



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005
ANSI/NCSL Z540-1-1994, & ANSI/NCSL Z540.3-2006

ANKO ELECTRONICS
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CALIBRATION

Valid until: October 31, 2018

Certificate Number: 3270.02

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} (±)	Comments
DC Voltage – Generate ³	(0 to 329.9999) mV (0 to 3.299999) V (3 to 32.99999) V (33 to 329.9999) V (0.1 to 1) kV	6 μV 39 μV 0.43 mV 6.2 mV 20 mV	Fluke 5520A
DC Current – Generate ³	(0 to 329.999) μA (0 to 3.29999) mA (0 to 32.9999) mA (0 to 329.999) mA (0 to 1.09999) A (1.1 to 2.99999) A (0 to 10.9999) A (11 to 20.5) A	54 nA 0.30 μA 2.8 μA 28 μA 0.19 mA 0.40 mA 4.7 mA 17 mA	Fluke 5520A
DC Voltage – Measure ³	Up to 100 mV 100 mV to 1 V (1 to 10) V (10 to 100) V 100 V to 1 kV ⁶	1.1 μV 7.6 μV 75 μV 0.95 mV 24 mV	Agilent 3458A, option 002

Parameter/Equipment	Range	CMC ² (±)	Comments
DC Current – Measure ³	(0 to 100) μ A 100 μ A to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A	4.3 nA 39 nA 0.39 μ A 0.81 μ A 0.15 mA	Agilent 3458A, option 002
DC Resistance – Generate ³	(0 to 10.9999) Ω (11 to 32.9999) Ω (33 to 109.9999) Ω (110 to 329.9999) Ω 330 Ω to 1.099999 k Ω (1.1 to 3.299999) k Ω (3.3 to 10.99999) k Ω (11 to 32.99999) k Ω (33 to 109.9999) k Ω (110 to 329.9999) k Ω 330 k to 1.099999 M Ω (1.1 to 3.299999) M Ω (3.3 to 10.99999) M Ω (11 to 32.9999) M Ω (33 to 109.9999) M Ω (110 to 329.9999) M Ω (330 to 1100) M Ω	0.45 m Ω 0.88 m Ω 2.4 m Ω 6.7 m Ω 24 m Ω 70 m Ω 0.25 Ω 0.70 Ω 2.5 Ω 7.8 Ω 30 Ω 0.14 k Ω 1.1 k Ω 6.2 k Ω 45 k Ω 0.68 M Ω 13 M Ω	Fluke 5520A
DC Resistance – Measure ³	(0 to 10) Ω (10 to 100) Ω 100 Ω to 1 k Ω (1 to 10) k Ω (10 to 100) k Ω 100 k Ω to 1 M Ω (1 to 10) M Ω (10 to 100) M Ω	0.26 m Ω 2.5 m Ω 14 m Ω 0.14 Ω 1.4 Ω 21 Ω 0.71 k Ω 64 k Ω	Agilent 3458A, option 002

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
AC Voltage – Generate ³			Fluke 5520A
(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	23 μV 8.9 μV 9.8 μV 29 μV 91 μV 0.23 mV	
(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	77 μV 41 μV 45 μV 89 μV 0.21 mV 0.53 mV	
(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	0.74 mV 0.41 mV 0.50 mV 0.75 mV 1.7 mV 6.1 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	7.5 mV 4.1 mV 6.1 mV 8.7 mV 22 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	47 mV 53 mV 64 mV 80 mV 0.51 V	
(330 to 1020) V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.13 V 0.11 V 0.13 V	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
AC Voltage – Measure ³			Agilent 3458A, option 002
(1 to 10) mV	40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	4.6 μV 5.6 μV 13 μV 60 μV 0.47 mV	
(10 to 100) mV	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	12 μV 20 μV 38 μV 0.10 mV 0.36 mV 1.2 mV	
100 mV to 1 V	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	0.12 mV 0.20 mV 0.39 mV 0.97 mV 3.6 mV 12 mV	
(1 to 10) V	40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz	1.2 mV 2.0 mV 3.9 mV 9.6 mV 36 mV	
(10 to 100) V	40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	27 mV 28 mV 45 mV 0.15 V	
(100 to 700) V	40 Hz to 8 kHz	0.35 V	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
AC Current – Generate ³			
(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	0.59 µA 0.47 µA 0.40 µA 0.89 µA 2.2 µA 4.4 µA	Fluke 5520A
330uA to 3.3mA	(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	5.3 µA 3.3 µA 2.6 µA 5.3 µA 13 µA 26 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	48 µA 25 µA 13 µA 22 µA 54 µA 0.11 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	0.48 mA 0.25 mA 0.12 mA 0.30 mA 0.59 mA 1.2 mA	
330 mA to 1.09999 A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	1.6 mA 0.51 mA 5.8 mA 25 mA	
(1.1 to 2.99999) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	1.8 mA 1.0 mA 5.9 mA 25 mA	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
AC Current – Generate (cont.) ³			Fluke 5520A
(3 to 10.9999) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	3.3 mA 3.5 mA 27 mA	
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5 kHz)	23 mA 28 mA 30 mA	
AC Current – Measure ³			Agilent 3458A, option 002
(0 to 100) µA	10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 1 kHz	0.50 µA 0.21 µA 0.11 µA 0.11 µA	
100 µA to 1 mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz	4.9 µA 2.0 µA 0.94 µA 0.60 µA 0.94 µA 5.1 µA	
(1 to 10) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz	49 µA 20 µA 9.5 µA 6.1 µA 9.5 µA 51 µA	
(10 to 100) mA	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz	0.49 mA 0.20 mA 95 µA 61 µA 95 µA 0.51 mA	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
AC Current – Measure (cont.) ³			Agilent 3458A, option 002
100 mA to 1 A	(10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz	4.9 mA 2.1 mA 1.2 mA 1.4 mA 3.7 mA	
Electrical Stimulation of Thermocouple ^{3,5}			Fluke 5520A
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.29 °C 0.13 °C 0.11 °C 0.13 °C 0.18 °C	
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.21 °C 0.13 °C 0.11 °C 0.14 °C 0.18 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.26 °C 0.14 °C 0.13 °C 0.21 °C 0.31 °C	
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.37 °C 0.28 °C 0.29 °C 0.38 °C	
Type T	(-250 to -150) °C (150 to 0) °C (0 to 120) °C (120 to 400) °C	0.49 °C 0.19 °C 0.13 °C 0.11 °C	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Capacitance-Generate ³	(0.4 to 3.29999) nF (3.3 to 32.9999) nF (33 to 329.999) nF (.33 to 3.29999) μF (3.3 to 32.999) μF (33 to 329.999) μF (.33 to 3.29999) mF	10 pF 58 pF 0.84 nF 8.4 nF 0.12 μF 1.3 μF 13 μF	Fluke 5520A
Oscilloscopes ^{3,5} –			Fluke 5520A
Amplitude DC Signal 50Ω load	(1 to 24.999) mV (25 to 109.99) mV 110 mV to 2.1999 V (2.2 to 10.999) V	78 μV 0.24 mV 4.4 mV 13 mV	
1 MΩ Load	(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	41 μV 74 μV 0.85 mV 4.3 mV 51 mV	
Rise Time	< 300 ps 2.5mV _{p-p} to 250 V _{p-p}	< 300 ps	
Leveled Sine Flatness (Relative to 50 kHz)	5 mV _(p-p) to 5.5 V _(p-p) 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	1.5 % + 100 μV 2 % + 100 μV 4 % + 100 μV	
Time Marker 50Ω load	(2 to 5) ns 10 ns (20 to 50) ns 100 ns to 20 ms 50 ms to 5 s	9.7 fs 19.4 fs 97 fs 39 ns (25 + 1000t) μs	<i>t</i> = time in seconds

II. Mechanical

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Pressure Gages ³	(0 to 5) psi (0 to 100) psi (0 to 10 000) psi ⁵	0.0013 psi 0.065 psi 2.5 psi	Additel ADT681-02-005 Additel ADT681-02-100 Additel ADT681-02-GP10k

III. Time and Frequency

Parameter/Equipment	Range	CMC ^{2,4,5} (±)	Comments
Frequency – Measuring Equipment	10 MHz Reference Signal	2 x 10 ⁻¹⁰ Hz	GPS Disciplined Oscillator 58540A
Frequency – Measure	10 Hz to 225 MHz 225 MHz to 3 GHz	45 mHz 0.6 Hz	53132A w/58540A GPS Disciplined Oscillator

IV. Thermodynamics

Parameter/Equipment	Range	CMC ^{2,4,5} (±)	Comments
Relative Humidity – Measuring Equipment	(0 to 40) % RH (40 to 90) % RH	1.2 % RH 1.4 % RH	Vaisala M170/HMP77B
Temperature Measure Fixed Point	22 °C (-70 to -10) °C (-10 to 60) °C (60 to 180) °C	±0.16 °C 0.4 °C 0.25 °C 0.40 °C	Vaisala M170/HMP77B

¹ This laboratory offers commercial 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, the value is defined as the percentage of reading, unless otherwise noted.

⁵ In the statement of CMC, repeatability is not included.

⁶ Add $12 \text{ ppm } X(V^{\text{in}}/1000)^2$ for values $> 100 \text{ VDC}$



Accredited Laboratory

A2LA has accredited

ANKO ELECTRONICS

Anaheim, CA

for technical competence in the field of

Calibration

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/NCSLI Z540-1-1994 and the requirements of ANSI/NCSLI Z540.3-2006 and R205 – *Specific Requirements: Calibration Laboratory Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).



Presented this 21st day of November 2016.

A handwritten signature in black ink, appearing to read "L. J. ...", positioned above a horizontal line.

President and CEO
For the Accreditation Council
Certificate Number 3270.02
Valid to October 31, 2018
Revised January 12, 2017

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