



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

TEKTRONIX CANADA
400 Britannia Road E, Unit 2
Mississauga, Ontario L4Z 1X9 Canada
Andrew Sweeny Phone: 905 241 3021

CALIBRATION

Valid To: February 28, 2019

Certificate Number: 2357.24

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

I. Dimensional

Parameter/Equipment	Range	CMC ^{2,4} (±)	Comments
Micrometers ³			
Flatness ³	Up to 12 in (12 to 48) in	(30 + 2.0L) μin (12 + 3.5L) μin	Gage blocks and surface plates
Parallelism ³	(0 to 1) in	6.1 μin	Optical flats/parallels
Calipers ³	Up to 12 in	(66 + 6.7L) μin	Gage blocks and surface plates
Height Gage ³	(12 to 40) in	(120 + 13L) μin	Gage blocks and surface plates
Surface Plate Flatness ³ (Flatness Only)	24 in x 24 in Minimum 72 in x 144 in Maximum	(6.6 + 2.0D) μin	Mahr leveling system D is the diagonal length of surface plate in inches

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
DC Voltage – Generate ³	(0 to 220) mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V	8.3 μV/V + 0.6 μV 6.3 μV/V + 1 μV 6.3 μV/V + 3.5 μV 6.3 μV/V + 6.5 μV 7.0 μV/V + 80 μV 8.6 μV/V + 500 μV	Fluke 5700A
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	9.1 nV/V + 230 nV 4.3 μV/V + 230 nV 4.3 μV/V + 380 nV 6.8 μV/V + 24 μV 8.7 μV/V + 78 μV	HP 3458A opt 002
DC Current – Generate ³	Up to 220 μA 220 μA to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A (2.2 to 11) A (11 to 20.5) A (20.5 to 1000) A	48 μA/A + 8 nA 48 μA/A + 8 nA 48 μA/A + 80 nA 54 μA/A + 0.8 μA 76 μA/A + 25 μA 0.28 mA/A + 480 μA 0.78 mA/A + 0.58 mA 4.0 mA/A + 0.39 mA	Fluke 5700A/5725 Fluke 5520A w/ 5500A 50 turn coil
DC Current – Measure ³	(0 to 100) μA 100 μA to 1 mA (1 to 10) mA (10 to 100) mA 100 mA to 1 A (1 to 15) A (15 to 100) A (100 to 300) A	28 μA/A + 800 pA 26 μA/A + 5 nA 26 μA/A + 50 nA 42 μA/A + 500 nA 120 μA/A + 10 μA 51 μA/A 72 μA/A 58 μA/A	HP 3458A opt 002 9211A w/ 3458A



Parameter/Equipment	Range	CMC ² (±)	Comments
Electrical Simulation of Thermocouples ³ –			
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 0.13 °C 0.12 °C 0.14 °C 0.18 °C	Fluke 5520A
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 0.20 °C 0.31 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.50 °C 0.19 °C 0.13 °C 0.11 °C	
Type R	(0 to 250) °C (250 to 400) °C (400 to 1000) °C (1000 to 1767) °C	0.45 °C 0.28 °C 0.26 °C 0.32 °C	
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.39 °C 0.13 °C 0.11 °C 0.13 °C 0.17 °C	
Electrical Simulation of RTDs ³ –			
Pt 385 / 100	(-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C (630 to 800) °C	0.085 °C 0.12 °C 0.12 °C 0.11 °C 0.097 °C 0.11 °C 0.20 °C	Fluke 5520A



Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
AC Voltage – Generate ³ (cont)			
(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 (0.5 to 1) MHz	0.55 mV/V + 13 μV 0.26 mV/V + 8 μV 0.10 mV/V + 8 μV 0.28 mV/V + 8 μV 0.71 mV/V + 25 μV 0.87 mV/V + 25 μV 1.4 mV/V + 35 μV 2.9 mV/V + 80 μV	Fluke 5700A w/ 5725A
(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 (0.5 to 1) MHz	0.64 mV/V + 80 μV 0.14 mV/V + 25 μV 0.06 mV/V + 6 μV 0.11 mV/V + 16 μV 0.23 mV/V + 70 μV 0.39 mV/V + 0.13 mV 0.95 mV/V + 0.35 mV 2.0 mV/V + 0.85 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 (0.5 to 1) MHz	0.56 mV/V + 0.80 mV 0.14 mV/V + 0.25 mV 0.069 mV/V + 0.06 mV 0.11 mV/V + 0.16 mV 0.22 mV/V + 0.35 mV 0.49 mV/V + 1.5 mV 1.1 mV/V + 4.3 mV 2.4 mV/V + 8.5 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 (300 to 500) kHz (0.5 to 1) MHz	0.60 mV/V + 8 mV 0.14 mV/V + 2.5 mV 0.07 mV/V + 0.8 mV 0.22 mV/V + 3.5 mV 0.48 mV/V + 8 mV 1.2 mV/V + 90 mV 4.2 mV/V + 90 mV 13 mV/V + 190 mV	
(220 to 250) V	(15 to 50) Hz	0.31 mV/V + 16 mV	



Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
AC Voltage – Generate ³ (cont)			
(220 to 1100) V	50 Hz to 1 kHz (1 to 20) kHz (20 to 30) kHz	0.075 mV/V + 3.5 mV 0.13 mV/V + 6 mV 0.48 mV/V + 11 mV	Fluke 5700A w/ 5725A
(220 to 750) V	(30 to 50) kHz (50 to 100) kHz	0.51 mV/V + 11 mV 1.9 mV/V + 45 mV	
AC Voltage – Measure ³			
(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	0.09 mV/V + 1.6 μV 0.13 mV/V + 1.6 μV 0.43 mV/V + 1.6 μV 0.72 mV/V + 1.6 μV 2.4 mV/V + 8 μV	HP 3458A opt 002
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	0.07 mV/V + 15 μV 0.12 mV/V + 15 μV 0.26 mV/V + 15 μV 0.65 mV/V + 15 μV 2.4 mV/V + 77 μV	
(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	0.10 mV/V + 160 μV 0.12 mV/V + 160 μV 0.26 mV/V + 160 μV 0.64 mV/V + 160 μV 2.3 mV/V + 760 μV	
(10 to 100) V	40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	0.17 mV/V + 1.6 mV 0.19 mV/V + 1.6 mV 0.30 mV/V + 1.6 mV 0.99 mV/V + 1.6 mV	
100 V to 1 kV	40 Hz to 1 kHz (1 to 20) kHz	0.32 mV/V + 16 mV 0.48 mV/V + 16 mV	



Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
AC Current – Generate ³			
(9 to 220) µA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.69 mA/A + 25 nA 0.33 mA/A + 20 nA 0.12 mA/A + 16 nA 0.57 mA/A + 40 nA 1.4 mA/A + 80 nA	Fluke 5700A
(0.22 to 2.2) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.67 mA/A + 40 nA 0.35 mA/A + 35 nA 0.17 mA/A + 35 nA 0.56 mA/A + 400 nA 1.4 mA/A + 800 nA	
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.67 mA/A + 0.4 µA 0.33 mA/A + 0.35 µA 0.13 mA/A + 0.35 µA 0.55 mA/A + 4 µA 1.4 mA/A + 8 µA	
(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	0.68 mA/A + 4 µA 0.33 mA/A + 3.5 µA 0.14 mA/A + 3.5 µA 0.55 mA/A + 40 µA 1.4 mA/A + 80 µA	
(0.22 to 2.2) A	20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.58 mA/A + 35 µV 0.67 mA/A + 80 µV 7.8 mA/A + 160 µV	
(2.2 to 11) A	40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.40 mA/A + 170 µV 0.76 mA/A + 380 µV 2.8 mA/A + 750 µV	
(11 to 20.5) A	(45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.96 mA/A + 3.9 mA 1.2 mA/A + 3.9 mA 23 mA/A + 3.9 mA	Fluke 5520A
(16.5 to 149.999) A	(45 to 65) Hz (65 to 440) Hz	0.31 % 0.81 %	Fluke 5520A w/ 5500A coil
(150 to 1025) A	(45 to 65) Hz (65 to 440) Hz	0.33 % 0.82 %	



Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
AC Current – Measure ³			
(0 to 100) μA	20 to 45 Hz 45 Hz to 5 kHz	1.2 mA/A + 24 nA 0.49 mA/A + 24 nA	HP 3458A opt 002
100 μA to 1 mA	20 to 45 Hz 45 to 100 Hz 100 Hz to 5 kHz	1.2 mA/A + 0.16 μA 0.52 mA/A + 0.16 μA 0.28 mA/A + 0.16 μA	
(1 to 10) mA	20 to 45 Hz 45 to 100 Hz 100 Hz to 5 kHz	1.2 mA/A + 1.6 μA 0.49 mA/A + 1.6 μA 0.28 mA/A + 1.6 μA	
(10 to 100) mA	20 to 45 Hz 45 to 100 Hz 100 Hz to 5 kHz	1.2 mA/A + 16 μA 0.49 mA/A + 16 μA 0.28 mA/A + 16 μA	
100 mA to 1 A	20 to 45 Hz 45 to 100 Hz 100 Hz to 5 kHz	1.3 mA/A + 160 μA 0.70 mA/A + 160 μA 0.83 mA/A + 160 μA	

Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Resistance – Generate ³	(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 MΩ to 1.1 GΩ	33 μΩ/Ω + 0.8 mΩ 24 μΩ/Ω + 1.2 mΩ 22 μΩ/Ω + 1.1 mΩ 23 μΩ/Ω + 1.6 mΩ 22 μΩ/Ω + 1.6 mΩ 23 μΩ/Ω + 16 mΩ 32 μΩ/Ω + 16 mΩ 23 μΩ/Ω + 160 mΩ 23 μΩ/Ω + 160 mΩ 26 μΩ/Ω + 1.6 Ω 26 μΩ/Ω + 1.6 Ω 48 μΩ/Ω + 23 Ω 0.10 mΩ/Ω + 39 Ω 0.21 mΩ/Ω + 1.9 kΩ 0.40 mΩ/Ω + 2.3 kΩ 2.3 mΩ/Ω + 78 kΩ 12 mΩ/Ω + 390 kΩ	Fluke 5520A



Parameter/Equipment	Range	CMC ^{2,5} (±)	Comments
Oscilloscopes ³ –			
Amplitude – DC			Fluke 5520A/SC1100
50 Ω	0 to ± 6.6 V	1.9 mV/V + 31 μV	
1 MΩ	0 to ± 130 V	0.39 mV/V + 31 μV	
Amplitude – Square Wave	1 mV to 6.6 V	2.0 mV/V + 31 μV	
50 Ω	10 Hz to 10 kHz		
1 MΩ	1 mV to ± 130 V	0.78 mV/V + 31 μV	
	10 Hz to 1 kHz		
Leveled Sine Wave (ref 50 kHz) 5 mV to 5.5 V _(p-p)	50 kHz to 100 MHz	2.8 %	
	(100 to 300) MHz	3.0 %	
	(300 to 600) MHz	4.1 %	
	600 MHz to 1.1 GHz	4.7 %	
Time Marker	20 ms to 1 ns	2.1 μs/s	<i>t</i> = time in seconds
	50 ms to 5 s	(19 + 39 <i>t</i>) μs/s	
Pulse Characterization	10 kHz to 2 MHz	19 ps	
Transition time (Rise Time) – Generate	(200 to 300) ps		
	(2 to 10) MHz	19 ps	
	(250 to 350) ps		



Parameter/Range	Frequency	CMC ^{2,5} (±)	Comments
Capacitance – Generate ³			
190 pF to 1.1 nF	10 Hz to 10 kHz	4.2 mF/F + 8 pF	Fluke 5520A/SC1100
(1.1 to 3.3) nF	10 Hz to 3 kHz	3.9 mF/F + 8 pF	
(3.3 to 11) nF	10 Hz to 1 kHz	2.3 mF/F + 8 pF	
(11 to 110) nF	10 Hz to 1 kHz	2.3 mF/F + 77 pF	
(110 to 330) nF	10 Hz to 1 kHz	2.3 mF/F + 230 pF	
330 nF to 1.1 μF	(10 to 600) Hz	2.3 mF/F + 1 nF	
(1.1 to 3.3) μF	(10 to 300) Hz	2.3 mF/F + 3 nF	
(3.3 to 11) μF	(10 to 150) Hz	2.3 mF/F + 8 nF	
(11 to 33) μF	(10 to 120) Hz	3.3 mF/F + 24 nF	
(33 to 110) μF	(10 to 80) Hz	3.8 mF/F + 78 nF	
(110 to 330) μF	(0 to 50) Hz	3.5 mF/F + 230 nF	
330 μF to 1.1 mF	(0 to 20) Hz	3.5 mF/F + 1 μF	
(1.1 to 3.3) mF	(0 to 6) Hz	3.5 mF/F + 3 μF	
(3.3 to 11) mF	(0 to 2) Hz	3.5 mF/F + 8 μF	
(11 to 33) mF	(0 to 0.6) Hz	5.8 mF/F + 23 μF	
(33 to 110) mF	(0 to 0.2) Hz	8.5 mF/F + 78 μF	

III. Electrical – RF/Microwave

Parameter/Range	Range	CMC ² (±)	Comments
RF Power – Generate ³			
DC to 20 MHz	(13 to 23) dBm, (-55 to 13.5) dBm	0.29 dB	33250A
20 MHz to 4.0 GHz	(16 to -115) dBm (-115 to -127) dBm	0.65 dB 1.60 dB	E4437B



IV. Mechanical

Parameter/Equipment	Range	CMC ² (±)	Comments
Pressure ³	ATM to 1500 psi (2.6 to 100) psi	(0.02 + 0.00064 <i>P</i>) psi (0.0059 + 0.000024 <i>P</i>) psi	DHI PPC3-10M A10Mp DHI RPM4 A700Kp <i>P</i> is pressure reading
Scales and Balances ³	1 mg 2 mg (2 to 5) mg (5 to 10) mg (10 to 20) mg (20 to 50) mg (50 to 100) mg (100 to 200) mg (200 to 500) mg 500 mg to 3 g (3 to 10) g (10 to 50) g (50 to 300) g (300 to 500) g 500 g to 1 kg (1 to 2) kg (2 to 3) kg (3 to 5) kg (5 to 10) kg (10 to 20) kg (20 to 25) kg	12 µg 18 µg 13 µg 11 µg 31 µg 8.5 µg 6.6 µg 6.4 µg 6.9 µg 36 µg 77 µg 0.32 mg 3.3 mg 5.1 mg 9.4 mg 13 mg 33 mg 50 mg 73 mg 100 mg 120 mg	Class 1 and Class 4 weights
Torque Wrenches ³	5 in·ozf to 2000 ft·lbf	0.33 %	CDI 2000 torque calibrator



V. Thermodynamics

Parameter/Equipment	Range	CMC ² (±)	Comments
Temperature – Measuring Equipment	(0 to 70) °C	0.091 °C	Thunder scientific 2500ST
Temperature – Measuring Equipment ³	(-25 to 150) °C (150 to 600) °C	0.020 °C 0.045 °C	PRT w/ dry blocks
Temperature – Measure ³	(-200 to 660) °C	0.02 °C	5626 PRT w/ 3458A
Relative Humidity – Measure	(10 to 95) % RH	0.53 % RH	Thunder scientific 2500ST
Relative Humidity – Measuring Equipment ³	(10 to 95) % RH	1.1 % RH	Rotronic HC2-S / HP22-A, humidity meter

VI. Time & Frequency

Parameter/Equipment	Range	CMC ² (±)	Comments
Frequency – Measure ³	0.001 Hz to 1 kHz (1 to 1000) kHz (1 to 225) MHz (0.225 to 3.0) GHz	0.12 mHz 0.34 μHz/kHz 0.22 mHz/MHz 0.22 mHz/MHz	5680A rubidium w/ Agilent 53132A
Frequency – Measuring Equipment ³	0.001 Hz to 1 kHz 1 kHz to 50 MHz 10 MHz to 4.0 GHz	0.12 mHz 0.25 mHz/MHz 0.26 Hz/GHz	FEI 5680A rubidium with 33250A FEI 5680A rubidium with E4437B



¹ This laboratory offers commercial calibration service 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. CMC's 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, L is the numerical value of the nominal length of the device measured in inches. R is the numerical value of the resolution of the device measured in inches. Percentages are percentage of reading, unless otherwise indicated

⁵ The measurements stated are generated using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure the measured in the ranges indicated. CMC's are expressed as either a specific value that covers the full range or as a fraction of the reading plus a fixed floor specification.

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Accredited Laboratory

A2LA has accredited

TEKTRONIX CANADA

Mississauga, Canada

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 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 29th day of August 2016.

A handwritten signature in black ink, appearing to read "L. S. ...".

President & CEO
For the Accreditation Council
Certificate Number 2357.24
Valid to February 28, 2019
Revised December 12, 2018

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