SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017, ANSI/NCSL Z540-1-1994 (R2002) AND ANSI/NCSL Z540.3 (R2013)

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CALIBRATION

Valid to: **September 7, 2021** Certificate Number: **AC-2489.13**

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Measure[1]	(0 to 100) µA (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	33 µA/A + 0.92 nA 30 µA/A + 5.8 nA 30 µA/A + 58 nA 41 µA/A + 0.58 µA 0.13 mA/A + 12 µA	8.5 Digit Multimeter
	(1 to 3) A	0.15 % of reading + 0.7 mA	6.5 Digit Multimeter
DC Current – Source[1]	(0 to 220) µA (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 A to 2.2) A	45 µA/A + 6 nA 39 µA/A + 7 nA 39 µA/A + 40 nA 58 µA/A + 0.7 µA 0.24 mA/A + 12 µA	Multiproduct Calibrator
	(2.2 to 11) A	0.41 mA/A + 0.48 mA	Multiproduct Calibrator, Amplifier
	(11 to 20.5) A	0.84 mA/A + 0.58 mA	Multiproduct Calibrator
DC Clamp-on Ammeter (Non-Toroidal Type) Hall Effect Sensor[1]	(20 to 150) A (150 to 1 000) A	0.51 % of reading + 0.14 A 0.51 % of reading + 0.5 A	Multiproduct Calibrator, 50-turn Coil

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Measure[1]	Up to 100 µA		8.5 Digit Multimeter
	(10 to 20) Hz	0.46 % of reading + 35 nA	
	(20 to 45) Hz	0.17 % of reading + 35 nA	
	(45 to 100) Hz	0.072 % of reading + 35 nA	
	100 Hz to 5 kHz	0.072 % of reading + 35 nA	
	(0.1 to 1) mA		
	(10 to 20) Hz	0.46 % of reading + 0.23 µA	
	(20 to 45) Hz	0.17 % of reading + 0.23 µA	
	(45 to 100) Hz	0.071 % of reading + 0.23 µA	
	100 Hz to 5 kHz	0.038 % of reading + 0.23 µA	
	(1 to 10) mA		
	(10 to 20) Hz	0.46 % of reading + 2.3 µA	
	(20 to 45) Hz	0.17 % of reading + 2.3 µA	
	(45 to 100) Hz	0.071 % of reading + 2.3 µA	
	100 Hz to 5 kHz	0.038 % of reading + 2.3 µA	
	(10 to 100) mA		
	(10 to 20) Hz	0.46 % of reading + 23 µA	
	(20 to 45) Hz	0.17 % of reading + 23 µA	
	(45 to 100) Hz	0.071 % of reading + 23 µA	
	100 Hz to 5 kHz	0.037 % of reading + 23 µA	
	100 mA to 1 A		
	(10 to 20) Hz	0.46 % of reading + 0.23 mA	
	(20 to 45) Hz	0.19 % of reading + 0.23 mA	
	(45 to 100) Hz	0.097 % of reading + 0.23 mA	
	100 Hz to 5 kHz	0.12 % of reading + 0.23 mA	
AC Current – Source[1]	Up to 220 µA		Multiproduct Calibrator
	(10 to 20) Hz	0.032 % of reading + 16 nA	
	(20 to 40) Hz	0.019 % of reading + 10 nA	
	40 Hz to 1 kHz	0.014 % of reading + 8 nA	
	(1 to 5) kHz	0.029 % of reading + 12 nA	
	(5 to 10) kHz	0.11 % of reading + 65 nA	
	(0.22 to 2.2) mA		
	(10 to 20) Hz	0.031 % of reading + 40 nA	
	(20 to 40) Hz	0.018 % of reading + 35 nA	
	40 Hz to 1 kHz	0.014 % of reading + 35 nA	
	(1 to 5) kHz	0.021 % of reading + 0.11 µA	
	(5 to 10) kHz	0.11 % of reading + 0.65 µA	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source[1]	(2.2 to 22) mA		Multiproduct Calibrator
	(10 to 20) Hz	0.035 % of reading + 0.4 µA	
	(20 to 40) Hz	0.019 % of reading + 0.35 µA	
	40 Hz to 1 kHz	0.015 % of reading + 0.35 µA	
	(1 to 5) kHz	0.022 % of reading + 0.55 µA	
	(5 to 10) kHz	0.11 % of reading + 5 µA	
	(22 to 220) mA		
	(10 to 20) Hz	0.033 % of reading + 4 µA	
	(20 to 40) Hz	0.018 % of reading + 3.5 µA	
	40 Hz to 1 kHz	0.014 % of reading + 2.5 µA	
	(1 to 5) kHz	0.021 % of reading + 3.5 µA	
	(5 to 10) kHz	0.11 % of reading + 10 µA	
	(0.22 to 2.2) A		
	20 Hz to 1 kHz	0.027 % of reading + 35 µA	
	(1 to 5) kHz	0.046 % of reading + 80 µA	
	(5 to 10) kHz	0.7 % of reading + 0.16 mA	
	(2.2 to 11) A		Multiproduct Calibrator, Amplifier
	40 Hz to 1 kHz	0.047 % of reading + 0.17 mA	
	(1 to 5) kHz	0.096 % of reading + 0.38 mA	
	(5 to 10) kHz	0.36 % of reading + 0.75 mA	
	(11 to 20.5) A		Multiproduct Calibrator
	(45 to 100) Hz	0.097 % of reading + 3.9 mA	
	100 Hz to 1 kHz	0.12 % of reading + 3.9 mA	
	(1 to 5) kHz	2.3 % of reading + 3.9 mA	
AC Current – Source[1] Extended Frequency Ranges	(29 to 330) µA		Multiproduct Calibrator
	(10 to 30) kHz	1.2 % of reading + 0.31 µA	
	(0.33 to 3.3) mA		
	(10 to 30) kHz	0.78 % of reading + 0.47 µA	
	(3.3 to 33) mA		
	(10 to 30) kHz	0.31 % of reading + 3 µA	
	(33 to 330) mA		
	(10 to 30) kHz	0.31 % of reading + 0.16 mA	
AC Clamp-on Ammeters (Toroidal Type) Transformer Type Sensor[1]	(20 to 150) A		Multiproduct Calibrator, 50-turn Coil
	(45 to 65) Hz	0.4 % of reading + 26 mA	
	(65 to 440) Hz	0.97 % of reading + 47 mA	
	(150 to 1 000) A		
	(45 to 65) Hz	0.43 % of reading + 0.12 A	
	(65 to 440) Hz	1.3 % of reading + 0.22 A	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Clamp-on Ammeters (Non-Toroidal Type) Hall Effect Sensor[1]	(20 to 150) A (45 to 65) Hz (65 to 440) Hz (150 to 1 000) A (45 to 65) Hz (65 to 440) Hz	 0.63 % of reading + 0.25 A 1.2 % of reading + 0.25 A 0.65 % of reading + 0.9 A 1.4 % of reading + 0.92 A	Multiproduct Calibrator, 50-turn Coil
DC Resistance – Source/Measure[1]	(0.01 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	18 µΩ/Ω + 58 µΩ 15 µΩ/Ω + 0.58 mΩ 13 µΩ/Ω + 0.58 mΩ 13 µΩ/Ω + 5.8 mΩ 13 µΩ/Ω + 58 mΩ 21 µΩ/Ω + 2.3 Ω 62 µΩ/Ω + 120 Ω 0.059 % of reading + 1.2 kΩ 0.58 % of reading + 12 kΩ	8.5 Digit Multimeter, Decade Resistor
DC Resistance – Source[1] (Variable) (5 kV Maximum)	(0.1 to 1) MΩ (230 V/step, 2.3 kV max)	0.035% of reading	High Voltage Decade Box
	(1 to 10) MΩ (1 kV/step, 5 kV max)	0.035 % of reading + 1.2 µΩ/Ω/V	
	(10 to 100) MΩ (0.1 to 1) GΩ (1 to 10) GΩ (10 to 100) GΩ (0.1 to 1) TΩ	0.12 % of reading + 1.2 µΩ/Ω/V 0.30 % of reading + 1.2 µΩ/Ω/V 0.59 % of reading + 1.2 µΩ/Ω/V 1.2 % of reading + 2.3 µΩ/Ω/V 2.6 % of reading + 5.8 µΩ/Ω/V	
DC Voltage – Measure[1]	(0 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 500) V (500 to 800) V (800 to 1 000) V	8.3 µV/V + 0.58 µV 5.3 µV/V + 0.58 µV 5.1 µV/V + 0.58 µV 7.6 µV/V + 35 µV 11 µV/V + 0.12 mV 16 µV/V + 0.12 mV 21 µV/V + 0.12 mV	8.5 Digit Multimeter
DC High Voltage – Measure[1]	Up to 10 kV (10 to 35) kV (35 to 70) kV (70 to 100) kV	0.039 % of reading + 35 mV 0.031 % of reading + 0.57 V 0.038 % of reading + 0.7 V 0.063 % of reading + 0.8 V	Vitrek 4700 Digital HV Meter, Associated High Voltage Probes
DC Voltage – Source[1]	Up to 220 mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1 100) V	9.6 µV/V + 0.4 µV 5.6 µV/V + 0.7 µV 4.1 µV/V + 2.5 µV 4.1 µV/V + 4 µV 5.9 µV/V + 40 µV 7.6 µV/V + 0.4 mV	Multiproduct Calibrator, Amplifier

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure[1]	Up to 10 mV		8.5 Digit Multimeter
	(1 to 40) Hz	0.039 % of reading + 3.5 µV	
	40 Hz to 1 kHz	0.028 % of reading + 1.2 µV	
	(1 to 20) kHz	0.038 % of reading + 1.2 µV	
	(20 to 50) kHz	0.15 % of reading + 1.2 µV	
	(50 to 100) kHz	0.59 % of reading + 1.2 µV	
	(100 to 300) kHz	4.6 % of reading + 2.3 µV	
	(10 to 100) mV		
	(1 to 40) Hz	0.013 % of reading + 4.6 µV	
	40 Hz to 1 kHz	0.009 4 % of reading + 2.3 µV	
	(1 to 20) kHz	0.017 % of reading + 2.3 µV	
	(20 to 50) kHz	0.037 % of reading + 2.3 µV	
	(50 to 100) kHz	0.093 % of reading + 2.3 µV	
	(100 to 300) kHz	0.36 % of reading + 12 µV	
	300 kHz to 1 MHz	1.2 % of reading + 12 µV	
	(1 to 2) MHz	1.9 % of reading + 12 µV	
	(0.1 to 1) V		
	(1 to 40) Hz	0.009 8 % of reading + 46 µV	
	40 Hz to 1 kHz	0.009 4 % of reading + 23 µV	
	(1 to 20) kHz	0.017 % of reading + 23 µV	
	(20 to 50) kHz	0.036 % of reading + 23 µV	
	(50 to 100) kHz	0.093 % of reading + 23 µV	
	(100 to 300) kHz	0.35 % of reading + 0.12 mV	
	300 kHz to 1 MHz	1.2 % of reading + 0.12 mV	
	(1 to 2) MHz	1.9 % of reading + 0.12 mV	
	(1 to 10) V		
	(1 to 40) Hz	0.009 5 % of reading + 0.46 mV	
	40 Hz to 1 kHz	0.009 5 % of reading + 0.23 mV	
	(1 to 20) kHz	0.017 % of reading + 0.23 mV	
	(20 to 50) kHz	0.036 % of reading + 0.23 mV	
	(50 to 100) kHz	0.093 % of reading + 0.23 mV	
	(100 to 300) kHz	0.35 % of reading + 1.2 mV	
	300 kHz to 1 MHz	1.2 % of reading + 1.2 mV	
	(1 to 2) MHz	1.8 % of reading + 1.2 mV	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure[1]	(10 to 100) V		8.5 Digit Multimeter
	(1 to 40) Hz	0.024 % of reading + 4.6 mV	
	40 Hz to 1 kHz	0.024 % of reading + 2.3 mV	
	(1 to 20) kHz	0.024 % of reading + 2.3 mV	
	(20 to 50) kHz	0.041 % of reading + 2.3 mV	
	(50 to 100) kHz	0.14 % of reading + 2.3 mV	
	(100 to 300) kHz	0.46 % of reading + 12 mV	
	300 kHz to 1 MHz	1.7 % of reading + 12 mV	
	(100 to 700) V		
	(1 to 40) Hz	0.047 % or reading + 46 mV	
	40 Hz to 1 kHz	0.047 % of reading + 23 mV	
	(1 to 20) kHz	0.071 % or reading + 23 mV	
	(20 to 50) kHz	0.14 % of reading + 23 mV	
	(50 to 100) kHz	0.35 % of reading + 23 mV	
AC High Voltage – Measure[1]	Up to 10 kV		Vitrek 4700 Digital HV Meter, Associated High Voltage Probes
	(50 to 60) Hz	0.14 % of reading + 0.15 V	
	(10 to 30) kV		
	(50 to 60) Hz	0.064 % of reading + 0.7 V	
	(30 to 50) kV		
	(50 to 60) Hz	0.091 % of reading + 0.7 V	
	(50 to 70) kV		
	(50 to 60) Hz	0.14 % of reading + 0.7 V	
AC Voltage – Source[1]	Up to 2.2 mV		Multiproduct Calibrator
	(10 to 20) Hz	0.16 % of reading + 4 µV	
	(20 to 40) Hz	0.1 % of reading + 4 µV	
	40 Hz to 20 kHz	0.077 % of reading + 4 µV	
	(20 o 50) kHz	0.13 % of reading + 4 µV	
	(50 to 100) kHz	0.17 % of reading + 5 µV	
	(100 to 300) kHz	0.33 % of reading + 10 µV	
	(300 to 500) kHz	0.47 % of reading + 20 µV	
	500 kHz to 1 MHz	0.58 % of reading + 20 µV	
	(2.2 to 22) mV		
	(10 to 20) Hz	0.044 % of reading + 4 µV	
	(20 to 40) Hz	0.031 % of reading + 4 µV	
	40 Hz to 20 kHz	0.015 % of reading + 4 µV	
	(20 o 50) kHz	0.032 % of reading + 4 µV	
	(50 to 100) kHz	0.059 % of reading + 5 µV	
	(100 to 300) kHz	0.12 % of reading + 10 µV	
	(300 to 500) kHz	0.16 % of reading + 20 µV	
	500 kHz to 1 MHz	0.3 % of reading + 20 µV	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source[1]	(2.2 to 22) mV		Multiproduct Calibrator
	(10 to 20) Hz	0.04 % of reading + 4 µV	
	(20 to 40) Hz	0.03 % of reading + 4 µV	
	40 Hz to 20 kHz	0.014 % of reading + 4 µV	
	(20 o 50) kHz	0.03 % of reading + 4 µV	
	(50 to 100) kHz	0.06 % of reading + 5 µV	
	(100 to 300) kHz	0.12 % of reading + 10 µV	
	(300 to 500) kHz	0.16 % of reading + 20 µV	
	500 kHz to 1 MHz	0.27 % of reading + 20 µV	
	(22 to 220) mV		
	(10 to 20) Hz	0.028 % of reading + 12 µV	
	(20 to 40) Hz	0.011 % of reading + 7 µV	
	40 Hz to 20 kHz	0.008 6 % of reading + 7 µV	
	(20 o 50) kHz	0.021 % of reading + 7 µV	
	(50 to 100) kHz	0.047 % of reading + 17 µV	
	(100 to 300) kHz	0.092 % of reading + 20 µV	
	(300 to 500) kHz	0.14 % of reading + 25 µV	
	500 kHz to 1 MHz	0.28 % of reading + 45 µV	
	(0.22 to 2.2) V		
	(10 to 20) Hz	0.028 % of reading + 40 µV	
	(20 to 40) Hz	0.01 % of reading + 15 µV	
	40 Hz to 20 kHz	0.004 8 % of reading + 8 µV	
	(20 o 50) kHz	0.008 2 % of reading + 10 µV	
	(50 to 100) kHz	0.012 % of reading + 30 µV	
	(100 to 300) kHz	0.043 % of reading + 80 µV	
	(300 to 500) kHz	0.1 % of reading + 0.2 mV	
	500 kHz to 1 MHz	0.18 % of reading + 0.3 mV	
	(2.2 to 22) V		
	(10 to 20) Hz	0.028 % of reading + 0.4 mV	
	(20 to 40) Hz	0.01 % of reading + 0.15 mV	
	40 Hz to 20 kHz	0.004 9 % of reading + 50 µV	
	(20 o 50) kHz	0.008 3 % of reading + 0.1 mV	
	(50 to 100) kHz	0.012 % of reading + 0.2 mV	
	(100 to 300) kHz	0.03 % of reading + 0.6 mV	
	(300 to 500) kHz	0.1 % of reading + 2 mV	
	500 kHz to 1 MHz	0.17 % of reading + 3.2 mV	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source[1]	(22 to 220) V		Multiproduct Calibrator
	(10 to 20) Hz	0.028 % of reading + 4 mV	
	(20 to 40) Hz	0.01 % of reading + 1.5 mV	
	40 Hz to 20 kHz	0.005 6 % of reading + 0.6 mV	
	(20 o 50) kHz	0.009 3 % of reading + 1 mV	
	(50 to 100) kHz	0.016 % of reading + 2.5 mV	
	(100 to 300) kHz	0.009 % of reading + 16 mV	
	(300 to 500) kHz	0.44 % of reading + 40 mV	
	500 kHz to 1 MHz	0.8 % of reading + 80 mV	
	(220 to 750) V		Multiproduct Calibrator, Amplifier
	40 Hz to 1 kHz	0.011 % of reading + 4 mV	
	(1 to 20) kHz	0.17 % of reading + 6 mV	
	(20 to 30) kHz	0.061 % of reading + 11 mV	
	(30 to 50) kHz	0.061 % of reading + 11 mV	
	(50 to 100) kHz	0.23 % of reading + 45 mV	
	(750 to 1 100) V		
	40 Hz to 1 kHz	0.11 % of reading + 4 mV	
	(1 to 20) kHz	0.017 % of reading + 6 mV	
	(20 to 30) kHz	0.061 % of reading + 11 mV	
Capacitance – Source[1]	(0.19 to 3.3) nF	0.39 % of reading + 7.8 pF	Multiproduct Calibrator
	(3.3 to 11) nF	0.21 % of reading + 7.8 pF	
	(11 to 110) nF	0.21 % of reading + 78 pF	
	(110 to 330) nF	0.21 % of reading + 0.23 nF	
	(0.33 to 1.1) µF	0.21 % of reading + 0.78 nF	
	(1.1 to 3.3) µF	0.21 % of reading + 2.3 nF	
	(3.3 to 11) µF	0.2 % of reading + 7.8 nF	
	(11 to 33) µF	0.32 % of reading + 23 nF	
	(33 to 110) µF	0.35 % of reading + 78 nF	
	(110 to 330) µF	0.35 % of reading + 0.23 µF	
	(0.33 to 1.1) mF	0.35 % of reading + 0.78 µF	
	(1.1 to 3.3) mF	0.35 % of reading + 2.3 µF	
	(3.3 to 11) mF	0.35 % of reading + 7.8 µF	
	(11 to 33) mF	0.58 % of reading + 23 µF	
	(33 to 110) mF	0.85 % of reading + 78 µF	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Measure/Source[1]	Type B		Ectron 1140A Thermocouple Calibrator/Simulator
	(250 to 350) °C	1.2 °C	
	(350 to 445) °C	0.9 °C	
	(445 to 580) °C	0.71 °C	
	(580 to 750) °C	0.55 °C	
	(750 to 1 000) °C	0.45 °C	
	(1 000 to 1 820) °C	0.35 °C	
	Type E		
	(-270 to -245) °C	1.6 °C	
	(-245 to -195) °C	0.24 °C	
	(-195 to -155) °C	0.12 °C	
	(-155 to -90) °C	0.095 °C	
	(-90 to 0) °C	0.08 °C	
	(0 to 15) °C	0.076 °C	
	(15 to 890) °C	0.064 °C	
	(890 to 1 000) °C	0.074 °C	
	Type J		
	(-210 to -180) °C	0.15 °C	
	(-180 to -120) °C	0.12 °C	
	(-120 to -50) °C	0.093 °C	
	(-50 to 990) °C	0.08 °C	
	(990 to 1 200) °C	0.094 °C	
	Type K		
	(-270 to -255) °C	2.5 °C	
	(-255 to -195) °C	0.85 °C	
	(-195 to -115) °C	0.16 °C	
	(-115 to -55) °C	0.12 °C	
	(-55 to 1 000) °C	0.087 °C	
	(1 000 to 1 372) °C	0.096 °C	
	Type N		
	(-270 to -260) °C	5.4 °C	
	(-260 to -200) °C	1.5 °C	
	(-200 to -140) °	0.29 °C	
	(-140 to -70) °C	0.18 °C	
	(-70 to 25) °C	0.14 °C	
	(25 to 160) °C	0.12 °C	
	(160 to 1 300) °C	0.11 °C	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices – Measure/Source[1]	Type R (-50 to -30) °C (-30 to 45) °C (45 to 160) °C (160 to 380) °C (380 to 775) °C (775 to 1 768) °C Type S (-50 to -30) °C (-30 to 45) °C (45 to 105) °C (105 to 310) °C (310 to 615) °C (615 to 1 768) °C Type T (-270 to -255) °C (-255 to -240) °C (-240 to -210) °C (-210 to -150) °C (-150 to -40) °C (-40 to 100) °C (100 to 400) °C	 0.8 °C 0.69 °C 0.49 °C 0.35 °C 0.2 °C 0.26 °C 0.76 °C 0.68 °C 0.49 °C 0.41 °C 0.35 °C 0.31 °C 1.9 °C 0.6 °C 0.36 °C 0.22 °C 0.15 °C 0.095 °C 0.08 °C	Ectron 1140A Thermocouple Calibrator/Simulator
Scope Voltage – Source[1] Amplitude DC into 50 Ω load into 1 MΩ load Square Wave into 50 Ω load into 1 MΩ load	 (-6 to 6) V (-130 to 130) V 10 Hz to 100 kHz 1 mV p-p to 6.6 Vp-p 10 Hz to 1 kHz 1 mV p-p to 6.6 Vp-p (1 kHz to 10) kHz 1 mV p-p to 6.6 Vp-p	 0.2 % of reading + 31 µV 0.04 % of reading + 31 µV 0.19 % of reading + 31 µV 0.078 % of reading + 31 µV 0.19 % of reading + 31 µV	Multiproduct Calibrator with 1.1 GHz Scope Option
Scope – Time Markers[1] into 50 Ω load	1 ns to 20 ms 50 ms 0.1 s 0.2 s 0.5 s 1 s	0.000 2 % of reading 2.3 µs 7.6 µs 28 µs 0.16 ms 0.62 ms	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Scope – Time Markers[1] into 50 Ω load	2 s 5 s	2.4 ms 15 ms	Multiproduct Calibrator with 1.1 GHz Scope Option
Scope Rise Time – Source[1,2] into 50 Ω load Rate: 1 kHz to 2 MHz Rate: 2 MHz to 10 MHz	5 mVp-p to 2.5 Vp-p 250 ps (nominal) 250 ps (nominal)	 50 ps 50 ps	
Scope Leveled Sine Wave – Source[1] into 50 Ω load	5 mVp-p to 5 Vp-p 50 kHz 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHZ (600 to 1 100) MHz	 1.8 % of reading + 0.23 mV 2.8 % of reading + 0.23 mV 3.2 % of reading + 0.23 mV 4 % of reading + 0.23 mV 5.5 % of reading + 0.23 mV	
Scope Bandwidth/Flatness – Source[1] into 50 Ω load (50 kHz Reference)	5 mVp-p to 5.5 Vp-p 50 kHz to 100 MHz (100 to 300) MHz (300 to 600) MHz (600 to 1 100) MHz	 1.4 % of reading + 78 µV 1.8 % of reading + 78 µV 3.2 % of reading + 78 µV 4 % of reading + 78 µV	
Scope Input Impedance – Measure[1]	(40 to 60) Ω (0.5 to 1.5) MΩ	0.082 % of reading 0.081 % of reading	
Scope Input Capacitance – Measure[1]	(5 to 50) pF	3.9 % of reading + 0.39 pF	
Scope Waveform Generator – Source[1] Amplitude (Sine, Square, Triangle) into 50 Ω load into 1 MΩ load Frequency (Sine, Square, Triangle)	 10 Hz to 10 kHz 1.8 mVp-p to 2.5 Vp-p 1.8 mVp-p to 55 Vp-p 10 Hz to 10 kHz	 2.3 % of reading + 78 µV 2.3 % of reading + 78 µV 0.001 9 % of reading + 12 mHz	
LF Phase – Source[1]	(0 to 180) ° (10 to 65) Hz (65 to 500) Hz 500 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (10 to 20) kHz	 0.11 ° 0.2 ° 0.39 ° 1.9 ° 3.9 ° 7.8 °	Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Power – Source[1]			
(0.33 to 330) mA	11 µW to 1.1 mW	0.024 % of reading	
	1.1 mW to 0.11 W	0.027 % of reading	
	(0.11 to 110) W	0.024 % of reading	
	(110 to 330) W	0.018 % of reading	
(0.33 to 3) A	11 µW to 110 mW	0.044 % of reading	Multiproduct Calibrator
	(0.11 to 990) W	0.053 % of reading	
	(0.99 to 3) kW	0.009 6 % of reading	
(3 to 20.5) A	99 mW to 0.99 W	0.088 % of reading	
	0.99 W to 6.8 kW	0.07 % of reading	
	(6.8 to 20.5) kW	0.04 % of reading	
AC Power – Source[1,3]			
PF = 1			
(3.3 to 9) mA	(10 to 65) Hz		
	(0.11 mW to 3) mW	0.13 % of reading	
	3 mW to 9 W	0.077 % of reading	
(9 to 33) mA	(10 to 65) W		
	(0.3 to 10) mW	0.089 % of reading	
	10 mW to 33 W	0.077 % of reading	
(33 to 90) mA	(10 to 65) Hz		
	(1 to 30) mW	0.071 % of reading	
	30 mW to 90 W	0.057 % of reading	
(90 to 330) mA	(10 to 65) Hz		
	(3 to 100) mW	0.089 % of reading	Multiproduct Calibrator
	100 mW to 300 W	0.078 % of reading	
(0.33 to 0.9) A	(10 to 65) Hz		
	(11 to 300) mW	0.071 % of reading	
	(0.3 to 900) W	0.081 % of reading	
(0.9 to 2.2) A	(10 to 65) Hz		
	(30 to 720) mW	0.089 % of reading	
	0.72 W to 2 kW	0.079 % of reading	
(2.2 to 4.5) A	(10 to 65) Hz		
	80 mW to 1.4 W	0.088 % of reading	
	1.4 W to 4.5 kW	0.18 % of reading	
(4.5 to 20.5) A	(10 to 65) Hz		
	150 mW to 230 kW	0.17 % of reading	

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Micrometers and Calipers[1,4] (Outside, Inside, Depth, Step)	Up to 6 in (6 to 12) in	(20 + 3.1*L*) µin (30 + 4.3*L*) µin	Gage Blocks, Long Gage Blocks
Anvil Flatness[1]	Up to 1 in	4.7 µin	Optical Flats
Indicators[1,4] (Dial and Digital)	Up to 4 in	(75 + 0.6*L*) in	Gage Blocks
Distance Measuring Equipment[4]	Up to 99 999 ft	(0.05 + 0.000 1*D*) ft	Cylindrical Square with Counter

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Balances and Scales[1,5]	Up to 5 g (5 to 10) g (10 to 20) g (20 to 50) g (50 to 100) g (100 to 200) g (200 to 500) g 500 g to 1 kg (1 to 2) kg (2 to 3) kg	0.04 mg 0.059 mg 0.089 mg 0.15 mg 0.31 mg 0.9 mg 1.5 mg 3.1 mg 4.4 mg 4.8 mg	ASTM E617 Class 1 weights and internal calibration procedure utilized for the calibration of the weighing system.
Mass Standards Avoirdupois Metric	 10 lb 20 lb 50 lb 10 kg 20 kg	 0.000 225 lb 0.000 231 lb 0.000 34 lb 258.5 mg 480.5 mg	 ASTM E617 Class 2 weights, Balance ASTM E617 Class 4 Weights, Balance
Torque – Measure[1] (Dial, Digital, Click Wrenches)	(20 to 200) ozf·in (4 to 1 000) lbf·in (20 to 250) lbf·ft (60 to 600) lbf·ft	0.71 % of reading 0.45 % of reading 0.45 % of reading 0.72 % of reading	Torque Calibration System
Torque – Measure[1] (Torque Screwdrivers)	(4 to 200) ozf·in	1 % of reading	Torque Transducers
Absolute Pressure Devices[1]	Up to 500 psia	0.006 7 % of reading + 0.001 psi	Pneumatic Pressure Controller
Pressure Devices[1]	(-14.2 to 25) psig	0.006 7 % of reading	

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pressure Devices[1]	(25 to 500) psig	0.006 6 % of reading	Pneumatic Pressure Controller
	(-22 to 22) inH_2O (22 to 60) inH_2O (60 to 72) inH_2O (72 to 804) inH_2O	0.002 inH_2O 0.009 % of reading + 0.000 15 inH_2O 0.006 5 inH_2O 0.009 % of reading + 0.000 15 inH_2O	Pneumatic Pressure Controller/Calibrator
Pressure – Source[1] (Hydraulic)	(500 to 15 000) psig	0.008 4 % of reading	Deadweight Tester

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature – Measure[1]	(-100 to 660) °C	15 mK	SPRT, Digital Indicator
Temperature – Source[1]	(-30 to -20) °C	45 mK	Micro-bath, SPRT, Temperature Indicator
	(-20 to 150) °C	21 mK	Liquid Bath, SPRT, Temperature Indicator
	(150 to 600) °C	232 mK	Dry-well, SPRT, Temperature Indicator

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Source/Measure	10 MHz	5.8 nHz/Hz	Rubidium 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. The stated uncertainty is the laboratory's ability to source a fast rise pulse that is approximately 250 ps. In the typical application of measuring rise time of an oscilloscope, this value is one of the contributing factors, but other factors are derived from the DUT.

3. The uncertainties shown are for the most favorable conditions. There is an increase in uncertainty that corresponds to the laboratory's AC voltage and current uncertainties at different frequencies other than the ones shown. Power factors (PF) other than the one shown contribute to the power uncertainty. PF is related to the cosine of phase. Therefore, uncertainties track the laboratory's phase uncertainty closely at PF near one but are magnified heavily as PF approaches zero. The lab may also report reactive power, apparent power, and power factor under this accreditation. If needed, contact laboratory for more information regarding uncertainties at frequency and power factor combinations other than the ones shown.
4. *L* = length in inches; *D* = Distance in feet.
5. The CMC for scales and balances is highly dependent upon the resolution of the unit under test. The CMC presented here does not include the resolution of the unit under test. The resolution will be included in the reported measurement uncertainty at the time of calibration.
6. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-2489.13.

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