



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017
& ANSI/NCSL Z540-1-1994 & ANSI/NCSL Z540.3-2006

ACUCAL INC., A TRESICAL COMPANY
98-025 Hekaha St.
Aiea, HI 96701
Dainna Lowrance Phone: 808 488 9890

CALIBRATION

Valid To: May 31, 2021

Certificate Number: 2737.04

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 ³ – Generate	(0 to 330) mV (0.33 to 3.3) V (3.3 to 33) V (33 to 330) V (330 to 1000) V	15 μ V/V + 1 μ V 11 μ V/V + 2 μ V 5 μ V/V + 20 μ V 15 μ V/V + 0.15 mV 22 μ V/V + 1.5 mV	Fluke 5520A

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
DC Voltage ³ – Measure	(0 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1000) V	12 μV/V + 0.3 μV 11 μV/V + 3 μV 11 μV/V + 0.5 μV 13 μV/V + 30 μV 15 μV/V + 100 μV	HP 3458A
DC Current ³ – Generate	(0 to 3.3) mA (3.3 to 330) mA (0.33 to 3.3) A (3.3 to 20) A	0.39 mA/A + 0.5 mA 0.39 mA/A + 0.5 mA 58 mA/A + 0.5 mA 0.29 A/A + 0.75 mA	Fluke 5520A
DC Current ³ – Measure	(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	0.21 mA/A + 0.04 nA 59 μA/A + 0.04 nA 27 μA/A + 0.1 nA 26 μA/A + 0.8 nA 26 μA/A + 5 pA 26 μA/A + 50 pA 46 μA/A + 0.5 μA 0.18 μA/A + 10 μA	HP 3458A
DC Resistance ³ – Generate	(0 to 10.999) Ω (11 to 32.999) Ω (33 to 109.999) Ω (110 to 329.999) Ω (0.33 to 1.0999) kΩ (1.1 to 3.2999) kΩ (3.3 to 109.999) kΩ (11 to 32.999) kΩ (33 to 109.999) kΩ (110 to 329.999) kΩ (0.33 to 1.0999) MΩ (1.1 to 3.2999) MΩ (3.3 to 10.999) MΩ (11 to 32.999) MΩ (33 to 109.999) MΩ (110 to 329.999) MΩ (330 to 1100) MΩ	0.1 mΩ/Ω + 1 mΩ 19 μΩ/Ω + 1.5 mΩ 33 μΩ/Ω + 1.4 mΩ 14 μΩ/Ω + 2 mΩ 17 μΩ/Ω + 2 mΩ 20 μΩ/Ω + 20 mΩ 23 μΩ/Ω + 20 mΩ 38 μΩ/Ω + 200 mΩ 21 μΩ/Ω + 200 mΩ 17 μΩ/Ω + 200 mΩ 15 μΩ/Ω + 200 mΩ 28 μΩ/Ω + 2 Ω 46 μΩ/Ω + 2 Ω 15 μΩ/Ω + 30 Ω 23 μΩ/Ω + 50 Ω 60 μΩ/Ω + 2.5 kΩ 0.32 mΩ/Ω + 3 kΩ	Fluke 5520A

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
DC Resistance ³ – Measure	(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 (0.1 to 1) GΩ	24 μΩ/Ω + 50 μΩ 10 μΩ/Ω + 500 μΩ 87 μΩ/Ω + 500 μΩ 87 μΩ/Ω + 500 μΩ 11 % + 5.0 μΩ 20 mΩ/Ω + 2 Ω 40 mΩ/Ω + 100 Ω 11 % + 1 kΩ 1.1 Ω/Ω + 10 kΩ	HP 3458A
Electrical Calibration of Thermocouples & Indicators ³ –			
Type B	(600 to 800) °C (800 to 1000) °C (1000 to 1550) °C (1550 to 1820) °C	0.35 °C 0.27 °C 0.25 °C 0.27 °C	Fluke 5520A
Type C	(0 to 150) °C (150 to 650) °C (650 to 1000) °C (1000 to 1800) °C (1800 to 2316) °C	0.24 °C 0.21 °C 0.29 °C 0.40 °C 0.66 °C	
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.40 °C 0.15 °C 0.13 °C 0.15 °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	0.22 °C 0.15 °C 0.13 °C 0.15 °C 0.19 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.27 °C 0.16 °C 0.15 °C 0.22 °C 0.32 °C	

Parameter/Equipment	Range	CMC ² (±)	Comments	
Electrical Calibration of Thermocouples & Indicators ³ – (cont)				
Type N	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1300) °C	0.32 °C 0.19 °C 0.17 °C 0.16 °C 0.22 °C	Fluke 5520A	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.45 °C 0.28 °C 0.27 °C 0.32 °C		
Type S	(0 to 250) °C (250 to 1000) °C (1000 to 1400) °C (1400 to 1767) °C	0.37 °C 0.29 °C 0.30 °C 0.37 °C		
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.50 °C 0.22 °C 0.15 °C 0.13 °C		
Type U	(-200 to 0) °C (0 to 600) °C	0.44 °C 0.22 °C		
Electrical Calibration of RTD Indicators ³ –				
Pt 385, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.04 °C 0.05 °C 0.07 °C 0.08 °C 0.09 °C 0.18 °C		Fluke 5520A
Pt 3926, 100 Ω	(-200 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	0.04 °C 0.05 °C 0.07 °C 0.08 °C 0.09 °C		

Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Calibration of RTD Indicators ³ – (cont)			
Pt 3916, 100 Ω	(-200 to -190) °C (-190 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.19 °C 0.03 °C 0.04 °C 0.05 °C 0.05 °C 0.06 °C 0.07 °C 0.08 °C 0.18 °C	Fluke 5520A
Pt 385, 200 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 300) °C (300 to 400) °C (400 to 600) °C (600 to 630) °C	0.16 °C 0.03 °C 0.03 °C 0.09 °C 0.09 °C 0.10 °C 0.11 °C 0.12 °C	
Pt 385, 500 Ω	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 260) °C (260 to 400) °C (400 to 600) °C (600 to 630) °C	0.03 °C 0.04 °C 0.04 °C 0.05 °C 0.06 °C 0.07 °C 0.09 °C	
Pt 385, 1000 Ω	(-200 to 0) °C (0 to 100) °C (100 to 260) °C	0.02 °C 0.03 °C 0.04 °C	
PtNi 385, 120 Ω	(-80 to 0) °C (0 to 100) °C (100 to 260) °C	0.07 °C 0.06 °C 0.11 °C	
Cu 427, 10 Ω	(-100 to 260) °C	0.23 °C	

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments	
Oscilloscope ³ –				
50 Ω Load	(1 to 24.999) mV (25 to 109.99) mV (0.11 to 2.1999) V (2.2 to 10.999) V	0.19 % of output + 40 μV 0.22 % of output + 40 μV 0.23 % of output + 40 μV 0.19 % of output + 40 μV	Fluke 5520A- SC1100	
1 MΩ Load	(1 to 24.999) mV (25 to 109.999) mV (0.11 to 2.1999) V (2.2 to 10.999) V (11 to 130) V	0.13 % of output + 40 μV 0.14 % of output + 40 μV 0.08 % of output + 40 μV 0.11 % of output + 40 μV 0.33 % of output + 40 μV		
Level Sine Wave:				
Amplitude (50 kHz Reference)	50 kHz 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz	1.8 % + 0.3 mV 3.0 % + 0.3 mV 4.7 % + 0.3 mV 5.0 % + 0.3 mV 5.6 % + 0.3 mV		
Flatness (50 kHz Reference)	50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1100) MHz	2.9 % + 0.1 mV 1.7 % + 0.1 mV 3.2 % + 0.1 mV 4.2 % + 0.1 mV		
Time Markers: Source and Period into a 50 Ω load	5 s to 20 ms 20 ms to 100 ns 100 ns to 20 ns 20 ms to 2 ns	35 μs + <i>t</i> parts in 10 ⁶ s 37 μs + <i>t</i> parts in 10 ⁶ s 22 μs + <i>t</i> parts in 10 ⁶ s 19 μs + <i>t</i> parts in 10 ⁶ s		<i>t</i> = time in seconds
Amplitude 1 MΩ 50 Ω	1.8 mV to 55 V _(pk-pk) 1.8 mV to 2.5 V _(pk-pk)	2.3 % + 0.1 mV 2.3 % + 0.1 mV		
Frequency	10 Hz to 100 kHz	11 parts in 10 ⁶ Hz +15 mHz		

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Voltage ³ – 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	0.062 % + 6 μV 0.012 % + 6 μV 0.016 % + 6 μV 0.078 % + 6 μV 0.27 % + 6 μV 0.62 % + 6 μV	Fluke 5520A
(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	0.023 % + 8 μV 0.011 % + 8 μV 0.012 % + 8 μV 0.027 % + 8 μV 0.062 % + 32 μV 0.16 % + 70 μV	
(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	0.024 % + 50 μV 0.013 % + 60 μV 0.019 % + 60 μV 0.027 % + 50 μV 0.059 % + 13 μV 0.22 % + 600 μV	
(3.3 to 33) V	45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.64 % + 0.65 mV 0.22 % + 0.6 mV 0.22 % + 0.6 mV 0.18 % + 1.6 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	0.59 % + 2 mV 0.60 % + 6 mV 0.60 % + 6 mV 0.68 % + 6 mV 0.69 % + 6 mV	
(330 to 1020) V	45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.59 % + 2 mV 0.68 % + 10 mV 0.68 % + 10 mV	

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Voltage ³ – Measure			
(0 to 10) mV	(1 to 40) Hz (40 to 1000) Hz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz (1 to 4) MHz	0.023 % + 3 μV 0.016 % + 1.1 μV 0.023 % + 1.1 μV 0.078 % + 1.1 μV 0.39 % + 1.1 μV 3.1 % + 2 μV 3.1 % + 2 μV 3.1 % + 2 μV	Agilent 3458A-002
(10 to 100) mV	(10 to 40) Hz (40 to 1000) Hz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (0.3 to 1) MHz (1 to 4) MHz	0.009 % + 4 μV 0.014 % + 2 μV 0.013 % + 2 μV 0.03 % + 2 μV 0.08 % + 2 μV 0.23 % + 10 μV 0.78 % + 10 μV 1.2 % + 10 μV	
(0.1 to 1) V	(1 to 40) Hz (40 to 1000) Hz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz (0.5 to 1) MHz (1 to 4) MHz	0.008 % + 400 μV 0.008 % + 200 μV 0.013 % + 200 μV 0.028 % + 200 μV 0.067 % + 200 μV 0.24 % + 1 mV 0.30 % + 1 mV 0.8 % + 1 mV 3.1 % + 1 mV	
(1 to 10) V	(1 to 40) Hz (40 to 1000) Hz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz (0.5 to 4) MHz	0.043 % + 400 μV 0.027 % + 200 μV 0.020 % + 200 μV 0.036 % + 200 μV 0.068 % + 200 μV 1.9 % + 1 mV 2.7 % + 1 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	0.97 % + 4 mV 0.97 % + 2 mV 1.4 % + 2 mV 1.6 % + 2 mV 3.9 % + 2 mV	
(100 to 10 000) V	(1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	8.9 % + 40 mV 8.9 % + 20 mV 8.9 % + 20 mV 8.9 % + 20 mV 8.9 % + 20 mV	

Parameter/Range	Frequency	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 3.29999) 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 1.09999) mF (1.1 to 3.2999) mF (3.3 to 10.9999) mF (11 to 32.9999) mF (33 to 110) mF	10 Hz to 10 kHz 10 Hz to 10 kHz 10 Hz to 3 kHz 10 Hz to 1 kHz 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 (10 to 50) Hz (10 to 20) Hz (0 to 6) Hz (0 to 2) Hz (0 to 0.6) Hz (0 to 0.2) Hz	0.40 % + 0.01 nF 0.42 % + 0.01 nF 0.43 % + 0.01 nF 0.19 % + 0.01 nF 0.19 % + 0.1 nF 0.19 % + 0.1 nF 0.19 % + 0.3 nF 0.19 % + 1 nF 0.19 % + 3 nF 0.19 % + 10 nF 0.31 % + 30 nF 0.35 % + 100 nF 0.35 % + 300 nF 0.35 % + 1 μF 0.35 % + 3 μF 0.35 % + 10 μF 0.58 % + 30 μF 0.85 % + 100 μF	Fluke 5520A
AC Current ³ – Generate (29 to 329.99) μA (0.33 to 3.2999) mA (3.3 to 32.999) mA (33 to 329.99) mA	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 30) kHz	0.16 % + 100 nA 0.097 % + 100 nA 0.23 % + 150 nA 0.62 % + 200 nA 1.2 % + 400 nA 0.16 % + 150 nA 0.078 % + 150 nA 0.16 % + 200 nA 0.39 % + 300 nA 0.78 % + 600 nA 0.14 % + 2 μA 0.031 % + 2 μA 0.062 % + 2 μA 0.16 % + 3 μA 0.31 % + 4 μA 0.14 % + 20 μA 0.031 % + 20 μA 0.078 % + 50 μA 0.16 % + 100 μA 0.31 % + 200 μA	Fluke 5520A

Parameter/Range	Frequency	CMC ^{2,4} (±)	Comments
AC Current ³ – Generate (cont)			
(0.33 to 1.099 99) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.14 % + 100 µA 0.04 % + 100 µA 0.47 % + 1 mA 1.9 % + 5 mA	Fluke 5520A
(1.1 to 2.999 99) A	(10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.18 % + 100 µA 0.11 % + 100 µA 0.14 % + 1 mA 2 % + 5 mA	
(3 to 10.9999) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.30 % + 2 mA 0.31 % + 2 mA 2.4 % + 2 mA	
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.54 % + 5 mA 0.54 % + 5 mA 2.4 % + 5 mA	
AC Current ³ – Measure			
Up to 100 µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	40 Hz to 5 kHz	0.079 % + 31 nA 0.036 % + 0.21 µA 0.036 % + 2.1 µA 0.036 % + 21 µA 0.13 % + 0.21 mA	HP 3458A-002

II. Mechanical

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
Pressure Gauges, Transducers & Calibrators – Measure and Measuring Equipment ³	(0 to 100) psi (0 to 500)psi (0 to 1000) psi (0 to 10 000) psi (0 to 30) psia	0.08 psi 0.06 psi 0.83 psi 9.4 psi 0.06 psia	Fluke 700P06 Fluke 700P07 Fluke 700P08 Fluke 700P31 Fluke 700PA5
Torque Equipment	(5 to 50) in·lbf (40 to 400) in·lbf (100 to 1000) in·lbf (25 to 250) ft·lbf	0.30 in·lbf 2.4 in·lbf 5.9 in·lbf 1.5 ft·lbf	CDI 4in1 Suretest

III. Time & Frequency

Parameter/Equipment	Range	CMC ^{2, 6} (±)	Comments
Time Interval	Up to 86 400 s	30 ms	Agilent 53131A-030 counter phase locked to GPS
Frequency – Measuring Equipment	10 MHz 1 mHz to 50 GHz	$1.6 \times 10^{-11} \times f$ $1.6 \times 10^{-11} \times f + 5 \mu\text{Hz}$	Datum GPS receiver (<i>f</i> is the frequency) Frequency signal source locked to Datum GPS receiver

¹ This laboratory offers commercial 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 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 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's 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*.
- ⁶ The type of instrument or material being calibrated is defined by the parameter. This indicates the laboratory is capable of calibrating instruments that measure or generate the values in the ranges indicated for the listed measurement parameter.





Accredited Laboratory

A2LA has accredited

ACUCAL, INC.

Aiea, HI

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/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 April 2017*).



Presented this 17th day of June 2019.

A blue ink signature of the Vice President of Accreditation Services.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2737.04
Valid to May 31, 2021

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