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

Avalon Test Equipment
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CALIBRATION

Valid To: July 31, 2022 Certificate Number: 4859.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations[1, 5]:

I. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
DC Voltage – Generate	(0 to 0.33) V (0.33 to 3.3) V (3.3 to 33) V 33 V to 0.33 kV (0.33 to 1.02) kV	7.7 µV 39 µV 0.43 mV 7.1 mV 20 mV	Fluke 5522A
DC Voltage – Measure	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V 100 V to 1 kV	0.94 µV 5.0 µV 47 µV 0.73 mV 7.3 mV	Agilent 3458A, option 002 Add 12 ppm x $(Vin/1000)^2$ for V > 100
DC Current – Generate	(0 to 0.33) mA (0.33 to 3.3) mA (3.3 to 33) mA 33 mA to 0.33 A (0.33 to 1.1) A (1.1 to 3) A (3 to 11) A (11 to 20.5) A	70 nA 0.38 µA 3.6 µA 36 µA 0.26 mA 1.2 mA 6.0 mA 21 mA	Fluke 5522A

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Parameter/Equipment	Range	CMC[2, 4] (±)	Comments
DC Current – Measure	(10 to 100) µA 100 µA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	3.3 nA 29 nA 0.29 µA 4.7 µA 0.12 mA	Agilent 3458A, option 002
DC Resistance – Generate	(0 to 11) Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω 330 Ω to 1.1 kΩ (1.1 to 3.3) kΩ (3.3 to 11) kΩ (11 to 33) kΩ (33 to 110) kΩ (110 to 330) kΩ 330 kΩ to 1.1 MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ (330 to 1100) MΩ	0.46 mΩ 1.0 mΩ 3.2 mΩ 9.4 mΩ 31 mΩ 96 mΩ 0.32 Ω 0.96 Ω 3.2 Ω 11 Ω 36 Ω 0.20 kΩ 1.4 kΩ 8.6 kΩ 56 kΩ 0.99 MΩ 17 MΩ	Fluke 5522A
DC Resistance – Measure	(0 to 10) Ω (10 to 100) Ω 100 Ω to 1 kΩ (1 to 10) kΩ (10 to 100) kΩ 100 kΩ to 1 MΩ (1 to 10) MΩ (10 to 100) MΩ	0.23 mΩ 2.0 mΩ 12 mΩ 0.12 Ω 1.2 Ω 20 Ω 0.69 kΩ 59 kΩ	Agilent 3458A, option 002

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate			
(1 to 33) 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	33 µV 11 µV 13 µV 39 µV 0.13 mV 0.31 mV	Fluke 5522A

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Generate (cont)			
(33 to 330) 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	0.12 mV 57 µV 62 µV 0.12 mV 0.30 mV 0.73 mV	Fluke 5522A
(0.33 to 3.3) 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	1.0 mV 0.56 mV 0.69 mV 1.0 mV 2.4 mV 8.6 mV	
(3.3 to 33) V	(10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	11 mV 5.6 mV 8.6 mV 12 mV 31 mV	
(33 to 330) V	45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	66 mV 73 mV 89 mV 0.11 V 0.71 V	
(330 to 1020) V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.32 V 0.27 V 0.32 V	
AC Voltage – Measure			
(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	13 µV 11 µV 19 µV 37 µV 95 µV 0.36 mV	Agilent 3458A, option 002
100 mV 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	0.13 mV 0.11 mV 0.19 mV 0.37 mV 0.95 mV 3.6 mV	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Voltage – Measure (cont)			
(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	1.3 mV 1.3 mV 1.9 mV 3.7 mV 9.5 mV 36 mV	Agilent 3458A, option 002
(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	28 mV 26 mV 26 mV 43 mV 0.14 V	
(100 to 1000) V	40 Hz to 1 kHz (1 to 20) kHz	0.49 V 0.72 V	
AC Current – Generate			
(29 to 330) µA	(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	0.77 µA 0.60 µA 0.51 µA 1.1 µA 2.8 µA 5.7 µA	Fluke 5522A
330 µA to 3.3 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	6.8 µA 4.3 µA 3.5 µA 6.8 µA 17 µA 34 µA	
(3.3 to 33) 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	62 µA 32 µA 16 µA 29 µA 70 µA 0.14 mA	
(33 to 330) 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	0.62 mA 0.32 mA 0.16 mA 0.38 mA 0.77 mA 1.5 mA	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Current – Generate (cont)			
330 mA to 1.1 A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	2.1 mA 0.66 mA 7.6 mA 33 mA	Fluke 5522A
(1.1 to 3) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	5.5 mA 2.1 mA 19 mA 80 mA	
(3 to 11) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	8.6 mA 13 mA 0.33 A	
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	30 mA 36 mA 0.62 A	
AC Current – Measure			
Up to 100 µA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz (0.1 to 1) kHz	0.50 µA 0.21 µA 0.10 µA 0.10 µA	Agilent 3458A, option 002
100 µA to 1 mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 10) kHz	4.9 µA 2.0 µA 0.93 µA 0.58 µA 0.93 µA	
(1 to 10) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 10) kHz	49 µA 20 µA 9.3 µA 5.8 µA 9.3 µA	
(10 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 10) kHz	0.49 mA 0.20 mA 93 µA 58 µA 93 µA	

Parameter/Range	Frequency	CMC[2, 4] (±)	Comments
AC Current – Measure (cont)			
100 mA to 1 A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 10) kHz	4.9 mA 2.1 mA 1.2 mA 1.4 mA 3.7 mA	Agilent 3458A, option 002
Capacitance – Generate			
(220 to 400) pF (0.04 to 1.1) nF (1.1 to 3.3) nF (3.3 to 11) nF	10 Hz to 10 kHz 10 Hz to 10 kHz 10 Hz to 3 kHz 10 Hz to 1 kHz	12 pF 16 pF 27 pF 39 pF	Fluke 5522A
(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 µF to 1.1 mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	10 Hz to 1 kHz 10 Hz to 1 kHz 10 Hz to 1 kHz (10 to 600) Hz (10 to 300) Hz (10 to 150) Hz (10 to 120) Hz (10 to 80) Hz (0 to 50) Hz (0 to 20) Hz (0 to 6) Hz (0 to 2) Hz (0 to 0.6) Hz (0 to 0.2) Hz	0.18 nF 0.38 nF 1.2 nF 3.8 nF 11 nF 39 nF 0.17 µF 0.61 µF 1.8 µF 6.1 µF 18 µF 60 µF 0.28 mF 1.3 mF	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Electrical Stimulation of Thermocouple			
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.44 °C 0.34 °C 0.3 °C 0.33 °C	Fluke 5522A
Type C	(0 to 150) °C (150 to 650) °C (650 to 1000) °C	0.3 °C 0.27 °C 0.31 °C	

Parameter/Equipment	Range	CMC[2] (±)	Comments
Electrical Stimulation of Thermocouple (cont)			
Type C	(1000 to 1800) °C (1800 to 2316) °C	0.5 °C 0.84 °C	Fluke 5522A
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.50 °C 0.17 °C 0.15 °C 0.17 °C 0.22 °C	
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.28 °C 0.17 °C 0.15 °C 0.18 °C 0.24 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.33 °C 0.19 °C 0.17 °C 0.27 °C 0.40 °C	
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.40 °C 0.23 °C 0.20 °C 0.19 °C 0.28 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.57 °C 0.35 °C 0.33 °C 0.40 °C	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.47 °C 0.36 °C 0.37 °C 0.46 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.63 °C 0.25 °C 0.17 °C 0.15 °C	
Type U	(-200 to 0) °C (0 to 600) °C	0.56 °C 0.28 °C	

Parameter/Equipment	Range	CMC[2, 3] (±)	Comments
Oscilloscopes –			
DC Voltage:			
50 Ω	(0 to 6.6) V	0.25 % + 40 µV	Fluke 5522A/SC1100
1 MΩ	(0 to 130) V	0.064 % + 40 µV	
AC Voltage (Square Wave):			
50 Ω	±1 mV_{pk-pk} to ± 6.6 V_{pk-pk}		
	10 Hz to 10 kHz	0.25 % + 40 µV	
1 MΩ	±1 mV_{pk-pk} to ± 130 V_{pk-pk}		
	10 Hz to 1 kHz	0.1 % + 40 µV	
	(1 to 10) kHz	0.25 % + 40 µV	
Leveled Sine Wave (Amplitude)			
50 kHz to 100 MHz	5 mV to 5.5 V	0.20 V	
(100 to 300) MHz		0.23 V	
(300 to 600) MHz		0.33 V	
600 MHz to 1.1 GHz		0.25 V	
Time Markers	5 s to 50 ms	25 ms	
	20 ms to 100 ns	50 ns	
	(50 to 20) ns	0.13 ps	
	10 ns	26 fs	
	(5 to 2) ns	14 fs	
Wave Generator:			
50 Ω	1.8 mV_{pk-pk} to 2.5 V_{pk-pk}	75 mV_{pk-pk}	
1 MΩ	1.8 mV_{pk-pk} to 55 V_{pk-pk}	1.7 V_{pk-pk}	
Pulse Generator:			
10 mV to 2.5 V	(4 to 500) ns width	0.20 µs	

II. Electrical – RF/Microwave

Parameter/Equipment	Range	CMC[2, 3] (±)	Comments
ESD Simulators –			
Contact Voltage	200 V to 35 kV	1.2 %	IEC/EN 61000-4-2, ISO 10605
Rise Time	(0.7 to 1) ns	7.8 %	Keytek DCA-2, Agilent 34401A, Teseq MD-103, Agilent DSO80604B
Peak Current	(1 to 60) A	6.3 %	
30 ns Current	(1 to 60) A	6.4 %	
60 ns Current	(1 to 60) A	6.4 %	
EFT/Burst Generators –			
Peak Voltage	10 V to 8 kV	3.3 %	IEC 61000-4-4
Rise Time	(0.5 to 13) ns	1.8 %	Agilent DSO80604B, Haefely PAT 50/1000
Impulse Duration	(30 to 150) ns	2.5 %	
Burst Duration	(0.75 to 30) ms	3.6 %	
Bust Period	300 ms	2.0 %	
Repetition Rate	(2.5 to 100) kHz	1.9 %	
Transient Generators –			
Front Time	(0.5 to 13) ns	0.61 %	IEC 61000-4-5, IEC 61000-4-12, IEC 61000-4-18
Rise Time	(0.5 to 13) ns	0.57 %	
Time to Half Value/Duration	5 µs to 1.5 ms	2.1 %	Agilent DSO80604B, KeyTek PK 1001D, Pearson 110
Peak Voltage	250 V to 6 kV	2.7 %	
Peak Current	5 A to 3 kA	2.7 %	
Phase Angle	Up to 360°	0.71 %	
Ring/Oscillatory Wave Frequency	100 kHz to 1 MHz	0.60 %	
Wave Decay	Up to 110 %	2.4 %	

Parameter/Equipment	Range	CMC[2, 3] (±)	Comments
PQT –			
Output Voltage	Up to 480 V (AC or DC)	0.049 %	IEC 61000-4-11
Voltage Pulse Rise/Fall Time	(1 to 5) µs	0.52 %	Agilent DSO80604B, KeyTek PK1001D, Pearson 110, Agilent 3458A
Phase Angle	Up to 360°	0.69 %	

[1] This laboratory offers commercial calibration.

[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 Generate. 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] In the statement of CMC, percentages are percentages of reading, unless otherwise indicated.

[4] 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. CMC are expressed as either a specific value that covers the full range or as a percent or fraction of the reading plus a fixed floor specification.

[5] This scope meets A2LA's *P112 Flexible Scope Policy*.

Accredited Laboratory

A2LA has accredited

AVALON TEST EQUIPMENT

Carlsbad, 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 20th day of January 2021.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 4859.01
Valid to July 31, 2022

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