CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

Accura Calibration
2834 West Kingsley Road
Garland, TX 75041

Fulfills the requirements of

ISO/IEC 17025:2017

and national standards

ANSI/NCSL Z540-1-1994 (R2002) and
ANSI/NCSL Z540.3-2006 (R2013)

In the field of

CALIBRATION

This certificate is valid only when accompanied by a current scope of accreditation document.
The current scope of accreditation can be verified at www.anab.org.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 01 February 2024
Certificate Number: AC-2548

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. 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).

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

AND

ANSI/NCSL Z540-1-1994 (R2002)
ANSI/NCSL Z540.3-2006 (R2013)

Accura Calibration
2834 West Kingsley Road
Garland, TX 75041
Dwight Martin 972-278-7878

CALIBRATION

Valid to: **February 1, 2024** Certificate Number: **AC-2548**

Acoustics and Vibration

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Accelerometers Frequency Response (1 g Reference)	(7 to 10) Hz (10 to 30) Hz (30 to 99) Hz 100 Hz (101 to 2 000) Hz (2 000 to 10 000) Hz	7 % of reading 4.6 % of reading 3.8 % of reading 3.8 % of reading 3.8 % of reading 5.3 % of reading	Modal Shop 9110D Workstation

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Clamp Meter [1] Toroidal Clamp (45 to 65) Hz 400 Hz 200 Hz	(20 to 300) A (300 to 600) A (600 to 1 000) A (20 to 300) A (300 to 600) A (600 to 1 000) A	11 mA/A + 90 mA 9.8 mA/A + 90 mA 11 mA/A + 0.09 A 19 mA/A + 0.1 A 18 mA/A + 0.1 A 18 mA/A + 0.1 A	Fluke 5500A/Coil, Valhalla 2575A Current Shunt, Keysight 3458A 8.5 Digit Multimeter, Current Source

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Clamp Meter [1] Non-Toroidal Clamp (45 to 65) Hz 400 Hz 200Hz	 (20 to 300) A (300 to 600) A (600 to 1 000) A (20 to 300) A (300 to 600) A (600 to 1 000) A	 15 mA/A + 0.9 A 14 mA/A + 0.9 A 14 mA/A + 0.9 A 22 mA/A + 0.9 A 21 mA/A + 0.9 A 22 mA/A + 0.9 A	Fluke 5500A/Coil, Valhalla 2575A Current Shunt, Keysight 3458A 8.5 Digit Multimeter, Current Source
DC Voltage – Source [1] (Locked Ranges)	(0 to 329.999 9) mV (0 to 3.299 999) V (0 to 32.999 99) V (30 to 329.999 9) V (100 to 1 020) V	16 µV/V + 0.78 µV 9.1 µV/V + 1.6 µV 9.7 µV/V + 16 µV 14 µV/V + 0.12 µV 15 µV/V + 1.2 µV	Fluke Multiproduct Calibrator
DC Voltage – Source (Fixed Artifact)	10 V	30 nV	Fluke 732B DC Voltage Reference Standard
DC Voltage – Measure [1]	Up to 120 mV (0.12 to 1.2) V (1.2 to 12) V (12 to 120) V (120 to 1 050) V	6.1 µV/V + 0.3 µV 5.1 µV/V + 0.3 µV 5.1 µV/V + 0.5 µV 7.3 µV/V + 30 µV 7.3 µV/V + 0.1 mV	Keysight 3458A 8.5 Digit Multimeter
DC High Voltage – Source/Measure [1]	(1 to 60) kV	1.8 mV/V	Ross Engineering VD60-6.2Y-A-LB-AL High Voltage Divider, Keysight 3458A 8.5 Digit Multimeter
DC Current – Source [1] (Locked Ranges)	(0 to 329) µA (0 to 3.299 999) mA (0 to 32.999 99) mA (0 to 329.999 9) mA (0 to 1.099 999) A (1.1 to 2.999 99) A (0 to 10.999 9) A (11 to 20.5) A	0.12 µA/µA + 16 nA 79 µA/µA + 39 nA 79 µA/µA + 0.19 µA 82 µA/µA + 1.9 µA 0.15 mA/A + 31 µA 0.3 mA/A + 31 µA 0.39 mA/A + 0.39 mA 0.78 mA/A + 0.58 mA	Fluke Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Measure [1]	(0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A (1 to 20) A (20 to 100) A	3.9 mA/A + 3 nA 0.41 mA/A + 30 nA 0.11 mA/A +0.3 µA 0.2 mA/A + 3 µA 30 nA/A + 0.16 mA 21 mA/A	Keysight 3458A 8.5 Digit Multimeter, Valhalla Scientific 2575A Active AC/DC Current Shunt
DC Current – Measure	(0 to 330) µA (> 0.33 to 3.3) mA (> 3.3 to 33) mA (> 33 to 330) mA (> 0.33 to 3) A (> 3 to 20.5) A	0.68 nA 5 nA 37 nA 1.4 µA 2.2 mA 22 mA	Keysight 3458A 8.5 Digit Multimeter, Current Shunts
AC Voltage – Source [1]	(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 (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 (0.33 to 3.299 99) 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 (3.3 to 32.999 9) V (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	 0.64 mV/V + 4.7 µV 0.15 mV/V + 4.7 µV 0.18 mV/V + 4.7 µV 0.79 mV/V + 4.7 µV 2.7 mV/V + 9.3 µV 6.4 mV/V + 39 µV 0.36 mV/V + 6.2 µV 0.3 mV/V + 6.2 µV 0.3 mV/V + 6.2 µV 0.52 mV/V + 6.2 µV 0.97 mV/V + 27 µV 2.8 mV/V + 54 µV 0.23 mV/V + 39 µV 0.12 mV/V + 47 µV 0.15 mV/V + 47 µV 0.24 mV/V + 39 µV 0.55 mV/V + 97 µV 1.9 mV/V + 0.47 mV 0.23 mV/V + 0.5 mV 0.12 mV/V + 0.47 mV 0.2 mV/V + 4.7 mV 0.23 mV/V + 4.7 mV 0.7 mV/V + 1.2 mV	Fluke Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source [1]	(33 to 329.999) V 45 Hz to 1 kHz (1 to 10) kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (330 to 1 020) V 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	 0.15 mV/V + 1.6 mV 0.16 mV/V + 4.7 mV 0.2 mV/V + 4.7 mV 0.25 mV/V + 4.7 mV 0.7 mV/V + 39 mV 0.24 mV/V + 7.8 mV 0.2 mV/V + 7.8 mV 0.24 mV/V + 7.8 mV	Fluke Multiproduct Calibrator
AC Voltage – Measure [1]	10 nV to 12 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 12 mV to 12 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 (0.3 to 1) MHz (1 to 2) MHz (12 to 120) 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 (0.3 to 1) MHz (120 to 700) V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz	 0.7 mV/V 0.36 mV/V 0.48 mV/V 1.3 mV/V 5.9 mV/V 46 mV/V 0.13 mV/V 0.11 mV/V 0.22 mV/V 0.37 mV/V 0.95 mV/V 3.6 mV/V 1.2 mV/V 17 mV/V 0.28 mV/V 0.26 mV/V 0.26 mV/V 0.43 mV/V 1.4 mV/V 4.7 mV/V 17 mV/V 0.53 mV/V 0.5 mV/V 0.73 mV/V 1.4 mV/V 3.5 mV/V	Keysight 3458A 8.5 Digit Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure	2.2 mV		Fluke 5790B AC Measurement Standard
	(10 to 20) Hz	0.14 % of reading + 1 µV	
	(20 to 40) Hz	0.067 % of reading + 1 µV	
	40 Hz to 20 kHz	0.045 % of reading + 1 µV	
	(20 to 50) kHz	0.072 % of reading + 1.6 µV	
	(50 to 100) kHz	0.098 % of reading + 1.9 µV	
	(100 to 300) kHz	0.18 % of reading + 3.1 µV	
	(300 to 500) kHz	0.19 % of reading + 6.2 µV	
	500 kHz to 1 MHz	0.27 % of reading + 6.2 µV	
	7 mV		
	(10 to 20) Hz	0.067 % of reading + 1 µV	
	(20 to 40) Hz	0.032 % of reading + 1 µV	
	40 Hz to 20 kHz	0.021 % of reading + 1 µV	
	(20 to 50) kHz	0.033 % of reading + 1.6 µV	
	(50 to 100) kHz	0.049 % of reading + 1.9 µV	
	(100 to 300) kHz	0.094 % of reading + 3.1 µV	
	(300 to 500) kHz	0.1 % of reading + 6.2 µV	
	500 kHz to 1 MHz	0.18 % of reading + 6.2 µV	
	22 mV		
	(10 to 20) Hz	0.23 % of reading + 1 µV	
	(20 to 40) Hz	0.015 % of reading + 1 µV	
	40 Hz to 20 kHz	0.009 % of reading + 1 µV	
	(20 to 50) kHz	0.016 % of reading + 1.6 µV	
	(50 to 100) kHz	0.024 % of reading + 1.9 µV	
	(100 to 300) kHz	0.063 % of reading + 3.1 µV	
	(300 to 500) kHz	0.069 % of reading + 6.2 µV	
	500 kHz to 1 MHz	0.14 % of reading + 6.2 µV	
	70 mV		
	(10 to 20) Hz	0.019 % of reading + 1.2 µV	
	(20 to 40) Hz	0.009 % of reading + 1.2 µV	
	40 Hz to 20 kHz	0.005 % of reading + 1.2 µV	
	(20 to 50) kHz	0.01 % of reading + 1.6 µV	
	(50 to 100) kHz	0.02 % of reading + 1.9 µV	
	(100 to 300) kHz	0.039 % of reading + 3.1 µV	
	(300 to 500) kHz	0.052 % of reading + 6.2 µV	
	500 kHz to 1 MHz	0.085 % of reading + 6.2 µV	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure	0.22 V		Fluke 5790B AC Measurement Standard
	(10 to 20) Hz	0.017 % of reading + 1.2 µV	
	(20 to 40) Hz	0.007 % of reading + 1.2 µV	
	40 Hz to 20 kHz	0.003 % of reading + 1.2 µV	
	(20 to 50) kHz	0.005 % of reading + 1.6 µV	
	(50 to 100) kHz	0.012 % of reading + 1.9 µV	
	(100 to 300) kHz	0.019 % of reading + 3.1 µV	
	(300 to 500) kHz	0.029 % of reading + 6.2 µV	
	500 kHz to 1 MHz	0.078 % of reading + 6.2 µV	
	0.7 V		
	(10 to 20) Hz	0.016 % of reading + 1.2 µV	
	(20 to 40) Hz	0.006 % of reading + 1.2 µV	
	40 Hz to 20 kHz	0.003 % of reading + 1.2 µV	
	(20 to 50) kHz	0.004 % of reading + 1.6 µV	
	(50 to 100) kHz	0.006 % of reading + 1.9 µV	
	(100 to 300) kHz	0.014 % of reading + 3.1 µV	
	(300 to 500) kHz	0.023 % of reading + 6.2 µV	
	500 kHz to 1 MHz	0.076 % of reading + 6.2 µV	
	2.2 V		
	(10 to 20) Hz	0.016 % of reading	
	(20 to 40) Hz	0.005 % of reading	
	40 Hz to 20 kHz	0.002 % of reading	
	(20 to 50) kHz	0.004 % of reading	
	(50 to 100) kHz	0.005 % of reading	
	(100 to 300) kHz	0.012 % of reading	
	(300 to 500) kHz	0.02 % of reading	
	500 kHz to 1 MHz	0.071 % of reading	
	7 V		
	(10 to 20) Hz	0.016 % of reading	
	(20 to 40) Hz	0.005 % of reading	
	40 Hz to 20 kHz	0.002 % of reading	
	(20 to 50) kHz	0.004 % of reading	
	(50 to 100) kHz	0.006 % of reading	
	(100 to 300) kHz	0.015 % of reading	
	(300 to 500) kHz	0.031 % of reading	
	500 kHz to 1 MHz	0.094 % of reading	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure	22 V		Fluke 5790B AC Measurement Standard
	(10 to 20) Hz	0.016 % of reading	
	(20 to 40) Hz	0.005 % of reading	
	40 Hz to 20 kHz	0.002 % of reading	
	(20 to 50) kHz	0.004 % of reading	
	(50 to 100) kHz	0.007 % of reading	
	(100 to 300) kHz	0.015 % of reading	
	(300 to 500) kHz	0.032 % of reading	
	500 kHz to 1 MHz	0.093 % of reading	
	70 V		
	(10 to 20) Hz	0.016 % of reading	
	(20 to 40) Hz	0.006 % of reading	
	40 Hz to 20 kHz	0.002 % of reading	
	(20 to 50) kHz	0.004 % of reading	
	(50 to 100) kHz	0.007 % of reading	
	(100 to 300) kHz	0.016 % of reading	
	(300 to 500) kHz	0.032 % of reading	
	500 kHz to 1 MHz	0.093 % of reading	
	220 V		
	(10 to 20) Hz	0.016 % of reading	
	(20 to 40) Hz	0.005 % of reading	
	40 Hz to 20 kHz	0.002 % of reading	
	(20 to 50) kHz	0.005 % of reading	
	(50 to 100) kHz	0.008 % of reading	
	(100 to 300) kHz	0.016 % of reading	
	(300 to 500) kHz	0.04 % of reading	
	700 V		
	(10 to 20) Hz	0.015 % of reading	
	(20 to 40) Hz	0.008 % of reading	
	40 Hz to 20 kHz	0.003 % of reading	
	(20 to 50) kHz	0.01 % of reading	
	(50 to 100) kHz	0.04 % of reading	
	1 000 V		
	(10 to 20) Hz	0.015 % of reading	
	(20 to 40) Hz	0.008 % of reading	
	40 Hz to 20 kHz	0.003 % of reading	
	(20 to 50) kHz	0.01 % of reading	
	(50 to 100) kHz	0.04 % of reading	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC High Voltage – Source/Measure [1]	(1 to 60) kV 60 Hz	5.9 mV/V	Ross Engineering VD60-6.2Y-A-LB-AL High Voltage Divider, Keysight 3458A 8.5 Digit Multimeter
AC Current – Source [1]	(29 to 329.99) uA (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 (0.33 to 3.299 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 (3.3 to 32.999 9) 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 (33 to 329.999) 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 (0.33 to 1.099 99) A (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	 1.6 nA/µA + 78 nA 1.2 nA/µA + 78 nA 0.97 nA/µA + 78 nA 2.3 nA/µA + 0.12 µA 6.4 nA/µA + 0.16 µA 12 nA/µA + 0.31 µA 1.6 µA/mA + 0.12 µA 0.97 µA/mA + 0.12 µA 0.79 µA/mA + 78 nA 1.5 µA/mA + 0.16 µA 3.9 µA/mA + 0.23 µA 7.9 µA/mA + 0.47 µA 1.4 µA/mA + 1.6 µA 0.7 µA/mA + 1.6 µA 0.3 µA/mA + 0.16 µA 0.64 µA/mA + 0.16 µA 1.5 µA/mA + 2.3 µA 3 µA/mA + 3.1 µA 1.4 µA/mA + 16 µA 0.7 µA/mA + 16 µA 0.33 µA/mA + 16 µA 0.79 µA/mA + 39 µA 1.6 µA/mA + 78 µA 3.3 µA/mA + 0.16 mA 0.11 mA/A + 78 µA 0.11 mA/A + 78 µA 0.16 mA/A + 0.78 mA 0.4 mA/A + 3.9 mA	Fluke Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source [1]	(1.1 to 2.999 99) A (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (3 to 10.9999) A (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (3 to 10.9999) A (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (11 to 20.5) A (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz	 1.4 mA/A + 78 µA 0.53 mA/A + 78 µA 4.7 mA/A + 0.78 mA 19 mA/A + 3.9 mA 1 mA/A + 1.6 mA 1.2 mA/A + 1.6 mA 23 mA/A + 1.6 mA 1 mA/A + 1.6 mA 1.2 mA/A + 1.6 mA 23 mA/A + 1.6 mA 1.8 mA/A + 3.9 mA 1.9 mA/A + 3.9 mA 23 mA/A + 3.9 mA	Fluke Multiproduct Calibrator
AC Current – Measure	Up to 330 µA 10 Hz to 1 kHz 1 kHz to 30 kHz (> 0.33 to 3.29) mA 10 Hz to 1 kHz 1 kHz to 30 kHz (> 3.29 to 32.9 mA) 10 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 30 kHz (> 32.9 to 329 mA) 10 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 30 kHz > 329 mA to 2.99 A 10 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 30 kHz	 9 nA 4 nA 32 µA 12 nA 29 µA 24 µA 39 µA 39 µA 25 µA 40 µA 59 µA 36 µA 85 µA	Fluke 5790B AC Measurement Standard, Current Shunts
AC Current – Source/Measure [1]	45 Hz to 1 kHz (0.1 to 2) mA (2 to 20) mA (20 to 200) mA (0.2 to 2) A (2 to 20) A (20 to 100) A	 4.1 mA/A + 3 nA 1.1 mA/A + 30 nA 1 mA/A + 0.3 µA 1 mA/A + 3 µA 1 mA/A + 30 µA 1 mA/A + 0.15 mA	Valhalla 2575A Current Shunt, Keysight 3458A 8.5 Digit Multimeter, Current Source

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Power – Source [1]			
33 mV to 1 020 V	0.33 mA to 2.9999 A 11 µW to 3.06 kW	0.018 % of reading	Fluke Multiproduct Calibrator
33 mV to 1 020 V	(3 to 20.5) A 0.1 W to 20.9 kW	0.054 % of reading	
AC Power – Source [1]			
33 mV to 1 020 V (45 to 65) Hz Power Factor: PF=1	(3 to 20.5) A 0.11 mW to 20.9 kW	0.11 % of reading	Fluke Multiproduct Calibrator
Capacitance – Source [1] (Simulated)			
10 Hz to 10 kHz	(220 to 399.9) pF	0.55 % of reading + 7.8 pF	Fluke Multiproduct Calibrator
10 Hz to 10 kHz	(0.4 to 1.099 9) nF	0.42 % of reading + 10 pF	
10 Hz to 3 kHz	(1.1 to 3.299 9) nF	0.39 % of reading + 10 pF	
10 Hz to 1 kHz	(3.3 to 10.999 9) nF	0.2 % of reading + 10 pF	
10 Hz to 1 kHz	(11 to 32.999 9) nF	0.2 % of reading + 8 pF	
10 Hz to 1 kHz	(33 to 109.999) nF	0.2 % of reading + 8 pF	
10 Hz to 1 kHz	(110 to 329.999) nF	0.27 % of reading + 0.23 nF	
(10 to 600) Hz	(0.33 to 1.099 99) µF	0.21 % of reading + 0.78 nF	
(10 to 300) Hz	(1.1 to 3.299 99) µF	0.2 % of reading + 2.3 nF	
(10 to 150) Hz	(3.3 to 10.999 9) µF	0.21 % of reading + 7.8 nF	
(10 to 120) Hz	(11 to 32.999 9) µF	0.3 % of reading + 23 nF	
(10 to 80) Hz	(33 to 109.999) µF	0.35 % of reading + 78 nF	
(0 to 50) Hz	(110 to 329.999) µF	0.36 % of reading + 0.23 µF	
(0 to 20) Hz	(0.33 to 1.099 99) mF	0.36 % of reading + 0.78 µF	
(0 to 6) Hz	(1.1 to 3.299 99) mF	0.36 % of reading + 2.3 µF	
(0 to 2) Hz	(3.3 to 10.999 9) mF	0.35 % of reading + 7.8 µF	
(0 to 0.6) Hz	(11 to 32.999 9) mF	0.58 % of reading + 23 µF	
(0 to 0.2) Hz	(33 to 110) mF	0.85 % of reading + 77 µF	
Capacitance – Measure [1]	12 Hz to 100 kHz		
	1 pF to 6.4 nF	0.12 % of reading	General Radio 1689M RLC Bridge
	(6.4 to 100) nF	0.38 % of reading	
	100 nF to 1.6 µF	0.81 % of reading	
	(1.6 to 100) µF	0.57 % of reading	
	1 kHz		
	1 pF to 1 µF	0.000 9 % of reading	Andeen-Hagerling 2500A Capacitance Bridge
Inductance – Source/Measure [1] (Artifact-Variable)	100 Hz to 1 kHz 1 mH to 11.11 H	0.27 % of reading	General Radio 1689M RLC Bridge, General Radio 1490D Decade Inductor

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Resistance – Source [1] (Simulated)	(0 to 11) Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω (0.33 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 (0.33 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 1 100) MΩ	33 µΩ/Ω + 0.78 mΩ 24 µΩ/Ω + 1.2 mΩ 22 µΩ/Ω + 1.1 mΩ 22 µΩ/Ω + 1.6 mΩ 23 µΩ/Ω + 1.6 µΩ 23 mΩ/Ω + 16 mΩ 23 mΩ/Ω + 16 mΩ 22 mΩ/Ω + 0.16 Ω 23 mΩ/Ω + 0.16 Ω 26 mΩ/Ω + 1.6 Ω 25 mΩ/Ω + 1.6 Ω 48 mΩ/Ω + 23 Ω 0.23 Ω/Ω + 39 Ω 0.2 Ω/Ω + 1.9 kΩ 0.4 Ω/Ω + 2.3 kΩ 2.3 Ω/kΩ + 78 kΩ 12 Ω/kΩ + 0.39 MΩ	Fluke Multiproduct Calibrator
DC Resistance – Source (Artifact-Fixed)	10 mΩ 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ	70 µΩ 8.9 µΩ 5.1 µΩ 0.37 mΩ 6.1 mΩ 62 mΩ	Standard Resistors
DC Resistance – Measure [1]	Up to 12 Ω (12 to 120) Ω (0.12 to 1.2) kΩ (1.2 to 12) kΩ (1.2 to 120) kΩ (0.12 to 1.2) MΩ (1.2 to 12) MΩ (12 to 120) MΩ (0.12 to 1.2) GΩ	19 µΩ/ Ω + 50 µΩ 15 µΩ/ Ω + 0.5 mΩ 13 µΩ/ Ω + 0.5 mΩ 12 µΩ/ Ω + 5 mΩ 13 µΩ/ Ω + 50 µΩ 24 µΩ/ Ω + 2 Ω 65 µΩ/ Ω + 100 Ω 0.58 mΩ/ Ω + 1 kΩ 5.8 mΩ/ Ω + 10 kΩ	Keysight 3458A 8.5 Digit Multimeter
DC Resistance – Measure	12 MΩ to 1.1 GΩ	0.007 % of reading	Fluke 5700A Multiproduct Calibrator, HP 3458A 8.5 Digit Multimeter
AC Resistance – Source/Measure [1]	1 kHz 1 Ω to 100 kΩ	0.39 mΩ/Ω	General Radio 1689M RLC Bridge, HP 16074A Standard Set

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes [1,2]			Fluke Multiproduct Calibrator
DC Voltage			
into 50 Ω	± (0 to 6.6) V	0.25 % of reading + 40 µV	
into 1 M Ω	± (0 to 130) V	0.05 % of reading + 40 µV	
Square Wave			
into 50 Ω	± 1 mV to 6.6 V p-p	0.25 % of reading + 40 µV	
into 1 M Ω	± 1 mV to 130 V p-p	0.1 % of reading + 40 µV	
Time Markers			
into 50 Ω	1 ns to 20 ms	2.5 µs/s	
	50 ms to 5 s	(25 + 1 000t) µs/s	
Leveled Sine Wave			
Frequency	50 kHz to 1.1 GHz	0.25 µHz/Hz	
Flatness			
50 kHz (reference)	5 mV to 5.5 V	2 % of reading + 0.3 mV	
50 kHz to 100 MHz	5 mV to 5.5 V	3.5 % of reading + 0.3 mV	
(100 to 300) MHz	5 mV to 5.5 V	4 % of reading + 0.3 mV	
(300 to 600) MHz	5 mV to 5.5 V	6 % of reading + 0.3 mV	
(0.6 to 1.1) GHz	5 mV to 3.5 V	7 % of reading + 0.3 mV	
Edge Characteristics			
into 50 Ω			
Rise Time	≤ 300 ps	+ 0 ps / - 100 ps	
Amplitude	5 mV to 2.5 V	2 % of reading + 0.2 mV	
Frequency	900 Hz to 11 MHz	2.5 µHz/Hz	
Wave Generator Amplitude (Square, Sine, Triangle)			
into 50Ω	1.8 mV to 2.5 Vp-p	30 mV/V + 0.1 mV	
into 1 MΩ	1.8 mV to 55 Vp-p	30 mV/V + 0.1 mV	
Frequency	10 Hz to 100 kHz	25 µHz/Hz + 15 mHz	
Input Resistance Measurement			
into 50 Ω	(40 to 60) Ω	0.1 % of reading	
into 1 MΩ	500 kΩ to 1.5 MΩ	0.1 % of reading	
Input Capacitance Measurement			
into 1 MΩ	(5 to 50) pF	5 % of reading + 0.5 pF	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Source/Measure [1]	Type B		Fluke Multiproduct Calibrator
	(600 to 800) °C	0.34 °C	
	(800 to 1 000) °C	0.27 °C	
	(1 000 to 1 550) °C	0.23 °C	
	(1 550 to 1 820) °C	0.26 °C	
	Type C		
	(0 to 150) °C	0.23 °C	
	(150 to 650) °C	0.2 °C	
	(650 to 1 000) °C	0.24 °C	
	(1 000 to 1 800) °C	0.39 °C	
	(1 800 to 2 316) °C	0.65 °C	
	Type E		
	(-250 to -100) °C	0.39 °C	
	(-100 to -25) °C	0.13 °C	
	(-25 to 350) °C	0.11 °C	
	(350 to 650) °C	0.13 °C	
	(650 to 1 000) °C	0.17 °C	
	Type J		
	(-210 to -100) °C	0.21 °C	
	(-100 to -30) °C	0.13 °C	
	(-30 to 150) °C	0.11 °C	
	(150 to 760) °C	0.14 °C	
	(760 to 1 200) °C	0.18 °C	
	Type K		
	(-200 to -100) °C	0.26 °C	
	(-100 to -25) °C	0.14 °C	
	(-25 to 120) °C	0.13 °C	
	(120 to 1 000) °C	0.2 °C	
	(1 000 to 1 372) °C	0.31 °C	
	Type L		
	(-200 to -100) °C	0.29 °C	
	(-100 to 800) °C	0.2 °C	
	(800 to 900) °C	0.14 °C	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Source/Measure [1]	Type N (-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 410) °C (410 to 1 300) °C Type R (0 to 250) °C (250 to 400) °C (400 to 1 000) °C (1 000 to 1 767) °C Type S (0 to 250) °C (250 to 1 000) °C (1 000 to 1 400) °C (1 400 to 1 767) °C Type T (-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C Type U (-200 to 0) °C (0 to 600) °C	 0.31 °C 0.17 °C 0.15 °C 0.14 °C 0.21 °C 0.44 °C 0.27 °C 0.26 °C 0.31 °C 0.37 °C 0.28 °C 0.29 °C 0.36 °C 0.49 °C 0.19 °C 0.13 °C 0.11 °C 0.44 °C 0.21 °C	Fluke Multiproduct Calibrator
Electrical Simulation of RTD Indicating Devices – Source [1]	Pt 385, 100 Ω (-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 Pt 3926, 100 Ω (-200 to -80) °C (-80 to 0) °C (0 to 100) °C (100 to 300) °C (300 to 400) °C (400 to 630) °C	 0.04 °C 0.04 °C 0.05 °C 0.07 °C 0.08 °C 0.09 °C 0.18 °C 0.04 °C 0.04 °C 0.05 °C 0.07 °C 0.08 °C 0.09 °C	Fluke Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of RTD Indicating Devices – Source [1]	Pt 3916, 100 Ω		Fluke Multiproduct Calibrator
	(-200 to -190) °C	0.19 °C	
	(-190 to -80) °C	0.03 °C	
	(-80 to 0) °C	0.04 °C	
	(0 to 100) °C	0.05 °C	
	(100 to 260) °C	0.05 °C	
	(260 to 300) °C	0.06 °C	
	(300 to 400) °C	0.07 °C	
	(400 to 600) °C	0.08 °C	
	(600 to 630) °C	0.18 °C	
	Pt 385, 200 Ω		
	(-200 to -80) °C	0.03 °C	
	(-80 to 0) °C	0.03 °C	
	(0 to 100) °C	0.03 °C	
	(100 to 260) °C	0.04 °C	
	(260 to 300) °C	0.09 °C	
	(300 to 400) °C	0.1 °C	
	(400 to 600) °C	0.11 °C	
	(600 to 630) °C	0.12 °C	
	Pt 385, 500 Ω		
	(-200 to -80) °C	0.03 °C	
	(-80 to 0) °C	0.04 °C	
	(0 to 100) °C	0.04 °C	
	(100 to 260) °C	0.05 °C	
	(260 to 300) °C	0.06 °C	
	(300 to 400) °C	0.06 °C	
	(400 to 600) °C	0.07 °C	
	(600 to 630) °C	0.09 °C	
	Pt 385, 1 000 Ω		
	(-200 to -80) °C	0.02 °C	
	(-80 to 0) °C	0.02 °C	
	(0 to 100) °C	0.03 °C	
	(100 to 260) °C	0.04 °C	
	(260 to 300) °C	0.05 °C	
	(300 to 400) °C	0.05 °C	
	(400 to 600) °C	0.05 °C	
	(600 to 630) °C	0.18 °C	
	Ni 385, 120 Ω		
	(-80 to 0) °C	0.06 °C	
	(0 to 100) °C	0.06 °C	
	(100 to 260) °C	0.01 °C	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of RTD Indicating Devices – Source [1]	Cu 427, 10 Ω (-100 to 260) °C	0.31 °C	Fluke Multiproduct Calibrator
Phase Measurement [1] (0 to 360)°	(0.329 to 360) V Up to 10 Hz > 10 Hz to 50 kHz > 50 kHz to 10 MHz	 0.12° 0.06° 0.4°	Krohn-Hite 6620A Phase Meter

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF/Microwave Power – Source/Measure [1]	100 kHz to 4.2 GHz (-30 to +20) dBm	0.13 dB	Keysight 8482A Power Sensor, Keysight E4418B Power Meter, Signal Generator
	10 MHz to 26.5 GHz (-30 to +20) dBm	0.11 dB	Keysight 8485A Power Sensor, Keysight E4418B Power Meter, Signal Generator
	10 MHz to 18 GHz (-70 to -20) dBm	0.13 dB	Keysight 8481D Power Sensor, Keysight E4418B Power Meter, Signal Generator
Attenuation – Measure or Tuned RF Power 2.5 MHz to 18 GHz	(0 to 10) dB (-10 to 0) dB (-20 to -10) dB (-30 to -20) dB (-40 to -30) dB (-50 to -40) dB (-60 to -50) dB	0.15 dB 0.15 dB 0.15 dB 0.15 dB 0.15 dB 0.15 dB 0.17 dB	Keysight 8902A Measuring Receiver, Keysight 11793A Microwave Converter

Electrical – RF/Microwave

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Attenuation – Measure or Tuned RF Power 2.5 MHz to 18 GHz	(-70 to -60) dB (-80 to -70) dB (-90 to -80) dB (-100 to -90) dB (-110 to -100) dB (-120 to -110) dB (-127 to -120) dB	0.17 dB 0.2 dB 0.22 dB 0.22 dB 0.33 dB 0.43 dB 0.43 dB	Keysight 8902A Measuring Receiver, Keysight 11793A Microwave Converter
Amplitude Modulation – Measure 150 kHz to 10 MHz 10 MHz to 1.3 GHz 10 MHz to 1.3 GHz (1.3 to 26.5) GHz (1.3 to 26.5) GHz	Rate: 50 Hz to 10 kHz Depths: (5 to 99) % Rate: 50 Hz to 50 kHz Depths: (5 to 99) % Rate: 20 Hz to 100 kHz Depths: (5 to 99) % Rate: 20 Hz to 100 kHz Depths: (5 to 99) % Rate: 20 Hz to 100 kHz Depths: (5 to 99) %	2.3 % of reading 1.2 % of reading 3.5 % of reading 1.8 % of reading 3.5 % of reading	Agilent 8902A Measuring Receiver
Frequency Modulation – Measure Carrier Frequency: 250 kHz to 10 MHz 10 MHz to 1.3 GHz	Rate: 20 Hz to 10 kHz Dev.: ≤ 40 kHz peak Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak	2.3 % of reading 5.8 % of reading	Keysight 8902A Measuring Receiver
Frequency Modulation – Measure Carrier Frequency: (1.3 to 26.5) GHz	Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak	5.8 % of reading	Keysight 8902A Measuring Receiver
Phase Modulation – Measure 10 MHz to 1.3 GHz 1.3 GHz to 26.5 GHz	Rate: 200 Hz 20 kHz Dev.: .1 to 400 rad Rate: 200 Hz 20 kHz Dev.: > .1 to 400 rad	3.5 % of reading 4.6 % of reading	Agilent 8902A Measuring Receiver, Keysight 11722A / 11792A Sensor Modules

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Height Gage [1,2]	Up to 24 in	(22 + 13*L*) µin	Gage Blocks, Height Gage, Repeat-O-Meter
Micrometer [1,2,3]	Up to 6 in	(30 + 4.9*L*) µin	Gage Blocks
Calipers [1,2]	Up to 36 in	(345 + 5*L*) µin	Gage Blocks
Caliper – Parallelism [1]	(0.15 to 0.5) in	8.8 µin/in	Pin Gage
Depth Micrometers [1,3]	Up to 6 in	(30 + 4.9*L*) µin	Gage Blocks
External Diameter [2] (Pin Gages, Set Plugs)	Up to 12 in	(4.5 + 5.6*L*) µin	Universal Length Measuring Machine
Internal Diameter [2]	(0.04 to 3) in	(9.4 + 3.2*L*) µin	Universal Length Measuring Machine
Length Standards [2]	(1 to 8) in	(5 + 1.8*L*) µin	Universal Length Measuring Machine, Gage Blocks
Radius Gages [2]	(0.031 25 to 1) in	(291 + 98*L*) µin	Keyence
Gage Blocks [2]	Up to 12 in	(1.5 + 5.7*L*) µin	Universal Length Measuring Machine, Master Gage Blocks
Angle Measurement [2] Digital Protractors, Levels, Inclinometers	Up to 90°	22″ (0.006°)	Sine Bar, Gage Blocks, Surface Plate, Right Angles
Steel Rules, Tape Measure	Up to 40 in (> 40 to 80) in	0.002 6 in 0.003 5 in	DRO Linear Recorder

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Class I Balances [1]			ASTM E617 Class 1 Weights and NIST Handbook 44 utilized for the calibration of the weighing system.
(0.000 01 g resolution)	Up to 100 g	0.29 mg	
(0.000 02 g resolution)	Up to 100 g	0.29 mg	
(0.000 05 g resolution)	Up to 100 g	0.3 mg	
(0.000 1 g resolution)	Up to 200 g	0.6 mg	
(0.000 2 g resolution)	Up to 200 g	0.6 mg	
(0.000 5 g resolution)	Up to 200 g	0.87 mg	
Class II Balances [1]			ASTM E617 Class 1 Weights and NIST Handbook 44 utilized for the calibration of the weighing system.
(0.001 g resolution)	Up to 100 g	1.3 mg	
(0.002 g resolution)	Up to 200 g	2.6 mg	
(0.005 g resolution)	Up to 500 g	6.6 mg	
(0.01 g resolution)	Up to 1 kg	13 mg	
(0.02 g resolution)	Up to 2 kg	29 mg	
(0.05 g resolution)	Up to 5 kg	0.15 g	
(0.1 g resolution)	Up to 10 kg	0.31 g	
(0.2 g resolution)	Up to 20 kg	0.36 g	
Class III Light Capacity Scales [1]			NIST Class F Weights and NIST Handbook 44 utilized for the calibration of the weighing system.
(0.000 5 lb resolution)	Up to 5 lb	0.000 87 lb	
(0.001 lb resolution)	Up to 10 lb	0.001 7 lb	
(0.002 lb resolution)	Up to 20 lb	0.002 6 lb	

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Class III Light Capacity Scales [1]			NIST Class F Weights and NIST Handbook 44 utilized for the calibration of the weighing system.
(0.005 lb resolution)	Up to 50 lb	0.008 7 lb	
(0.01 lb resolution)	Up to 100 lb	0.018 lb	
(0.02 lb resolution)	Up to 200 lb	0.036 lb	
(0.05 lb resolution)	Up to 500 lb	0.087 lb	
(0.1 lb resolution)	Up to 500 lb	0.14 lb	
Force Gages – Tension [1]	(1 to 110) lbf	0.06 lb	NIST Class F Weights, Hangers
Durometers – Spring Force Only Types A, B, O, C, D, DO	209.04 gf to 4.079 kgf	0.01 % of reading	ASTM E617 Class 1 Weights, Triple Beam Balance
Pressure – Source/Measure [1]	(-5 to 5) psi	0.081 psi	Comparison to Fluke 700PD3 Pressure Module
Pressure – Source/Measure [1]	(-12 to 100) psi	0.19 psi	Fluke 718-300 Pressure Calibrator
	Up to 1 000 psig	0.66 psi	Comparison to Crystal XP2i Master Digital Pressure Gage
	Up to 3 000 psig	2.4 psi	Comparison to Druck DPI 104-3000 Digital Pressure Gage
	Up to 10 000 psig	6 psi	Comparison to Druck DPI 104-10000 Digital Pressure Gage
	Up to 10 inH_2O	0.3 inH_2O	Comparison to Fluke 700PO1 Pressure Module
Torque Indicating Device [1]	(40 to 200) ozf·in (4 to 50) lbf·in (30 to 400) lbf·in (80 to 1 000) lbf·in (20 to 250) lbf·ft (60 to 600) lbf·ft	0.29 % of reading 0.29 % of reading 0.29 % of reading 0.3 % of reading 0.34 % of reading 0.59 % of reading	Torque Transducers

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Torque Analyzers, Torque Transducers	(40 to 200) ozf·in (4 to 50) lbf·in (30 to 400) lbf·in (80 to 1 000) lbf·in (20 to 250) lbf·ft (60 to 600) lbf·ft	0.044 % of reading 0.044 % of reading 0.044 % of reading 0.044 % of reading 0.054 % of reading 0.096 % of reading	Torque Wheels/Arms, Master Weights, Weight Hanger

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature – Generate/Measure [1]	(-25 to 420) °C	0.04 °C	Fluke Blackstack Readout, SPRT, Heat Source
	(400 to 1 200) °C	0.32°C	Fluke Blackstack Readout, Type-S Thermocouple Probe, Heat Source
Infrared Thermometers [1]	100 °C 300 °C 500 °C	0.6 °C 0.85 °C 1.2 °C	Comparison to SPRT w/ Fluke 9132A Blackbody Calibrator (flat plate) $\varepsilon = 0.95$, $\lambda = (8 \text{ to } 14)$ µm
Humidity – Generate	(10 to 90) %RH	1.2 %RH	Thunder Scientific, Psychrometer

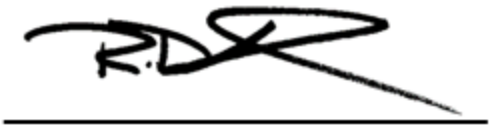
Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source/Measure	10 Hz to 26.5 GHz	50 pHz/Hz	GPS Disciplined Oscillator, Signal Generators, Universal Counters

Calibration and Measurement Capability (CMC) is expressed in terms of the measurement parameter, measurement range, expanded uncertainty of measurement and reference standard, method, and/or equipment. The expanded uncertainty of measurement is expressed as the standard uncertainty of the measurement multiplied by a coverage factor of 2 (k=2), corresponding to a confidence level of approximately 95%.

Notes:

1. On-site calibration service is available for this parameter, since on-site conditions are typically more variable than those in the laboratory, larger measurement uncertainties are expected on-site than what is reported on the accredited scope.
2. *L* = length in inches, *T* = time in seconds; ″ = arc-second.
3. Resolution is not included on the CMC as the best device may not have been available for repeatability studies/ The Resolution will be add as 0.6*R*, where *R* = resolution, at the time of calculating Measurement Uncertainty (MU) during calibration.
4. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2548.



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