



# CERTIFICATE OF ACCREDITATION

## The ANSI National Accreditation Board

Hereby attests that

### Trident Calibration Labs

1725 E. Robin Lane  
Phoenix, AZ 85024

Fulfills the requirements of

### ISO/IEC 17025:2017

and national standard

### ANSI/NCSL Z540-1-1994 (R2002)

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](http://www.anab.org).

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 11 September 2023

Certificate Number: AC-1986



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)**

**Trident Calibration Labs**

1725 E. Robin Lane  
Phoenix, AZ 85024  
Craig Fink (480) 686-9365  
craig.fink@tridentcalibration.com

**CALIBRATION**

Valid to: **September 11, 2023**

Certificate Number: **AC-1986**

**Electrical – DC Low Frequency**

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
DC Voltage - Source	Up to 220 mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V 220 V to 1.1 kV	7.4 nV/mV + 0.5 $\mu$ V 4.7 $\mu$ V/V + 0.5 $\mu$ V 3.3 $\mu$ V/V + 3 $\mu$ V 3.3 $\mu$ V/V + 0.5 $\mu$ V 4.7 $\mu$ V/V + 50 $\mu$ V 6.5 $\mu$ V/V + 0.4 mV	Fluke 5730A Multiproduct Calibrator
DC Voltage - Measure	Up to 100 mV 100 mV to 1 V (1 to 10) V (10 to 100) V 100 V to 1 kV	7.4 nV/mV + 0.2 $\mu$ V 2.9 $\mu$ V/V + 0.3 $\mu$ V 2.5 $\mu$ V/V + 0.5 $\mu$ V 4 $\mu$ V/V + 30 $\mu$ V 4 $\mu$ V/V + 0.5 mV	Fluke 8588A Multimeter
DC Voltage - Measure	(1 to 10) kV	0.05 % of reading	Vitrek 4700
DC Current - Source	Up to 220 $\mu$ A 220 $\mu$ A to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A	0.03 nA/ $\mu$ A + 5.7 nA 29 nA/mA + 5.4 nA 28 nA/mA + 31 nA 37 nA/mA + 0.54 nA 86 $\mu$ A/A + 9 $\mu$ A	Fluke 5730A Multiproduct Calibrator
DC Current - Source	(2.2 to 11) A (11 to 20.5) A	0.42 mA/A + 0.39 mA 0.86 mA/A + 0.58 mA	Fluke 5522A/SC1100 Multiproduct Calibrator

**Electrical – DC Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current - Measure	(1 to 10) $\mu$ A (10 to 100) $\mu$ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (1 to 30) A	33 nA/A + 0.4 nA 5 nA/A + 0.4 nA 5 nA A/A + 4 nA 5 nA/A + 40 nA 10 $\mu$ A/A + 1 $\mu$ A 0.49 mA/A + 1.5 mA	Fluke 8588A Multimeter
DC Resistance - Source	Up to 11 $\Omega$ (11 to 33) $\Omega$ (33 to 110) $\Omega$ (110 to 330) $\Omega$ 330 $\Omega$ to 1.1 k $\Omega$ (1.1 to 3.3) k $\Omega$ (3.3 to 11) k $\Omega$ (11 to 33) k $\Omega$ (33 to 110) k $\Omega$ (110 to 330) k $\Omega$ 330 k $\Omega$ to 1.1 M $\Omega$ (1.1 to 3.3) M $\Omega$ (3.3 to 11) M $\Omega$ (11 to 33) M $\Omega$ (33 to 110) M $\Omega$ (110 to 330) M $\Omega$ (330 to 1 100) M $\Omega$	38 $\mu\Omega/\Omega$ + 0.78 m $\Omega$ 25 $\mu\Omega/\Omega$ + 1.2 m $\Omega$ 23 $\mu\Omega/\Omega$ + 1.1 m $\Omega$ 22 $\mu\Omega/\Omega$ + 1.6 m $\Omega$ 22 m $\Omega/k\Omega$ + 1.6 m $\Omega$ 22 m $\Omega/k\Omega$ + 16 m $\Omega$ 22 m $\Omega/k\Omega$ + 16 m $\Omega$ 22 m $\Omega/k\Omega$ + 0.16 $\Omega$ 22 m $\Omega/k\Omega$ + 0.16 $\Omega$ 25 m $\Omega/k\Omega$ + 1.6 $\Omega$ 26 $\Omega/M\Omega$ + 1.6 $\Omega$ 48 $\Omega/M\Omega$ + 23 $\Omega$ 0.1 k $\Omega/M\Omega$ + 39 $\Omega$ 0.22 k $\Omega/M\Omega$ + 1.9 k $\Omega$ 0.45 k $\Omega/M\Omega$ + 2.3 k $\Omega$ 2.3 k $\Omega/M\Omega$ + 78 k $\Omega$ 12 k $\Omega/M\Omega$ + 0.39 M $\Omega$	Fluke 5522A/SC1100 Multiproduct Calibrator
DC Resistance Fixed Points	1 $\Omega$ 1.9 $\Omega$ 10 $\Omega$ 19 $\Omega$ 100 $\Omega$ 190 $\Omega$ 1 k $\Omega$ 1.9 k $\Omega$ 10 k $\Omega$ 19 k $\Omega$ 100 k $\Omega$ 190 k $\Omega$ 1 M $\Omega$ 1.9 M $\Omega$ 10 M $\Omega$ 19 M $\Omega$ 100 M $\Omega$	99 $\mu\Omega/\Omega$ 0.1 m $\Omega/\Omega$ 94 $\mu\Omega/\Omega$ 0.2 m $\Omega/\Omega$ 84 m $\Omega/\Omega$ 0.2 $\Omega/\Omega$ 2 m $\Omega/\Omega$ 3.6 m $\Omega/\Omega$ 18 m $\Omega/\Omega$ 40 m $\Omega/\Omega$ 0.2 $\Omega/\Omega$ 0.7 $\Omega/\Omega$ 4.1 $\Omega/\Omega$ 13 $\Omega/\Omega$ 0.1 k $\Omega/\Omega$ 0.1 k $\Omega/\Omega$ 4.5 k $\Omega/\Omega$	Fluke 5730A Multiproduct Calibrator

**Electrical – DC Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
High Power Fixed Resistance	1 k $\Omega$	5 m $\Omega$	IET VRS-100-9-1K-ROT Resistance Standard Set
	10 k $\Omega$	50 m $\Omega$	
	100 k $\Omega$	1 $\Omega$	
	1 M $\Omega$	10 $\Omega$	
	10 M $\Omega$	100 $\Omega$	
	100 M $\Omega$	2 k $\Omega$	
High Power Fixed Resistance	1 G $\Omega$	20 k $\Omega$	IET VRS-100-9-1K-ROT Resistance Standard Set
	10 G $\Omega$	10 M $\Omega$	
	100 G $\Omega$	40 M $\Omega$	
Resistance – Measure (4 Wire Measurements)	(0 to 1) $\Omega$	14 $\mu\Omega/\Omega$ + 4 $\mu\Omega$	Fluke 8588A Multimeter
	(1 to 10) $\Omega$	8.7 $\mu\Omega/\Omega$ + 14 $\mu\Omega$	
	(10 to 100) $\Omega$	7.6 $\mu\Omega/\Omega$ + 50 $\mu\Omega$	
	(0.1 to 1) k $\Omega$	7.6 $\mu\Omega/\Omega$ + 0.5 m $\Omega$	
	(1 to 10) k $\Omega$	7.7 $\mu\Omega/\Omega$ + 5 m $\Omega$	
	(10 to 100) k $\Omega$	8.2 $\mu\Omega/\Omega$ + 50 m $\Omega$	
	(0.1 to 1) M $\Omega$	9.3 $\mu\Omega/\Omega$ + 1 $\Omega$	
	(1 to 10) M $\Omega$	9.7 $\mu\Omega/\Omega$ + 10 $\Omega$	
	(10 to 100) M $\Omega$	21 $\mu\Omega/\Omega$ + 1 k $\Omega$	
	(0.1 to 1) G $\Omega$	0.13 m $\Omega/\Omega$ + 0.1 M $\Omega$	
(1 to 10) G $\Omega$	1.5 m $\Omega/\Omega$ + 10 M $\Omega$		

**Electrical – DC Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source	Up to 2.2 mV		Fluke 5730A Multiproduct Calibrator
	(10 to 20) Hz	0.39 $\mu\text{V}/\text{mV}$ + 4 $\mu\text{V}$	
	(20 to 40) Hz	0.85 $\mu\text{V}/\text{mV}$ + 4 $\mu\text{V}$	
	40 Hz to 20 kHz	1.0 $\mu\text{V}/\text{mV}$ + 4 $\mu\text{V}$	
	(20 to 50) kHz	0.32 $\mu\text{V}/\text{mV}$ + 4 $\mu\text{V}$	
	(50 to 100) kHz	0.54 $\mu\text{V}/\text{mV}$ + 5 $\mu\text{V}$	
	(100 to 300) kHz	1.2 $\mu\text{V}/\text{mV}$ + 10 $\mu\text{V}$	
	(300 to 500) kHz	2.1 $\mu\text{V}/\text{mV}$ + 20 $\mu\text{V}$	
	500 kHz to 1 MHz	3.4 $\mu\text{V}/\text{mV}$ + 20 $\mu\text{V}$	
	(2.2 to 22) mV		
	(10 to 20) Hz	0.22 $\mu\text{V}/\text{mV}$ + 4 $\mu\text{V}$	
	(20 to 40) Hz	0.13 $\mu\text{V}/\text{mV}$ + 4 $\mu\text{V}$	
	40 Hz to 20 kHz	0.12 $\mu\text{V}/\text{mV}$ + 4 $\mu\text{V}$	
	(20 to 50) kHz	0.17 $\mu\text{V}/\text{mV}$ + 4 $\mu\text{V}$	
	(50 to 100) kHz	0.4 $\mu\text{V}/\text{mV}$ + 5 $\mu\text{V}$	
	(100 to 300) kHz	0.84 $\mu\text{V}/\text{mV}$ + 10 $\mu\text{V}$	
	(300 to 500) kHz	1.1 $\mu\text{V}/\text{mV}$ + 20 $\mu\text{V}$	
	500 kHz to 1 MHz	2.6 $\mu\text{V}/\text{mV}$ + 20 $\mu\text{V}$	
	(22 to 220) mV		
	(10 to 20) Hz	0.36 $\mu\text{V}/\text{mV}$ + 12 $\mu\text{V}$	
	(20 to 40) Hz	0.08 $\mu\text{V}/\text{mV}$ + 7 $\mu\text{V}$	
	40 Hz to 20 kHz	0.06 $\mu\text{V}/\text{mV}$ + 7 $\mu\text{V}$	
	(20 to 50) kHz	0.1 $\mu\text{V}/\text{mV}$ + 7 $\mu\text{V}$	
	(50 to 100) kHz	0.26 $\mu\text{V}/\text{mV}$ + 17 $\mu\text{V}$	
(100 to 300) kHz	0.53 $\mu\text{V}/\text{mV}$ + 20 $\mu\text{V}$		
(300 to 500) kHz	1.1 $\mu\text{V}/\text{mV}$ + 25 $\mu\text{V}$		
500 kHz to 1 MHz	2.2 $\mu\text{V}/\text{mV}$ + 45 $\mu\text{V}$		

**Electrical – DC Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source	220 mV 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 500 kHz to 1 MHz	0.51 mV/V + 40 μV 73 μV/V + 15 μV 38 μV/V + 8 μV 54 μV/V + 10 μV 0.11 mV/V + 30 μV 0.28 mV/V + 80 μV 0.8 mV/V + 0.2 mV 1.4 mV/V + 0.3 mV	Fluke 5730A Multiproduct Calibrator
	(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 500 kHz to 1 MHz (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 220 V to 1 kV (15 to 50) Hz 50 Hz to 1 kHz	0.37 mV/V + 0.4 mV 0.08 mV/V + 0.15 mV 40 μV/V + 0.05 mV 54 μV/V + 0.1 mV 0.07 mV/V + 0.2 mV 0.22 mV/V + 0.6 mV 0.78 mV/V + 2 mV 1.2 mV/V + 3.2 mV 0.44 mV/V + 4 mV 76 μV/V + 1.5 mV 49 μV/V + 0.6 mV 74 μV/V + 1 mV 0.15 mV/V + 2.5 mV 0.71 mV/V + 16 mV 3.4 mV/V + 40 mV 6.3 mV/V + 80 mV 0.24 mV/V + 16 mV 67 μV/V + 3.5 mV	
AC Voltage – Source	(0.22 to 1) kV (1 to 20) kHz (20 to 30) kHz (220 to 750) V (30 to 50) kHz (50 to 100) kHz	13 mV/V + 6 mV 0.47 mV/V + 11 mV 0.47 mV/V + 11 mV 1.8 mV/V + 45 mV	Fluke 5730A Multiproduct Calibrator / 5725A Amplifier

**Electrical – DC Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure	(1 to 10) mV		Fluke 8588A Multimeter
	1 Hz to 2 kHz	0.52 $\mu$ V/V + 1.1 $\mu$ V	
	(2 to 10) kHz	0.58 $\mu$ V/V + 1.1 $\mu$ V	
	(10 to 30) kHz	0.59 $\mu$ V/V + 1.1 $\mu$ V	
	(30 to 100) kHz	3.1 $\mu$ V/V + 1.1 $\mu$ V	
	(100 to 300) kHz	10 $\mu$ V/V + 4 $\mu$ V	
	300 kHz to 1 MHz	20 $\mu$ V/V + 4 $\mu$ V	
	(10 to 100) mV		
	1 Hz to 2 kHz	94 $\mu$ V/V + 0.5 $\mu$ V	
	(2 to 10) kHz	0.12 mV/V + 0.5 $\mu$ V	
	(10 to 30) kHz	0.21 mV/V + 1 $\mu$ V	
	(30 to 100) kHz	0.51 mV/V + 5 $\mu$ V	
	(100 to 300) kHz	2.3 mV/V + 30 $\mu$ V	
	300 kHz to 1 MHz	11 mV/V + 0.1 mV	
	(1 to 2) MHz	20 mV/V + 0.5 mV	
	(0.1 to 1) V		
	1 Hz to 2 kHz	85 $\mu$ V/V + 5 $\mu$ V	
	(2 to 10) kHz	0.12 mV/V + 5 $\mu$ V	
	(10 to 30) kHz	0.22 mV/V + 10 $\mu$ V	
	(30 to 100) kHz	0.55 mV/V + 50 $\mu$ V	
	(100 to 300) kHz	2.3 mV/V + 0.3 mV	
	300 kHz to 1 MHz	11 mV/V + 1 mV	
	(1 to 2) MHz	20 mV/V + 5 mV	
	(1 to 10) V		
	1 Hz to 2 kHz	71 $\mu$ V/V + 50 $\mu$ V	
	(2 to 10) kHz	0.1 mV/V + 50 $\mu$ V	
	(10 to 30) kHz	0.2 mV/V + 0.1 mV	
	(30 to 100) kHz	0.51 mV/V + 0.5 mV	
(100 to 300) kHz	2 mV/V + 3 mV		
300 kHz to 1 MHz	10 mV/V + 10 mV		
(1 to 2) MHz	16 mV/V + 50 mV		
(10 to 100) V			
1 Hz to 2 kHz	81 $\mu$ V/V + 0.5 mV		
(2 to 10) kHz	96 $\mu$ V/V + 0.5 mV		
(10 to 30) kHz	0.21 mV/V + 1 mV		
(30 to 100) kHz	0.5 mV/V + 5 mV		
(100 to 300) kHz	3.5 mV/V + 50 mV		
300 kHz to 1 MHz	10 mV/V + 0.2 V		



**Electrical – DC Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure	(100 to 1 000) V 1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.1 mV/V + 25 mV 0.1 mV/V + 25 mV 0.21 mV/V + 25 mV 0.5 mV/V + 0.1 V	Fluke 8588A Multimeter
AC Voltage – Measure	(1 to 10) kV (50, 60) Hz	0.16 % of reading	Vitretek 4700 High Voltage Meter
AC Current - Source	(1 to 220) $\mu$ A (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (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 (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 (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 (0.22 to 2.2) A 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	0.37 mA/A + 16 nA 0.12 mA/A + 10 nA 0.08 mA/A + 8 nA 0.22 mA/A + 12 nA 0.9 mA/A + 65 nA 0.33 mA/A + 40 nA 0.16 mA/A + 35 nA 0.13 mA/A + 35 nA 0.19 mA/A + 0.11 $\mu$ A 0.9 mA/A + 0.65 $\mu$ A 0.33 mA/A + 0.4 $\mu$ A 0.12 mA/A + 0.35 $\mu$ A 0.08 mA/A + 0.35 $\mu$ A 0.16 mA/A + 0.55 $\mu$ A 0.9 mA/A + 5 $\mu$ A 0.34 mA/A + 4 $\mu$ A 0.12 mA/A + 3.5 $\mu$ A 0.08 mA/A + 2.5 $\mu$ A 0.16 mA/A + 3.5 $\mu$ A 0.9 mA/A + 10 $\mu$ A 0.21 mA/A + 35 $\mu$ A 0.37 mA/A + 80 $\mu$ A 5.5 mA/A + 0.16 mA	Fluke 5730A Multiproduct Calibrator
AC Current – Source	(2.2 to 11) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	0.4 mA/A + 0.17 mA 0.76 mA/A + 0.38 mA 2.9 mA/A + 0.75 mA	Fluke 5730A Multiproduct Calibrator / 5725A Amplifier



**Electrical – DC Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current - Source	(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 5522A/SC1100 Multiproduct Calibrator
AC Current - Measure	(1 to 10) $\mu$ A 1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (10 to 100) $\mu$ A 1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (0.1 to 1) mA 1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (1 to 10) mA 1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (10 to 100) mA 1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (0.1 to 1) A 1 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (1 to 10) A 10 Hz to 2 kHz (2 to 10) kHz (10 to 30) A 10 Hz to 2 kHz (2 to 10) kHz	20 nA/A + 2.5 nA 20 nA/A + 2.5 nA 20 nA/A + 2.5 nA 4.7 nA/A + 5 nA 5.9 nA/A + 5 nA 7.6 nA/A + 5 nA 33 nA/A + 10 nA 0.27 $\mu$ A/A + 50 nA 0.47 $\mu$ A/A + 50 nA 0.62 $\mu$ A/A + 50 nA 3.3 $\mu$ A/A + 0.1 $\mu$ A 2.7 $\mu$ A/A + 0.5 $\mu$ A 4.7 $\mu$ A/A + 0.5 $\mu$ A 6.2 $\mu$ A/A + 0.5 $\mu$ A 33 $\mu$ A/A + 1 $\mu$ A 27 $\mu$ A/A + 5 $\mu$ A 47 $\mu$ A/A + 5 $\mu$ A 62 $\mu$ A/A + 5 $\mu$ A 0.39 mA/A + 0.1 mA 0.57 mA/A + 0.1 mA 0.72 mA/A + 0.1 mA 7.2 mA/A + 0.5 mA 7.1 mA/A + 0.5 mA 22 mA/A + 12 mA 28 mA/A + 12 mA	Fluke 8588A Multimeter



ANSI National Accreditation Board

Electrical – DC Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source 10 Hz to 10 kHz 10 Hz to 3 kHz (0.01 to 1) kHz (0.01 to 1) kHz (0.01 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 Up to 6 Hz Up to 2 Hz Up to 0.6 Hz Up to 0.2 Hz	(0.19 to 1.1) nF (1.1 to 3.3) nF (3.3 to 11) nF (11 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 to 1.1) mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	5 pF/nF + 7.8 pF 4 pF/nF + 7.8 pF 2 pF/nF + 7.8 pF 7 pF/nF + 78 pF 2.1 pF/nF + 0.23 nF 2.1 nF/μF + 0.78 nF 2 nF/μF + 2.3 nF 2.1 nF/μF + 7.8 nF 3.2 nF/μF + 23 nF 3.7 nF/μF + 78 nF 3.7 nF/μF + 0.23μF 3.7 μF/mF + 0.78 μF 3.7 μF/mF + 2.3 μF 3.5 μF/mF + 7.8 μF 5.9 μF/mF + 23 μF 8.5 μF/mF + 78 μF	Fluke 5522A/SC1100 Multiproduct Calibrator
Capacitance - Measure	(50 to 60) Hz (0 to 1) nF (1 to 10) nF (10 to 100) nF (0.1 to 1) μF (1 to 10) μF (10 to 100) μF (0.1 to 1) mF (1 to 10) mF (10 to 100) mF	0.82 nF/F + 0.1 nF 0.73 nF/F + 0.2 nF 0.21 nF/F + 0.01 nF 3.4 nF/F + 0.1 nF 20 nF/F + 1 nF 0.28 μF/F + 0.01 μF 3.1 μF/F + 0.1 μF 34 μF/F + 1 μF 0.56 mF/F + 0.1 mF	Fluke 8588A Multimeter
Inductance – Source	(0.1 to 1) mH 1 kHz (1 to 10) mH 500 Hz (10 to 100) mH 200 Hz (0.1 to 1) H 100 Hz (1 to 10) H 100 Hz	0.2 μH/H 2 μH/H 20 μH/H 0.2 mH/H 2 mH/H	IET 1491-G Decade Inductor

**Electrical – DC Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Oscilloscopes			
Square Wave 50 Ω Load	±1 mV to ±6.6 V p-p 10 Hz to 10 kHz	2.7 mV/V + 32 μV	Fluke 5522A/SC1100 Multiproduct Calibrator
1 MΩ Load	±1 mV to ±130 V p-p 10 Hz to 10 kHz	1.3 mV/V + 32 μV	
Leveled Sine Wave Relative to 50 kHz	5 mVpp to 5.5 Vpp 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz	15 mV/V + 78 μV 18 mV/V + 78 μV 34 mV/V + 78 μV	
Time Marker Into 50 Ω Load	5 mVpp to 3.5 Vpp 600 Hz to 1100 MHz Cardinal Points 1 ns to 20 ms Non-Cardinal Points 1 ns to 20 ms Any value in range 50 ms to 5 s	42 mV/V + 78 μV  46 ns/s 0.81 μs/s 0.21 ms/s	
Rise Time	300 ps	9.4 ps	
Electrical Simulation of Thermocouple Indicators	Type B (600 to 800) °C (800 to 1 000) °C (1 000 to 1 550) °C (1 550 to 1 820) °C Type C (0 to 150) °C (150 to 650) °C (650 to 1 000) °C (1 000 to 1 800) °C (1 800 to 2 316) °C Type E (-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1 000) °C	0.46 °C 0.39 °C 0.37 °C 0.38 °C  0.33 °C 0.32 °C 0.34 °C 0.54 °C 0.85 °C  0.52 °C 0.22 °C 0.2 °C 0.25 °C 0.25 °C	

**Electrical – DC Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicators	Type J		Fluke 5522A/SC1100 Multiproduct Calibrator
	(-210 to -100) °C	0.33 °C	
	(-100 to -30) °C	0.22 °C	
	(-30 to 150) °C	0.2 °C	
	(150 to 760) °C	0.23 °C	
	(760 to 1 200) °C	0.27 °C	
	Type K		
	(-200 to -100) °C	0.36 °C	
	(-100 to -25) °C	0.23 °C	
	(-25 to 120) °C	0.22 °C	
	(120 to 1 000) °C	0.29 °C	
	(1 000 to 1 372) °C	0.44 °C	
	Type N		
	(-200 to -100) °C	0.43 °C	
	(-100 to -25) °C	0.29 °C	
	(-25 to 120) °C	0.23 °C	
	(120 to 410) °C	0.22 °C	
	(410 to 1 300) °C	0.3 °C	
	Type R		
	(0 to 250) °C	0.59 °C	
	(250 to 400) °C	0.38 °C	
	(400 to 1 000) °C	0.36 °C	
	(1 000 to 1 767) °C	0.44 °C	
	Type S		
(0 to 250) °C	0.49 °C		
(250 to 1 000) °C	0.39 °C		
(1 000 to 1 400) °C	0.39 °C		
(1 400 to 1 767) °C	0.5 °C		
Type T			
(-250 to -150) °C	0.65 °C		
(-150 to 0) °C	0.26 °C		
(0 to 120) °C	0.22 °C		
(120 to 400) °C	0.19 °C		
Type U			
(-200 to 0) °C	0.6 °C		
(0 to 600) °C	0.31 °C		

**Electrical – DC Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment	
Electrical Simulation of RTD Indicators	PtNi 385 (120 Ω)		Fluke 5522A/SC1100 Multiproduct Calibrator	
	(-80 to 0) °C	0.13 °C		
	(0 to 100) °C	0.1 °C		
	(100 to 260) °C	0.17 °C		
	Cu 427 (10 Ω)			
	(-100 to 260) °C	0.31 °C		
	Pt 395 (100 Ω)			
	(-200 to -80) °C	0.07 °C		
	(-80 to 0) °C	0.07 °C		
	(0 to 100) °C	0.08 °C		
	(100 to 300) °C	0.11 °C		
	(300 to 400) °C	0.11 °C		
	(400 to 630) °C	0.13 °C		
	(630 to 800) °C	0.25 °C		
	Pt 3926 (100 Ω)			
	(-200 to -80) °C	0.1 °C		
	(-80 to 0) °C	0.1 °C		
	(0 to 100) °C	0.11 °C		
	(100 to 300) °C	0.13 °C		
	(300 to 400) °C	0.16 °C		
	(400 to 630) °C	0.15 °C		
	Pt 3916 (100 Ω)			
	(-200 to -190) °C	0.28 °C		
	(-190 to -80) °C	0.09 °C		
	(-80 to 0) °C	0.11 °C		
	(0 to 100) °C	0.12 °C		
	(100 to 260) °C	0.1 °C		
	(260 to 300) °C	0.14 °C		
(300 to 400) °C	0.15 °C			
(400 to 600) °C	0.14 °C			
(600 to 630) °C	0.26 °C			
Pt 385 (200 Ω)				
(-200 to -80) °C	0.06 °C			
(-80 to 0) °C	0.11 °C			
(0 to 100) °C	0.11 °C			
(100 to 260) °C	0.12 °C			
(260 to 300) °C	0.16 °C			
(300 to 400) °C	0.15 °C			
(400 to 600) °C	0.16 °C			
(600 to 630) °C	0.17 °C			

**Electrical – DC Low Frequency**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of RTD Indicators	Pt 385 (500 Ω)		Fluke 5522A/SC1100 Multiproduct Calibrator
	(-200 to -80) °C	0.06 °C	
	(-80 to 0) °C	0.09 °C	
	(0 to 100) °C	0.1 °C	
	(100 to 260) °C	0.09 °C	
	(260 to 300) °C	0.12 °C	
	(300 to 400) °C	0.09 °C	
	(400 to 600) °C	0.1 °C	
	(600 to 630) °C	0.14 °C	
	Pt 385 (1 000 Ω)		
	(-200 to -80) °C	0.05 °C	
	(-80 to 0) °C	0.09 °C	
	(0 to 100) °C	0.06 °C	
	(100 to 260) °C	0.12 °C	
	(260 to 300) °C	0.07 °C	
	(300 to 400) °C	0.1 °C	
(400 to 600) °C	0.11 °C		
(600 to 630) °C	0.25 °C		

**Electrical – RF/Microwave**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Attenuation – Tuned RF Power Measure 100 kHz to 26.5 GHz	(-10 to 0.0) dB	0.02 dB	Keysight N5531X Measuring Receiver with HP 11722A, HP 11792A, HP 11793A Power Sensors
	(-20 to -10) dB	0.06 dB	
	(-30 to -20) dB	0.08 dB	
	(-40 to -30) dB	0.11 dB	
	(-50 to -40) dB	0.14 dB	
	(-60 to -50) dB	0.16 dB	
	(-70 to -60) dB	0.2 dB	
	(-80 to -70) dB	0.23 dB	
	(-90 to -80) dB	0.25 dB	
	(-100 to -90) dB	0.27 dB	
	(-110 to -100) dB	0.35 dB	
	(-120 to -110) dB	0.42 dB	

**Electrical – RF/Microwave**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
RF Power - Source	(16 to 20) dBm		Fluke 96270A Reference Source w/ Leveling Head Output
	(0.2 to 100) kHz	0.023 dB	
	(0.1 to 125) MHz	0.045 dB	
	(3 to 16) dBm		
	(0.2 to 100) kHz	0.023 dB	
	(0.1 to 150) MHz	0.043 dB	
	(0.25 to 1.4) GHz	0.16 dB	
	(-17 to 3) dBm		
	(0.2 to 100) kHz	0.024 dB	
	(0.1 to 300) MHz	0.047 dB	
	(0.3 to 1.4) GHz	0.16 dB	
	(1.4 to 4.0) GHz	0.26 dB	
	(-47 to -17) dBm		
	(0.2 to 100) kHz	0.024 dB	
	(0.1 to 300) MHz	0.047 dB	
	(0.3 to 1.4) GHz	0.16 dB	
(1.4 to 3.5) GHz	0.24 dB		
(3.5 to 4.0) GHz	0.4 dB		
(-66 to -47) dBm			
(0.1 to 10) MHz	0.16 dB		
(10 to 300) MHz	0.083 dB		
(0.3 to 1.4) GHz	0.31 dB		
(1.4 to 4.0) GHz	0.41 dB		
(-85 to -66) dBm			
(0.1 to 10) MHz	0.56 dB		
(10 to 150) MHz	0.41 dB		
(0.15 to 1.5) GHz	0.82 dB		
(1.5 to 4.0) GHz	0.8 dB		
RF Power - Source	(-124 to -85) dBm (10 to 100) MHz (0.1 to 1.4) GHz	0.6 dB 1.4 dB	Fluke 96270A Reference Source w/ Leveling Head Output
RF Power - Source	(-120 to +24) dBm Up to 100 MHz (0.1 to 1) GHz (1 to 2.4) GHz (2.4 to 8) GHz (8 to 12) GHz (12 to 18) GHz (18 to 22) GHz (22 to 26.5) GHz	0.43 % of reading + 0.004 dB 0.57 % of reading + 0.006 dB 0.7 % of reading + 0.007 dB 0.88 % of reading + 0.009 dB 1 % of reading + 0.01 dB 1.2 % of reading + 0.012 dB 1.6 % of reading + 0.016 dB 2.5 % of reading + 0.025 dB	Fluke 92670A Reference Source Characterized Microwave Output w/ 11667B Splitter



**Electrical – RF/Microwave**

<b>Parameter/Equipment</b>	<b>Range</b>	<b>Expanded Uncertainty of Measurement (+/-)</b>	<b>Reference Standard, Method, and/or Equipment</b>
RF Power - Source	(-110 to +21) dBm (26.5 to 40) GHz (40 to 50) GHz	2.3 dB 2.9 dB	Keysight E8257D PSG Analog Signal Generator
RF Power – Measure	(+30 to -10) dBm DC to 50 GHz	3.6 % of reading + 0.004 dB	Keysight N5531X Measuring Receiver with HP 11722A, HP 11792A HP 8487A Power Sensors
Power Reference Out	1 mW, 50 MHz	2.1 % of reading	HP 432A Power Meter, HP 3458A Multimeter, with HP 8478A Power Sensor
Phase Modulation – Measure	200 Hz to 10 kHz 200 Hz to 20 kHz 100 kHz to 3.6 GHz (3.6 to 17.1) GHz (17.1 to 34.5) GHz (34.5 to 50) GHz	4.8 % of reading + 1 Digit 3.7 % of reading + 1 Digit 2.7 % of reading + 1 Digit 1.8 % of reading + 1 Digit	Keysight N5531 Measuring Receiver with HP 11722A, HP 11792A, HP 11793A Power Sensors
Amplitude Modulation – Measure	150 kHz to 3.6 GHz Rate: 50 Hz to 10 kHz Depths: 5 % to 99 % 150 kHz to 3.6 GHz Rate: 20 Hz to 10 kHz Depths: to 99 % (3.6 to 13.6) GHz Rate: 50 Hz to 50 kHz Depths: 5 % to 99 %	3.5 % of reading + 1 Digit  2.3 % of reading + 1 Digit  3.5 % of reading + 1 Digit	Keysight N5531 Measuring Receiver with HP 11722A, HP 11792A, HP 11793A Power Sensors

**Electrical – RF/Microwave**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Amplitude Modulation Measure	(3.6 to 13.6) GHz Rate: 20 Hz to 100 kHz Depths: to 99 %	1.2 % of reading + 1 Digit	Keysight N5531 Measuring Receiver with HP 11722A, HP 11792A, HP 11793A Power Sensors
	(13.6 to 26.5) GHz Rate: 20 Hz to 100 kHz Depths: 5 % to 99 %	3.5 % of reading + 1 Digit	
	(13.6 to 26.5) GHz Rate: 20 Hz to 100 kHz Depths: to 99 %	1.7 % of reading + 1 Digit	
	(26.5 to 34.5) GHz Rate: 20 Hz to 100 kHz Depths: 5 % to 99 %	2.9 % of Reading + 1 Digit	
	(26.5 to 34.5) GHz Rate: 20 Hz to 100 kHz Depths: to 99 %	1.2 % of reading + 1 Digit	
	(34.5 to 50) GHz Rate: 20 Hz to 100 kHz Depths: 5 % to 99 %	2.3 % of reading + 1 Digit	
	(34.5 to 50) GHz Rate: 20 Hz to 100 kHz Depths: to 99 %	2.0 % of reading + 1 Digit	
	Frequency Modulation – Measure	100 kHz to 3.6 GHz Rate: 20 Hz to 10 kHz Dev.: ≤ 40 kHz peak	
(3.6 to 8.4) GHz Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz peak		2.3 % of reading + 1 Digit	
(3.6 to 8.4) GHz Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz peak		1.2 % of reading + 1 Digit	
(8.4 to 13.6) GHz Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak		3.5 % of reading + 1 Digit	
(8.4 to 13.6) GHz Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz peak		1.2 % of reading + 1 Digit	
(13.6 to 17.1) GHz Rate: 20 Hz to 10 kHz Dev.: ≤ 400 kHz peak		5.8 % of reading + 1 Digit	

**Electrical – RF/Microwave**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency Modulation – Measure	(13.6 to 17.1) GHz Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz peak	1.2 % of reading + 1 Digit	Keysight N5531X Measuring Receiver with HP 11722A, HP 11792A, HP 11793A Power Sensors
	(17.1 to 26.5) GHz Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak	4.1 % of reading + 1 Digit	
	(17.1 to 26.5) GHz Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz peak	1.2 % of reading + 1 Digit	
	(26.5 to 34.5) GHz Rate: 20 Hz to 10 kHz Dev.: ≤ 400 kHz peak	4.1 % of reading + 1 Digit	
	(26.5 to 34.5) GHz Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz peak	1.2 % of reading + 1 Digit	
	(34.5 to 50) GHz Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak	5.2 % of reading + 1 Digit	
	(34.5 to 50) GHz Rate: 50 Hz to 100 kHz Dev.: ≤ 400 kHz peak	1.2 % of reading + 1 Digit	

**Length – Dimensional Metrology**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Micrometers <sup>2</sup>	Up to 10 in	(50 +2.4L) μin	Grade 0 Gage Blocks
Calipers <sup>2</sup>	Up to 10 in	(126 +1.7L) μin	Grade 0 Gage Blocks
Height/Depth Gages <sup>2</sup>	Up to 10 in	(117 +2.4L) μin	Grade 0 Gage Blocks
Indicators <sup>2</sup>	Up to 4 in	(51 +1.0L) μin	Grade 0 Gage Blocks
Length Standards <sup>2</sup>	Up to 4 in	(40 + 1.5L) μin	Pratt & Whitney Supermic with Grade 0 Gage Blocks
Feeler Gages	(0.001 to 0.2) in	42 μin	Pratt & Whitney Supermic with Grade 0 Gage Blocks
Pin and Plug Gages <sup>2</sup>	Up to 4 in	(44 + 1.1L) μin	Pratt & Whitney Supermic with Grade 0 Gage Blocks

**Mass and Mass Related**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scales and Balances	Up to 5 g (5 to 20) g (20 to 100) g 100 g to 1 kg	2.3 mg 3.5 mg 12 mg 120 mg	ASTM 6 Weights
Pressure Instruments	(0 to 20) psi (0 to 50) psi (0 to 1 00) psi (0 to 200) psi (0 to 500) psi (0 to 1 000) psi	0.018 psi 0.046 psi 0.061 psi 0.3 psi 0.34 psi 0.6 psi	Condec UPC5000 Pressure Standard
Pressure Instruments	(0 to 2 000) psi (0 to 5 000) psi (0 to 10 000) psi	1.1 psi 3.5 psi 6.1 psi	Condec UPC5200 Pressure Standard
Torque Tools	(2 to 10) lbf-in	0.59% of reading	Mountz EX TORQ III Torque Analyzer
	4 lbf·in to 600 lbf·ft	0.31 % of reading	CDI 5000-ST Torque Monitor with CDI 2000-400-02, CDI 2000-12-02 Torque Cells

**Thermodynamics**

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Relative Humidity Measure	(10 to 90) %RH	1.6 %RH	Vaisala HMI41 and HMP46 Humidity Indicator
Relative Humidity Generate	(10 to 20) %RH (20 to 50) %RH (50 to 80) %RH (80 to 95) %RH	0.7 %RH 0.6 %RH 0.61 %RH 0.58 %RH	Thunder Scientific 2500 Humidity Generator
Temperature Measure	(-200 to -39) °C (-39 to 0) °C (0 to 232) °C (232 to 420) °C	0.04 °C 0.06 °C 0.08 °C 0.15 °C	Fluke 5627A SPRT and 1524 Readout

### Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Time Interval / Stopwatches	1 s to 24 hours	38 ms	HP 53230A Counter
Frequency – Source	10 MHz DC to 20 MHz 20 MHz to 50 GHz	7.5 mHz 58 mHz 0.88 Hz	SRS FS725 Frequency Standard, HP 3325B, HP 83650B Signal Generators
Frequency – Measure	DC to 350 MHz	0.048 Hz	HP 53230A Counter with SRS FS725 Frequency Standard
Frequency – Measure	350 MHz to 46 GHz	0.59 Hz	HP 53152A Counter with SRS FS725 Frequency Standard

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.
3. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-1986.



R. Douglas Leonard Jr., VP, PILR SBU