1119.99) Hz	2.9 µHz/Hz + 8.4 µHz	Fluke 5522A
	(120 to 1199.9) Hz	2.7 µHz/Hz + 25 µHz	
	(1.2 to 11.999) kHz	2.7 µHz/Hz + 0.14 mHz	
	(12.00 to 119.99) kHz	2.5 µHz/Hz + 1.6 mHz	
	(120 to 1199.9) kHz	2.5 µHz/Hz + 5.1 mHz	
	(1.200 to 2.000) MHz	2.4 µHz/Hz + 0.25 Hz	

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

² Calibration and Measurement Capability (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. Calibration and Measurement Capabilities 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, percentages are percentages of reading.

- ⁵ The measurands stated are generated with the Fluke 5500 & 5700 series of instruments. This capability is suitable for the calibration of the devices intended to measure the stated measurand in the ranges indicated. CMC is expressed as either a specific value that covers the full range or as a fraction of the reading plus a fixed floor specification.
- ⁶ The measurands stated are measured with the HP 3458A. This capability is suitable for the calibration of the devices intended to generate the measurand in the ranges indicated. CMC is expressed as either a specific value that covers the full range or as a combination of the fraction of the reading/output plus a range specification.



American Association for Laboratory Accreditation

Accredited Laboratory

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for technical competence in the field of

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This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and any additional program requirements in the field of calibration. 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 8 January 2009*).

Presented this 6th day of February 2014.





President & CEO
For the Accreditation Council
Certificate Number 3272.01
Valid to February 29, 2016

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